NASA SP-7037(247)

AERONAUTICAL ENGINEERING

A CONTINUING BIBLIOGRAPHY WITH INDEXES

(Supplement 247)

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced in December 1989 in

- Scientific and Technical Aerospace Reports (STAR)
- International Aerospace Abstracts (IAA).



National Aeronautics and Space Administration Office of Management Scientific and Technical Information Division Washington, DC 1990

This supplement is available from the National Technical Information Service (NTIS), Springfield, Virginia 22161, price code A07.

T

ĺ

Ì

1

INTRODUCTION

This issue of Aeronautical Engineering -- A Continuing Bibliography (NASA SP-7037) lists 437 reports, journal articles and other documents originally announced in December 1989 in Scientific and Technical Aerospace Reports (STAR) or in International Aerospace Abstracts (IAA).

The coverage includes documents on the engineering and theoretical aspects of design, construction, evaluation, testing, operation, and performance of aircraft (including aircraft engines) and associated components, equipment, and systems. It also includes research and development in aerodynamics, aeronautics, and ground support equipment for aeronautical vehicles.

Each entry in the bibliography consists of a standard bibliographic citation accompanied in most cases by an abstract. The listing of the entries is arranged by the first nine *STAR* specific categories and the remaining *STAR* major categories. This arrangement offers the user the most advantageous breakdown for individual objectives. The citations include the original accession numbers from the respective announcement journals. The *IAA* items will precede the *STAR* items within each category.

Seven indexes -- subject, personal author, corporate source, foreign technology, contract number, report number, and accession number -- are included.

An annual cumulative index will be published.

Information on the availability of cited publications including addresses of organizations and NTIS price schedules is located at the back of this bibliography.

TABLE OF CONTENTS

Cotogory 01	Acconduction (Constal)	Page
Category 01	Aeronautics (General)	815
	Aerodynamics aerodynamics of bodies, combinations, wings, rotors, and control sur- nd internal flow in ducts and turbomachinery.	816
Category 03 Includes	Air Transportation and Safety passenger and cargo air transport operations; and aircraft accidents.	825
	Aircraft Communications and Navigation digital and voice communication with aircraft; air navigation systems and ground based); and air traffic control.	828
Category 05 Includes	Aircraft Design, Testing and Performance aircraft simulation technology.	831
	Aircraft Instrumentation cockpit and cabin display devices; and flight instruments.	837
Includes	Aircraft Propulsion and Power prime propulsion systems and systems components, e.g., gas turbine and compressors; and onboard auxiliary power plants for aircraft.	838
Category 08 Includes	Aircraft Stability and Control aircraft handling qualities; piloting; flight controls; and autopilots.	842
	Research and Support Facilities (Air) airports, hangars and runways; aircraft repair and overhaul facilities; nels; shock tubes; and aircraft engine test stands.	854
facilities space co spacecra	Astronautics astronautics (general); astrodynamics; ground support systems and (space); launch vehicles and space vehicles; space transportation; ommunications, spacecraft communications, command and tracking; aft design, testing and performance; spacecraft instrumentation; and aft propulsion and power.	855
physical	Chemistry and Materials chemistry and materials (general); composite materials; inorganic and chemistry; metallic materials; nonmetallic materials; propellants and d materials processing.	857

v

Category 12 Engineering

Geosciences

Category 13

Includes engineering (general); communications and radar; electronics and electrical engineering; fluid mechanics and heat transfer; instrumentation and photography; lasers and masers; mechanical engineering; quality assurance and reliability; and structural mechanics.

includes geosciences (general); earth resources and remote sensing; energy production and conversion; environment pollution; geophysics; meteorology and climatology; and oceanography. Category 14 Life Sciences N.A. Includes life sciences (general); aerospace medicine; behavioral sciences; man/system technology and life support; and space biology. 873 Category 15 **Mathematical and Computer Sciences** Includes mathematical and computer sciences (general); computer operations and hardware; computer programming and software; computer systems; cybernetics; numerical analysis; statistics and probability; systems analysis; and theoretical mathematics. 876 Category 16 **Physics** Includes physics (general); acoustics; atomic and molecular physics; nuclear and high-energy physics; optics; plasma physics; solid-state physics; and thermodynamics and statistical physics. 877 Category 17 Social Sciences

Includes social sciences (general); administration and management; documentation and information science; economics and cost analysis; law, political science, and space policy; and urban technology and transportation.

Category 18 Space Sciences

Includes space sciences (general); astronomy; astrophysics; lunar and planetary exploration; solar physics; and space radiation.

Category 19 General

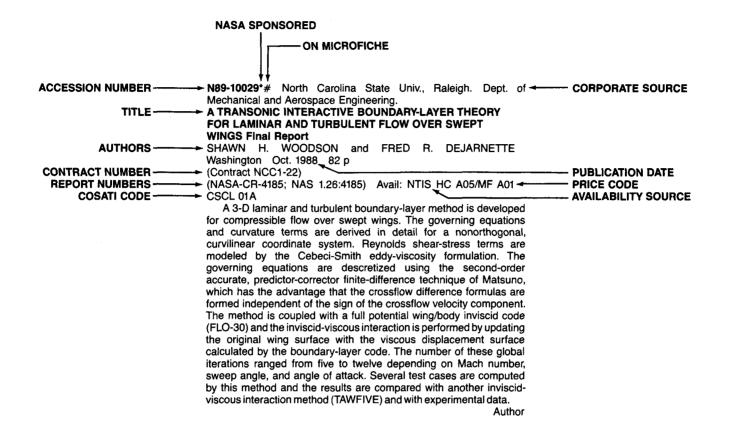
Subject Index	A-1
Personal Author Index	3-1
Corporate Source Index	C-1
Foreign Technology Index	D-1
Contract Number Index	E-1
Report Number Index I	F-1
Accession Number Index	3-1

867

N.A.

879

TYPICAL REPORT CITATION AND ABSTRACT



TYPICAL JOURNAL ARTICLE CITATION AND ABSTRACT



AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 247)

JANUARY 1990

01

AERONAUTICS (GENERAL)

A89-52614*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

APPLICATION OF ARTIFICIAL INTELLIGENCE (AI) PROGRAMMING TECHNIQUES TO TACTICAL GUIDANCE FOR FIGHTER AIRCRAFT

JOHN W. MCMANUS and KENNETH H. GOODRICH (NASA, Langley Research Center, Hampton, VA) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 2. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 851-858. refs (AIAA PAPER 89-3525) Copyright

A research program investigating the use of Artificial Intelligence (AI) programming techniques to aid in the development of a Tactical Decision Generator (TDG) for Within-Visual-Range (WVR) air combat engagements is discussed. The application of AI methods for development and implementation of the TDG is presented. The history of the Adaptive Maneuvering Logic (AML) program is traced and current versions of the (AML) program is traced and current versions of the AML program are compared and contrasted with the TDG system. The Knowledge-Based Systems (KBS) used by the TDG to aid in the decision-making process are outlined and example rules are presented. The results of tests to evaluate the performance of the TDG against a version of AML and against human pilots in the Langley Differential Maneuvering Simulator (DMS) are presented. To date, these results have shown significant performance gains in one-versus-one air combat engagements.

Author

A89-52950

AHS NATIONAL SPECIALISTS' MEETING ON THE ROTARY WING AIRCRAFT CONCEPTUAL DESIGN PROCESS, ATLANTA, GA, APR. 3-5, 1989, PROCEEDINGS

Meeting sponsored by AHS. Alexandria, VA, American Helicopter Society, 1989, 725 p. No individual items are abstracted in this volume.

This volume contains the viewgraphs and charts for papers presented at the April 1989 AHS National Specialists' Meeting. Topics covered include the development history of VSTOL aircraft; future operational requirements and market opportunities for helicopters; the presentation of requests for proposals (RFPs) in military and commercial programs; weight and cost methods; and technology assessment of rotors and propellers, engines and drive systems, structures and materials, flight controls, avionics, and cockpit equipment. Consideration is given to vertiports and ATC, the problems of new development programs, industry presentations of point-design solutions to military and commercial RFPs, the advanced counter-air fighter, and techniques for improving the conceptual-design process for rotorcraft.

A89-52975 CLOSING THE GAP GRAHAM WARWICK Flight International (ISSN 0015-3710), vol. 136, Sept. 2, 1989, p. 34-37. Copyright

An evaluation is made of the MiG-29 air-superiority fighter, Su-27 long-range interceptor, and Su-25 close ground-support/ antiinsurgency aircraft. it is noted that some measure of the shortcomings of the radars employed by the former two aircraft is compensated for by the use of an IR search/track system located at the base of the windscreen. This passive sensor, which scans like radar and is not an imaging device, has its output displayed on a small CRT in the upper left-hand corner of the Su-27 and MiG-29. The radar, the IR sensor, and a helmet-mounted sight are interlinked. Each of the three aircraft incorporates an internal 30 mm cannon, but carries surprisingly little ammunition by Western standards. The MiG-29's primary armament is the AA-10A 'Alamo' medium-range AAM; the substantially larger Su-27 can carry as many as 10 AAMs. O.C.

A89-53334#

ROTORCRAFT RESEARCH AND TECHNOLOGY ADVANCES AT MBB

HELMUT B. HUBER (Messerschmitt-Boelkow-Blohm GmbH, Munich, Federal Republic of Germany) Aeronautical Society of India and Indian Institute of Technology, Annual General Meeting, 14th, Madras, India, Dec. 19-21, 1988, Paper. 20 p. (MBB-UD-0537-88-PUB)

The most important applied research and technology demonstration programs being undertaken at MBB are reviewed. The areas addressed include aerodynamics and dynamics, advanced composite applications to new rotor systems and airframe structures, active control technologies and their integration, advanced development tools, and new rotorcraft configurations. Various systems under development are shown and/or diagrammed. C.D.

A89-54472#

AEROSPACE INDUSTRY IN INDIA - PAST, PRESENT AND FUTURE

I. M. CHOPRA (Hindustan Aeronautics, Ltd., Bangalore, India) Aeronautical Society of India, Journal (ISSN 0001-9267), vol. 41, Mar.-May 1989, p. 237-241.

Important milestones in the history of India's aeronautics industry are discussed. Consideration is given to the design and development of the HF-24 Marut aircraft. Advanced light helicopters which will use the latest hingeless rotor both for the main rotor and the tail rotor are described as well as light combat aircraft.

K.K.

N89-28485# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (Germany, F.R.).

ACTIVITIES REPORT IN AEROSPACE RESEARCH IN GERMANY E.B. Appual Report 1987

GERMANY, F.R. Annual Report, 1987 Sep. 1988 101 p In GERMAN Previously announced in IAA as A89-32775 Report contains color illustrations

(ISSN-0070-3966; ETN-89-94382) Avail: NTIS HC A06/MF A01

The activities of the FRG aerospace research organization DFVLR for 1987 are reported. In the research field of aeronautics, investigations were performed on Compas (a planning and decision aid for air traffic controllers) and on a delta wing (a contribution to the International Vortex Flow Experiment). Space-related

02 AERODYNAMICS

activities were the German Front Experiment 1987 (an example for the mesoscale probing of the atmosphere) and wind tunnel testing of reentry bodies in the hypersonic range. In the field of energy technology, renewable energy sources for Baden-Wuerttemberg were investigated. Photographs, drawings, and diagrams are provided, and an English summary is given for each section ESA

02

AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

A89-51625

THIN AEROFOIL WITH MULTIPLE SLOTTED FLAP

T. S. PATEL, T. A. DERBASI, and A. N. HASSANEN (Al-Fateh University, Tripoli, Libya) Rozprawy Inzynierskie (ISSN 0035-9408), vol. 36, no. 1, 1988, p. 3-14. refs Copyright

The paper deals with the problem of a thin airfoil with multiple slotted movable hinge flaps. Two particular cases are considered: (1) assuming no gaps exist at the hinges and (2) considering the existence of slots. The conventional assumptions of small angle of attack, small flap deflection, and small camber are omitted.

Author

A89-51678

THEORETICAL STUDY ON THE UNSTEADY AERODYNAMIC CHARACTERISTICS OF AN OSCILLATING CASCADE WITH TIP CLEARANCE - IN THE CASE OF A NONLOADED CASCADE

TOSHINORI WATANABE (Tokyo University of Agriculture and Technology, Koganei, Japan) and SHOJIRO KAJI (Tokyo, University, Japan) JSME International Journal, Series II (ISSN 0914-8817), vol. 32, Aug. 1989, p. 368-374. refs Copyright

This paper describes a theoretical analysis based on potential flow. By use of the vortex lattice method, calculations were performed to obtain unsteady aerodynamic forces acting on oscillating blades with tip clearances. Calculated damping forces in the case of large tip clearance showed good agreement with the experimental data. When the clearance was small, however, a discrepancy was found between the experimental and analytical results. This discrepancy was thought to be ascribable to the viscous effect of the flow near the blade tips. To explain the experimental data it was necessary to apply a model such that each blade should retain finite circulation at the extremity of its tip. From the calculated results for various reduced frequencies it was confirmed that aerodynamic characteristics found in the experimental study could be applied equally to the wide range of reduced frequencies. Author

A89-51679

SECONDARY FLOW CONTROL AND LOSS REDUCTION IN A TURBINE CASCADE USING ENDWALL FENCES

TATSUO KAWAI, TSUTOMU ADACHI (Tsukuba, University, Japan), and SHUJI SHINOKI (Sumitomo Electric Industries, Ltd., Itami, Japan) JSME International Journal, Series II (ISSN 0914-8817), vol. 32, Aug. 1989, p. 375-387. refs Copyright

An attempt to control secondary flow was made in order to

improve turbine aerodynamic performance. Boundary layer fences were attached to endwalls of a linear turbine rotor cascade. Measurements of total pressure losses and three-dimensional flow velocities were taken for 5 different heights and 7 different pitchwise locations of the fences. It was found that the fences were most effective when they were 1/3 of the inlet boundary layer thickness high and located half a pitch away from the blades. These optimum fences reduced streamwise vorticities, the thickness of the endwall loss region, secondary kinetic energy, and the maximum underturning by half. Moreover, they diminished the secondary loss by 22 percent, and the gross loss, including kinetic energy dissipation, by 25 percent. A critical fence height above which the fences trap the pressure side legs of horseshoe vortices was found, and the optimum fences proved to be fences of the minimum critical height. Author

A89-51756

SYMBOLIC EIGENVALUE ANALYSIS FOR ADAPTIVE STEPSIZE CONTROL IN PNS SHOCK STABILIZATION DOUGLAS D. CLINE and GRAHAM F. CAREY (Texas, University,

Austin) Computers and Fluids (ISSN 0045-7930), vol. 17, no. 4, 1989, p. 527-535. refs

Copyright

Parabolized Navier-Stokes (PNS) solution techniques for high speed compressible flow involve marching in a 'time like' spatial coordinate but have been observed in practice to be sensitive to flow conditions and require stabilization by numerical dissipation techniques. In this study, an eigenvalue analysis is developed for shock stability. Using the algebraic symbolic manipulator MACSYMA, an explicit closed-form solution for the shock system eigenvalues is developed. This is then applied on the evolving shock contour to determine the stability limit on the PNS stepsize. Numerical experiments confirm the validity of the approach and demonstrate thagt the approach can be implemented explicitly to vield an adaptive stepsize algorithm and thereby a more robust PNS scheme. Author

A89-51760* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

PREDICTION OF SECONDARY SEPARATION IN SHOCK WAVE BOUNDARY-LAYER INTERACTIONS

C. C. HORSTMAN (NASA, Ames Research Center, Moffett Field, Computers and Fluids (ISSN 0045-7930), vol. 17, no. 4, CA) 1989, p. 611-614. refs

Copyright

A complex three-dimensional shock-wave/turbulent boundary layer interaction at Mach 4 has been investigated experimentally and computationally, using two turbulence models with substantial refinement. With the use of a fine grid model, secondary flow separation was successfully computed, and grid changes did not improve agreement with experiment for the extent of upstream influence. The use of a non-isotropic turbulence model gave a slight improvement in upstream influence, but the size of the interaction was still significantly less than in the experiment. C.E.

A89-52043

ANALYSIS OF REATTACHMENT DURING RAMP DOWN TESTS

ANDREW J. NIVEN, RODERICK A, MCD, GALBRAITH, and DAVID G. F. HERRING (Glasgow, University, Scotland) (European Rotocraft Forum, 14th, Milan, Italy, Sept. 20-23, 1988) Vertica (ISSN 0360-5450), vol. 13, no. 2, 1989, p. 187-196. Research supported by the Department of Trade and Industry and Ministry of Defence of England. refs

Copyright

The paper considers the reattachment of the flow over the upper surface of an aerofoil undergoing a constant negative pitch rate motion, from an incidence well above the static stall value. Experimental data from a variety of aerofoils tested using the University of Glasgow facilities have been recorded. All data were collected at an effective Mach and Reynolds numbers of 0.11 and 1.5x10 to the 6th, respectively. Various improvements for future work are noted, and the predominant features of the reattachment process are discussed. Finally a preliminary attempt at predicting the collected reattachment data was made. Author

A89-52307#

COMPUTATION OF THE DETACHED SHOCK SHAPE IN A SUPERSONIC OR TRANSONIC CASCADE YAONAN HUA (Chinese Academy of Sciences, Institute of

Engineering Thermophysics, Beijing, People's Republic of China) Journal of Aerospace Power (ISSN 1000-8055), vol. 4, July 1989, p. 223-227, 290. In Chinese, with abstract in English. refs

A method is presented for determining the shape of the detached shock and the flowfield in the supersonic entrance region on an arbitrary stream surface of revolution. The equation of characteristics and the corresponding equation of compatibility are derived. The shape of the detached shock obtained is taken as the initial-value curve to calculate the flowfield in the supersonic entrance region by means of the method of characteristics. As an application of the present method, three stream surface of revolution in a transonic compressor rotor have been calculated. The results show that the method is effective and useful to determine rapidly the shape of the detached shock wave as well as the flowfield parameters in the supersonic entrance region.

Author

A89-52308#

SOLUTION FOR TWO-DIMENSIONAL INVISCID TRANSONIC CASCADE FLOWS WITH MULTIPLE-GRID ALGORITHM

CHUNHUA SHENG and LICHENG WANG (Nanjing Aeronautical Institute, People's Republic of China) Journal of Aerospace Power (ISSN 1000-8055), vol. 4, July 1989, p. 228-232, 291. In Chinese, with abstract in English. refs

This paper gives an efficient form of multiple-grid scheme and presents a prediction-correction method for processing the boundary conditions on a solid wall. The convergency and the stability of the scheme can be further improved by using local time stepping and residual smoothing. Two-dimensional inviscid transonic cascade flows are calculated. The comparison between the calculated and the measured results shows that this scheme possesses a very fast convergence speed and satisfactory accuracy. Author

A89-52309#

APPLICATION OF UPWIND FACTOR METHOD TO TRANSONIC CASCADE CALCULATION

LICHENG WANG, HUIMIN ZHANG, and XIAOLING LU (Nanjing Aeronautical Institute, People's Republic of China) Journal of Aerospace Power (ISSN 1000-8055), vol. 4, July 1989, p. 233-236, 291. In Chinese, with abstract in English.

The upwind factor method is extended to treating the two-dimensional transonic flows. The Navier-Stokes equations with k-sigma turbulence model are discretized in a nonorthogonal body-fitted coordinate system, and the upwind factor method is employed to ensure the numerical stability of the scheme. The maximum local time step is determined by the criterion that the coefficients in discretized equations must be nonnegative. The numerical experiments are carried out for DFVLR transonic cascade for inlet Mach number of 0.82 and 1.05. The numerical results are compared with the experimental data and with the results calculated with a four-stage Runge-Kutta time stepping scheme of an Euler code.

A89-52316#

ACTIVE CONTROL OF INLET DISTORTED FLOW FIELD IN COMPRESSOR INLET

LIPING XU (Beijing University of Aeronautics and Astronautics, People's Republic of China) Journal of Aerospace Power (ISSN 1000-8055), vol. 4, July 1989, p. 262-264, 293. In Chinese, with abstract in English. refs

The feasibility of alleviating the destabilizing effect of the inlet circumferential total pressure distortion on an axial compressor by active control of individually adjustable inlet guide vanes (LAIGV) has been qualitatively analyzed under the parallel compressor hypothesis. The result shows that when the distortion is quasi-steady, it is possible to use the actively controlled LAIGV with a relatively simple proportional control scheme to adjust the flow angle, and thus to prevent the compressor entering the unstable state. For a typical blade setting, the angular adjustment of LAIGV needed to cope with 10 percent total pressure distortion is of only few degrees. Author

A89-52481

NUMERICAL SIMULATION AND HYDRODYNAMIC VISUALIZATION OF TRANSIENT VISCOUS FLOW AROUND AN OSCILLATING AEROFOIL

O. DAUBE, L. TA PHUOC, A. DULIEU (CNRS, Laboratoire d'Informatique pour la Mecanique et les Sciences de l'Ingenieur, Orsay, France), M. COUTANCEAU, K. OHMI (Poitiers, Universite, France) et al. International Journal for Numerical Methods in Fluids (ISSN 0271-2091), vol. 9, Aug. 1989, p. 891-920. refs (Contract DRET-84-34-020-000)

Copyright

Unsteady viscous flow around a large-amplitude and high-frequency oscillating aerofoil is examined in this paper by numerical simulation and experimental visualization. The numerical method is based on the combination of a fourth-order Hermitian finite difference scheme for the stream function equation and a classical second-order scheme to solve the vorticity transport equation. Experiments are carried out by a traditional visualization method using solid tracers suspended in water. The comparison between numerical and experimental results is found to be satisfactory. Time evolutions of the flow structure are presented for Reynolds numbers of 3,000 and 10,000. The influence of the amplitude and frequency of the oscillating motion on the dynamic stall is analyzed.

A89-52483

NAVIER-STOKES COMPUTATION OF TRANSONIC VORTICES OVER A ROUND LEADING EDGE DELTA WING

BERNHARD MUELLER (Forsvarsdepartementet, Flygtekniska Forsoksanstalten, Bromma, Sweden) and ARTHUR RIZZI (Forsvarsdepartementet, Flygtekniska Forsoksanstalten, Bromma; Kungliga Tekniska Hogskolan, Stockholm, Sweden) International Journal for Numerical Methods in Fluids (ISSN 0271-2091), vol. 9, Aug. 1989, p. 943-962. Research supported by Styrelsen for Teknisk Utveckling, U.S. Navy, University of Minnesota, and NSF. refs

Copyright

A three-dimensional Navier-Stokes solver has been developed to simulate laminar compressible flow over quadrilateral wings. The finite-volume technique is employed for spatial discretization, with a novel variant for the viscous fluxes. An explicit three-stage Runge-Kutta scheme is used for time integration, taking local time steps according to the linear stability condition. The code is applied to compute primary and secondary separation vortices at transonic speeds over a 65-deg-swept delta wing with round leading edges and cropped tips. The results are compared with experimental data and Euler solutions, and Reynolds-number effects are investigated. Author

A89-52484

ON TVD DIFFERENCE SCHEMES FOR THE THREE-DIMENSIONAL EULER EQUATIONS IN GENERAL CO-ORDINATES

YOKO TAKAKURA (Fujitsu, Ltd., Scientific Systems Dept., Tokyo, Japan), TOMIKO ISHIGURO, and SATORU OGAWA (National Aerospace Laboratory, Chofu, Japan) International Journal for Numerical Methods in Fluids (ISSN 0271-2091), vol. 9, Aug. 1989, p. 1011-1024. refs

Copyright

Ăn improved treatment for the Harten-Yee and Chakravarthy-Osher TVD numerical flux functions in general co-ordinates is presented. The proposed formulation is demonstrated by a series of numerical experiments for three-dimensional flows around the ONERA-M6 wing. The numerical results indicate that it is important to use a suitable artificial compression parameter in order to obtain more accurate solutions around the leading edge of the wing. The two TVD numerical fluxes give excellent results: they capture the shock wave without numerical oscillations, they capture the rapid expansion around the leading edge sharply, they have self-adjusting mechanisms regarding numerical viscosity and they also have robustness. Author

02 AERODYNAMICS

A89-52485

ANALYSIS OF INCOMPRESSIBLE MASSIVELY SEPARATED VISCOUS FLOW USING UNSTEADY NAVIER-STOKES EQUATIONS

K. N. GHIA, G. A. OSSWALD, and U. GHIA (Cincinnati, University, OH) International Journal for Numerical Methods in Fluids (ISSN 0271-2091), vol. 9, Aug. 1989, p. 1025-1050. refs Copyright

The unsteady incompressible Navier-Stokes equations are formulated in terms of vorticity and streamfunction in generalized curvilinear orthogonal coordinates to facilitate analysis of flow configurations with general geometries. The numerical method developed solves the conservative form of the vorticity transport equation using the alternating direction implicit method, whereas the streamfunction equation is solved by direct block Gaussian elimination. The method is applied to a model problem of flow over a backstep in a doubly infinite channel, using clustered conformal coordinates. One-dimensional stretching functions, dependent on the Reynolds number and the asymptotic behavior of the flow, are used to provide suitable grid distribution in the separation and reattachment regions, as well as in the inflow and outflow regions. Author

A89-52498* Massachusetts Inst. of Tech., Cambridge. CALCULATIONS OF INLET DISTORTION INDUCED COMPRESSOR FLOW FIELD INSTABILITY

R. CHUE, E. M. GREITZER, C. S. TAN (MIT, Cambridge, MA), T. P. HYNES, and J. P. LONGLEY (Cambridge, University, England) International Journal of Heat and Fluid Flow (ISSN 0142-727X), vol. 10, Sept. 1989, p. 211-223. refs (Contract NSG-3208)

Copyright

Calculations of the onset of flow instability are carried out for low-speed multistage axial compressors operating with asymmetric inlet flow. The modeling of the fluid dynamic interaction between the spoiled and unspoiled sectors of the compressor is the most important feature of the calculation procedure. The calculations show that annulus average slope of the compressor pressure rise characteristic equal to zero is a useful approximate stability criterion for situations where the dynamics of the compressor flow field do not couple strongly to the compression system or the structure of the imposed distortion is not similar to that of the eigenmodes of the flow in the compressor annulus. This criterion is employed to investigate the relationship between the present model and the 'parallel compressor' model. Calculations are also presented for cases when compressor and compressor system are closely coupled, and situations in which the compressor is subjected to a rotating distortion. These first-of-a-kind computations, and the accompanying description of the physical mechanisms, show that the stability of the flow in the compressor can be adversely affected if the temporal or spatial structure of the distortion is such that resonant type responses can be evoked either from the compressor or from compressor/compression system interactions. C.E.

A89-52843

A THREE-DIMENSIONAL BOUNDARY LAYER IN FINITE-SPAN THIN WINGS [PROSTRANSTVENNYI POGRANICHNYI SLOI NA TONKIKH KRYL'IAKH KONECHNOGO RAZMAKHA]

A. D. KHON'KIN and V. I. SHALAEV Akademiia Nauk SSSR, Doklady (ISSN 0002-3264), vol. 307, no. 2, 1989, p. 312-315. In Russian.

Copyright

The wings of many aircraft can be treated as thin wings, with cruising flight characterized by small angles of attack. In view of this fact, perturbation methods are commonly used in calculating the aerodynamic characteristics of aircraft in the context of a nonviscous flow model. Here, it is shown that, under these conditions, the statement and solution of three-dimensional boundary layer problems is also significantly simplified and reduced to that of solving a set of two-dimensional problems. The approach proposed here makes it possible to obtain some new analytical results.

A89-52852

A SECOND-ORDER FINITE-DIFFERENCE SCHEME FOR CALCULATING THREE-DIMENSIONAL SUPERSONIC FLOWS OF AN IDEAL GAS [KONECHNO-RAZNOSTNAIA SKHEMA VTOROGO PORIADKA DLIA RASCHETA TREKHMERNYKH SVERKHZVUKOVYKH TECHENII IDEAL'NOGO GAZA] M. K. AUKIN and R. K. TAGIROV Zhurnal Vychislitel'noi

Matematiki i Matematicheskoi Fiziki (ISSN 0044-4669), vol. 29, July 1989, p. 1057-1066. In Russian. refs Copyright

An explicit second-order finite-difference scheme for calculating three-dimensional stationary supersonic flows of an inviscid gas is proposed, and some methodological features of the scheme are discussed. Results of calculations for conical flows and a submerged jet are found to be in good agreement with the results obtained by using some well-known second-order schemes. Examples of calculations for complex three-dimensional supersonic flows are presented. V.L.

A89-52945

EVOLUTION OF AXISYMMETRIC WAKES FROM ATTACHED AND SEPARATED FLOWS

H. C. CHEN and V. C. PATEL (Iowa, University, Iowa City) IN: Turbulent shear flows 6; International Symposium, 6th, Toulouse, France, Sept. 7-9, 1987, Selected Papers. Berlin and New York, Springer-Verlag, 1989, p. 215-231. refs (Contract N00014-83-K-0136)

Copyright

The Reynolds-averaged Navier-Stokes equations, together with a two-layer turbulence model, have been solved to study the evolution of the near and far wake of elongated axisymmetric bodies, such as a prolate spheroid, with attached or separated flow at the tail. Supplemental calculation with the body in a circular duct were also performed to determine the effects of wind-tunnel blockage in the experiments. The results are examined in the light of experimental data and theories for turbulent near and far wakes. Is is found that the numerical solutions reproduce most of the essential features of the theory and experiments. Author

A89-53367#

APPLICATION OF COMPOUND COMPRESSIBLE FLOW TO NONUNIFORMITIES IN HYPERSONIC PROPULSION SYSTEMS MARK J. LEWIS and DANIEL E. HASTINGS (MIT, Cambridge, MA) Journal of Propulsion and Power (ISSN 0748-4658), vol. 5, Sept.-Oct. 1989, p. 626-634. Research supported by Charles Stark

Draper Laboratory, Inc. refs Copyright

An analytical model is presented to study the propagation of the forebody boundary layer inside the engine channel of a hypersonic engine, based on a compound compressible one-dimensional streamtube method. It is shown that the compound compressible flow model can be greatly simplified in the hypersonic regime to study the effects of nonuniform flow inside a supersonic combustion ramjet. It is found that even a small boundary layer can produce noticeable changes in freestream properties inside the inlet. In the combustor models, freestream Mach number is generally increased, and so static pressure and temperature are decreased. These effects reduce the combustion reaction rate relative to that expected in a uniform flow and therefore reduce the total heat release and increase losses inside the engine.

Author

A89-53570

A REGULAR PERTURBATION METHOD FOR SUBCRITICAL FLOW OVER A TWO-DIMENSIONAL AIRFOIL

YUE-KUEN KWOK (West Virginia University, Morgantown) IMA Journal of Applied Mathematics (ISSN 0272-4960), vol. 43, no. 1, 1989, p. 71-81. refs Copyright

This paper presents a renewal of the classical Janzen-Rayleigh perturbation method or the so-called M-squared series expansion method for solving a steady inviscid irrotational subcritical flow over a two-dimensional airfoil. It seeks a regular perturbation

expansion of the state variables in terms of a power series in the free-stream Mach number M of the flow. The method is computerized so that it can treat bodies of arbitrary shapes, and the perturbation series is extended up to the fourth-order approximation. To facilitate the computation, the particular integrals of successive-order equations are found by MACSYMA. The literal operations of routine algebra of extending the series are then performed by FORTRAN. The order of accuracy is M to the 6th in the fourth-order approximation, which is generally higher than most approximation methods. However, divergence of the perturbation series is apparent when the free-stream Mach number increases beyond the critical Mach number. Author

A89-53830*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA. TRANSITION FLIGHT EXPERIMENTS ON A SWEPT WING

WITH SUCTION

D. V. MADDALON (NASA, Langley Research Center, Hampton, VA), F. S. COLLIER, JR. (High Technology Corp., Hampton, VA), L. C. MONTOYA (NASA, Flight Research Center, Edwards, CA), and R. J. PUTNAM (PRC Kentron, Inc., Hampton, VA) IUTAM, Symposium on Laminar-Turbulent Transition, 3rd, Toulouse, France, Sept. 11-15, 1989, Paper. 11 p. refs

Flight boundary-layer transition experiments were conducted on a 30-degree swept wing with a perforated leading-edge suction panel. The transition location on the panel was changed by systematically varying the location and amount of suction. Transition from laminar to turbulent flow was due to leading-edge turbulence contamination or crossflow disturbance growth and/or Tollmien-Schlichting disturbance growth, depending on flight condition and suction variation. Amplification factor correlations with transition location were made for various suction configurations using a state-of-the-art linear stability theory which accounts for body and streamline curvature and compressibility. Author

A89-53926#

NUMERICAL SIMULATION OF ROLLING UP OF LEADING/TRAILING-EDGE VORTEX SHEETS FOR SLENDER WINGS

XIE-YUAN YIN, NAN XIA, and GUO-HUA DENG (University of Science and Technology of China, Hefei, People's Republic of China) AIAA Journal (ISSN 0001-1452), vol. 27, Oct. 1989, p. 1313-1318. refs

Copyright

A simple, two-dimensional discrete vortex model is used to compute the rolling up of leading/trailing edge vortex sheets, as well as their interactions, in the cases of both delta and double-delta wing planforms. The numerical results thus obtained indicate that a trailing-edge vortex having a sense of circulation opposite that of the leading-edge vortices can be rolled up for both types of wing. In addition, two separated leading-edge vortices, inboard and outboard, can be formed over a double-delta wing surface; the vortices are separated from each other at small angles of attack, but the inboard vortex merges with the outboard one when the angles of attack are increased. 00

A89-53928#

CONSTRUCTING A CONTINUOUS PARAMETER RANGE OF COMPUTATIONAL FLOWS

H. THOMAS SHARP and L. SIROVICH (Brown University, Providence, RI) AIAA Journal (ISSN 0001-1452), vol. 27, Oct. 1989, p. 1326-1331.

Copyright

A method which can be used to describe the solution of a nonlinear system of partial differential equations is presented. The method was applied to supersonic flow over an airfoil. However, the generality of the method suggests that it is possible to achieve more versatile and efficient use of flow computations by mode changes to already existing flow codes. K.K.

A89-53930#

COMBUSTION-RELATED SHEAR-FLOW DYNAMICS IN **ELLIPTIC SUPERSONIC JETS**

K. C. SCHADOW, E. GUTMARK, S. KOSHIGOE, and K. J. WILSON (U.S. Navy, Naval Weapons Center, China Lake, CA) AIAA Journal (ISSN 0001-1452), vol. 27, Oct. 1989, p. 1347-1353. refs Copyright

An elliptic jet having an aspect ratio of 3:1 was studied and compared to a circular jet at three Mach numbers: M = 0.15, 1, and 1.3. Hot-wire measurements and schlieren photography were employed in this study. The superior mixing characteristics of an elliptic jet relative to a circular jet, which were found in previous works on subsonic jets, prevail in the sonic jet and are further augmented by the shock structures of the supersonic underexpanded jet. The major and minor axes switch at a distance of 3 diameters from the nozzle, and the spreading rate of the minor axis side is twice that of a subsonic jet. The experimental data are supported by results of the linear instability analysis of the supersonic elliptic jet. This analysis shows that the initial vortices are bending at the major axis side in a process similar to that which occurs in a subsonic elliptic jet. Author

A89-53931*# Virginia Polytechnic Inst. and State Univ., Blacksburg.

TURBULENCE MODELING IN A HYPERSONIC INLET

W. F. NG, K. AJMANI, and A. C. TAYLOR, III (Virginia Polytechnic Institute and State University, Blacksburg) AIAA Journal (ISSN 0001-1452), vol. 27, Oct. 1989, p. 1354-1360. Previously cited in issue 18, p. 2995, Accession no. A88-44705. refs (Contract NAG3-676) Copyright

A89-53934#

EULER CORRECTION METHOD FOR TWO- AND THREE-DIMENSIONAL TRANSONIC FLOWS

THONG Q DANG and LEE-TZONG CHEN (Douglas Aircraft Co., Long Beach, CA) AIAA Journal (ISSN 0001-1452), vol. 27, Oct. 1989, p. 1377-1386. Research supported by McDonnell Douglas Independent Research and Development Program. Previously cited in issue 08, p. 1042, Accession no. A87-22684. refs (Contract N00167-85-C-0134) Copyright

A89-53944# UNSTEADY VORTICAL DISTURBANCES AROUND A THIN AIRFOIL IN THE PRESENCE OF A WALL

G. A. GEBERT and H. M. ATASSI (Notre Dame, University, IN) AIAA Journal (ISSN 0001-1452), vol. 27, Oct. 1989, p. 1448-1451. refs

Copyright

The Sears (1941) function originally derived for the unsteady lift generated when a gust is convected by an incompressible inviscid flow around an airfoil is presently extended to include the effect of a wall located under the airfoil. The fluctuating aerodynamic forces in question occur in such engineering problems as wings during takeoff and landing, ships in restricted waters, and structures in ground transportation. An effort is made to determine the unsteady velocity field downstream of the airfoil.

O.C.

A89-53947#

DIFFERING DEVELOPMENT OF THE VELOCITY PROFILES OF THREE-DIMENSIONAL TURBULENT BOUNDARY LAYERS

H. PFEIL and T. AMBERG (Darmstadt, Technische Hochschule, Federal Republic of Germany) AIAA Journal (ISSN 0001-1452), vol. 27, Oct. 1989, p. 1456-1459. Research supported by DFG. refs

Copyright

An analysis of three-dimensional turbulent boundary-layer data shows that, even for small crossflow, the velocity profiles of the main-flow and crossflow components deviate distinctly from simple descriptive profile models when the streamlines are not congruent. It is presently demonstrated that these deviations can be accurately characterized by additional, correlated distributions. 0.C.

02 AERODYNAMICS

A89-53949#

TRANSONIC FLOWS WITH VORTICITY TRANSPORT AROUND SLENDER BODIES

GOETZ H. KLOPFER and DAVID NIXON (Nielsen Engineering and Research, Inc., Mountain View, CA) AIAA Journal (ISSN 0001-1452), vol. 27, Oct. 1989, p. 1461-1464. Copyright

A technique is derived for compressible flows which is similar to that for incompressible flows. The vorticity transport equations are derived from Crocco's equation; it is found that, for slender bodies, the flow is isentropic to a first approximation, and only the crossflow vorticity is significant. This method does not require discrete vortices, but rather computes a vorticity field, and thereby avoids the need for vortex-element tracking. Since, in the incompressible limit, the standard formulation is recovered, this theory may be regarded as a unifying theory for all speed ranges. O.C.

A89-54129#

STUDY ON BOUNDARY LAYER OF HYPERSONIC INLETS

QIANLIE GUAN and JUNBO XING (31st Research Institute, People's Republic of China) Journal of Propulsion Technology (ISSN 1001-4055), Aug. 1989, p. 19-25, 79, 80. In Chinese, with abstract in English.

A very thick forebody boundary layer existing in front of a hypersonic inlet is studied. The temperature within the boundary layer is very high and the mass flux very low. The presence of the boundary layer displaces the shock wave outward, so that the real geometric wedge angle should be equal to that of the theoretical compression angle minus the equivalent angle of displacement thickness of the boundary layer. In the range of Mach 6 to Mach 8, the boundary layer loss is about 40-50 percent of the total pressure loss of the inlet.

A89-54373

WATER TUNNEL FLOW VISUALIZATION ON A HYPERSONIC CONFIGURATION

LURA KERN and GREGORY NOFFZ (California, University, Los Angeles) IN: International Conference on Hypersonic Flight in the 21st Century, 1st, Grand Forks, ND, Sept. 20-23, 1988, Proceedings. Grand Forks, ND, University of North Dakota, 1988, p. 476-488. refs

Copyright

Low-speed and high-speed flow visualization results were obtained using models of a hypersonic aircraft. Low-speed visualizations performed in a water tunnel using a three-dimensional model containing dye emitting ports revealed vortex formation and shedding. The model was tested for a range of sideslip angles and angles of attack. Employing the mathematical analogy between shock waves in the air and free-surface water waves, shock formations off the vehicle were simulated by placing models representing two-dimensional projections of a hypersonic aircraft in a free-surface channel flow. The analogy was found to provide accurate results for low Mach numbers, but to break down at higher Mach numbers. R.R.

A89-54484

DEVELOPMENT ALONG DIFFERENT PATHS [ENTWICKLUNG AUF VERSCHIEDENEN WEGEN]

H. J. HENNING Luft- und Raumfahrt (ISSN 0173-6264), vol. 10, 3rd Quarter, 1989, p. 39, 40, 42. In German.

Copyright

The development of electronic control methods in the FRG, the UK, and the U.S. is discussed. The emphasis given to flow control and acceleration control in British engines and to rotational control in U.S. engines is pointed out. The transition from hydromechanical to electronic controllers is reviewed. C.D.

A89-54486#

CALCULATION OF THE EFFECT OF THE LOCATION OF THE JET-ENGINE AIR INLETS ON THE AIR FLOW IN FRONT OF THE INLETS [ANALIZA OBLICZENIOWA WPLYWU USYTUOWANIA WLOTOW SILNIKOW ODRZUTOWYCH NA PRZEPLYW POWIETRZA W STREFIE PRZEDWLOTOWEJ] LUCJAN MADEJ, STEFAN SZCZECINSKI, and ZDZISLAW WOJCIECHOWSKI Technika Lotnicza i Astronautyczna (ISSN 0040-1145), vol. 44, Jan. 1989, p. 7-10. In Polish. refs

A mathematical model for analyzing the effect of the location of the air inlets in jet engines on the distribution of air flow streamlines and velocities in front of the inlets is presented. Calculation results are given. B.J.

A89-54535

CALCULATION OF TRANSONIC FLOW PAST THE TAIL SECTION OF A PLANE OR AXISYMMETRIC BODY [RASCHET TRANSZVUKOVOGO OBTEKANIIA KORMOVOI CHASTI PLOSKOGO ILI OSESIMMETRICHNOGO TELA]

S. A. SHCHERBAKOV Zhurnal Vychislitel'noi Matematiki i Matematicheskoi Fiziki (ISSN 0044-4669), vol. 29, Sept. 1989, p. 1367-1379. In Russian. refs Copyright

Based on a modified version of Godunov's finite difference scheme, a method is developed for calculating transonic flow of an ideal gas past the tail section of a plane or axisymmetric oblong body with steep angles and bends of the generatrix. Use is made of difference grids adapted to flow characteristics, and the new version of the scheme is implemented. Formulas for calculating transonic flow at a distance from the body are obtained using a linear approximation. V.L.

A89-54614

THEORY FOR SEPARATED FLOW AROUND THE TRAILING EDGE OF A THIN PROFILE [K TEORII OTRYVNOGO OBTEKANIIA ZADNEI KROMKI TONKOGO PROFILIA]

G. L. KOROLEV Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza (ISSN 0568-5281), July-Aug. 1989, p. 55-59. In Russian. refs

Copyright

Nonsymmetrical flow past the trailing edge is investigated theoretically for the case of flow separation. Numerical solutions are obtained for equations describing the interaction region located near the trailing edge. It is shown that a solution for this region exists up to a certain angle of attack. It is also noted that the friction on the upper surface at the very end of the trailing edge remains positive under all flow conditions. The nonuniqueness of solutions to the equations in the case of separated flow is demonstrated. V.L.

A89-54619

SEPARATED FLOW PAST A CONCAVE CONICAL WING OF LARGE TRANSVERSE CURVATURE AT SMALL ANGLES OF ATTACK [OTRYVNOE OBTEKANIE VOGNUTOGO KONICHESKOGO KRYLA S BOL'SHOI POPERECHNOI KRIVIZNOI POD NEBOL'SHIMI UGLAMI ATAKI]

V. L. BORSHCH and V. V. KRAVETS Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza (ISSN 0568-5281), July-Aug. 1989, p. 130-136. In Russian. refs

Copyright

Laminar flow past a wing model in the form of a circular half-cone with an angle of taper of 34 deg was modeled numerically in the context of a quasi-conical approximation for three-dimensional Navier-Stokes equations. Under such an assumption, the displacement of external nonviscous flow due to intense flow separation beyond the leading edges leads to flow patterns similar to those observed in the case of V-shaped wings with a bend in the transverse profile. A weak secondary separation is shown to occur under primary separation regions at nonzero angles of attack. V.L.

A89-54624

CONSTRUCTION OF GENERAL-PURPOSE SUPERSONIC NOZZLES OF CONICAL CROSS SECTION [POSTROENIE UNIVERSAL'NYKH SVERKHZVUKOVYKH SOPEL S KONICHESKIM TECHENIEM]

I. S. ZORINA, M. IU. KURSHAKOV, and I. V. CHIRKOV Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza (ISSN 0568-5281), July-Aug. 1989, p. 183-186. In Russian. Copyright

A solution is presented for the problem of calculating the profile of the supersonic section of nozzles, producing flows from a source, that are self-similar with respect to the isentropic index. A function is obtained which approximates the geometry of nozzles with angles of the conical section up to 15 deg. The accuracy of the approximation is supported by calculations for the direct nozzle problem. V.L.

A89-54625

OPTIMAL PERMEABILITY OF WIND TUNNEL WALLS AT LOW SUPERSONIC VELOCITIES [OPTIMAL'NAIA PRONITSAEMOST' STENOK AERODINAMICHESKOI TRUBY PRI MALYKH SVERKHZVUKOVYKH SKOROSTIAKH]

V. M. NEILAND Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza (ISSN 0568-5281), July-Aug. 1989, p. 187-189. In Russian.

Copyright

The interaction of oblique shock and rarefaction waves at free-stream Mach of 1 or greater with the porous walls of a wind tunnel is investigated theoretically. Conditions are determined under which these perturbations are not reflected from the tunnel walls and therefore do not affect flow around the model. The theoretical conclusions reached here are supported by experimental data.

V.L.

N89-28486* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

LOW-SPEED STATIC AND DYNAMIC FORCE TESTS OF A GENERIC SUPERSONIC CRUISE FIGHTER CONFIGURATION DAVID E. HAHNE Washington Oct. 1989 35 p

(NASA-TM-4138; L-16599; NAS 1.15:4138) Avail: NTIS HC A03/MF A01 CSCL 01A

Static and dynamic force tests of a generic fighter configuration designed for sustained supersonic flight were conducted in the Langley 30- by 60-foot tunnel. The baseline configuration had a 65 deg arrow wing, twin wing mounted vertical tails and a canard. Results showed that control was available up to C sub L,max (maximum lift coefficient) from aerodynamic controls about all axes but control in the pitch and yaw axes decreased rapidly in the post-stall angle-of-attack region. The baseline configuration showed stable lateral-directional characteristics at low angles of attack but directional stability occurred near alpha = 25 deg as the wing shielded the vertical tails. The configuration showed positive effective dihedral throughout the test angle-of-attack range. Forced oscillation tests indicated that the baseline configuration had stable damping characteristics about the lateral-directional axes. Author

N89-28487# Midwest Research Inst., Golden, CO. Solar Energy Research Inst.

THREE-DIMENSIONAL AIRFOIL PERFORMANCE MEASUREMENTS ON A ROTATING WING

C. P. BUTTERFIELD Jun. 1989 6 p Presented at the European Wind Energy Conference and Exhibition, Glasgow, Scotland, 10 Jul. 1989

(Contract DE-AC02-83CH-10093)

(DE89-009443; SERI/TP-217-3505; CONF-890717-2) Avail: NTIS HC A02/MF A01

The objective of this comprehensive research program was to study the effects of Horizontal Axis Wind Turbine (HAWT) blade rotation on aerodynamic behavior below, near, and beyond stall. The flow angle sensor used to measure Angle Of Attack (AOA) is described along with how the sensor was calibrated, and results are given of pressure integrations on the blade. Aerodynamic, load, flow visualization, and inflow measurements were made on a 10-m, three-bladed, downwind HAWT. A video camera was mounted on the rotor to record video images of tufts attached to the low pressure side of a constant-chord, zero-twist blade. Load measurements were made using strain gages mounted every 10 percent of the blade's span. Pressure taps were located at 32 chordwise positions and revealed pressure distributions comparable with wind tunnel data. Inflow was measured using a vertical plane array of eight propvane and five triaxial (U-V-W) prop-type anemometers located 10 m upwind in the predominant wind direction. Results show evidence of stall hysteresis and unsteadiness at high AOA. Correlations with analytical predictions and wind tunnel tests show good agreement at low AOA and poor agreement at high AOA. DOE

N89-28488# General Dynamics Corp., Fort Worth, TX. SMALL SCALE MODEL TESTS IN SMALL WIND AND WATER TUNNELS AT HIGH INCIDENCE AND PITCH RATES. VOLUME

1: TEST PROGRAM AND DISCUSSION OF RESULTS Final Report, Sep. 1985 - Sep. 1988

ATLEE M. CUNNINGHAM, JR., TODD BUSHLOW, JOHN R. MERCER, TIM A. WILSON, and STEVE N. SCHWOERKE Apr. 1989 144 p

(Contract N00014-85-C-0419)

(AD-A208647) Avail: NTIS HC A07/MF A01 CSCL 01/1

Volume 1 presents the test program, correlations with other data, and discussions of the specific objectives of this investigation. In general it was shown that the small scale wind tunnel and water tunnel test techniques do provide reasonable dynamic force and moment data for a wide variety of planforms and conditions. The force testing of small-scale models in either a small wind tunnel or a water tunnel was investigated as an inexpensive and quick means to obtain meaningful dynamic force and moment data representative of rapidly maneuvering full-scale aircraft. Force tests of flat-plate semi-span models were conducted in the General Dynamics Aerodynamic Development Facility (ADF) which is a small 14x14 in. low speed wind tunnel. Oscillatory model motions up to 48 deg (peak to peak) amplitude were tested at frequencies of 1 to 3 Hz. Force tests of flat and three-dimensional full span models were conducted in the General Dynamics Hydroflow Facility (HFF) which is a horizontal flow water tunnel with a 24x24 in, test section, Pitch/pulse model motions were tested for conditions similar to those tested in the ADF. GRA

N89-28489# Aeronautical Research Labs., Melbourne (Australia).

COMPARISON OF FLOW-VISUALISED VORTICES WITH COMPUTED GEOMETRY OVER THIN DELTA WINGS L. D. MACLAREN Feb. 1989 6 p

(AD-A209083; ARL-FLIGHT-MECH-TM-409) Avail: NTIS HC A02/MF A01 CSCL 01/1

The vortex flow patterns over thin delta wings were photographed during experiments in a vertical water tunnel making use of appropriate flow visualization techniques. The flow geometry for these wings was also calculated using the VORSBA vortex flow computer program. A comparison is made between the calculated and experimental results and discrepancies between them are discussed. GRA

N89-28490# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering. GLIDER GROUND EFFECT INVESTIGATION M.S. Thesis

GLIDER GROUND EFFECT INVESTIGATION M.S. Thesis NATHAN H. JONES May 1989 131 p

(AD-A209152; AFIT/GAE/ENY/89J-2) Avail: NTIS HC A07/MF A01 CSCL 01/3

This research used glider flight tests and optimized glider simulations to evaluate the aerodynamics of ground effect and to determine the optimum flight profile for maximum gliding range in gliders. A series of 122 sorties were flown in the Grob G-103 Twin II and the Let L-13 Blanik gliders on a specially designed very low altitude speed course. Radar tracking data were used to determine the glider position and velocity, and a 3 degree of freedom glider performance simulation was used to determine the glider parasite and induced drag coefficients in ground effect. Lifting

02 AERODYNAMICS

line derived predictions of ground effect induced drag reduction developed by Dr. Sighard Hoerner were found to be accurate at altitudes above 20 percent wingspan but were up to 16 percent too optimistic at low altitudes. A revised prediction of ground effect induced drag reduction was developed based on the flight test data, and this revised prediction was used along with a turbulent boundary layer wind model in two optimization algorithms to develop the optimum flight profiles for maximum range gliding flight.

GRA

N89-28492# National Aerospace Lab., Tokyo (Japan). Structural Mechanics Div.

SOME COMPUTATIONS OF UNSTEADY NAVIER-STOKES FLOW AROUND OSCILLATING AIRFOIL/WING JIRO NAKAMICHI Oct. 1988 25 p

(NAL-TR-1004T; ISSN-0389-4010) Avail: NTIS HC A03/MF A01

Unsteady Navier-Stokes calculations around an airfoil/wing are demonstrated. 2D transonic flutter simulations are performed about the NACA 64A010 airfoil using not only a diagonal form of a Beam-Warming scheme but also a non-diagonal form. The effects of time accuracy of the algorithms on the flutter boundaries are checked by comparing two results. 3D unsteady computations around an oscillating wing in elastic motions are also carried out and the obtained results are compared with experimental data. It is found that the diagonal form of a Beam-Warming scheme is efficient in predicting the flutter boundaries of airfoils where the flow is not separated. It is also demonstrated that the present 3D code gives results in agreement with experimental data and it can be used for 3D flutter simulation programs in a similar manner to 2D programs.

N89-28493*# California Polytechnic State Univ., San Luis Obispo.

ANALYSIS OF LEADING EDGE SEPARATION USING A LOW ORDER PANEL METHOD Final Report

DORAL R. SANDLIN Sep. 1989 26 p

(Contract NCC2-226)

(NASA-CR-185892; NAS 1.26:185892) Avail: NTIS HC A03/MF A01

An examination of the potential flow computer code VSAERO to model leading edge separation over a delta wing is examined. Recent improvements to the code suggest that it may be capable of predicting pressure coefficients on the body. Investigation showed that although that code does predict the vortex roll-up, the pressure coefficients have significant error. The program is currently unsatisfactory, but with some additional development it may become a useful tool for this application. Author

N89-28494# Institut Franco-Allemand de Recherches, Saint-Louis (France).

STUDY OF THE WING-VORTEX INTERACTION IN THREE DIMENSIONAL FLOWS (INCOMPRESSIBLE INVISCID FLOW) [ETUDE DE L'INTERACTION AILE/TOURBILLON EN TRIDIMENSIONNEL (ECOULEMENT INCOMPRESSIBLE SANS VISCOSITE)]

M. SCHAFFAR 16 Aug. 1987 45 p In FRENCH Original contains color illustrations

(ISL-R-123/87; ETN-89-94856) Avail: NTIS HC A03/MF A01

The use of horseshoe vortices on the wing and of a turbulent network for the wake, permitted treatment in three dimensions of the case of a thin wing for steady flow and unsteady flow (incident wing with upstream vortex). For steady flow and large spans the calculated lift is close to the two dimensional value. For the unsteady case the variations in lift along the path of the vortex are described.

N89-28495# Institut Franco-Allemand de Recherches, Saint-Louis (France).

PROFILE-VORTEX INTERACTIONS [INTERACTION PROFIL/TOURBILLON]

J. HAERTIG, CH. JOHE, and M. SCHAFFAR 3 Nov. 1987 49 p In FRENCH

(Contract DRET-85-031)

(ISL-R-125/87; ETN-89-94858) Avail: NTIS HC A03/MF A01

The time evolution of the lift coefficient of a profile exposed to incident vortices is calculated by a perfect fluid two dimensional method and compared to experimental results obtained in a hydrodynamic channel. The unsteady turbulent field is analyzed using laser anemometry. The results are in good agreement with the theoretical model adopted, except for the case when the vortex path is too close to the profile.

N89-28497# National Aeronautical Lab., Bangalore (India). Computational and Theoretical Fluid Dynamics Div.

FLOW CALCULATION OVER A DELTA-WING USING THE THIN-LAYER NAVIER-STOKES EQUATIONS

ANAND KUMAR Jun. 1989 9 p Presented at the International Symposion on CFD, Nagoya (Japan), 28-31 Aug. 1989 (PD-CF-8924) Avail: NTIS HC A02/MF A01

A 3D laminar thin-layer Navier-Stokes solver is developed which employs finite volume spatial discretisation and Runge-Kutta time integration. The code is applied to compute vortex flow over a round leading edge delta wing, and the results are compared with experiment and an Euler simulation. Author

N89-28498*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA. **CORRELATION OF PUMA AIRLOADS: EVALUATION OF CFD**

PREDICTION METHODS

ROGER C. STRAWN, ANDRE DESOPPER, JUDITH MILLER, and ALAN JONES (Royal Aerospace Establishment, Farnborough, England) Aug. 1989 22 p

(NASA-TM-102226; A-89223; NAS 1.15:102226;

USAAVSCOM-TM-89-A-001) Avail: NTIS HC A03/MF A01 CSCL 01/1

A cooperative program was undertaken by research organizations in England, France, Australia and the U.S. to study the capabilities of computational fluid dynamics codes (CFD) to predict the aerodynamic loading on helicopter rotor blades. The program goal is to compare predictions with experimental data for flight tests of a research Puma helicopter with rectangular and swept tip blades. Two topics are studied. First, computed results from three CFD codes are compared for flight test cases where all three codes use the same partial inflow-angle boundary conditions. Second, one of the CFD codes (FPR) is iteratively coupled with the CAMRAD/JA helicopter performance code. These results are compared with experimental data and with an uncoupled CAMRAD/JA solution. The influence of flow field unsteadiness is found to play an important role in the blade aerodynamics. Alternate boundary conditions are suggested in order to properly model this unsteadiness in the CFD codes.

N89-28499# Technische Univ., Delft (Netherlands). Inst. for Wind Energy.

THE ANGLÉS OF THE KOLIBRIE ROTOR TIPVANES ON THE RODS AND ON THE BLADES

A. BRUINING Delft University Press Oct. 1988 24 p Sponsored by the Netherlands Ministry of Economic Affairs

(IW-R515; ISBN-90-627-5496-1; ETN-89-95428) Copyright Avail: NTIS HC A03/MF A01

The data of the adjusted angles of the tipvanes used on the Kolibrie rotor blades and rods, are reported. Two measuring methods are applied: one method is based on determining the chord vector and the span wise vector of the tipvane. The other method is based on the angles of the mounting parts of the tipvanes. The theoretical background and the measurement procedure are not included. Due to the unreliability of the position of the chord vector and the span wise vector the results from the first method are not used. Calculations are carried out with the data from the second method, based on the angles of the mounting parts of the tipvanes. ESA

N89-28500# Aeronautical Research Inst. of Sweden, Stockholm. Aerodynamics Dept.

WIND TUNNEL TESTS OF 16 PERCENT THICK AIRFOIL WITH 30 PERCENT TRAILING EDGE FLAP AT HIGH ANGLES OF ATTACK AND WITH FLAP ANGLES

SVEN-OLOF RIDDER Dec. 1988 45 p Sponsored by the Swedish National Energy Administration

(FFA-TN-1985-58; ETN-89-94312) Avail: NTIS HC A03/MF A01 Wind tunnel tests are carried out at low speeds. The test program includes high negative flap angles and an angle of attack range of 180 deg. The test Revnolds number is 2.200.000. The test results indicate that it is impossible to overcome the strong driving tangential force of the basic section by means of any of the trailing edge devices investigated. **FSA**

N89-28501 British Aerospace Public Ltd. Co., Preston (England). Military Aircraft Div.

A DETAILED SURVEY OF THE FLOW PASSING THROUGH AN ASYMMETRIC CONTRACTION AND PARALLEL DUCT

M. T. STICKLAND 16 Nov. 1988 44 p (BAE-WWT-RP-RES-AXR-000194-PT-A; ETN-89-94958) Avail: British Aerospace Public Ltd. Co., Preston Lancs PR4 1AX, United Kingdom

A research program was undertaken to reduce or remove an undesirable flow effect in a transonic wind tunnel. The effect is a four lobe swirl appearing in the working section. An experimental study was carried out in the wind tunnel using a model of the contraction and square duct, and existing software was used to numerically simulate the phenomena. The physical simulation was quite successful in reproducing the flow perturbation, while the numerical simulation failed. The flow anomaly is found not to be a problem with the normal types of test work carried out in the tunnel, but it casts serious doubts on the tunnel value in duct code validation work. **FSA**

N89-28502 British Aerospace Public Ltd. Co., Preston (England). Military Aircraft Div.

A DETAILED SURVEY OF THE FLOW PASSING THROUGH AN ASYMMETRIC CONTRACTION AND PARALLEL DUCT

M. T. STICKLAND 16 Nov. 1988 179 p

(BAE-WWT-RP-RES-AXR-000194-PT-B; ETN-89-94959) Avail: British Aerospace Public Ltd., Preston Lancs, PR4 1AX, United Kingdon

A research program was undertaken to reduce or remove an undesirable flow effect in a transonic wind tunnel. The effect is a four lobe swirl appearing in the working section. An experimental study was carried out in the wind tunnel using a model of the contraction and square duct, and existing software was used to numerically simulate the phenomena. The physical simulation was quite successful in reproducing the flow perturbation, while the numerical simulation failed. The flow anomaly is found not to be a problem with the normal types of test work carried out in the tunnel, but it casts serious doubts on the tunnel value in duct code validation work. FSA

N89-28505# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (Germany, F.R.). Abteilung Messphysik.

EVALUATION OF LDA 3-COMPONENT VELOCITY DATA ON A 65 DEG DELTA WING AT M = 0.85 AND FIRST RESULTS OF AN ANALYSIS

S. N. SESHADRI and KARL-ALOYS BUETEFISCH Mar. 1989 67 p

(DFVLR-FB-89-19; ISSN-0171-1342; ETN-89-95314) Avail: NTIS HC A04/MF A01; DFVLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 21 DM

The laser Doppler anenometry (LDA) three-component velocity data obtained for a 65 deg sweptback, cropped delta wing at a free stream Mach number of 0.85 is analyzed with the aid of a menu driven computer program. The program was developed to process the LDA data employing a linear or a weighted quadratic interpolation technique to compute velocities in the vortex core or at any other field point where no measurement data is available.

Basic results obtained using the two techniques to compute velocities in the vortex core or at any other field point polation scheme are presented. Limited analysis related to the structure of the vortex and the development of the leeside flow field is made. A good correlation of LDA results with surface results obtained through oil flow/static pressure is found. Existence of a shock wave located above the vortex core is indicated. The weighted quadratic interpolation theory is concluded to give preferable results to these produced by linear technique. FSA

N89-29305*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA. BOUNDARY-LAYER MEASUREMENTS ON A TRANSONIC

LOW-ASPECT RATIO WING

EARL R. KEENER May 1985 40 p (NASA-TM-88214; A-86133; NAS 1.15:88214) Avail: NTIS HC A03/MF A01 CSCL 01/1

Tabulations and plots are presented of boundary-layer velocity and flow-direction surveys from wind-tunnel tests of a large-scale (0.90 m semi-span) model of the NASA/Lockheed Wing C. This wing is a generic, transonic, supercritical, highly three-dimensional, low-aspect-ratio configuration designed with the use of a three-dimensional, transonic full-potential-flow wing code (FLO22). Tests were conducted at the design angle of attack of 5 deg over a Mach number range from 0.25 to 0.96 and a Revnolds number range of 3.4x10 to the 6th power. Wing pressures were measured at five span stations, and boundary-layer surveys were measured at the midspan station. The data are presented without analysis. Author

N89-29306# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Fluid Dynamics Panel. SPECIAL COURSE ON AEROTHERMODYNAMICS OF HYPERSONIC VEHICLES

Jun. 1989 336 p Course held in Rhode-Saint-Genese, Belgium, 30 May - 3 Jun. 1988; sponsored by AGARD and the Von Karman Inst. of Fluid Dynamics

(AGARD-R-761; ISBN-92-835-0515-8) Copyright Avail: NTIS HC A15/MF A01

This AGARD Fluid Dynamics Panel/von Karman Institute Special Course was inspired by new ventures in the hypersonic domain moving forward on both sides of the Atlantic-HERMES in Europe and the NASP (X-30) in the United States. Following the review of basic principles including real gas effects, a series of lectures were presented on experimental and computational methods specific to hypersonic flows. Stress was placed on measurement techniques developed primarily for flows with heat transfer, chemical reactions, strong shocks, and compressible boundary layers. Both surface measurements and flow field measurements including species concentration techniques, were discussed. The same spirit governed the lecture on computational methods: stress was placed on the new problems in CFD posed by high speeds and chemical reactions. The course finished with state of the art reviews onthree critical flow problems: transition to turbulence; ininteractions between shocks and boundary layers; and shock/shock impingement.

N89-29308# Maryland Univ., College Park, Dept. of Aerospace Engineering. INVISCID AND VISCOUS HYPERSONIC AERODYNAMICS: A

REVIEW OF THE OLD AND NEW

JOHN D. ANDERSON, JR. In AGARD, Special Course on Aerothermodynamics of Hypersonic Vehicles 25 p Jun. 1989 Copyright Avail: NTIS HC A15/MF A01

Both inviscid and viscous hypersonic aerodynamics are reviewed. It is tutorial in manner, and is addressed to students and workers who want to learn the subject, or need to review various aspects of the discipline. Also represented is a survey of hypersonics, contrasting the old with the new. It covers both classical hypersonic considerations as well as the new hypersonics, which is heavily based on computational fluid dynamic methods. High temperature flows are also considered. Author

N89-29312# Calspan Corp., Buffalo, NY. SPECIES COMPOSITION MEASUREMENTS IN NONEQUILIBRIUM HIGH-SPEED FLOWS

In AGARD, Special Course on DONALD W. BOYER Aerothermodynamics of Hypersonic Vehicles 23 p Jun. 1989 Copyright Avail: NTIS HC A15/MF A01

Descriptions of some diagnostic methods for species concentration measurements are reviewed which are applicable to high-speed flows. Some of the theoretical framework was included but only as background to support the descriptions. Referral is intended, of course, to the literature cited, and references therein, for greater detail concerning analysis and implementation. The summaries can help to appraise as well as guide in the selection of a method most suitable for a given flow situation. Some of the methods are not new. The more recent and yet-developing laser techniques have singular advantages by virtue of their ability to interrogate very fast flows, and to be applicable to reactive and hostile environments. However, the techniques can be quite complex both analytically and in their optical requirements and configurations. Author

N89-29316# McDonnell-Douglas Missile Systems Co., Saint Louis, MO

CHAOTIC RESPONSE OF AEROSURFACES WITH STRUCTURAL NONLINEARITIES Annual Technical Report, 1 Mar. 1988 - 28 Feb. 1989

ANTHONY J. HAUENSTEIN and ROBERT M. LAURENSON Mar. 1989 70 p Sponsored in part by Missouri Univ., Rollo

(Contract F49620-88-C-0047; AF PROJ. 2308)

(AD-A208433; MDC-ATN-E466-014; AFOSR-89-0651TR) Avail: NTIS HC A04/MF A01 CSCL 16/2

An analytical and experimental research activity is being performed to investigate the chaotic response behavior of aerosurfaces containing discrete structural nonlinearities. Chaos is the paradoxical emergence of random-like motion in completely deterministic nonlinear systems. This research is developing an understanding of an aerosurface containing discrete structural nonlinearities. The dynamic behavior of a rigid aerosurface has been investigated analytically and experimentally. The rigid surface analysis and test activities are to be continued. A flexible aerosurface will be designed and fabrication begun during the second year. The third year of the program will move to test and analysis of the flexible aerosurface. Studies were performed for a long range of rigid aerosurface configurations and various root spring stiffnesses and nonlinearities. Test apparatus was designed and fabricated to experimentally demonstrate the nonlinear behavior of a rigid aerosurface containing discrete structural nonlinearities. Wind tunnel testing for the rigid aerosurface configuration was initiated and evaluation of the results of the wind tunnel tests is underway. Initial design and fabrication of the rigid aerosurface dynamic test setup was completed. GRA

Vrije Univ., Brussels (Belgium). Dept. of Fluid N89-29317# Mechanics.

TRANSITION AND TURBULENCE STRUCTURE IN THE BOUNDARY LAYERS OF AN OSCILLATING AIRFOIL Final Technical Report, 1 Jan. 1985 - 31 Dec. 1988

J. DERUYCK, B. HAZARIKA, and CH. HIRSCH 1989 102 p (Contract DAJA45-85-C-0039)

(AD-A208968; VUB-STR-16; R/D-2835A-AN) Avail: NTIS HC A06/MF A01 CSCL 01/1

Objectives of this investigation were: (1) to identify the conditions under which a sinusoidally oscillating NACA 0012 airfoil operates with a leading edge separation bubble and the conditions under which it operates with leading edge stall; (2) to conduct complete boundary layer and near wake survey in the presence of the leading edge separation bubble; and (3) to investigate the flow near the trailing edge and in the near wake while the airfoil was undergoing leading edge stalt. The airfoil oscillates about an axis at 25 percent chord from the leading edge, with a nominal reduced frequency of 0.3 and Reynolds number of 300,000. Experiments were made at 4 to 14, 5 to 15, 6 to 16 and 8 to 18 deg angle of attack. It was found that the most probable cause

of leading edge stall was due to the leading edge separation bubble burst which occurred soon after static stall limit was exceeded. Leading edge stall is not due to the rapid upstream movement of the trailing edge separation. The velocity vectors and the Reynolds stress tensors were measured using a slanted rotating single sensor hot-wire. The complete suction side boundary layer profile and the near wake was surveyed at 5 to 15 deg oscillation where no interaction is observed between leading edge and trailing edge flows. GRA

N89-29318# Aeronautical Research Labs., Melbourne (Australia).

FLUTTER CALCULATIONS FOR A MODEL WING USING THE MSC NASTRAN STRUCTURAL ANALYSIS PROGRAM BETTY EMSLIE Nov. 1988 45 p

(AD-A209244; ARL-STRUC-TM-495; DODA-AR-005-544) Avail: NTIS HC A03/MF A01 CSCL 01/1

Flutter calculations for a semispan model wing with a trailing edge control surface were carried out using the MSC NASTRAN computer program. In order to alter the critical flutter speeds of the model wing, provision was made to allow rods or other masses to be attached at the wing tip. In these calculations aluminum and steel rods were used to modify the flutter characteristics of the model. Eleven configurations of the model wing were considered. For each of the 11 configurations, flutter calculations were carried out for a number of different aileron rotational stiffnesses. GRA

N89-29321*# National Aerospace Lab., Tokyo (Japan). Aircraft Aerodynamics Div.

USE OF HIGH-RESOLUTION UPWIND SCHEME FOR VORTICAL FLOW SIMULATIONS

KOZO FUJII and SHIGERU OBAYASHI (National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.) Dec. 1988 16 p Sponsored by NASA

(NASA-CR-185910; NAS 1.26:185910; NAL-TR-1007T;

ISSN-0389-4010) Avail: NTIS HC A03/MF A01 CSCL 01/1

For vortical flow simulations at high Reynolds numbers, it is important to keep the artificial dissipation as small as possible since it induces unphysical decay of the vortex strength. One way to accomplish this is to decrease the grid spacing. Another way is to use computational schemes having little dissipation. Here, one of the high-resolution upwind schemes called MUSCL with Roe's average is applied to vortical flow fields. Two examples are considered. One is the leading-edge separation-vortex flow over a strake-delta wing. The other is a high-angle of attack supersonic flow over a spaceplane-like geometry. Comparison with the central difference solutions indicates that the present upwind scheme is less dissipative and thus has better resolution for the vortical flows. Author

N89-29323*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

STOL AND STOVL HOT GAS INGESTION AND AIRFRAME HEATING TESTS IN THE NASA LEWIS 9- BY 15-FOOT LOW-SPEED WIND TUNNEL

ALBERT L. JOHNS Sep. 1989 33 p

(NASA-TM-102101; E-4864; NAS 1.15:102101) Avail: NTIS HC A03/MF A01 CSCL 01/1

Short takeoff and landing (STOL) and advanced short takeoff and vertical landing (STOVL) aircraft are being pursued for deployment near the end of this century. These concepts offer unique capabilities not seen in conventional aircraft; for example, shorter takeoff distances and the ability to operate from damaged runways and remote sites. However, special technology is critical to the development of this unique class of aircraft. Some of the real issues that are associated with these concepts are hot gas ingestion and airframe heating while in ground effects. Over the past nine years, NASA Lewis Research Center has been involved in several cooperative programs in the 9- by 15 Foot Low-Speed Wind Tunnel (LSWT) to establish a database for hot gas ingestion and airframe heating. The modifications are presented that were made in the 9- by 15-Foot LSWT, including the evolution of the

ground plane, model support system, and tunnel sidewalls; and flow visualization techniques, instrumentation, test procedures, and test results. The 9- by 15-Foot LSWT tests were conducted at full scale exhaust nozzle pressure ratios. The headwind velocities varied from 8 to 120 kn depending on the concept (STOL or STOVL). Typical compressor-face distortions (pressure and temperature), ground plane contours, and model surface temperature profiles are presented. Author

N89-29324*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

SOME EFFECTS OF AERODYNAMIC SPOILERS ON WING FLUTTER

ROBERT V. DOGGETT, JR. Jul. 1989 18 p

(NASA-TM-101632; NAS 1.15:101632) Avail: NTIS HC A03/MF A01 CSCL 01/1

The effects of deployment angle and size of symmetrically mounted upper-surface and lower-surface spoilers on the flutter characteristics of a simple, paddle-like, low-aspect-ratio, rectangular wing model that was tested at Mach number 0.80 in the Langley Transonic Dynamics Tunnel are presented. The results show that the flutter dynamic pressure is increased by increasing either spoiler deployment angle or spoiler size. For the configurations studied spoiler size was more effective than deployment angle in increasing the flutter dynamic pressure. Author

N89-29325# Centre d'Etudes et de Recherches, Toulouse (France). Dept. Aerothermodynamique.

EXPERIMENTAL INVESTIGATION OF A THREE DIMENSIONAL WAKE IN THE VICINITY OF A WING-BODY JUNCTION

G. PAILHAS and V. JAYARAMAN Mar. 1989 115 p

(Contract STPA-85-95004-35)

(CERT-0A-29/5025-AYD; DERAT-29/5025-20; ETN-89-95278) Avail: NTIS HC A06/MF A01

The development of a pressure gradient turbulent incompressible wake in the vicinity of a junction between the test section tunnel floor and a constant chord swept wing (i.e., simulated wing-body junction) is studied. Use of a four-wire probe (CTA type) is employed as a measurement technique. Static pressure measurements are made both on either sides of the model and in the wake; flow visualization is carried out to supplement the above information. Mean and fluctuating turbulent velocities and shear stresses are deduced from the hot-wire output. The results indicate that the characteristics of such a complex flow field (dissimilar pressure gradients and three dimensional effects) are different from that of a classical self-preserving two dimensional wake. The flow field around the simulated wing-body junction and its influence on the wake development is discussed. ESA

N89-29326*# Stanford Univ., CA. Dept. of Aeronautics and Astronautics.

CONTROL OF SEPARATED FLOW PAST A CYLINDER USING TANGENTIAL WALL JET BLOWING

SEJONG OH and LEONARD ROBERTS Jul. 1989 34 p (Contract NCC2-55)

(NASA-CR-185918; NAS 1.26:185918; JIAA-TR-93) Avail: NTIS HC A03/MF A01 CSCL 01/1

A theoretical analysis is conducted to study the effect of a tangential wall jet on the control of two dimensional separated flow past a circular cylinder. For a tangential wall jet, the mathematical model derived previously is used and the vortex cloud method is adopted for the calculation of the external flow field. For certain limiting cases, the governing equations are simplified and closed forms of solutions for the wall jet is very efficient in reducing drag by delaying the separation point in the range of small blowing strength. The suction force induced by the wall jet is negligible to the drag when the blowing strength is large.

Author

03 AIR TRANSPORTATION AND SAFETY

N89-29328*# Old Dominion Univ., Norfolk, VA. Dept. of Mechanical Engineering and Mechanics.

THERMO-VISCOPLASTIC ANALYSIS OF HYPERSONIC STRUCTURES SUBJECTED TO SEVERE AERODYNAMIC HEATING Progress Report, 31 Dec. 1988 - 30 Sep. 1989 EARL A. THORNTON, J. TINSLEY ODEN, W. WOYTEK TWORZYDLO, and SUNG-KIE YOUN (Computational Mechanics

Co., Austin, TX.) Oct. 1989 18 p Previously announced in IAA as A89-30713 (Contract NSG-1321)

(NASA-CR-185915; NAS 1.26:185915) Avail: NTIS HC A03/MF A01 CSCL 01/1

A thermoviscoplastic computational method for hypersonic structures is presented. The method employs unified viscoplastic constitutive model implemented in a finite element approach for quasi-static thermal-structural analysis. Applications of the approach to convectively cooled hypersonic structures illustrate the effectiveness of the approach and provide insight into the transient inelastic structural behavior at elevated temperatures.

Author

03

AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

A89-52325

PROPORTIONAL HAZARDS MODELLING OF AIRCRAFT CARGO DOOR COMPLAINTS

A. L. F. LEITAO and D. W. NEWTON (Birmingham, University, England) Quality and Reliability Engineering International (ISSN 0748-8017), vol. 5, July-Sept. 1989, p. 229-238. refs Copyright

Proportional hazards modelling is a powerful technique which can be used to investigate the effects of various explanatory variables on the life length of equipment. In this paper the analysis of aircraft cargo door complaints is considered, as this can cause serious delay problems. Particular attention is given to the assumptions supporting the application of the model. Consideration is given to problems in the choice of the appropriate basic metric time, definition of covariates and adapting the methodologies to this particular problem. Emphasis is placed upon the validation of the results by attempting several different structures of the dependent variables.

A89-52513

ARE THE SOVIETS SET TO MAKE THE BIG TIME?

OLIVER SUTTON Interavia (ISSN 0020-5168), vol. 44, Aug. 1989, p. 772-776.

Copyright

The commercial viability of Soviet-manufactured airliners is evaluated in light of current production airframe production-capacity saturation in both the U.S. and Western Europe, opening opportunities for Soviet airframe manufacturing enterprises capable of delivering aircraft ahead of Western competitors. The II-96-300 and the Tu-204 airliners are noted to respectively fit into two popular aircraft categories, namely those for the long-range routes that are eventually to be served by the A 340, and those for the medium-range routes currently served by such aircraft as the B 757. Attention is given to Western certification criteria for the Soviet aircraft and the prospects for cooperative efforts with Western manufacturers. O.C.

A89-53474

LIGHTNING PROTECTION TESTING OF THE E-6 WING TIP ANTENNA POD/HF PROBE

G. L. ENOCHSON, S. W. KORMANYOS, and V. L. SEVERSON (Boeing Aerospace, Seattle, WA) IN: IEEE 1989 National

03 AIR TRANSPORTATION AND SAFETY

Symposium on Electromagnetic Compatibility, Denver, CO, May 23-25, 1989, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1989, p. 59-64.

Copyright

A brief summary is presented of lightning tests conducted on the US Navy E-6 aircraft wing tip antenna pod/HF probe in accordance with MIL-STD-1757 to demonstrate compliance with MIL-B-5087B lightning protection requirements. The tests were conducted on a 22-ft full-sized electrically representative model of the pod/HF probe. Three types of tests were conducted. Long arc attachment tests (MIL-STD-1757 test method T01) were performed to determine the lightning arc entry angle. Direct effects testing (method T02) was conducted to examine the extent of damage which could result from direct attachment of a high-current lightning strike to the pod. Indirect effects testing (method T05) was conducted to assess the voltage levels induced on equipment cables that result from lightning strike attachment. The waveforms applied, test article configurations, and current injection points were chosen to represent worst-case conditions. Test operations and test results are discussed. 1E

A89-53793#

AIRCRAFT ICING CAUSED BY LARGE SUPERCOOLED DROPLETS

MARCIA K. POLITOVICH (NOAA, Environmental Science Group, Boulder, CO) Journal of Applied Meteorology (ISSN 0894-8763), vol. 28, Sept. 1989, p. 856-868. refs

The characteristics of aircraft icing environments containing large supercooled droplets are described. Substantial loss in rate of climb capability can result from less than 10 minutes duration in conditions where fewer than 0.1-1 cu cm of droplets 30-400 microns in diameter are present. These conditions are found to have a greater effect than those where the liquid water was confined to smaller droplets. Measurements from research aircraft flying in regions containing these large droplets, located in the Sierra Nevada in California, near Amarillo, Texas, and in northern Arizona are presented. Temperatures ranged from -5.5 to -9.4 C in 13 regions The sizes of the droplets responsible for performance loss varied with each encounter but ranged from tens to hundreds of micrometers, and these were accompanied by few to no ice crystals. Two case studies are examined in further detail, including the weather conditions present at the time of the encounters. The meteorological situations leading to formation of these large droplets provide suitable environments for coalescence growth, or for prolonged depositional growth, and include weak atmospheric instability, warm (temperatures greater than about -15 C) cloud tops, and sufficient moisture. Author

A89-53971* Princeton Univ., NJ. AN EXPERT SYSTEM FOR WIND SHEAR AVOIDANCE

ROBERT F. STENGEL and D. ALEXANDER STRATTON (Princeton University, NJ) IN: 1989 American Control Conference, 8th, Pittsburgh, PA, June 21-23, 1989, Proceedings. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1989, p. 349-354. refs

(Contract NAG1-834)

Copyright

A study of intelligent guidance and control concepts for protecting against the adverse effects of wind shear during aircraft takeoffs and landings, with current emphasis on developing an expert system for wind shear avoidance, is reported. Principal objectives are to develop methods for assessing the likelihood of wind shear encounter (based on real-time information in the cockpit), for deciding what flight path to pursue (e.g., takeoff abort, landing go-around, or normal climbout or glide slope), and for using the aircraft's full potential for combating wind shear. This study requires the definition of both deterministic and statistical techniques for fusing internal and external information, for making go/no-go decisions, and for generating commands to the aircraft's autopilot and flight directors for both automatic and manually controlled flight. The development is described of the windshear safety advisor, an expert system for pilot aiding that is based on the FAA Windshear Training Aid, a two-volume manual that presents an overview, pilot guide, training program, and substantiating data providing guidelines for this initial development. The windshear safety advisor expert system contains over 200 rules and is coded in the LISP programming language. I.E.

A89-54802

OBSERVATIONS AND FORECASTS FOR RUNWAY (PAVEMENT) SURFACES

J. R. KELLEY, DAVID C. TRASK, and OLGA HUNT (Surface Systems, Inc., Saint Louis, MO) IN: International Conference on the Aviation Weather System, 3rd, Anaheim, CA, Jan. 30-Feb. 3, 1989, Preprints. Boston, MA, American Meteorological Society, 1989, p. 148-153. refs

Copyright

The production of pavement-specific forecasts for use in airports is discussed. Surface sensors that provide data on runway conditions are described and the methods for processing data from these sensors are outlined. Methods for producing runway surface forecasts are considered, including 24-h projections of pavement temperatures, precipitation, pavement conditions, snow accumulation, runway wind speed, air temperature, and wind chill equivalent temperature. Also, a numerical forecasting model specifically for pavement forecasts is outlined. R.B.

A89-54803* Massachusetts Inst. of Tech., Cambridge. THE INFLUENCE OF ICE ACCRETION PHYSICS ON THE FORECASTING OF AIRCRAFT ICING CONDITIONS

R. JOHN HANSMAN, JR. (MIT, Cambridge, MA) IN: International Conference on the Aviation Weather System, 3rd, Anaheim, CA, Jan. 30-Feb. 3, 1989, Preprints. Boston, MA, American Meteorological Society, 1989, p. 154-158. Research supported by FAA. refs

(Contract NGL-22-009-640; NAG3-666)

Copyright

The physics which control aircraft ice accretion are reviewed in the context of identifying and forecasting hazardous icing conditions. The severity of aircraft icing is found to be extremely sensitive to temperature, liquid water content and droplet size distribution particularly near the transition between rime and mixed icing. The difficulty in measurement and the variability of these factors with altitude, position and time coupled with variable aircraft sensitivity make forecasting and identifying icing conditions difficult. Automated Pilot Reports (PIREPS) are suggested as one mechanism for improving the data base necessary to forecast icing conditions.

A89-54804

MEASUREMENTS OF HAZARDOUS ICING CONDITIONS

MARCIA K. POLITOVICH (NOAA, Boulder, CO) IN: International Conference on the Aviation Weather System, 3rd, Anaheim, CA, Jan. 30-Feb. 3, 1989, Preprints. Boston, MA, American Meteorological Society, 1989, p. 159-163. refs Copyright

Airborne measurements of hazardous icing conditions are used to study the effects of the icing environment on aircraft. The measurements include temperature, cloud droplets, cloud hydrometeors, and liquid water content. The characteristics of the icing regions are discussed. It is found that hazardous icing environments have a higher concentration of particles with diameters between 30 and 400 microns, compared with nearby nonhazardous regions. These hydrometeors are usually supercooled water droplets. It is concluded that these supercooled droplets pose the greatest hazard to flight in icing conditions.

R.B.

A89-54805

REMOTE DETECTION OF AIRCRAFT ICING HAZARDS BY DOPPLER RADAR

LEON F. OSBORNE, JR. (North Dakota, University, Grand Forks) IN: International Conference on the Aviation Weather System, 3rd, Anaheim, CA, Jan. 30-Feb. 3, 1989, Preprints. Boston, MA, American Meteorological Society, 1989, p. 164-168. refs

(Contract DTFA01-87-C-00019) Copyright

Results are presented from tests of an algorithm for the detection of icing hazards. The algorithm was developed from studies on the use of single-Doppler radar in icing detection (Osborne, 1986). The algorithm is directed toward the identification of regions of supercooled liquid water under stratiform or stratocumulus conditions during cool season months. The software is described and tests to identify the signatures discernable from the algorithm components and to determine the relative importance of the signatures are outlined. Preliminary results are given, showing a high variability in the success of the various components. R.B.

A89-54807

AIRCRAFT ICING CONDITIONS DETECTED BY COMBINED REMOTE SENSORS - A PRELIMINARY STUDY

INGRID A. POPA FOTINO, MARCIA K. POLITOVICH, and JOHN W. HINKLEMAN, JR. (NOAA, Boulder, CO) IN: International Conference on the Aviation Weather System, 3rd, Anaheim, CA, Jan. 30-Feb. 3, 1989, Preprints. Boston, MA, American Meteorological Society, 1989, p. 173-177. Research supported by FAA. refs

Copyright

Consideration is given to the use of microwave radiometers and remote sensing data to obtain data on the horizontal and vertical liquid distribution for forecasts of aircraft icing conditions. Data from two microwave radiometers, IR satellite images of cloud tops, and ceilometer measurements of cloud base altitudes are examined. The horizontal variability of icing conditions and the capability of complementary remote sensors to delimit a vertical range for radiometer-detected liquid water are studied. Average liquid-water concentrations are estimated in order to determine icing probability. It is found that the method of combining remote sensing data extends the icing detection capability of microwave radiometers. R.B.

A89-54821

AIRCRAFT ICING HAZARDS FORECASTING AND SYNOPTIC CLASSIFICATION

DAVID W. BERNHARDT (North Dakota, University, Grand Forks) IN: International Conference on the Aviation Weather System, 3rd, Anaheim, CA, Jan. 30-Feb. 3, 1989, Preprints. Boston, MA, American Meteorological Society, 1989, p. 249-251. refs (Contract DTFA01-87-C-00019)

Copyright

A program to improve forecasts of aircraft icing potential and the synoptic classification of icing events is discussed. Daily forecasts were made for the winters seasons from 1985-86 to 1988-89. The performance of these forecasts was evaluated for the development of an algorithm to detect icing hazards using Doppler radar. The skill in forecasting icing, timing, type, intensity, and levels is examined. The process of classifying the events according to large-scale synoptic conditions is outlined. R.B.

A89-54823

THE ROLE OF THE SMITH-FEDDES MODEL IN IMPROVING THE FORECASTING OF AIRCRAFT ICING

P. A. HAINES (Purdue University, West Lafayette, IN), J. K. LUERS, and C. A. CERBUS (Dayton Research Institute, OH) IN: International Conference on the Aviation Weather System, 3rd, Anaheim, CA, Jan. 30-Feb. 3, 1989, Preprints. Boston, MA, American Meteorological Society, 1989, p. 258-263. refs Copyright

Icing parameters from the updated Smith-Feddes model (Rogers et al., 1985) are compared with observational data to study the use of the model in forecasts of aircraft icing conditions. The model is reviewed and the process of validating the model using the FAA/NRL data base. The values of liquid water content, temperature, and mean volume drop observed by particle spectrometers and the Johnson-Williams meter are compared with values calculated by the model. It is found that, when accurate cloud information is available, the Smith-Feddes model exhibits skill in diagnosing vertical profiles of cloud liquid water. R.B.

A89-54838

SEVERE AIRCRAFT ICING EVENTS - A COLORADO CASE STUDY

DAVID BERNHARDT and LEON F. OSBORNE, JR. (North Dakota, University, Grand Forks) IN: International Conference on the Aviation Weather System, 3rd, Anaheim, CA, Jan. 30-Feb. 3, 1989, Preprints. Boston, MA, American Meteorological Society, 1989, p. 327-330.

(Contract DTFA01-87-C-00019) Copyright

A large-scale icing event that took place on January 31 and February 1, 1988 over eastern Colorado is described together with the results of the analysis of Doppler radar data collected during the event. The analysis of atmospheric conditions showed that the pattern of westerly flow across the Rocky Mountains at midlevels with a cold dome of surface air over the Central Plains provided an upslope scenario conducive to continual conditions of supercooled liquid water in a low stratus deck, the presence of which was maintained for extended periods without significant reduction by glaciation. It is emphasized that, when an aircraft must remain within the confines of this layer of supercooled liquid water, the aircraft hazards are magnified; the use of radar detection during these times becomes extremely difficult due to the lack of significant backscatters.

N89-28507# National Transportation Safety Board, Washington, DC. Bureau of Field Operations.

AIRCRAFT ACCIDENT/INCIDENT SUMMARY REPORTS: BELLEVILLE, ILLINOIS, AUGUST 22, 1987; PENSACOLA, FLORIDA, DECEMBER 27, 1987 30 Jun. 1989 25 p

(PB89-910405; NTSB/AAR-89/02/SUM) Avail: NTIS HC A03/MF A01 CSCL 01/3

Two separate aircraft accidents investigated by the National Transportation Safety Board are compiled. The accident locations and their dates are as follows: Belleville, Illinois, August 22, 1987; and Pensacola, Florida, December 27, 1987. Author

N89-28508# Technische Univ., Berlin (Germany, F.R.). Wirtschaftswissenschaftliche Dokumentation.

COMPETITION AND SAFETY IN AIR TRAFFIC Thesis (WETTBEWERB UND SICHERHEIT IM LUFTVERKEHR)

MATTHIAS-WOLFGANG STOETZER 1988 50 p In GERMAN; ENGLISH summary

(TUB-DISS-PAPER-128; ETN-89-94421) Avail: NTIS HC A04/MF A01

The relations between competition and safety in the air transportion market are investigated. The allegation that competition in the air transportion market necessarily results in a deterioration of flight safety is examined on theoretical grounds. Existing studies of the relationship of safety and competition in flight transportation are summarized. The development of flight safety in the USA before and after the Airline Deregulation Act of 1978 is analyzed. Theoretical reasoning and the empirical confirmation lead to the conclusion that economic regulation is not inevitable in order to secure a high level of safety in air transportion. The maintaining or the regulation of technical standards is advised.

N89-29332# RJO Enterprises, Inc., Lanham, MD. ACCIDENT/INCIDENT DATA ANALYSIS DATABASE SUMMARIES, VOLUME 1 Final Report

T. P. MURPHY and R. J. LEVENDOSKI Mar. 1989 193 p (DOT/FAA/DS-89/17-1) Avail: NTIS HC A01/MF A01

This two volume report provides a compendium of the existence, availability, limitations, and applicability of aviation accident and incident databases for use in human factors research. An aviation and data processing oriented form was used to survey 41 U.S. Government, military, aircraft manufacturers, airlines, special interest groups, and international aviation safety database sources. The compendium in Volume 1 presents information about 34 aviation safety databases. Recommendations include a feasibility study of a combined master aviation safety database, the convening

03 AIR TRANSPORTATION AND SAFETY

of a task force to standardize human factors terminology and data collection, the establishment of a limited immunity program to facilitate the flow of air carrier incident data, and a more vigorous effort to present available aviation safety information to pilots. Appendices are contained in Volume 2 to provide detailed information about database collection forms, data structures, and human factors information within the database. Author

N89-29333# RJO Enterprises, Inc., Lanham, MD. ACCIDENT/INCIDENT DATA ANALYSIS DATABASE SUMMARIES, VOLUME 2 Final Report

T. P. MURPHY and R. J. LEVENDOSKI Mar. 1989 281 p (DOT/FAA/DS-89/17-2) Avail: NTIS HC A13/MF A01

This two volume report provides a compendium of the existence, availability, limitations, and applicability of aviation accident and incident databases for use in human factors research. An aviation and data processing oriented form was used to survey 41 U.S. Government, military, aircraft manufacturers, airlines, special interest groups, and international aviation safety database sources. The compendium in Volume 1 presents information about 34 aviation safety databases. Recommendations include a feasibility study of a combined master aviation safety database, the convening of a task force to standardize human factors terminology and data collection, the establishment of a limited immunity program to facilitate the flow of air carrier incident data, and a more vigorous effort to present available aviation safety information to pilots. Appendices are contained in Volume 2 to provide detailed information about database colletion forms, data structures, and human factors information within the database. Author

04

AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

A89-51716#

IMPROVED GUIDANCE LAW DESIGN BASED ON THE MIXED-STRATEGY CONCEPT

J. SHINAR (Technion - Israel Institute of Technology, Haifa) and I. FORTE Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 12, Oct. 1989, p. 739-745. Previously cited in issue 22, p. 3533, Accession no. A87-50469. refs (Contract AF-AFOSR-86-0355) Copyright

A89-52590#

DEVELOPMENT AND FLIGHT EVALUATION OF AN INTEGRATED GPS/INS NAVIGATION SYSTEM

WILMER A. MICKELSON and MATTHEW J. CARRICO (Rockwell International Corp., Collins Government Avionics Div., Cedar IN: AIAA Guidance, Navigation and Control Rapids, IA) Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 1. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 618-627. refs (AIAA PAPER 89-3498) Copyright

A low-cost strapdown IMU and a single channel P-code GPS receiver are integrated to provide an accurate navigation solution with in-flight IMU calibration and alignment capability. The tightly coupled integration uses INS velocity to aid GPS acquisition and tracking while the GPS measurements are used to estimate IMU errors. A data decoupling technique is described which allows separate GPS and INS Kalman filters to operate independently on the satellite line-of-sight pseudorange and delta-range measurements. The system provides modularity and reversionary modes to GPS-alone of IMU-alone navigation by using separate hardware for the GPS receiver and INS computer. The GPS receiver also uses baro altimeter data to extend its operation during periods of fewer than four SV coverage. Flight test data from the Yuma

Proving Ground laser test range is presented. The test results demonstrate the expected navigation accuracy and transfer alignment capabilities. Author

A89-52591#

GLOBAL POSITIONING SYSTEM ACCURACY IMPROVEMENT USING RIDGE REGRESSION

R. J. KELLY (Allied-Signal Aerospace Co., Bendix Communications Div., Baltimore, MD) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 1. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 628-638. refs

(AIAA PAPER 89-3499) Copyright

A method for reducing the effects of the geometric dilution of position in GPS navigation system is proposed which is based on the incorporation of the Ridge regression into the GPS receiver signal processor. A computer simulation confirms the theoretical prediction that bias and variance inflation caused by the geometric dilution of position can be measurably reduced through the use of the Ridge regression algorithm. The technique proposed here can be applied to any position-fix navigation. VI.

A89-52592*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

PASSIVE NAVIGATION USING IMAGE IRRADIANCE TRACKING

P. K. A. MENON and B. SRIDHAR (NASA, Ames Research Center, Moffett Field, CA) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 1. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 639-646. refs (Contract NAG2-463)

AIAA PAPER 89-3500) Copyright

Rotorcraft operating at low altitudes require navigational schemes for locating the terrain and obstacles. Due to the covert nature of missions to be accomplished, a passive navigation scheme is desirable. This paper describes the development of a passive navigation scheme combining image sequences from a vehicle mounted camera with vehicle motion variables. Geometric properties of perspective projection together with an image irradiance tracking scheme at each pixel are used to determine the range to various objects within the field-of-view. Derivation of the numerical algorithm and simulation results are given. Other applications of the proposed approach include navigation for autonomous planetary rovers and telerobots. Author

A89-52594*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

FLIGHT-TEST EVALUATION OF CIVIL HELICOPTER TERMINAL APPROACH OPERATIONS USING DIFFERENTIAL GPS

F. G. EDWARDS and D. M. HEGARTY (NASA, Ames Research Center, Moffett Field, CA) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 1. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 657-666. (AIAA PAPER 89-3635) Copyright refs

A civil code differential Global Positioning System (DGPS) has been developed and flight-tested by the NASA Ames Research Center. The system was used to evaluate the performance of the DGPS for support of helicopter terminal approach operations. The airborne component of the DGPS was installed in a NASA helicopter. The ground-reference component was installed in a mobile van and equipped with a real-time VHF telemetry data link to transmit correction information to the aircraft system. An extensive series of tests was conducted to evaluate the performance of the system for several different configurations of the airborne navigation filter. This paper will describe the systems. the results of the flight tests, and the results of the posttest analysis. Author

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

National Aeronautics and Space Administration. A89-52663*# Goddard Space Flight Center, Greenbelt, MD. **OBSERVABILITY STUDIES OF INERTIAL NAVIGATION**

SYSTEMS

i. Y. BAR-ITZHACK (NASA, Goddard Space Flight Center, Greenbelt, MD; Technion - Israel Institute of Technology, Haifa) and D. GOSHEN-MESKIN IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 2. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 1283-1289. refs

(AIAA PAPER 89-3580) Copyright The present work deals with an undamped three-channel inertial-navigation-system error model. It is shown that it is possible to fully observe, and thus estimate, all the states of the system. This is in contrast to a previous two-channel system, in which it was impossible to fully observe and estimate all the states of the system. The conclusions of the analysis are verified through covariance simulation, which yields identical results. Author

A89-52699*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

CONTROLLER EVALUATIONS OF THE DESCENT ADVISOR **AUTOMATION AID**

LEONARD TOBIAS, UWE VOLCKERS, and HEINZ ERZBERGER (NASA, Ames Research Center, Moffett Field, CA) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 2. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 1609-1618. Previously announced in STAR as N89-25981. refs (AIAA PAPER 89-3624) Copyright

An automation aid to assist air traffic controllers in efficiently

spacing traffic and meeting arrival times at a fix has been developed at NASA Ames Research Center. The automation aid, referred to as the descent advisor (DA), is based on accurate models of aircraft performance and weather conditions. The DA generates suggested clearances, including both top-of-descent point and speed profile data, for one or more aircraft in order to achieve specific time or distance separation objectives. The DA algorithm is interfaced with a mouse-based, menu-driven controller display that allows the air traffic controller to interactively use its accurate predictive capability to resolve conflicts and issue advisories to arrival aircraft. This paper focuses on operational issues concerning the utilization of the DA, specifically, how the DA can be used for prediction, intrail spacing, and metering. In order to evaluate the DA, a real time simulation was conducted using both current and retired controller subjects. Controllers operated in teams of two, as they do in the present environment; issues of training and team interaction will be discussed. Evaluations by controllers indicated considerable enthusiasm for the DA aid, and provided specific recommendations for using the tool effectively. Author

A89-52700*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

PILOTED SIMULATION OF A GROUND-BASED

TIME-CONTROL CONCEPT FOR AIR TRAFFIC CONTROL

THOMAS J. DAVIS and STEVEN M. GREEN (NASA, Ames Research Center, Moffett Field, CA) IN: AIAA Guidance. Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 2. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 1619-1625. (AIAA PAPER 89-3625) Copyright

A joint simulation was carried out using a piloted simulator and an advanced-concept air traffic control simulation to study the acceptability and accuracy of the ground-based fourdimensional descent advisor (DA), an automation aid based on accurate models of aircraft performance and weather conditions. In the piloted simulation, airline crews executed controller-issued descent advisories along standard curved-path arrival routes and were able to achieve an arrival-time precision of plus or minus 20 s at the metering fix. An analysis of errors generated in turns resulted in a further enhancement of the DA algorithm. V.L.

A89-52701#

A MODEL OF THE NATIONAL AIRSPACE SYSTEM

MICHAEL J. WHITE (Mitre Corp., Bedford, MA) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technica Papers. Part 2. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 1626-1634.

(AIAA PAPER 89-3626) Copyright

A project is described in which the tools of operations research are applied to the analysis of the performance of the National Airspace System (NAS) in the face of changes in airport and airspace capacity and demand. Computer models created and used by the project team in predicting NAS performance under various conditions of capacity and demand are described, and examples of their performance metrics and outputs are shown. Author

A89-52702#

GROUND-HOLDING STRATEGIES FOR ATC FLOW CONTROL MOSTAFA TERRAB, AMEDEO R. ODONI (MIT, Cambridge, MA),

and OWEN L. DEUTSCH (Charles Stark Draper Laboratory, Inc., IN: AIAA Guidance, Navigation and Control Cambridge, MA) Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 2. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 1635-1646. refs

(AIAA PAPER 89-3628) Copyright

One of the most important functions of any air traffic management system is the assignment of 'ground-holding' times to flights, i.e., the determination of whether and by how much the take-off of a particular aircraft headed for a congested part of the ATC system should be postponed in order to reduce the likelihood and extent of airborne delays. An analysis is presented of the fundamental case in which flights from many destinations must be scheduled for arrival at a single congested airport. A set of approaches for addressing a deterministic and stochastic version of this problem is described. Optimal solution approaches include minimum cost flow algorithms and dynamic programming. Under a particular natural assumption regarding the functional form of delay, a very efficient algorithm can be used. This algorithm is also useful in addressing heuristically the stochastic version of the problem. Author

A89-52703#

AIRCRAFT TRAJECTORY PREDICTION FOR TERMINAL **AUTOMATION**

JAMES L. STURDY, JOHN W. ANDREWS, and JERRY D. WELCH (MIT, Lexington, MA) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 2. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 1647-1652. Research sponsored by FAA. refs

(AIAA PAPER 89-3634) Copyright

As part of the Terminal Air Traffic Control Automation (TATCA) program, equations and aircraft performance models have been integrated into a unified framework to support automation assistance over all phases of aircraft flight. The integrated set of mode-based aircraft trajectory-prediction algorithms is shown to deliver the accuracy required to support automated terminal planning while simultaneously achieving computational efficiency required to allow implementation on workstation or mini computers. VI.

A89-52721#

OPERATIONAL EXPERIENCE WITH THE COMPUTER ORIENTED METERING PLANNING AND ADVISORY SYSTEM

(COMPAS) AT FRANKFURT, GERMANY UWE VOELCKERS and HANS-DIETER SCHENK (DLR, Institut fuer Flugfuehrung, Brunswick, Federal Republic of Germany) AIAA, Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989. 8 p. refs (AIAA PAPER 89-3627) Copyright

The current status of a project to develop an operational COMPAS (Computer-Oriented Metering, Planning, and Advisory System) is reviewed. COMPAS is a computer-controlled planning system which helps the ATC controller to plan and control more

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

efficiently the inbound flow of air traffic in the airport terminal control area. The experimental and operational COMPAS are briefly compared, and the technical concept of the operational COMPAS is described. The technical realization of COMPAS is addressed, including the interface computer, main computer, display station computer, and network communication. The software development, mechanical construction, and system tests are briefly considered.

A89-52779

PRECISION CHARACTERISTICS OF A COORDINATE DEVICE FOR ESTIMATING THE VELOCITY OF AN OBJECT [TOCHNOSTNYE KHARAKTERISTIKI KOORDINATNOGO USTROISTVA OTSENKI SKOROSTI OB'EKTA]

A. A. ELISEEV, A. V. POKROVSKII, V. G. FARAFONOV, and G. G. GETMANENKO (Leningradskii Institut Aviatsionnogo Priborostroeniia, Leningrad, USSR) Priborostroenie (ISSN 0021-3454), vol. 32, July 1989, p. 10-14. In Russian. refs Copyright

An analysis is made of numerical differentiation errors associated with calculations of the distance to an object based on the coordinate method of velocity estimation. The calculations are carried out under the assumption that the current distance function can be represented as a sum of regular and random components. An analysis is carried out for four approximations of the envelope of the spectral density of random component fluctuations of the distance parameter of interest. V.L.

A89-53484

OUT-OF-BAND RESPONSE OF VHF/UHF AIRBORNE ANTENNAE

ELYA B. JOFFE (K. T. M. Project Engineering, Ltd., Kfar-Sava, Israel) IN: IEEE 1989 National Symposium on Electromagnetic Compatibility, Denver, CO, May 23-25, 1989, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1989, p. 196-201. refs

Copyright

A method for measuring the response of antennas below band is presented that is reliable, repeatable, and simulates to a high level of confidence plane-wave conditions-the actual propagation mode that all airborne communication/navigation (COMM/NAV) antennas sense from most ground emitters and broadcast stations. The method has shown that the gain of most airborne COMM/NAV antennas is approximately -60 dBi, in the higher frequency range, to -120 dBi, in the lower frequency range, depending on the antenna. The VHF Whip antenna presents higher gain, due to its mechanical dimensions.

A89-53660#

THE LOCSTAR RADIODETERMINATION SATELLITE SYSTEM

RENAUD REGIS (Locstar, S.A., France) Ortung und Navigation (ISSN 0474-7550), vol. 30, no. 2, 1989, p. 259-267.

The design and current status of the Locstar commercial RDSS system are reviewed. Locstar is intended to provide radio location service with accuracy 100 m, radio navigation service, and limited-length (100 characters) alphanumeric message service to users in Europe, Africa, and the Middle East. The planned Locstar network comprises two or three GEO satellites with transceivers; a central ground segment with ground connection stations, satellite control station, position-computation and message-processing facilities, and a data-distribution network; and mobile user terminals. The development schedule calls for service to Western Europe (using one satellite) beginning in 1991. The many potential applications of the Locstar RDSS are discussed and illustrated with diagrams.

A89-53663#

MLS 1989 - STATUS REPORT FROM THE PERSPECTIVE OF THE AIRLINE COMPANIES [MLS 1989 -STANDORTBESTIMMUNG AUS DER SICHT DER LUFTVERKEHRSGESELLSCHAFTEN]

JENS-UWE KOCH (Deutsche Lufthansa AG, Frankfurt am Main,

Federal Republic of Germany) Ortung und Navigation (ISSN 0474-7550), vol. 30, no. 2, 1989, p. 326-332. In German.

The current implementation status of the precision microwave approach and landing system MLS is assessed, with a focus on European developments. Consideration is given to European ILS-MLS transition planning, the installation of new onboard equipment (including some numerical data for Lufthansa), the claimed advantages of MLS, and critical opinions voiced by industry spokesmen. It is concluded that MLS does offer significant advantages and that the current European requirements (as formulated in IMTEG/7) allow enough freedom with regard to hardware purchases for the companies to react to the final ICAO decision (to be taken in 1992) and/or the results of ongoing FAA studies on the MLS use categories. T.K.

A89-53969

AIR TRAFFIC CONTROL SYSTEM - CAN WE CLOSE THE CONTROL LOOP?

ANDREW J. KORNECKI (Embry Riddle Aeronautical University, Daytona Beach, FL) IN: 1989 American Control Conference, 8th, Pittsburgh, PA, June 21-23, 1989, Proceedings. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1989, p. 310, 311. Research supported by the Florida High Technology/Industrial Council.

Copyright

The air traffic control (ATC) system is analyzed from the control engineering viewpoint. Despite the human operator in the loop, ATC represents a conventional, multidimensional control system. The system observability and controllability can be analyzed. A control performance index representing safety, accuracy, and fuel consumption is introduced. The author presents the concept of using an expert system as an automatic controller and outlines the ATC knowledge-domain representation. The implementation of such an expert controller is discussed.

A89-54082* National Aeronautics and Space Administration. Arnes Research Center, Moffett Field, CA. ROTORCRAFT DECELERATION TO HOVER USING

IMAGE-BASED GUIDANCE

BANAVAR SRIDHAR (NASA, Ames Research Center, Moffett Field, CA) and ANIL V. PHATAK (Analytical Mechanics Associates, Mountain View, CA) IN: 1989 American Control Conference, 8th, Pittsburgh, PA, June 21-23, 1989, Proceedings. Volume 3. New York, Institute of Electrical and Electronics Engineers, 1989, p. 2459, 2460. refs

Copyright

Rotorcraft operating in hostile environment fly at low altitudes to minimize exposure to the defensive weapons arrayed against them. The development of intelligent guidance commands at low altitudes requires the integration of conventional guidance with the information provided by the sensor on relative position between the vehicle and local terrain or obstacles. Deceleration to hover (DTH) is one of the common maneuvers executed by a rotorcraft. The authors describe the integration of DTH guidance logic with an image-based scheme to estimate the hover point. The guidance and by navigation and image processing algorithms. Results are presented on the effect of the parameters on system performance. I.E.

A89-54083* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

INTEGRATION OF ACTIVE AND PASSIVE SENSORS FOR OBSTACLE AVOIDANCE

VICTOR H. L. CHENG and BANAVAR SRIDHAR (NASA, Ames Research Center, Moffett Field, CA) IN: 1989 American Control Conference, 8th, Pittsburgh, PA, June 21-23, 1989, Proceedings. Volume 3. New York, Institute of Electrical and Electronics Engineers, 1989, p. 2461-2468. refs

Copyright

The automatic obstacle-avoidance guidance problem is studied under the operational constraints imposed by the rotorcraft nap-of-the-earth (NOE) environment. The problem is discussed for two different circumstances. The first assumes that a full range map is available, irrespective of the type of sensor being used. Two approaches are proposed to extend a two-dimensional obstacle-avoidance concept presented by Cheng (1988). The situation where only a sparse range map is available from a passive sensor is also treated. An integrated approach that augments the passive sensor with an active one is discussed, along with the problem of data fusion and how it is affected by the characteristics of NOE flight.

A89-54366

INTERFACING HYPERSONIC AIRCRAFT IN THE NATIONAL AIRSPACE SYSTEM

TIMOTHY J. LAEL (North Dakota, University, Grand Forks) IN: International Conference on Hypersonic Flight in the 21st Century, 1st, Grand Forks, ND, Sept. 20-23, 1988, Proceedings. Grand Forks, ND, University of North Dakota, 1988, p. 409-417. Copyright

The relationships between hypersonic aircraft and the National Airspace System and air traffic control are discussed. The National Airspace System is described, including airport and air traffic control facilities. Consideration is given to the possible expansion of air traffic control zones to incorporate microwave landing system approach areas, the creation of specific hypersonic arrival and departure corridors, and the implementation of a hypersonic transition area for arriving and departing LEO-tracking airspace jurisdiction. It is suggested that the current National Airspace System could accommodate hypersonic aircraft with few alterations. Recommendations are made for facilitating the introduction of hypersonic aircraft.

A89-54859

DATA LINK PROCESSOR (DLP), PILOT ACCESS TO WEATHER DATA

PAVEL KLEIN (Stanford Telecommunications, Inc., Reston, VA) IN: International Conference on the Aviation Weather System, 3rd, Anaheim, CA, Jan. 30-Feb. 3, 1989, Preprints. Boston, MA, American Meteorological Society, 1989, p. 430-432. Copyright

The development of the Data Link Processor (DLP) to provide pilots with direct access to current weather products is discussed. The requirements, functions, and performance of the DLP systems are outlined. The operation of the system is described, including interfaces, product handling, and system hardware. The schedule for implementing the system and for proposed expansions to the system is presented. R.B.

N89-28509# Mitre Corp., McLean, VA. COLLISION AVOIDANCE OPERATIONAL CONCEPT Final Report

MEERA SHARMA Jun. 1989 33 p (Contract DTFA01-89-C-00001) (WP-88W00418; NAS-SR-1325; DOT/FAA/DS-89/27) Avail: NTIS HC A03/MF A01

An operational concept is presented for collision avoidance services which will be in place upon implementation of the Federal Aviation Administration (FAA) National Airspace System (NAS) Plan. This operational concept only discusses the ground-base portion of how the Air Traffic Control System (ATCS) provides flight safety by maintaining adequate aircraft separation. This concept discusses the aircraft separation assurance per the National Airspace System Requirement Specification (NASSRS). The objective is to describe the relationship among subsystems, facilities, information, and operators/users involved in the collision avoidance service. In addition, the elements and operations of the NAS Plan are mapped into the collision avoidance requirements stated in the NASSRS, NAS-SR-1000. Several types of block diagrams are used to illusrate systems connectively and operational flow. Scenarios are also derived to describe the collision avoidance process from a user's perspective. Author

05

AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

A89-51701*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Facility, Edwards, CA. PARAMETER ESTIMATION FOR FLIGHT VEHICLES KENNETH W. ILIFF (NASA, Flight Research Center, Edwards, CA) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 12, Sept.-Oct. 1989, p. 609-622. Previously cited in issue 08, p. 1049, Accession no. A87-22745. refs

A89-51703*# Georgia Inst. of Tech., Atlanta. STUDY OF AIRCRAFT CRUISE

P. K. A. MENON (Georgia Institute of Technology, Atlanta) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 12, Sept.-Oct. 1989, p. 631-639. Previously cited in issue 23, p. 3399, Accession no. A86-47704. refs (Contract NAS2-11978) Copyright

A89-51898

Copyright

ULTRA HIGH BYPASS AIRCRAFT SONIC FATIGUE

DANIEL R. LORCH (Douglas Aircraft Co., Long Beach, CA) (Institute of Environmental Sciences, Annual Meeting, Anaheim, CA, May 3-5, 1989) Journal of Environmental Sciences (ISSN 0022-0906), vol. 32, July-Aug. 1989, p. 26-34. refs Copyright

The development of a sonic fatigue treatment design of the ultra high bypass (UHB) engine for the MD-80 aircraft using high intensity noise testing and analysis is examined. Aircraft components are evaluated using progressive wave tube and shaker table tests to determine dammping, structural response, and sonic fatigue life. The testing of various sonic fatigue treatment designs on the UHB demonstrator aircraft is discussed. It is noted that lightweight and inexpensive treatments that protect against sonic fatigue can be developed. I.F.

A89-52041

A COUPLED ROTOR AEROELASTIC ANALYSIS UTILIZING NONLINEAR AERODYNAMICS AND REFINED WAKE MODELING

MICHAEL S. TOROK and INDERJIT CHOPRA (Maryland, University, College Park) (European Rotorcraft Forum, 14th, Milan, Italy, Sept. 20-23, 1988) Vertica (ISSN 0360-5450), vol. 13, no. 2, 1989, p. 87-106. refs

(Contract DAAL03-88-C-0002)

Copyright

The effects of improved aerodynamic modeling on rotor blade section and root loads, and blade response, are investigated. A nonlinear aerodynamic model based on an indicial method, is incorporated into a coupled rotor aeroelastic analysis. The aerodynamic analysis consists of three phases: a linear attached flow solution, a separated flow solution, and a dynamic stall solution. A prescribed and a free wake model are also included into the analysis. Blade responses and loadings are calculated using a finite element formulation in space and time. A modified Newton iterative method is used to calculate blade response and trim controls as one coupled solution. Results show that at high speed flight conditions, nonlinear effects dominate blade section forces, and significantly affect peak-to-peak values and the harmonic content of blade root loads. These effects are amplified at higher thrust conditions. Compressibility effects and blade twist considerably influence the extent of separated flow on the rotor disk. Firee and prescribed wakes give similar results at a high speed flight condition. Author

A89-52042 Florida Atlantic Univ., Boca Raton. PREDICTION OF INPLANE DAMPING FROM DETERMINISTIC AND STOCHASTIC MODELS

GOPAL H. GAONKAR, C. S. NAGARAJ (Florida Atlantic University, Boca Raton), and J. NAGABHUSHANAM (Indian Institute of Science, Bangalore, India) Vertica (ISSN 0360-5450), vol. 13, no. 2, 1989, p. 143-158. Research supported by the U.S. Army and NASA. refs

Copyright

This paper reviews computational reliability, computer algebra, stochastic stability and rotating frame turbulence (RFT) in the context of predicting the blade inplane mode stability, a mode which is at best weakly damped. Computational reliability can be built into routine Floquet analysis involving trim analysis and eigenanalysis, and a highly portable special purpose processor restricted to rotorcraft dynamics analysis is found to be more economical than a multipurpose processor. While the RFT effects are dominant in turbulence modeling, the finding that turbulence stabilizes the inplane mode is based on the assumption that turbulence is white noise. The relaxation of this assumption to include RFT effects merits further research.

A89-52044

FINITE ELEMENT BASED MODAL ANALYSIS OF HELICOPTER ROTOR BLADES

O. A. BAUCHAU and S. P. LIU (Rensselaer Polytechnic Institute, Troy, NY) Vertica (ISSN 0360-5450), vol. 13, no. 2, 1989, p. 197-206. refs

(Contract DAAG29-82-K-0093) Copyright

A finite element formulation for arbitrarily large displacements and rotations of a naturally curved and twisted composite rotor blade including transverse shearing and torsion related warping deformations is presented. The formulation is based on Reissner's principle, and Euler parameters are used to represent the finite rotations. The resulting governing equations are shown to contain simple algebraic nonlinearities only, of the cubic order. Such a formulation is ideally suited for a modal approximation of the problem since no additional assumption is required to accommodate the modal representation. The concept of perturbation is introduced and shown to yield an extremely efficient and accurate solution procedure. Numerical examples show an excellent agreement between modal representation and full finite element solutions for both static and dynamic problems. C.E.

A89-52201

AT3 DEMONSTRATES FEASIBILITY OF CARGO STOL WITH LONG RANGE

WILLIAM B. SCOTT Aviation Week and Space Technology (ISSN 0005-2175), vol. 131, Sept. 4, 1989, p. 38-40, 45, 48, 49. Copyright

An account is given of the design features and performance capabilities of the 62-percent scale proof-of-concept/flight test model of DARPA's Advanced Technology Tactical Transport (AT3) aircraft. The twin engine boom/tandem wing configuration of the AT3 has been shown to furnish the intended combination of STOL performance with extremely long range capability and high payload capacity. DARPA intends to continue the program by defining military requirements for a stealthy special-operations full-scale version of the AT3. The 'trimaran' configuration of the longitudinal structures linking the lifting surfaces of the AT3 is derived from the circumnavigation-range Rutan Voyager aircraft. O.C.

A89-52514

MI-28 HAVOC IS STILL TOMORROW'S TANK-BUSTER

MARK LAMBERT Interavia (ISSN 0020-5168), vol. 44, Aug. 1989, p. 802-805.

Copyright ~

A design-features exploration and performance capability evaluation is presented for the Mi-28 antiarmor helicopter designated 'Havoc' by NATO. Crew survival is noted to have been given high design-priority as a result of experience with the Mi-24 in Afghanistan; composite armor accordingly surrounds the crew below the window line. Armament consists of a 30-mm turret-mounted Gatling-action cannon, 20-tube pods of unguided rockets, and 'eight-packs' of AT-6 'Spiral' radio-guided antitank missiles. An export version of the Havoc is expected to be marketed. O.C.

A89-52525

GLAZING INTO THE FUTURE

Flight International (ISSN 0015-3710), vol. 136, Aug. 19, 1989, p. 33, 34.

Copyright

An account is given of the development status of novel aircraft cockpit transparency technologies. A transparency coating with 'memory' characteristics has been devised which is able to recover its original smooth surface after minor impact damage; another canopy material is undergoing development which darkens or lightens in response to a small voltage (which can be indefinitely sustained) in order to control radiant heat and glare. Also undergoing refinement are exotic films of Ag and Au for the reflection of EM interference used by enemy forces to affect the operation of military avionics, and ultrafine Cu grids furnishing protection from nuclear blast-generated EMP.

A89-52693*# Cincinnati Univ., OH.

PARALLEL DYNAMIC PROGRAMMING FOR ON-LINE FLIGHT PATH OPTIMIZATION

G. L. SLATER and K. HU (Cincinnati, University, OH) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 2. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 1553-1559. refs

(Contract NAG2-175)

(AIAA PAPER 89-3615) Copyright

Parallel systolic algorithms for dynamic programming(DP) and their respective hardware implementations are presented for a problem in on-line trajectory optimization. The method is applied to a model for helicopter flight path optimization through a complex constraint region. This problem has application to an air traffic control problem and also to a terrain following/threat avoidance problem. Author

A89-52712*# Massachusetts Inst. of Tech., Cambridge. HIGH PERFORMANCE LINEAR-QUADRATIC AND H-INFINITY DESIGNS FOR A 'SUPERMANEUVERABLE' AIRCRAFT

PETROS VOULGARIS and LENA VALAVANI (MIT, Cambridge, MA) AIAA, Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989. 10 p. refs

(Contract F08635-87-K-0031; NAG2-297)

(AIAA PAPER 89-3456) Copyright

Recent efforts by the National Aeronautics and Space Administration Langley Research Center have focused on expanding the flight envelope of the F/A-18 aircraft. Of particular concern has been the low speed, high angle-of-attack regime over which the conventional aerodynamic controls of the F/A-18 lose their effectiveness. In order to address this problem the F18 high alpha research vehicle was developed. This aircraft is essentially a modified F/A-18 which possesses thrust vectoring capabilities and hence increased maneuverability in this flight regime. The linear-quadratic-Gaussian with loop-transfer-recovery and H(infinity) design methodologies are used to design high performance controllers for the F18 at an operating point within the expanded envelope. In addition, how the control redundancy of the F18 can be used to maintain nominal performance, as well as nominal stability, in situations where failures occur, is shown. Author

A89-52959

SOME ASPECTS OF AIRCRAFT DYNAMIC LOADS DUE TO FLOW SEPARATION

D. G. MABEY (Royal Aerospace Establishment, Aerodynamics Dept., Bedford, England) Progress in Aerospace Sciences (ISSN 0376-0421), vol. 26, no. 2, 1989, p. 115-151. refs Copyright

Topics discussed in this paper include the need for consistent

definitions of buffet and buffeting, the advantages of a consistent notation, buffeting due to wings and other components, the alleviation of buffeting, the special difficulties of flight tests and the special advantages of buffeting measurements in cryogenic wind-tunnels. Single degree of freedom flutter due to flow separation is not discussed, but may contribute significant dynamic loads. Author

A89-53255#

HEAT TRANSFER CHARACTERISTICS OF AN AERO-ENGINE INTAKE FITTED WITH A HOT AIR JET IMPINGEMENT ANTI-ICING SYSTEM

S. J. DOWNS (Rolls-Royce, PLC, Derby, England) and E. H. JAMES (Loughborough University of Technology, England) IN: ASME 1988 National Heat Transfer Conference, Houston, TX, July 24-27, 1988, Proceedings. Volume 1. New York, American Society of Mechanical Engineers, 1988, p. 163-170. refs Copyright

Aircraft leading edges are commonly protected from potentially hazardous ice build-up by means of thermal anti-icing systems. Investigations have been carried out into the heat transfer characteristics of a typical aero-engine intake fitted with a jet impingement hot air anti-icing system to improve modeling techniques and thus facilitate optimization of this type of system. The results of experimental investigations into the internal lipskin heat transfer characteristics, a re-assessment of external heat transfer, conduction effects and a simple freezing option for areas of lipskin falling below zero degrees centigrade have been used to refine a computer thermal model. Proposed changes to modeling techniques are validated by reference to temperatures recorded during flight testing in dry air and in natural and simulated icing conditions. The resultant prediction capability in terms of skin temperature levels and residual ice quantities is satisfactory.

Author

A89-53308#

EUROFAR - PROJECT FOR A PERPENDICULARLY LAUNCHED CRUISING AIRCRAFT [EUROFAR - PROJEKT FUER EIN SENKRECHT STARTENDES REISEFLUGZEUG]

R. D. VON RETH, U. HAGMANN, and H. (Messerschmitt-Boelkow-Blohm GmbH, Ottobrunn, HUBER Federal DGLR and ASI, Symposium ueber Republic of Germany) Luftfahrt-Staedtebau-Umwelt, Essen, Federal Republic of Germany, Jan. 17, 18, 1989, Paper. 38 p. In German.

(MBB-UD-538-88-PUB)

The operational characteristics and possible applications of the EUROFAR (European Future Advanced Rotorcraft) project are discussed. The flight profile, noise level, and safety of the aircraft are briefly examined, and the launch area and infrastructure required by it are addressed. The civil uses of the aircraft are discussed, and its cost aspects and future outlook are considered.

A89-53630

MDX - A HELICOPTER DESIGNED BY ITS USERS

JAMES H. BRAHNEY Aerospace Engineering (ISSN 0736-2536), vol. 9, Sept. 1989, p. 23-25.

Copyright

The MDX helicopter, which will incorporate the latest technologies and a wide range of user inputs to become the first new light helicopter of the 1990s, is discussed. The role of the users in the design of the aircraft is described. The main design features of the helicopter and its components are presented, giving data. C.D.

A89-53631

HISTORY OF THE AIRFRAME. III

TOM RHODES Aerospace Engineering (ISSN 0736-2536), vol. 9, Sept. 1989, p. 27-32. Copyright

The history of the all-wood Mosquito aircraft is described. The development of wood aircraft in the 1930s is reviewed, including the Comet, Albatross, and Vega aircraft. The advances in airframe construction that these aircraft represented are pointed out. The fuselage and wing construction of the Mosquito are then described, and the characteristics of its performance that gave it a significant role in the Second World War are discussed. CD

A89-53641 A NEW HYBRID AIRSHIP ('HELISHIP') FOR COMMUTER TRANSPORT

SHIGENORI ANDO Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 37, no. 426, 1989, p. 344-351. In Japanese, with abstract in English. refs Copyright

As commuter air-transport vehicles to be used over both landand water-surfaces, hybrid-airship has been noticed recently. The best one seems to be a hybrid between airship and helicopter. It relieves the serious defects before hybridization, significantly. The development of 'Helistat' is now substantially stopped, mainly because of catastrophic vibration problem. Presented here is named 'Heliship' which is a combination of a tandem-roter helicopter (at center) and two airship (both sides). Failure of one engine is less severe than the Helistat. Insufficient roll-control power at hover would be overcome through appropriate operating procedure. Author

A89-54006

AN INTEGRATED CONFIGURATION AND CONTROL ANALYSIS TECHNIQUE FOR HYPERSONIC VEHICLES

NEIL J. ADAMS and PHILLIP D. HATTIS (Charles Stark Draper Laboratory, Inc., Cambridge, MA) IN: 1989 American Control Conference, 8th, Pittsburgh, PA, June 21-23, 1989, Proceedings. Volume 2. New York, Institute of Electrical and Electronics Engineers, 1989, p. 1105-1110. refs

Copyright

A design analysis methodology for hypersonic vehicles that treats the vehicle configuration and trajectory simultaneously is described. Vehicle geometry, dynamic discontinuities, and time-dependent control variables are all treated as optimization parameters with respect to a single performance measure. A generalized first-order gradient method is used to affect changes in the optimization variables to minimize a performance or cost measure. This is done while maintaining prescribed two-point boundary conditions and any path constraints imposed on the problem. The current research status and projected benefits of these activities are discussed. IF.

A89-54066

AN UNCERTAINTY MODEL FOR SATURATED ACTUATORS

MARK R. ANDERSON (Systems Control Technology, Inc., Palo Alto, CA) and DAVID K. SCHMIDT (Arizona State University, Tempe) IN: 1989 American Control Conference, 8th, Pittsburgh, PA. June 21-23, 1989, Proceedings. Volume 3. New York, Institute of Electrical and Electronics Engineers, 1989, p. 2257-2262. refs

Copyright

An uncertainty model for saturated actuators is reported. The model includes linear as well as quasi-linear elements, the latter being used to model the effects of rate and deflection limiting within the actuator. Since the actuator uncertainty model is quasi-linear, the magnitudes of the signals within the actuator model must be known. Linear and nonlinear simulations are considered for determining the actuator signal magnitudes. An actuator uncertainty model is then obtained for a forward-swept-wing fighter aircraft model. The example demonstrates how actuator saturation uncertainty can affect stability and performance robustness of a flight control system. LE.

A89-54200#

HIGH ALTITUDE RECONNAISSANCE AIRCRAFT DESIGN

D. POLADIAN and D. J. REINHARD AIAA, AHS, and ASEE, Aircraft Design, Systems and Operations Conference, Seattle, WA, July 31-Aug. 2, 1989. 13 p. refs

(AIAA PAFER 89-2109) Copyright

A Universities Space Research Association (USRA) sponsored

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

(undergraduate) study is presented on the feasibility and design of a high altitude reconnaissance/research aircraft. The aircraft mission was to carry 1,000 - 3,000 ponds of atmospheric pollutant monitoring equipment for 1-5 hours at an altitude of 100,000 -130,000 feet. Three configurations subject to the same mission requirements were studied in detail. The three designs analyzed were the tandem-wing-twin-boom, joined wing and conventional twin-boom configurations. The performance of the three proposed configurations is presented and shows that high altitude flight is possible with current technology. Different possible propulsion systems were investigated and suggestions are made for further investigation and better optimization of the designs. Author

A89-54338

CONCEPTUAL DESIGN TOOLS FOR INTERNAL TANKAGE OF THE HYPERSONIC TRANSPORT

TIMOTHY K. HIGHT (Santa Clara, University, CA) IN: International Conference on Hypersonic Flight in the 21st Century, 1st, Grand Forks, ND, Sept. 20-23, 1988, Proceedings. Grand Forks, ND, University of North Dakota, 1988, p. 166-169.

Copyright

An account is given of investigations conducted at NASA-Ames into the conceptual design of LH2 fuel storage systems for single-stage-to-orbit airbreathing launch vehicles and hypersonic transport aircraft. These efforts were directed, first, to vehicles of elliptic cross-section, aiming to optimize the 'pillow' configuration for maximum inscribed area with minimum structural weight. Then, work was undertaken on a more complex cross-section defined by a power-law function with a broader scope of components; a truly three-dimensional solution was sought. O.C.

A89-54344

HYPERSONIC AIR VEHICLE STABILITY AND CONTROL

JAMES W. KELLY (Kelly Engineering, Los Angeles, CA) IN: International Conference on Hypersonic Flight in the 21st Century, 1st, Grand Forks, ND, Sept. 20-23, 1988, Proceedings. Grand Forks, ND, University of North Dakota, 1988, p. 219-225. Copyright

In the present method for determining the stability and control of any aircraft, including those which are hypersonic cruise-capable, the DOFs are aircraft aerodynamics, guidance, control systems, structure, and propulsion; the airframe is represented by the classical, six-DOF Laplace-transformed equations-of-motion. Guidance is added in the form of additional equations whose feedback is proportional to each of the terms in the aerodynamic equations; the structure and control-system equations are added as required in order to represent those DOFs. The stability of the system is judged by the position of the roots on the complex plane and the root locus closures. O.C.

A89-54370

THE ADVANCED AERONAUTIC DESIGN PROGRAM - DESIGNING FOR THE FUTURE

SUSAN K. DURLAK (California, University, Los Angeles) IN: International Conference on Hypersonic Flight in the 21st Century, 1st, Grand Forks, ND, Sept. 20-23, 1988, Proceedings. Grand Forks, ND, University of North Dakota, 1988, p. 445-454. refs Copyright

Work carried out as part of the NASA/USRA (University Space Research Association) Advanced Design Program for Aeronautics at UCLA during 1987-1988 is presented. The program was divided into the following three groups: (1) propulsion, (2) thermal management, and (3) flight systems. Each group focused on one portion of the design of a hypersonic (Mach 10) drone aircraft. It was found that, after being involved in the design program, the students had greater experience with design teams and familiarity with NASA projects. K.K.

A89-54372

RESULTS OF A PRELIMINARY STUDY OF TWO HIGH-SPEED CIVIL TRANSPORT DESIGN CONCEPTS

LOUIS J. HENDRICH (Kansas, University, Lawrence) IN: International Conference on Hypersonic Flight in the 21st Century, 1st, Grand Forks, ND, Sept. 20-23, 1988, Proceedings. Grand Forks, ND, University of North Dakota, 1988, p. 469-475. Research supported by the Universities Space Research Association. refs Copyright

Two high speed civil transport (HSCT) design concepts are presented. Both transports are designed for 5500 n.m. range with 300 passengers. The first design concept is a Mach 2.5 joined-wing single fuselage transport. The second design concept is a Mach 4.0, twin fuselage, variable sweep wing transport. The use of conventional hydrocarbon fuels is emphasized to reduce the amount of change required in current airport facilities. Advanced aluminums are used in the designs when possible to reduce material and production costs over more 'exotic' materials. Methods to reduce the airport noise, community noise, and fly-over noise are incorporated into the designs. In addition, requirements set forth by the Federal Aviation Regulations (FAR's) have been addressed. Author

A89-54462#

OVERVIEW OF BUCKLING IN AIRCRAFT DESIGN

D. Y. KATTI (Aeronautical Development Agency, Bangalore, India) (NASAS - 89: National Seminar on Aero Structures, Bangalore, India, Mar. 1989) Aeronautical Society of India, Journal (ISSN 0001-9267), vol. 41, Mar.-May 1989, p. 97-109. refs

An overview is given of buckling from the designer's point of view. Providing a historical background, consideration is given to design philosophies, design office practices, and structural optimization. Future trends and the design approach adopted for light combat aircraft are discussed.

A89-54471#

APPLICATION OF MODERN OPTIMIZATION TOOLS FOR THE DESIGN OF AIRCRAFT STRUCTURES

A. LOTZE and J. SCHWEIGER (Messerschmitt-Boelkow-Blohm GmbH, Munich, Federal Republic of Germany) Aeronautical Society of India, Journal (ISSN 0001-9267), vol. 41, Mar.-May 1989, p. 225-235. refs

The structural optimization for aircraft structures is discussed. Attention given to early investigations with FASTOP (Flutter and Strength Optimization Program), the preliminary design of lifting surfaces with TSO (aeroelastic tailoring and structural optimization), and modern aircraft design with MBB-LAGRANGE. An example is presented of the structural design of vertical tails for high elastic directional stability and rudder effectiveness in the presence of strength flutter constraints. K.K.

A89-54901

DESIGN, FABRICATION, AND TESTING OF A COMPOSITE MAIN LANDING GEAR RETRACTING BEAM

KEVIN A. MCAFEE (Advance Ratio Design Co., Inc., Chester, PA) Society of Manufacturing Engineers, Fabricating Composites '88 Conference, Philadelphia, PA, Sept. 12-15, 1988. 15 p. (SME PAPER EM88-551) Copyright

A more reliable, economical, and lighter composite retracting beam has been developed to replace the previously designed welded steel beam for an advanced technology tandem rotor helicopter. The helicopter incorporates a tricycle gear arrangement which requires the main gear to extend out from the side of the aircraft to provide acceptable tip over angles. The beam then must retract by folding forward and upward into the side of the aircraft while rotating the oleo and wheels to a horizontal position and folding the door behind it. Flight beam tests were conducted and a short beam specimen was tested to evaluate manufacturing techniques The design, fabrication, and testing an of unprecedented thick walled composite main landing gear retracting beam are discussed. C.E.

N89-28511# Aerospace Medical Research Labs., Wright-Patterson AFB, OH.

SPECIFICATIONS AND MEASUREMENT PROCEDURES AND AIRCRAFT TRANSPARENCIES Final Report, Dec. 1987 - Jun. 1988

PETER T. LAPUMA and JOHN C. BRIDENBAUGH Sep. 1988

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

56 p

(AD-A209396; AAMRL-TR-88-058) Avail: NTIS HC A04/MF A01 CSCL 01/3

This report is a summary of the specification requirements for optical quality for several military aircraft transparencies. It is intended to provide the design engineer with an easy reference to a majority of the accumulated historical information concerning optical quality. GRA

N89-28513# Office of the Secretary of Defense, Washington, DC.

OPERATIONAL TEST PLAN CONCEPT FOR EVALUATION OF CLOSE AIR SUPPORT ALTERNATIVE AIRCRAFT Summary Report

31 Mar. 1989 130 p

(AD-A208185) Avail: NTIS HC A07/MF A01 CSCL 15/6

The FY 1989 Defense Authorization Amendments and Base Closure and Realignment Act, Public Law 100-526, required the Director, Operational Test and Evaluation (DOT&E) to prepare an operational test plan to conduct a competitive fly-off of alternative aircraft for the Close Air Support (CAS) mission and to complete the test plan. The Act also directed the Secretary of Defense to conduct an independent assessment of ongoing studies and analyses related to selection of an aircraft for the CAS mission and to examine the feasibility of transferring the CAS mission from the Air Force to the Army. The Army and Air Force have jointly developed a list of requirements for a CAS aircraft. In addition, a Mission Need Statement (MNS) for a fixed wing aircraft has been developed and approved by the Joint Requirements Oversight Council, Office of the Chairman, Joint Chiefs of Staff. These requirements can be grouped into three principal categories: effectiveness in killing assigned targets, survivability and responsiveness. The USAF has proposed to replace the A-10 Thunderbolt, which is currently its primary CAS aircraft. Air Force assessments have concluded that the A-10, even with an engine modification, cannot survive on current and future battlefields while faster aircraft have significantly greater survivability. The Air Force has recommended that the A-10 be replaced by a modified version of the F-16, which has been designated the A-16, GRA

N89-28514# National Aerospace Lab., Tokyo (Japan). AN EXPERIMENTAL OPTICAL COUPLING DEVICE FOR AN AIRBORNE DIGITAL REDUNDANT SYSTEM

AKIRA WATANABE and KAORU WAKAIRO 1988 41 p In JAPANESE; ENGLISH summary

(NAL-TR-1003; ISSN-0389-4010) Avail: NTIS HC A03/MF A01 A new optical coupling device for an airborne digital redundant system is described. For an onboard system, it is very important to increase reliability and safety, so a redundant system is applied. In a redundant system, in order to verify whether each operation is correct, it is necessary to compare it with the same time data from other systems. A new characteristic coupling device was developed and its features verified experimentally. This system has the following characteristics: (1) It has a simple hardware architecture in order to increase reliability and safety; (2) Synchronization and data exchange are separated in time, so this system utilizes the same hardware for these tasks; (3) To increase transfer speed, a broadcast method is used and the number of receivers is (redundancy-1); thus each system can transmit and receive simultaneously; and (4) An optical signal is used in order to increase transfer speed and this is effective for electric separation among systems. Finally, a discussion is presented of how to recognize the end of transfer without an interrupt signal in a digital computer. Author

N89-29335# Aeronautical Research Labs., Melbourne (Australia).

AIRCRAFT TRAJECTORY GENERATION: A LITERATURE REVIEW

M. C. WALLER, D. R. BLACKMAN, and T. F. BERREEN (Monash Univ., Clayton, Australia) Jun. 1989 27 p

(AR-005-609; ARL-SYS-TM-121) Avail: NTIS HC A03/MF A01 There is a need in the current economic environment to minimize costs and maximize efficiency in aircraft operations. Optimal flight trajectory generation can reduce operating costs, increase passenger and aircrew comfort and in the case of military operations reduce the loss of aircrew and aircraft. A review is presented of the field of optimal flight path generation for both civil and military operations and gives some recommendations for future research.

N89-29336# Office of Naval Research, London (England). WORKSHOP PROCEEDINGS ON COMPOSITE AIRCRAFT CERTIFICATION AND AIRWORTHINESS

DENNIS R. SADOWSKI 6 Oct. 1988 74 p Workshop held in London, United Kingdom, 16 Jul. 1987

(AD-A209321; ONRL-8-017-R) Avail: NTIS HC A04/MF A01 CSCL 01/3

This report contains a summary of the workshop, a list of attendees, a prepaper entitled, Some Areas for Discussion Suggested by RAE, and the presentations on Composite Aircraft Structures. Civil Aviation Concerns, Impact Damage, RAE Composite Certification, and the Effect of Observed Climatic Conditions on the Moisture Equilibrium Level of Fiber-Reinforced Plastics. GRA

N89-29337# Naval Postgraduate School, Monterey, CA. FLIGHT TEST METHOD DEVELOPMENT FOR A QUARTER-SCALE AIRCRAFT WITH MINIMUM INSTRUMENTATION M.S. Thesis NICOLAOS D. BAMICHAS Mar. 1989 80 p

(AD-A207896) Avail: NTIS HC A05/MF A01 CSCL 01/4

A flight test method was developed for a quarter-scale model aircraft with minimum onboard instrumentation for the determination of the drag polar, the thrust required curve and the power required curve. The test included a wind tunnel test for propeller efficiencies and thrust coefficients, a torque test for engine shaft horsepower, and a flight test for flight speeds at measured operating conditions. The only additional onboard instrumentation besides that for radio control was a small cassette recorder. Two methods are described for data manipulation and an error analysis is provided for each method. GRA

N89-29338# Aeronautical Research Labs., Melbourne (Australia).

INCORPORATION OF VORTEX LINE AND VORTEX RING HOVER WAKE MODELS INTO A COMPREHENSIVE ROTORCRAFT ANALYSIS CODE

R. TOFFOLETTO, N. E. GILBERT, S. HILL, and K. R. REDDY Jan. 1989 67 p

(AD-A208036; ARL-FLIGHT-MECH-TM-408; DODA-AR-005-586) Avail: NTIS HC A04/MF A01 CSCL 01/1

The incorporation of simplified hover wake models into the comprehensive rotorcraft analysis code CAMRAD is described and examples are given on their use. The axisymmetric models, in which vortices are represented by either straight lines or rings, are a more generalized form of the free wake models of R. T. Miller at MIT, with the wake geometry also able to be prescribed. Incorporation has allowed access to the tabular representation in CAMRAD of airfoil section characteristics as functions of angle attack and Mach number, and has broadened the range of rotor wake models in the code to include a free wake hover model that does not have the convergence problems of the existing free wake model when used for hover.

N89-29339# Aeronautical Research Labs., Melbourne (Australia).

A USER'S MANUAL FOR THE ARL MATHEMATICAL MODEL OF THE SEA KING MK-50 HELICOPTER. PART 1: BASIC USE

A. M. ARNEY and N. E. GILBERT Oct. 1988 38 p (AD-A:208058; ARL-AERO-TM-406-PT-1) Avail: NTIS HC A03/MF A01 CSCL 12/4

A mathematical model of the Sea King Mk 50 helicopter, as used in the Anti-Submarine Warfare (ASW) role, was developed at the Aeronautical Research Labs (ARL). This document describes the basic use of the computer program representing this model on the ELXSI 6400. Details are given on setting up the model and running it, first in ASW mode as a means of trimming the aircraft, and then in either ASW, ASE (Auto Stabilizing Equipment), or pilot modes to simulate a desired maneuver. GRA

N89-29340# Aeronautical Research Labs., Melbourne (Australia).

À USER'S MANUAL FOR THE ARL MATHEMATICAL MODEL OF THE SEA KING MK-50 HELICOPTER. PART 2: USE WITH ARL FLIGHT DATA

A. M. ARNEY and N. E. GILBERT Oct. 1988 61 p (AD-A208059; ARL-AERO-TM-407-PT-2) Avail: NTIS HC A04/MF A01 CSCL 12/4

A mathematical model of the Sea King Mk 50 helicopter, as used in the Anti-Submarine Warfare (ASW) role, was developed at the Aeronautical Research Labs (ARL) to run on the ELXSI 6400 computer. To validate this model, extensive flight trials were conducted by the Royal Australian Navy (RAN). This document provides a catalog of the many flight trials data files, shows how to access and process the flight data, and then how to run the mathematical model with inputs obtained from the flight data.

GRA

N89-29341# Aeronautical Research Labs., Melbourne (Australia).

IDENTIFICATION OF AN ADEQUATE MODEL FOR COLLECTIVE RESPONSE DYNAMICS OF A SEA KING HELICOPTER IN HOVER

R. A. FEIK and R. H. PERRIN Jul. 1988 30 p (AD-A208060; ARL-AERO-TM-399) Avail: NTIS HC A03/MF A01

(AD-A208060; AHL-AERO-IM-399) Avail: NTIS HC A03/MF A01 CSCL 01/3

A mathematical representation of vertical acceleration response characteristics of a helicopter in hover is developed, including blade flapping, inflow, and rotor speed dynamics. A maximum likelihood parameter estimation technique is applied to assess the adequacy of the model, and to identify the relevant parameters, using flight data from a Sea King Mk 50 helicopter. A number of conclusions related to the validity of the modelling approach have resulted from comparisons between predicted and identified parameters, and further investigation of some aspects is indicated. GRA

N89-29343# Sandia National Labs., Albuquerque, NM. FULL-SCALE AIRCRAFT IMPACT TEST FOR EVALUATION OF IMPACT FORCES. PART 1: TEST PLAN, TEST METHOD, AND TEST RESULTS

W. A. VONRIESEMANN, R. L. PARRISH, D. C. BICKEL, S. R. HEFFELFINGER, K. MUTO, T. SUGANO, H. TSUBOTA, N. KOSHIKA, M. SUZUKI, and S. OHRUI Mar. 1989 9 p Presented at the 10th International Conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim. CA, 14-18 Aug. 1989 Prepared in cooperation with Muto Inst. of Structural Mechanics, Tokyo (Japan)

(Contract DE-AC04-76DP-00789)

(DE89-009329; SAND-89-0345C; CONF-890855-6) Avail: NTIS HC A02/MF A01

One of the factors considered in the design of critical concrete structures is the estimation of the global elasto-plastic structural response caused by the accidental impact of an aircraft. To estimate the response of the structure, the impact force (the force versus time relationship) must be known. Previous analytical studies have derived the forcing function using the impact velocity of the aircraft and the calculated mass and strength distribution of the aircraft. This paper describes a test conducted on April 19, 1988, at an existing rocket sled facility at Sandia National Laboratories in Albuquerque, New Mexico, USA, in which an actual F-4 Phantom aircraft was impacted at a nominal velocity of 215 m/s into an essentially rigid block of concrete. This was accomplished by supporting the F-4 on four struts that were attached to the sled track by carriage shoes to direct the path of the aircraft. Propulsion was accomplished by two stages of rockets. The concrete target was floated on a set of air bearings. Data acquisition consisted of measurements of the acceleration of the fuselage and engines of the F-4, and measurements of the displacement, velocity and acceleration of the concrete target. High-speed photography recorded the impact process and also permitted the determination of the impact velocity. This paper describes the test plan, method and results, while a companion paper discusses the analyses of the results.

N89-29344# Sandia National Labs., Albuquerque, NM. FULL-SCALE AIRCRAFT IMPACT TEST FOR EVALUATION OF IMPACT FORCE. PART 2: ANALYSIS OF RESULTS

K. MUTO, T. SUGANO, H. TSUBOTA, N. KOSHIKA, M. SUZUKI, S. OHRUI, W. A. VONRIESEMANN, D. C. BICKEL, R. L. PARRISH, and R. D. M. TACHAU 1989 6 p Presented at the 10th International Conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA, 14-18 Aug. 1989 Prepared in cooperation with Muto Inst. of Structural Mechanics, Tokyo (Japan)

(Contract DE-AC04-76DP-00789)

(DE89-009335; SAND-89-0619C; CONF-890855-13) Avail: NTIS HC A02/MF A01

For estimating the global elasto-plastic structural response of critical concrete structures subjected to an aircraft crash, the time dependent impact force of a flat rigid barrier against a normally impacting aircraft was evaluated and then the response to the impact force was calculated. In this approach, a significant problem was to determine the impact force for the aircraft against a rigid target. A review of the method proposed to determine the impact forces showed that all were based on analytical methods. However, in these analytical methods, there were many assumptions and many questions remaining to be answered. Because of the uncertainty involved in the analytical prediction of the impact force, a full-scale aircraft impact test was performed and an extensive suite of response measurements was obtained. In this paper, these measurements are analyzed to evaluate the impact force accurately. Also, the results were used to evaluate existing analytical methods for prediction of the impact force. DOĔ

N89-29345 Wisconsin Univ., Madison. DESIGN BY FUNCTIONAL FEATURE FOR AIRCRAFT STRUCTURE Ph.D. Thesis SPENCER P. MAGLEBY 1988 155 p

Avail: Univ. Microfilms Order No. DA8903300

The term Functional Features refers to discrete functional aspects of a product model. Design by Functional Feature is a concept wherein product models are both designed and digitally represented in a database, in terms of functional features. This dissertation presents new concepts in the following areas: (1) a canonical functional feature definition and representation scheme that accommodates design needs and captures design intent; (2) feature-based user interfaces that guide and constrain the user while enforcing a predefined structure on the database being created; (3) use of geometry as constraints for a product model: and (4) a means to map functional features to another set of features in order to accommodate diverse features views of a product model. A software architecture for a design by functional feature system (DFFS) is presented. A review of related literature shows the growing popularity of this field but also its immaturity. The objectives and requirements of a DFFS are presented and detailed explanations of proposed representation methods and philosophies are discussed. Methods to supply intelligent feature-related data to application programs are presented. User interface issues are discussed and a sample design session is illustrated. Previous work leading to this system design is outlined. Finally, the benefits of the DFFS approach are enumerated and outstanding research issues are presented. An appendix contains a detailed example of an aircraft structural part designed by using functional features. Author

AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

A89-51704*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

EVALUATION OF A TAKEOFF PERFORMANCE MONITORING SYSTEM DISPLAY

DAVID B. MIDDLETON (NASA, Langley Research Center, Hampton, VA) and RAGHAVACHARI SRIVATSAN (University of Kansas Center for Research, Inc., Lawrence) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 12, Sept.-Oct. 1989, p. 640-646. Previously cited in issue 22, p. 3535, Accession no. . A87-50419. refs Copyright

A89-52540#

WIDEBAND LINEAR QUADRATIC GAUSSIAN CONTROL OF STRAPDOWN DRY TUNED GYRO/ACCELEROMETERS

PIERRE CONSTANCIS (Societe d'Applications Generales d'Electricite et de Mecanique, Cergy-Pontoise, France) and MICHEL SORINE (Institut National de Recherche en Informatique et en Automatique, Le Chesnay, France) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 1. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 141-145. refs

(AIAA PAPER 89-3441) Copyright The sophisticated LQG control strategy developed by Craig (1972) is applied to regulate the miniature gyro/accelerometers employed in the SIGAL family of strapdown inertial navigation systems. A stochastic model of the angular rate and linear acceleration of the system is derived and used in the construction of the Kalman filter algorithm, keeping the closed-loop bandwidth and the potentially much higher estimation bandwidth separate. Results obtained in laboratory frequency-response tests with the LQG controller implemented using a TMS 320C25 digital signal microprocessor are presented in graphs and briefly characterized. Data reported include unity steady-state gain, bandwidth 140 Hz, gain margin 6 dB, phase margin 40 deg, and closed-loop resonance 3 dB. T.K.

A89-52559#

INTEGRATED CONTROL AND AVIONICS FOR AIR SUPERIORITY - COMPUTATIONAL ASPECTS OF REAL-TIME FLIGHT MANAGEMENT

STEVEN M. WAGNER and STEVEN W. ROTHSTEIN (USAF, Wright Research Development Center, Wright-Patterson AFB, OH) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 1. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 321-326. refs

(AIAA PAPER 89-3463)

The current status of the air-combat flight-management system (ACFMS) being developed in the USAF Integrated Control and Avionics for Air Superiority (ICAAS) program is surveyed, with an emphasis on computational aspects. Consideration is given to the ICAAS multiprocessor architecture, the ICAAS Integration Computer (for the ACFMS tactics algorithm, the attack-guidance algorithm, the defense-assets manager, the aircraft performance monitor, and the flight-control coupler) and the ICAAS Support Computer (for integrated flight and fire control, air-to-air combat management, and the air-combat engagement system). Flow charts, diagrams, and tables listing the computer resource requirements are provided. T.K.

A89-52716#

UPDATE 89 - ADDITIONAL RESULTS WITH THE MULTIFUNCTION RLG SYSTEM

MICHAEL J. HADFIELD and R. E. WHEELER (Honeywell, Inc., Military Avionics Div., Clearwater, FL) AIAA, Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989. 23 p. refs

(AIAA PAPER 89-3583) Copyright

The expanded roles being assumed by ring laser gyro (RLG) technologies in military and commercial navigation systems are discussed, using two systems as examples and emphasizing the capability of current RLG system technology to meet more dynamic output requirements. Linear velocity, angular velocity and angular/linear acceleration requirements are taken into account along with accuracy, jitter, and other noise characteristics of RLG systems. Data on frequency-domain characterization for linear velocities and accelerations and on attitude, angular rates, and accelerations are presented. C.D

A89-52717#

PERFORMANCE TEST RESULTS OF A MULTI-FUNCTION FAULT-TOLERANT RLG SYSTEM

MAHESH K. JEERAGE (Honeywell Systems and Research Center, Minneapolis, MN) AIAA, Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989. 11 p.

(AIAA PAPER 89-3584) Copyright

This paper presents the performance test results of a fault-tolerant RLG system featuring skewed axis inertial sensors, sensor redundancy management scheme, and fault-tolerant electronics. This system, built by Honeywell's Commercial Flight Systems Group, was calibrated and tested in the laboratory by Honeywell's Systems and Research Center. This system is currently being flight tested by Boeing Commercial Airplane Company. A brief description of the system is presented in the paper with emphasis on the fault-tolerant aspects. The performance test results presented include nominal navigation performance and navigation performance under sensor failures. Performance of the failure detection and isolation scheme is also presented. Author

A89-52974 SENSITIVE SKINS

NORMAN LYNN Flight International (ISSN 0015-3710), vol. 136, Aug. 26, 1989, p. 34-36.

Copyright

'Smart-skin' technology designates a potentially revolutionary family of aircraft structural surface-design and fabrication methods incorporating electronic and avionic sensors for real-time, continuous monitoring of both the vehicle's environment and the status of the structure itself. Communications and electronic warfare functions are also possible for smart-skinned/smart-structured vehicles; applicable sensors encompass phased radar arrays, IR focal plane arrays, and parallel processors, as well as sensors able to monitor the chemical and physical environment, the vehicle's navigational status, and the military or collisional threat environment, in all directions. Fiber-optics is the most important of the smart-skin technologies. O.C.

A89-53309#

VISUAL AND SENSORY AIDS FOR HELICOPTERS IN THE YEAR 2000 [VISIONIK/SENSORIK IM HUBSCHRAUBEREINSATZ DES JAHRES 2000]

H.-D. V. BOEHM (Messerschmitt-Boelkow-Blohm GmbH, Ottobrunn, Federal Republic of Germany) Internationales Hubschrauber-Forum, 17th, Bueckeburg, Federal Republic of Germany, May 9, 10, 1988, Paper. 29 p. In German. refs (MBB UD-541-89-PUB)

The use of visual and sensory aids for maintaining high performance in helicopters in the year 2000 is discussed. Aids used for night flight are addressed, including image-strengthening goggles, infrared devices, and low light level TV cameras. Technical data are presented for sensory platforms for helicopter night flight. Aids for pilot self-defense and for night fighting are examined.

C.D.

A89-53313* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

AIRBORNE RAIN MAPPING RADAR

W. J. WILSON, G. S. PARKS, F. K. LI, K. E. IM, and R. J. HOWARD

(California Institute of Technology, Jet Propulsion Laboratory, Pasadena) IN: Tropical rainfall measurements. Hampton, VA, A. Deepak Publishing, 1988, p. 229-233.

Copyright

An airborne scanning radar system for remote rain mapping is described. The airborne rain mapping radar is composed of two radar frequency channels at 13.8 and 24.1 GHz. The radar is proposed to scan its antenna beam over + or - 20 deg from the antenna boresight; have a swath width of 7 km; a horizontal spatial resolution at nadir of about 500 m; and a range resolution of 120 m. The radar is designed to be applicable for retrieving rainfall rates from 0.1-60 mm/hr at the earth's surface, and for measuring linear polarization signatures and raindrop's fall velocity.

A89-54345

INTELLIGENT AVIONICS

WARREN MOSELEY (Alabama, University, Huntsville) IN: International Conference on Hypersonic Flight in the 21st Century, 1st, Grand Forks, ND, Sept. 20-23, 1988, Proceedings. Grand Forks, ND, University of North Dakota, 1988, p. 226-234. Copyright

Such next-generation aerospace systems as the Space Station, the Advanced Tactical Fighter, autonomous vehicles, and hypersonic cruise aircraft, will require real-time expert system collaboration with crews and ground controllers. In avionics applications, such AI systems would be intimately involved in mission planning on the basis of real-time-accessible guidance and sensor data; these data can be processed by highly parallel computer architectures. The activities of the ground personnel responsible for the inspection and maintenance of these aircraft will also be greatly aided by the application of AI avionics that can be interrogated to ascertain subsystems' status. O.C.

A89-54482

CAMOUFLAGE CAP ALLOWS AIRCRAFT TO DISAPPEAR [TARNKAPPE LAESST FLUGZEUGE VERSCHWINDEN]

Luft- und Raumfahrt (ISSN 0173-6264), vol. 10, 3rd Quarter, 1989, p. 18, 19. In German.

Copyright

A method for providing complete radar camouflage to military aircraft is briefly discussed. A step-by-step description of the method is given. Applications of the method are addressed.

C.D.

A89-54848

AIRCRAFT LOW LEVEL WIND SHEAR DETECTION AND WARNING SYSTEM

PETER C. SINCLAIR (Colorado State University, Fort Collins, CO) and PETER M. KUHN (Aris, Inc., Boulder, CO) IN: International Conference on the Aviation Weather System, 3rd, Anaheim, CA, Jan. 30-Feb. 3, 1989, Preprints. Boston, MA, American Meteorological Society, 1989, p. 381-384. Research supported by NOAA. refs

(Contract NSF ATM-84-20980) Copyright

This paper describes techniques involved in a test for assessing the ability of a prototype airborne IR system to detect, in advance, thunderstorm downbursts and low-level wind shear in the presence of light-to-moderate rain. In this test, the IR sensing system, which is a modified Barnes precision radiation thermometer with special filters for sensing in the 13 to 15 micron portion of the atmospheric molecular spectrum CO2, was mounted, forward pointing, on the wing of a research aircraft. To test the detection capability of the system, the aircraft penetrated several downbursts. The results of two of these penetrations are presented. New microburst features are pointed out.

N89-28515# School of Aerospace Medicine, Brooks AFB, TX. TOWARDS A PHYSIOLOGICALLY BASED HUD (HEAD-UP DISPLAY) SYMBOLOGY Final Report, Jul. 1987 - Jun. 1988 FRED H. PREVIC Jan. 1989 22 p

(AD-A207748; USAFSAM-TR-88-25) Avail: NTIS HC A03/MF A01 CSCL 01/4

New concepts in HUD symbology, based on an understanding of the physiological mechanisms and ecological origins of the human visual system are described which may enable future HUD displays to serve as primary flight directors in addition to their current roles. The four key elements of this new symbology are: (1) prioritization of space according to the three-dimensional structure of visual attention, (2) an attitude display in the form of a global percept; (3) effective preattentive attitude cueing based on an ecologically valid simulation of the visual terrain during flight ; and (4) visual reference framing which depicts the roll of the aircraft relative to a stable horizon. Prototypes which illustrate the physiological HUD concept are presented. The specific advantage of the proposed symbology may be to allow the pilot to maintain effective attitude control while directing his attention towards the out-the-window environment. GRA

07

AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and on-board auxiliary power plants for aircraft.

A89-52025*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

FUEL PROPERTIES EFFECT ON THE PERFORMANCE OF A SMALL HIGH TEMPERATURE RISE COMBUSTOR

WALDO A. ACOSTA (NASA, Lewis Research Center; U.S. Army, Propulsion Directorate, Cleveland, OH) and STEPHEN A. BECKEL (United Technologies Corp., Pratt and Whitney Group, West Palm Beach, FL) AIAA, ASME, SAE, and ASEE, Joint Propulsion Conference, 25th, Monterey, CA, July 10-12, 1989. 11 p. Previously announced in STAR as N89-25238. refs (Contract N00140-83-C-8899)

(AIAA PAPER 89-2901) Copyright

The performance of an advanced small high temperature rise combustor was experimentally determined at NASA-Lewis. The combustor was designed to meet the requirements of advanced high temperature, high pressure ratio turboshaft engines. The combustor featured an advanced fuel injector and an advanced segmented liner design. The full size combustor was evaluated at power conditions ranging from idle to maximum power. The effect of broad fuel properties was studied by evaluating the combustor with three different fuels. The fuels used were JP-5, a blend of Diesel Fuel Marine/Home Heating Oil, and a blend of Suntec C/Home Heating Oil. The fuel properties effect on the performance of the combustion in terms of pattern factor, liner temperatures, and exhaust emissions are documented. Author

A89-52306#

A MULTI-OBJECTIVE OPTIMUM DESIGN METHOD FOR A RADIAL-AXIAL FLOW TURBINE WITH THE OPTIMUM CRITERIA OF BLADE TWIST AT OUTLET OF BLADES

LINGEN CHEN (Naval Academy of Engineering, People's Republic of China) Journal of Aerospace Power (ISSN 1000-8055), vol. 4, July 1989, p. 218-222, 290. In Chinese, with abstract in English. refs

This paper provides a multiobjective optimum design method for a radial-axial flow turbine stage. The method takes the parameters in mean radius and the criteria of blade twist at the outlet of the blades as design variables and selects the internal efficiency in the design conditions and the total weight of the turbine stage as objective functions. The model presented is a nonlinear multiobjective programming problem of two objective functions with 29 constrained functions and 6 variables. The mathematical model for optimization and some analytical results of single- and multiobjective optimizations for a variety of twisted blades are also presented. Author

A89-52315#

AN INVESTIGATION ON STAGNATION PRESSURE ERRORS DUE TO ROTATION STATE BEHIND A ROTOR

GUOCAI TANG (Nanjing Aeronautical Institute, People's Republic of China) Journal of Aerospace Power (ISSN 1000-8055), vol. 4, July 1989, p. 259-261, 293. In Chinese, with abstract in English.

This paper proposes that the errors in stagnation pressure measurement due to rotation state behind a rotor should include perception errors in addition to the weighting error and dynamic response errors. The analysis and experimental data show that the stagnation pressure in the wake may be higher than that in the main flow, so the weighting error may be positive. Author

A89-52317#

FLIGHT TESTS FOR AIR INTAKE FLOWFIELD AND ENGINE **OPERATING STABILITY**

YIYUN LUN (Shenyang Aeroengine Research Institute, People's Republic of China) Journal of Aerospace Power (ISSN 1000-8055), vol. 4, July 1989, p. 265-268, 294. In Chinese, with abstract in English.

The operating compatibility between air intake and engine during the flight tests of a supersonic fighter is considered. The flight tests were completed under conditions of horizontal accelerating flight, uprated and retarded throttles of the engine during horizontal flight, and constant-Mach climbing with maximum and augmented thrust rating. The flow conditions at the intake and the tendency of flowfield variation at the inlet of the engine were evaluated by means of six pressure tappings at the variable intake cone and a cross rake pressure probe at the exit of the intake. Author

A89-52319#

OPTIMUM DESIGN FOR GEOMETRIC PARAMETERS OF AXISYMMETRIC CONVERGING-DIVERGING NOZZLE

JUN ZEN and JINGYUN ZHAO (Gas Turbine Establishment, People's Republic of China) Journal of Aerospace Power (ISSN 1000-8055), vol. 4, July 1989, p. 271, 272, 294. In Chinese, with abstract in English.

A mathematical model of an axisymmetric converging-diverging nozzle in design conditions is set up by guadratic-regression equation. The thrust force coefficient is taken as an objective function. The three geometric parameters (half-convergent angle, half-divergent angle, radius ratio of throat curvature to throat) are chosen as design variables. The optimum design is completed by the random-walk method. The relationships of the optimum geometric parameters to the designed pressure ratio of the nozzle are obtained. The results provide the basis for designing the axisymmetric convergent-divergent nozzle of an axhaust system. Author

A89-52320#

EFFECT OF GEOMETRIC PARAMETERS ON INTERNAL PERFORMANCE OF CONVERGENT-DIVERGENT NOZZLE

JINGYUN ZHAO (Gas Turbine Establishment, People's Republic of China) Journal of Aerospace Power (ISSN 1000-8055), vol. 4, July 1989, p. 273, 274, 295. In Chinese, with abstract in English.

The effect of geometric parameters on internal performance of convergent-divergent nozzle has been investigated experimentally. The relationships of thrust coefficient and wall static pressure distribution to area ratio, divergent angle, convergent angle, and throat radius of curvature are presented in this paper. Author

A89-52323#

FLOW SIMILARITY IN IGNITION PROCESS OF JET ENGINE

HONGMING WANG (Beijing University of Aeronautics and Astronautics, People's Republic of China) Journal of Aerospace Power (ISSN 1000-8055), vol. 4, July 1989, p. 283-285, 296. In Chinese, with abstract in English. refs

An analytical study on the flow similarity in ignition process is completed in respect to the effects of the airflow on the local fuel and oxygen distribution near the plug. For lean light-off limitation, a momentum criteria is derived from the motion equation of a fuel droplet. The criteria state that the ignition velocity rises with the increase of altitude. It is in quite good agreement with the

experimental data. The results suggest that the ignition process changes gradually with the decrease of p(a) into optimum range when the fuel flow is kept constant. Author

A89-52482

THE DEVELOPMENT OF ADVANCED COMPUTATIONAL METHODS FOR TURBOMACHINERY BLADE DESIGN

P. STOW (Rolls-Royce, PLC, Derby, England) International Journal for Numerical Methods in Fluids (ISSN 0271-2091), vol. 9, Aug. 1989, p. 921-941. refs

Copyright

The paper describes the basic components of a turbomachinery blade design system. A number of modeling aspects of the advanced computational methods in use and under development are reviewed, together with areas for future research and development. Various features of blade-to-blade analysis are discussed, including the use of compatible design and analysis modes and coupled boundary-layer analysis capable of handling attached and separated flow; examples are included to show capabilities. Advances being made in the development and application of Reynolds-averaged Navier-Stokes models are covered showing capabilities with regard to loss and heat-transfer prediction. Author

A89-52660#

DESIGN OF TUNABLE DIGITAL SET-POINT TRACKING PID CONTROLLERS FOR GAS TURBINES WITH UNMEASURABLE OUTPUTS

B. PORTER and H. YAMANE (Salford, University, England) IN AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 2. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 1258-1266. refs (AIAA PAPER 89-3577) Copyright

The tunable digital set-point tracking PID controllers of Porter and Jones are enriched by the inclusion of pre-filters so as to embrace linear multivariable plants with unmeasurable outputs. It is shown that the pre-filter matrices, together with the proportional, integral, and derivative controller matrices embodied in the resulting tunable digital PID controllers, can be determined from open-loop step-response tests. The effectiveness of the resulting design methodology is illustrated by designing a tunable digital set-point tracking PID controller for a modern gas-turbine engine with five measurable outputs and five unmeasurable outputs. Author

A89-52832

PROBABILISTIC METHODS FOR ESTIMATING THE REMAINING LIFE OF STRUCTURAL ELEMENTS OF **OPERATING AIRCRAFT GAS TURBINE ENGINES** [VEROIATNOSTNYE METODY OTSENKI OSTATOCHNOGO RESURSA KONSTRUKTIVNYKH ELEMENTOV AVIATSIONNYKH GTD V EKSPLUATATSII]

A. N. VETROV and A. G. KUCHER (Kievskii Institut Inzhenerov Grazhdanskoi Aviatsii, Kiev, Ukrainian SSR) Problemy Prochnosti (ISSN 0556-171X), Aug. 1989, p. 70-76. In Russian. refs Copyright

Based on the linear damage summation hypothesis, two probabilistic approaches are proposed for estimating the remaining life of aircraft engines using a criterion related to the strength loss of engine components. One approach is based on the correlation theory of random values and the central limiting theorem; the other is based on the analysis of the distribution of the random damage of structural components per flight loading cycle and on the property of infinite divisibility of the lognormal distribution law. Examples of turbine life calculations are presented. V.L.

A89-52960

DIAGNOSTIC TECHNIQUES FOR PROPULSION SYSTEMS

Y. M. TIMNAT (Technion - Israel Institute of Technology, Haifa) Progress in Aerospace Sciences (ISSN 0376-0421), vol. 26, no. 2, 1989, p. 153-168. Research supported by the Technion - Israel

Institute of Technology. refs Copyright

The paper discusses diagnostic techniques for propulsion systems dealing with temperature measurements by thermocouples and non-intrusive optical methods, velocity determination with lasers, concentration measurements using probes and optical techniques and regression rates in solid propellants, employing microwaves and ultrasonics. Different types of measurements of the same parameter are compared, stressing the suitability of each technique for particular experimental conditions. Particular attention will be given to application in supersonic flow, specially for propulsive systems, and to the author's original contributions.

Author

A89-52991#

COMPUTERISED DESIGN OF BLADE ELEMENTS IN TURBOMACHINES

K. A. DAMODARAN (Indian Institute of Technology, Madras, India) and T. VENKATA KRISHNAIAH Aeronautical Society of India, Journal (ISSN 0001-9267), vol. 41, Feb. 1989, p. 25-31. refs

This paper deals with a method of computerized design of blade elements for compressible or incompressible, inviscid flow in high-solidity stators and rotors of axial, radial or mixed flow compressors, turbines or two-dimensioal cascades. The method is based on Stanitz inverse methods of profile design in which the blade element profile is generated for a given distribution of surface velocities. In order to take into account the real-flow viscous effects, a blade boundary-layer estimation code is incorporated, and the new blade profile is generated deducting the boundary-layer displacement thickness. Author

A89-53304*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

AERONAUTICAL APPLICATIONS OF HIGH-TEMPERATURE SUPERCONDUCTORS

GEORGE E. TURNEY, ROGER W. LUIDENS (NASA, Lewis Research Center, Cleveland, OH), KENNETH UHERKA, and JOHN HULL (Argonne National Laboratory, IL) AIAA, AHS, and ASEE, Aircraft Design, Systems and Operations Conference, Seattle, WA, July 31-Aug. 2, 1989. 14 p. Previously announced in STAR as N89-26008. refs

(AIAA PAPER 89-2142) Copyright

high-temperature development of The successful superconductors (HTS) could have a major impact on future aeronautical propulsion and aeronautical flight vehicle systems. A preliminary examination of the potential application of HTS for aeronautics indicates that significant benefits may be realized through the development and implementation of these newly discovered materials. Applications of high-temperature superconductors (currently substantiated at 95 k) were envisioned for several classes of aeronautical systems, including subsonic and supersonic transports, hypersonic aircraft, V/STOL aircraft, rotorcraft, and solar, microwave and laser powered aircraft. Introduced and described are the particular applications and potential benefits of high-temperature superconductors as related to aeronautics and/or aeronautical systems. Author

A89-53351*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

MIXING AUGMENTATION TECHNIQUE FOR HYPERVELOCITY SCRAMJETS

A. KUMAR, D. M. BUSHNELL, and M. Y. HUSSAINI (NASA, Langley Research Center, Hampton, VA) Journal of Propulsion and Power (ISSN 0748-4658), vol. 5, Sept.-Oct. 1989, p. 514-522. Previously cited in issue 20, p. 3156, Accession no. A87-45275. refs

Copyright

A89-53366#

FLIGHT TEST OF THE F100-PW-220 ENGINE IN THE F-16

MARK T. CHILDRE and KEVIN D. MCCOY (General Dynamics Corp., Fort Worth, TX) Journal of Propulsion and Power (ISSN 0748-4658), vol. 5, Sept.-Oct. 1989, p. 620-625. Previously cited in issue 20, p. 3155, Accession no. A87-45245. Copyright

A89-53956* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

TURBOFAN ENGINE CONTROL SYSTEM DESIGN USING THE LQG/LTR METHODOLOGY

SANJAY GARG (NASA, Lewis Research Center; Sverdrup Technology, Inc., Cleveland, OH) IN: 1989 American Control Conference, 8th, Pittsburgh, PA, June 21-23, 1989, Proceedings. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1989, p. 134-141. Previously announced in STAR as N89-26004. refs Copyright

Application of the linear-quadratic-Gaussian with looptransfer-recovery methodology to design of a control system for a simplified turbofan engine model is considered. The importance of properly scaling the plant to achieve the desired target feedback loop is emphasized. The steps involved in the application of the methodology are discussed via an example, and evaluation results are presented for a reduced-order compensator. The effect of scaling the plant on the stability robustness evaluation of the closed-loop system is studied in detail. Author

A89-54131#

RESEARCH ON SURGE MONITORING SYSTEM OF TURBOJET ENGINE ON ACTIVE SERVICE

WANXUE LIU (Air Force PR China, Engineering Institute, People's Republic of China) Journal of Propulsion Technology (ISSN 1001-4055), Aug. 1989, p. 34-38, 81. In Chinese, with abstract in English. refs

In this paper, the severe surge failures of turbojet engines serving in the Chinese Air Force are analyzed and a proposal on a surge-prevention monitoring system (SPMS) is presented, based on which, FCJ-124 SPMS has been developed. The FCJ-124 system have been used in many surge monitor tests with engines on ground and on active fighters. The results are satisfactory.

Author

A89-54132#

A METHOD FOR CALCULATION OF MATCHING POINT OF INLET AND ENGINE

XUELIANG ZHANG (Chengdu Aircraft Corp., People's Republic of China) Journal of Propulsion Technology (ISSN 1001-4055), Aug. 1989, p. 43-45, 82. In Chinese, with abstract in English.

A method for the calculation of matching point of inlet and engine according to testing data of inlet and flow performance is presented. Inlet performance data can be precisely calculated for any flight condition and engine throttle. The method in this paper can be used to set a mathematical model based on inlet performance data from wind tunnel tests and given engine performance. Author

A89-54328

PROPULSION CYCLES FOR TRANSATMOSPHERIC ACCELERATORS

FREDERICK S. BILLIG (Johns Hopkins University, Laurel, MD) IN: International Conference on Hypersonic Flight in the 21st Century, 1st, Grand Forks, ND, Sept. 20-23, 1988, Proceedings. Grand Forks, ND, University of North Dakota, 1988, p. 45-67. Copyright

A comprehensive assessment is made of the design features and comparative performance and economic advantages of the composite airbreathing propulsion system configurations conceived to date for transatmospheric vehicles, which require that efficient operation be achieved from Mach 0 at takeoff/launch at sea level to Mach 16 at extreme altitude before final acceleration on nonairbreathing power to orbital velocity. LH2 is in all cases the requisite fuel. Attention is given to liquid air cycle engine (LACE), rocket ejector-compressor engine, and scramjet engine

configurations, as well as such combinations of these features as the ejector ramjet, scram-LACE, etc. O.C.

A89-54473#

GAS TURBINE RESEARCH AND DEVELOPMENT IN INDIA

ARUN PRASAD (Gas Turbine Research and Development Establishment, Bangalore, India) Aeronautical Society of India, Journal (ISSN 0001-9267), vol. 41, Mar.-May 1989, p. 243-252.

A survey is presented of the R & D activities in aircraft gas turbines in India. Particular attention given to the technological challenges of the GTX engine development program for the light combat aircraft. The development of a high-speed small engine for the pilotless target aircraft is discussed as well. K.K.

A89-54483

HISTORY OF LOW-POWER JET ENGINES [GESCHICHTE DER TRIEBWERKE KLEINER LEISTUNG]

KARL-HEINZ COLLIN and HANS FRICKE (Kloeckner-Humboldt-Deutz AG, Oberursel, Federal Republic of Germany) Luft- und Raumfahrt (ISSN 0173-6264), vol. 10, 3rd Quarter, 1989, p. 34, 36, 38, 39. In German. Copyright

The development of low-power jet aircraft engines since World War II is described. The early history is traced, including the first auxiliary gas turbines, turboprops, and small turbojet engines, and the major developments in France, the U.S., and the Soviet Union are described in detail, with an emphasis on German participation. Numerical data on engines developed between 1950 and 1989 are presented in tables, and it is shown that current computer technology and advanced materials make possible the development of more efficient jet engines, taking into account air flow rates, compression ratios, turbine inlet temperatures, and component performance.

A89-54881

DIAGNOSTICS AND CONTROL OF THE FUEL SYSTEMS OF AIRCRAFT ENGINES [DIAGNOSTIROVANIE I REGULIROVANIE TOPLIVNOI APPARATURY AVIADVIGATELEI]

ALEKSANDR A. ZÁRIN, VASILII E. LOGINOV, and ZAKHARII S. OTMAN Moscow, Izdatel'stvo Transport, 1989, 80 p. In Russian. refs

Copyright

Various problems related to the technical diagnostics and control of the fuel systems of aircraft engines during operation and maintenance are examined. The factors affecting the output characteristics and functioning of fuel system components are discussed. Mathematical models of the principal functional components of fuel systems are presented, and the possibilities afforded by these models in optimizing the output parameters of fuel system components are demonstrated. V.L.

A89-54884

JET ENGINES FOR HIGH SUPERSONIC FLIGHT VELOCITIES (2ND REVISED AND ENLARGED EDITION) [REAKTIVNYE DVIGATELI DLIA BOL'SHIKH SVERKHZVUKOVYKH SKOROSTEI POLETA /2ND REVISED AND ENLARGED EDITION/]

RUVIM I. KURZINER Moscow, Izdatel'stvo Mashinostroenie, 1989, 264 p. In Russian. refs

Copyright

Theoretical principles are presented for jet engines designed for use in aircraft flying at high supersonic velocities in the atmosphere. In particular, attention is given to the thermodynamic principles of ramjet and combination turbojet-ramjet engines; methods for calculating the cycle parameters of ramjet and turbojet-ramjet engines; ramjet engines for supersonic and hypersonic flight; and turboramjet engines. The discussion also covers integral rocket ramjets; cryogenic-fuel combination turbojet-ramjet engines; and methods for the analysis of the efficiency and applications of combination turbojet-ramjet and high-velocity jet engines. V.L.

N89-28516# Naval Air Propulsion Test Center, Trenton, NJ. STATISTICS ON AIRCRAFT GAS TURBINE ENGINE ROTOR FAILURES THAT OCCURRED IN US COMMERCIAL AVIATION DURING 1984 Final Report

R. A. DELUCIA, J. T. SALVINO, and B. C. FENTON (Federal Aviation Administration, Atlantic City, NJ.) Jun. 1989 26 p (Contract DOT/FA71NA-AP98)

(NAPC-PE-185; DOT/FAA/CT-89/6) Avail: NTIS HC A03/MF A01

Presented here is statistical information relating to gas turbine engine rotor failures which occurred during 1984 in commercial aviation service use. Two hundred and six failures occurred in 1984. Rotor fragments were generated in 114 of the failures and, of these, 18 were uncontained. The predominant failure involved blade fragments, 90.3 percent of which were contained. Seven disk failures occurred and all were uncontained. Seventy percent of the 2C6 failures occurred during the takeoff and climb stages of flight. This service data analysis is prepared on a calendar year basis and published yearly. The data are useful in support of flight safety analyses, proposed regulatory actions, certification standards, and cost benefit analyses. Author

N89-28517# Naval Air Propulsion Test Center, Trenton, NJ. STATISTICS ON AIRCRAFT GAS TURBINE ENGINE ROTOR FAILURES THAT OCCURRED IN US COMMERCIAL AVIATION DURING 1985 Final Report

R. A. DELUCIA, J. T. SALVINO, and B. C. FENTON (Federal Aviation Administration, Atlantic City, NJ.) Jul. 1989 28 p (Contract DOT/FA71NA-AP98)

(NAPC-PE-188; DOT/FAA/CT-89/7) Avail: NTIS HC A03/MF A01

Statistics relating to gas turbine engine rotor failures which occurred during 1985 in U.S. commercial aviation service use are given. Two hundred and seventy-three failures occurred in 1985. Rotor fragments were generated in 150 of the failures, and of these 14 were uncontained. The predominant failure involved blade fragments, 94.4 percent of which were contained. Six disk failures occurred and all were uncontained. Fifty-seven percent of the 273 failures occurred during the takeoff and climb stages of flight. This service data analysis is prepared on a calendar year basis and published yearly. The data support flight safety analyses, proposed regulatory actions, certification standards, and cost benefit analyses.

N89-28518# Aeronautical Research Labs., Melbourne (Australia).

AERODYNAMIC MODEL TESTS OF EXHAUST AUGMENTORS FOR F/A-18 ENGINE RUN-UP FACILITY AT RAAF WILLIAMTOWN Summary Report

S. A. FISHER and A. M. ABDEL-FATTAH Dec. 1988 29 p (AD-A208110; ARL-AERO-PROP-TM-458; AR-005-583) Avail: NTIS HC A03/MF A01 CSCL 21/5

Model tests of the air cooled exhaust augmentors proposed for the F/A-18 engine ground run-up facilities at RAAF Williamtown were undertaken, to confirm satisfactory aerodynamic behavior of the augmentor designs and to provide data for optimizing certain aspects of the designs. The tests were carried out on 1/45 scale models, using an unheated air jet to represent the engine exhaust. Geometric features were identified which had important influence on augmentor duct flow symmetry and the cooling flow augmentation ratio. GRA

N89-28519# Institut Franco-Allemand de Recherches, Saint-Louis (France).

MEASUREMENTS OF MEAN-FLOW AND TURBULENCE CHARACTERISTICS IN A TURBOJET EXHAUST USING A LASER VELOCIMETER

H. J. SCHAEFER 13 Sep. 1988 16 p Presented at the 11th Symposium on Turbulence, Rolla, MO, 17-19 Oct. 1988

(ISL-CO-226/88; ETN-89-95033) Avail: NTIS HC A03/MF A01 Mean-flow and turbulence characteristics are measured in a high-temperature axisymmetric jet exhausting from an aero engine. The effects of exit Mach number and temperature on the jet flow

field are studied. A laser Doppler velocimeter is used to map the flow characteristics over a range of Mach numbers from 0.46 to 0.84. Radial distributions of the mean axial velocity and the root mean square of the corresponding fluctuations are obtained at different axial stations in the flow. The various distributions are found to collapse when plotted in appropriate coordinates. The collapsed data can be approximated by a universal profile. The radial mean-velocity scans at various axial stations exhibit a strong similarity when compared in reduced lateral coordinates. The spread of the mixing layer decreases with increasing exit Mach number and temperature. **FSA**

N89-29347# DieselDyne Corp., Morrow, OH.

A STUDY OF AN ADVANCED VARIABLE CYCLE DIESEL AS APPLIED TO AN RPV: EVALUATION OF AN RPV VARIABLE CYCLE DIESEL ENGINE Final Report, 11 Aug. 1988 - 28 Feb. 1989

RICHARD P. JOHNSTON 1 May 1989 85 p

(Contract DAAH01-88-C-0660; DARPA ORDER 5916)

(AD-A207754; DDC-89-01) Avail: NTIS HC A05/MF A01 CSCL 21/7

A variable cycle diesel is examined for use in an unmanned long endurance remotely piloted vehicle (RPV). Engine configuration studies are made and a possible installation arrangement developed. Installed performance projections are made and a long endurance RPV mission fuel, installed engine weight and propeller performance estimates made along with several aircraft installation drawings. It was found that the final engine configuration performed the specified mission with a total fuel and installed engine weight fraction of only 24 percent of the vehicle Take Off Gross Weight. The mission was evaluated at a cruise altitude of 65000 feet and an engine configuration suitable for use at 85000 feet was also investigated. GRA

N89-29348# Aeronautical Research Labs., Melbourne (Australia).

A MODIFIED LEAST SQUARES ESTIMATOR FOR GAS TURBINE IDENTIFICATION

G. L. MERRIGNTON Dec. 1988 34 p (AD-A207911; ARL-AERO-PROP-TM-445; DODA-AR-004-577) Avail: NTIS HC A03/MF A01 CSCL 21/5

A simple estimator is proposed for use in extracting the spool dynamic characteristics of a gas turbine engine. It provides realistic estimates even when the input/output signals are contaminated by high levels of measurement noise. As a result, it has the potential to form the basis of a useful engine health monitoring tool. GRA

N89-29351*# General Electric Co., Cincinnati, OH. Aircraft Engines Dept.

REVOLUTIONARY OPPORTUNITIES FOR MATERIALS AND STRUCTURES STUDY, ADDENDUM

P. D. FEIG 1987 39 p

(Contract NAS3-24622)

(NASA-CR-179642-ADD; NAS 1.26:179642-ADD) Avail: NTIS HC A03/MF A01 CSCL 21/5

This report is an addendum to the Revolutionary Opportunities for Materials and Structures Study (ROMS), modifying the original by the addition of two tasks. The primary purpose of these tasks was to conduct additional aircraft/engine sizing and mission analysis to obtain contributory aircraft performance data such as fuel burns and direct operating costs for both the subsonic and supersonic engines. Author

08

AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

A89-51702*# Systems Technology, Inc., Hawthorne, CA. FLIGHT INVESTIGATION OF HELICOPTER LOW-SPEED **RESPONSE REQUIREMENTS**

DAVID G. MITCHELL, ROGER H. HOH (Systems Technology, Inc., Hawthorne, CA), and J. MURRAY MORGAN (National Aeronautical Establishment, Ottawa, Canada) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 12, Sept.-Oct. 1989, p. 623-630. Research supported by the U.S. Army. Previously cited in issue 22, p. 3537, Accession no. A87-49578. refs (Contract NAS2-11304) Copyright

A89-51723#

DESIGN OF A MODALIZED OBSERVER WITH EIGENVALUE SENSITIVITY REDUCTION

KENNETH M. SOBEL (City College, New York) and SIVA S. BANDA (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, OH) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090). vol. 12, Oct. 1989, p. 762-764.

(Contract F49620-87-R-0004)

A novel approach is proposed for the design of modalized observers which yields an observer possing both good error attenuation to an initial condition mismatch of known direction and small eigenvalue sensitivity. The basis of the method is the minimization of a cost function that is dependent on the norm of the observer modal matrix, as well as the condition number of this modal matrix and directional information concerning the initial condition mismatch. An illustrative example is presented for the lateral dynamics of the L-1011 aircraft which demonstrates the superiority of the new approach. OC.

A89-52168

PERFORMANCE ANALYSIS OF VOTING STRATEGIES FOR A FLY-BY-WIRE SYSTEM OF A FIGHTER AIRCRAFT

C. SUBRAMANIAN and D. K. SUBRAMANIAN (Indian Institute of Science, Bangalore, India) IEEE Transactions on Automatic Control (ISSN 0018-9286), vol. 34, Sept. 1989, p. 1018-1021. refs

Copyright

Findings of studies on processing data from a digital fly-by-wire system of a fighter aircraft are presented. The objectives are to select a suitable software structure complying with reliability and fault-tolerance requirements and to assess its computational load. Ramp and constant input signals with noise are studied using on Monte Carlo methods. Voting strategies studied and compared include lower median, upper median, and weighted average. Execution times and memory requirements of each strategy are also assessed. I.E.

A89-52526

AIAA GUIDANCE, NAVIGATION AND CONTROL CONFERENCE, BOSTON, MA, AUG. 14-16, 1989, TECHNICAL PAPERS, PARTS 1 & 2

Conference sponsored by AIAA. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. Pt. 1, 864 p.; pt. 2, 856 p. For individual items see A89-52527 to A89-52710. Copyright

Recent advances in aircraft and spacecraft navigation, guidance, and control are discussed in reviews and reports. Topics addressed include multidisciplinary flight controls, control methods for spacecraft, component development, launch-vehicle guidance, aircraft control systems, design techniques, intelligent systems to pilot decisions, aerostructural controls, aid momentum management, missile guidance, and nonlinear techniques. Consideration is given to aided inertial navigation; robustness analysis; fault accommodation; dynamics and control methods for spacecraft; mission planning; robotics for aerospace applications; large-space-structure control; filters and observers; spacecraft guidance; missile autopilot design; experiments on active control of flexible structures; output feedback; strapdown alignment and navigation; differential games; spacecraft attitude control; eigenstructure design; optimization; navigation, sensors, and simulations for spacecraft; and ATC. T.K.

A89-52527#

A NEW TECHNIQUE FOR AIRCRAFT FLIGHT CONTROL RECONFIGURATION

MARCELLO R. NAPOLITANO and ROBERT L. SWAIM (Oklahoma State University, Stillwater) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 1. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 1-9. refs

(AIAA PAPER 89-3425) Copyright

An original algorithm is applied to the aircraft flight control reconfiguration problem. The determination of the desired control law, which can adapt in a very short period of time to a major damage to a control surface, is obtained by making use of the recent control and response time histories. In addition, a method is proposed to efficiently distribute the reconfiguration task among all the remaining healthy control surfaces. The estimated model of the damaged aircraft used in this technique is obtained by using a multiple model Kalman filtering approach. The model estimation and the control algorithm have been codified in a computer simulation program for a 6 degrees of freedom aircraft model. The simulation results of the reconfiguration are presented. Author

A89-52528*# Integrated Systems, Inc., Santa Clara, CA. A REAL-TIME EXPERT SYSTEM FOR SELF-REPAIRING FLIGHT CONTROL

S. A. GAITHER, A. K. AGARWAL, S. C. SHAH (Integrated Systems, Inc., Santa Clara, CA), and E. L. DUKE (NASA, Flight Research Center, Edwards, CA) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 1. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 10-16. refs

(AIAA PAPER 89-3427) Copyright

An integrated environment for specifying, prototyping, and implementing a self-repairing flight-control (SRFC) strategy is described. At an interactive workstation, the user can select paradigms such as rule-based expert systems, state-transition diagrams, and signal-flow graphs and hierarchically nest them, assign timing and priority attributes, establish blackboard-type communication, and specify concurrent execution on single or multiple processors. High-fidelity nonlinear simulations of aircraft and SRFC systems can be performed off-line, with the possibility of changing SRFC rules, inference strategies, and other heuristics to correct for control deficiencies. Finally, the off-line-generated SRFC can be transformed into highly optimized application-specific real-time C-language code. An application of this environment to the design of aircraft fault detection, isolation, and accommodation algorithms is presented in detail. T.K.

A89-52529*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Facility, Edwards, CA. A DESIGN PROCEDURE FOR THE HANDLING QUALITIES **OPTIMIZATION OF THE X-29A AIRCRAFT**

JOHN T. BOSWORTH and TIMOTHY H. COX (NASA, Flight Research Center, Edwards, CA) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 1. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 17-34. refs (AIAA PAPER 89-3428) Copyright

The techniques used to improve the pitch-axis handling qualities of the X-29A wing-canard-planform fighter aircraft are reviewed. The aircraft and its FCS are briefly described, and the design method, which works within the existing FCS architecture, is characterized in detail. Consideration is given to the selection of

design goals and design variables, the definition and calculation of the cost function, the validation of the mathematical model on the basis of flight-test data, and the validation of the improved design by means of nonlinear simulations. Flight tests of the improved design are shown to verify the simulation results. тк

A89-52547#

SYNTHESIS OF A HELICOPTER FULL AUTHORITY CONTROLLER

M. W. HEIGES, P. K. MENON, and D. P. SCHRAGE (Georgia Institute of Technology, Atlanta) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 1. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 207-213. refs

(AIAA PAPER 89-3448) Copyright

A full-authority controller for an autonomous helicopter is developed analytically on the basis of nonlinear transformation theory. A 6-DOF model is employed, and the twelfth-order nonlinear system of equations is reduced using a singular-perturbation technique, separating the position and attitude dynamics under the assumption that the former is slower than the latter. Details of the inverse transformation and the solution of the inverse kinematics problem are given; the transformed linear feedback controller is described; and results from controller evaluations using the NASA Ames TMAN program (Lewis and Aiken, 1985) to simulate one-on-one nap-of-the-earth air combat are presented graphically. The controller is found to function adequately with errors of up to 20 percent in the force and moment terms used in the transformation. T.K.

A89-52548#

TIME PERIODIC CONTROL OF A MULTI-BLADE HELICOPTER STEVEN G. WEBB (U.S. Air Force Academy, Colorado Springs, CO). ROBERT A. CALICO, and WILLIAM E. WIESEL (USAF, Institute of Technology, Wright-Patterson AFB, OH) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 1. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 214-220. refs. (AIAA PAPER 89-3449)

The equations of motion for a rigid helicopter containing four blades free to flap and lag are determined. Control techniques are developed which stabilize the entire system for a variety of flight conditions. A modal control technique, based on Floquet theory, is used to eliminate multiple blade instabilities by controlling pairs of unstable roots at a specific design point. Another modal controller is designed for the resulting new system which shifts a second pair of unstable roots to desired locations. This process is repeated until all instabilities are eliminated. Numerical inaccuracies, however, limit the number of possible repetitions of this procedure. Author

A89-52549*# California Univ., Davis. SELF-TUNING GENERALIZED PREDICTIVE CONTROL **APPLIED TO TERRAIN FOLLOWING FLIGHT**

R. A. HESS (California, University, Davis) and Y. C. JUNG IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 1. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 221-235. refs

(Contract NAG2-221)

(AIAA PAPER 89-3450) Copyright

Generalized Predictive Control (GPC) describes an algorithm for the control of dynamic systems in which a control input is generated which minimizes a quadratic cost function consisting of a weighted sum of errors between desired and predicted future system output and future predicted control increments. The output predictions are obtained from an internal model of the plant dynamics. Self-tuning GPC refers to an implementation of the GPC algorithm in which the parameters of the internal model(s) are estimated on-line and the predictive control law tuned to the parameters so identified. The self-tuning GPC algorithm is applied to a problem of rotorcraft longitudinal/vertical terrain-following flight. The ability of the algorithm to tune to the initial vehicle parameters

and to successfully adapt to a stability augmentation failure is demonstrated. Flight path performance is compared to a conventional, classically designed flight path control system.

Author

A89-52550#

COMPARISON OF EIGENSTRUCTURE ASSIGNMENT AND THE SALFORD SINGULAR PERTURBATION METHODS IN VSTOL AIRCRAFT CONTROL LAW DESIGN

P. R. SMITH (Royal Aerospace Establishment, Bedford, England), D. HOPPER (Salford, University, England), and A. BRADSHAW (Lancaster, University, England) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 1. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 236-246. refs (AIAA PAPER 89-3451) Copyright

The fundamental principles of the eigenstructure assignment and singular-perturbation techniques, as applied to the design of control laws for VSTOL aircraft, are examined in an analytical review, with a focus on developments at the University of Salford. The mathematical bases of the methods are outlined, and a control law for a hypothetical thrust-vectoring VSTOL aircraft in steady level flight at 120 knots is developed using each of the methods. Details of the procedures and numerical results are presented in extensive tables and graphs, and both of the controllers developed are found to have satisfactory performance. It is pointed out that the singular-perturbation method, with its graphical approach, is easier to use, but that eigenstructure assignment offers superior treatment of system zeros and is applicable to studies of handling qualities. T.K.

A89-52551#

FLIGHT CONTROL SYNTHESIS FOR AN UNSTABLE FIGHTER AIRCRAFT USING THE LOG/LTR METHODOLOGY

THOMAS R. WENDEL (McDonnell Aircraft Co., Saint Louis, MO) and DAVID K. SCHMIDT (Arizona State University, Tempe) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 1. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 247-254. refs

(AIAA PAPER 89-3452) Copyright

The Linear-Quadratic-Gaussian with Loop-Transfer-Recovery design methodology is used to develop the flight control laws for a representative advanced fighter aircraft. The ability of the technique to meet both flying qualities and robustness requirements is examined. Initial application of the LOG/LTR methodology reveals that, because of an unstable pole in the open-loop plant, a relatively high bandwidth (30 radians/second) is required to achieve the desired loop shape. The ability to closely match a desired loop shape is important when flying qualities requirements must be satisfied. With this high bandwidth system, the flying qualities requirements are satisfied, however, insufficient high frequency attenuation exists to account for an unmodeled structural mode. The implications of this development are examined and potential solutions are identified and investigated. Author

A89-52552#

APPLICATION OF PERFECT MODEL FOLLOWING TO A **CONTROL CONFIGURED VEHICLE**

WAYNE C. DURHAM IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 1. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 255-262. (AIAA PAPER 89-3453) Copyright

Perfect explicit model following control is applied to a flight path angle command design problem for an aerodynamically unstable F-104 airplane. The problem features a model of lower order than the plant, performance specifications on the response to step commands and to external disturbances, and a requirement for satisfactory performance in the presence of changes in the plant parameters due to center of gravity shifts. The method presented features perfect model trajectory following, unambiguous understanding of the roles of the gains, and simple expressions

for error dynamics. The expressions for the error dynamics permit analysis of system performance in the presence of variations in plant parameters using conventional methods. Author

A89-52555#

LINEAR QUADRATIC GAUSSIAN DESIGN FOR ROBUST PERFORMANCE OF A HIGHLY MANEUVERABLE AIRCRAFT

DOUGLAS P. LOOZE (Massachusetts, University, Amherst) and JAMES S. FREUDENBERG (Michigan, University, Ann Arbor) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 1. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 282-288. refs

(Contract F33615-88-C-3601)

(AIAA PAPER 89-3457) Copyright

The robust command following problem with input uncertainty is investigated analytically. The derivation of the governing equations is outlined; design criteria are defined in terms of the desired characteristics of the compensated loop transfer function; a procedure for selecting the LQG/LTR weights is developed; and particular attention is given to the case of longitudinal dynamic control of a highly maneuverable aircraft (Hartmann et al., 1979). Numerical results are presented in extensive graphs and discussed in detail.

A89-52558#

ON-BOARD AUTOMATIC AID AND ADVISORY FOR PILOTS OF CONTROL-IMPAIRED AIRCRAFT

ELAINE A. WAGNER (General Dynamics Corp., Fort Worth, TX) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 1. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 306-320. refs

(AIAA PAPER 89-3460) Copyright

The design and performance of an automatic aid and advisory system to permit pilots to maneuver an aircraft after partial failure of the flight-control systems are discussed, summarizing the results of the author's dissertation (Wagner, 1987). The need to change the automatic-control law after failure is stressed. Topics addressed include operating constraints, airspeed-type limitations on controllability, changes in stall and control-reversal airspeed, performance constraints, equilibria and other retrim information, and the structure of an expert system to find the appropriate postfailure emergency response. The response of a C-130 aircraft to -9-deg off-nominal elevator jam and expert-system-directed compensation is shown in graphs, and a preliminary description of an integrated recovery aid and advisory system is given.

National Aeronautics and Space Administration. A89-52561*# Hugh L. Dryden Flight Research Facility, Edwards, CA. MODELING OF AERODYNAMIC FORCES IN THE LAPLACE DOMAIN WITH MINIMUM NUMBER OF AUGMENTED STATES FOR THE DESIGN OF ACTIVE FLUTTER SUPPRESSION SYSTEMS

E. NISSIM (NASA, Flight Research Center, Edwards, CA) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 1. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 332-352 refs

(AIAA PAPER 89-3466) Copyright

A method is proposed by which an aeroservoelastic problem is brought to a state-space form with a minimum number of augmented aerodynamic terms. The examples treated in this work relate to NASA's Drone for Aerodynamic and Structural Testing-Aerodynamic Research Wing 1 (DAST-ARW1) and to the YF-17 fighter model. It is shown that in all cases considered, the method yields a very good accuracy regarding the flutter parameters and the dynamic behavior of the systems, using only two augmented aerodynamic states. The method should prove useful in the design of lower order control laws based on optimal control theory. Author

A89-52562#

SENSITIVITY DERIVATIVES OF FLUTTER CHARACTERISTICS AND STABILITY MARGINS FOR AEROSERVOELASTIC DESIGN

M. KARPEL (Technion - Israel Institute of Technology, Haifa) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 1. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 354-364. refs

(AIAA PAPER 89-3467) Copyright

The interaction between aeroelastic response, flutter, and control systems in a highly maneuverable flight vehicle is characterized analytically. A state-space approach is used to obtain exact derivatives of the flutter dynamic pressure, flutter frequency, and gain and phase margins with respect to the structural and control design variables. These expressions are then applied to the control-gain design problem for an active flexible wing model to be tested in the NASA Langley Transonic Dynamics Tunnel. Numerical results are presented in tables and graphs, demonstrating the accuracy and efficiency of the derivatives and their ease of implementation in control algorithms. тк

A89-52563#

AN EFFECTIVE FLUTTER CONTROL METHOD USING FAST, TIME-ACCURATE CFD CODES

D. OMINSKY and H. IDE (Rockwell International Corp., Los Angeles, CA) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 1. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 365-375. (AIAA PAPER 89-3468) Copyright

The application of state-of-the-art CFD codes to the construction of aircraft flutter-control laws is described and demonstrated. The advantages of the CFD time-integration approach over classical frequency-domain control-design methods are reviewed; the derivation of the equations of motion and the steps in a time-dependent aeroelastic computation are outlined; the information provided by the generic flexible-wing model is summarized; and the experimental verification of a full potential CFD code on this model is explained. For the flutter analysis, consideration is given to the harmonic control inputs and the effects of phase angle, amplitude, and frequency. The feedback-control formulation is presented, and numerical results are shown in extensive graphs. It is found that a control law capable of damping out a specified flutter mode can be developed at minimal cost in computation time and effort. ТΚ

A89-52565#

STABILITY ANALYSIS OF FLEXIBLE BODY DYNAMICS FOR A HIGHLY MANEUVERABLE FIGHTER AIRCRAFT

H. M. YOUSSEF, S. P. LEE, and D. DINGEMAN (Lockheed Aeronautical Systems Co., Burbank, CA) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 1. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 386-390. refs

(AIAA PAPER 89-3471) Copyright

Dynamics equations for an advanced fighter aircraft with flexible body structure have been developed. The linear and angular deformations are assumed to be small in the body reference frame. This allows the equations to be linearized in the deformation variables. The resulting integrated equations, the total body dynamics, and the flexible body dynamics are formulated in a state-space-like format for convenient implementation of computer programs. The equations simplify considerably in the case of constant angular rate of the body reference frame. A generic fighter aircraft structure model was developed and the stability effects due to high roll rate were studied. The results show that at high roll rates the rigid body modes become unstable and the frequency of the first bending mode is slightly lower with higher damping. The dynamics effects of the high roll rate is equivalent to adding a negative stiffness constant to the structure model. Author

A89-52579*# Minnesota Univ., Minneapolis. NONLINEAR CONTROL OF A SUPERMANEUVERABLE AIRCRAFT

S. ANTONY SNELL, WILLIAM L. GARRARD (Minnesota, University, Minneapolis), and DALE F. ENNS (Honeywell Systems and Research Center; Minnesota, University, Minneapolis) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 1. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 519-531. refs (Contract NAG1-821)

(AIAA PAPER 89-3486) Copyright

This paper describes a technique which may be used to design the flight control system for a highly maneuverable aircraft. The control system was provided to stabilize the dynamics of the aircraft model and allow it to fly simulated, poststall 'supermaneuvers'. Although the aircraft dynamics are highly nonlinear under these conditions, the gain-scheduled, flight control system was designed using basically linear techniques. A manuever generator was implemented to pilot the mathematical model through prescribed optimal trajectories. The control system design performed well while executing maneuvers involving small angular rates where the governing dynamics could be considered linear. However, the performance deteriorated once the model was subjected to high angular rates at high angle of attack. Author

A89-52580#

NONLINEAR STABILIZING CONTROL OF HIGH ANGLE OF ATTACK FLIGHT DYNAMICS

EYAD H. ABED (Maryland, University, College Park) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 1. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 532-536. refs (Contract NSF CDR-88-03012; NSF ECS-86-57561; AF-AFOSR-87-0073)

(AIAA PAPER 89-3487) Copyright

A new approach to the feedback control of aircraft at high angles of attack is presented which is based on recent results of control of nonlinear systems at bifurcation points. The bifurcation control technique used here provides an analytically-based algorithmic approach to the stabilization of vehicles at the onset of flow separation. Wing rock stabilization for the HP 115 research aircraft is considered as an example. V.L.

A89-52581#

HIGH GAIN FLIGHT CONTROLLERS FOR NONLINEAR SYSTEMS

MARIO INNOCENTI (Auburn University, AL) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 1. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 537-545. refs

(AIAA PAPER 89-3488) Copyright An approach to flight vehicle control is presented which is based on a combination of variable structure control (VSC) and hyperstability. VSC is used to derive the error dynamics and the convergence of the sliding hyperplanes. Hyperstability theory is used to derive the passive switching control laws by ensuring global stability of the sliding motion. Results of a prelimiary simulation involving glide slope and flare trajectories are examined. VI.

A89-52582*# California Univ., Berkeley.

ON THE DESIGN OF NONLINEAR CONTROLLERS FOR FLIGHT CONTROL SYSTEMS

JOHN HAUSER, SHANKAR SASTRY (California, University, Berkeley), and GEORGE MEYER (NASA, Ames Research Center, Moffett Field, CA) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 1. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 546-555. Research supported by the Schlumberger Foundation and Berkeley Engineering Fund. refs (Contract NAG2-243)

(AIAA FAPER 89-3489) Copyright

A method of approximate input-output linearization by dynamic

state feedback is presented, with the flight control of VTOL aircraft used as an example. It is shown that the closed loop system has a graceful degradation of performance as the moment-to-force coupling is increased. It is also demonstrated that the approach proposed here leads to an asymptotically stable closed loop system with guaranteed bounds on the tracking error caused by the nonminumum phase character of the system.

A89-52583#

OPTIMAL CONTROL FOR MAXIMUM ENERGY EXTRACTION FROM WIND SHEAR

GOTTFRIED SACHS, KLAUS LESCH, and ALEXANDER KNOLL (Muenchen, Technische Universitaet, Munich, Federal Republic of Germany) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 1. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 556-564. refs

(AIAA PAPER 89-3490) Copyright

Maximum energy extraction from wind shear by appropriate flight maneuvers is treated as an optimal control problem. This problem is solved by applying a numerical optimization procedure based on the method of multiple shooting. Necessaray optimality conditions are formulated with the use of the minimum principle. Additional optimization considerations are concerned with limiting bounds in regard to the optimal flight path, thus resulting in an optimization problem with a state variable constraint. The basic characteristics of optimal control for maximizing energy transfer from wind shear to the aircraft and the properties of the resulting trajectory are shown. Furthermore, an evaluation of the wind shear conditions necessary for maintaining a continuous flight is presented, covering a wide range of parameters generally important for the performance of aircraft. It is shown which of these parameters are significant for the energy extraction problem considered. Author

A89-52584#

COMPARISON OF CHARACTERISTIC LOCUS AND H-INFINITY METHODS IN VSTOL FLIGHT CONTROL SYSTEM DESIGN

S. J. WILLIAMS (Cambridge Control, England) and P. R. SMITH (Royal Aerospace Establishment, Bedford, England) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers, Part 1, Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 565-575. Research supported by the Ministry of Defence Procurement Executive. refs

(AIAA PAPER 89-3491) Copyright

The objective of the work described in this paper has been to investigate the application of a variety of frequency-domain multivariable design techniques to the design of a VSTOL aircraft pitch plane dynamics control system. Multivariable 'Nyquist-like' methods have been used, including the Characteristic Locus and Direct Nyquist Array methods. In addition, more modern, optimization-based H(infinity) methods have also been used. The paper describes the background to the methods and then their use in design. The H(infinity) methods show great promise but there is still some work to be done before they will be established in common use - particularly for nonsquare systems. Author

A89-52587#

DESIGN OF ADAPTIVE DIGITAL MODEL-FOLLOWING FLIGHT-MODE CONTROL SYSTEMS FOR **HIGH-PERFORMANCE AIRCRAFT**

B. PORTER and M. Z. OTHMAN (Salford, University, England) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 1. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 593-601.

(AIAA PAPER 89-3495) Copyright

It is shown that by incorporating on-line recursive identifiers to provide updated step-response matrices for inclusion in digital PID control laws, highly effective adaptive digital model-following control systems can be readily designed for multivariable plants. The effectiveness of such a 'certainty equivalent' adaptive digital modelfollowing control system is illustrated by the design of an adaptive digital flight-mode control system for the F-16 aircraft. Author

A89-52595#

EVALUATION METHODS FOR COMPLEX FLIGHT CONTROL SYSTEMS

MARK R. ANDERSON, URI H. RABIN, and JAMES H. VINCENT (Systems Control Technology, Inc., Palo Alto, CA) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 1. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 667-675. refs (Contract N00421-85-D-0155)

(AIAA PAPER 89-3502) Copyright

Fight control system verification requires an analytical comparison of system characteristics to the control system specification MIL-F-9490 and the appropriate flying quality specifications MIL-F-8785, MIL-F-8330, or MIL-STD-1797. These evaluations become increasingly difficult, however, as the design trend towards increased control system integration, sophistication, and coupling continues. This paper documents several extensions to existing methods for evaluating system stability margins and producing low-order equivalent models (for flying qualities evaluations) of complex aircraft flight control systems which may include over one-hundred states. Author

A89-52598*# Princeton Univ., NJ.

APPLICATION OF STOCHASTIC ROBUSTNESS TO AIRCRAFT CONTROL SYSTEMS

ROBERT F. STENGEL (Princeton University, NJ) and LAURA E. RYAN IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 1. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 698-708. Research sponsored by FAA. refs

(Contract NGL-31-001-252)

(AIAA PAPER 89-3505) Copyright

Stochastic robustness, a simple numerical procedure for estimating the stability robustness of linear, time-invariant systems, is applied to a forward-swept-wing aircraft control system. Based on Monte Carlo evaluation of the system's closed-loop eignevalues, this analysis approach introduces the probability of instability as a scalar stability robustness measure. The related stochastic root locus provides insight into robustness characteristics of the closed-loop system. Three Linear Quadratic controllers of decreasing robustness are chosen to demonstrate the use of stochastic robustness to analyze and compare control designs. Examples are presented illustrating the use of stochastic robustness analysis to address the effects of actuator dynamics and unmodeled dynamics on the stability robustness of the forward-swept-wing aircraft. Author

A89-52600#

MODIFICATION OF TRIM POINT AND FEEDBACK GAINS FOR FAILED AIRCRAFT

YOSHIMASA OCHI and KIMIO KANAI (Defense Academy, Yokosuka, Japan) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 1. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 717-727. refs (AIAA PAPER 89-3507) Copyright

In this paper, two approaches are proposed for a restructurable flight control system which stabilizes and settles a failed aircraft at a desirable trim point. The first approach is based on the optimal regulator with identification both of the linearized mathematical model of the aircraft and of disturbances caused by failures. The trim point is modified to a desirable one using the estimates, and feedback gains are also updated with the Kleinman method at regular intervals. Simulation results are presented for the longitudinal motion of the F-8 with failures at the horizontal tails. The second one is based on the feedback linearization method with parameter identification of the nonlinear model of the aircraft. Since the state variables used are not their perturbations around the trim point. It is possible to settle them at a desirable point directly. Incorporating control distributor into the controller, simulation was conducted for the six degrees of freedom nonlinear aircraft model with many effectors. Author

A89-52602#

SURFACE FAILURE DETECTION AND EVALUATION OF CONTROL LAW FOR RECONFIGURATION OF FLIGHT CONTROL SYSTEM

PETROS IOANNOU (Southern California, University, Los Angeles, CA) and R. ROONEY (Lockheed Aeronautical Systems Co., Burbank, CA) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 1. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 733-740. refs

(AIAA PAPER 89-3509) Copyright

The problem of detecting actuator surface failures and evaluating the control law for reconfiguration of flight control systems is considered. The method used for detecting failures is based on tracking error criteria which are developed by considering linear combinations of measured residual tracking errors. The tracking errors are generated using a model of the aircraft multivariable dynamics. Measurement disturbances/noise are also included and avoidance of false alarms is discussed. The detection and control law, which consists of a control mixer and a compensating signal, evaluation method is demonstrated using a six degree of freedom A-7D Digitac II aircraft model at 0.6 Mach and 15,000 ft. altitude. The simulation results indicate that failure detection can be fast and successful, and false alarms can be avoided by properly modifying the tracking error criteria. The method developed is independent of the feedback control input and therefore the controller of the system can be updated at different failure situations with absolutely no effect on the detection decision making. Author

A89-52609*# California Univ., Davis. EVALUATION OF A TECHNIQUE FOR PREDICTING LONGITUDINAL PILOT-INDUCED-OSCILLATIONS

R. A. HESS (California, University, Davis) and R. M. KALTEIS IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 1. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 802-815. refs

(Contract NAG2-490)

(AIAA PAPER 89-3517) Copyright

A technique for predicting the susceptibility of an aircraft to longitudinal pilot-induced-oscillations (PIO's) is evaluated using 62 configurations from a pair of flight tests involving the NT-33 variable stability aircraft. The technique is based upon the characteristics of the open-loop pilot/vehicle system for attitude control as predicted by the Optimal Control Model (OCM) of the human pilot. The OCM is simplified so that only the index of performance weighting coefficients need to be considered as problem variables and a simple technique for generating these coefficients is reviewed. Author

A89-52611*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

INTEGRATED FLIGHT/PROPULSION CONTROL SYSTEM DESIGN BASED ON A CENTRALIZED APPROACH

SANJAY GARG, DUANE L. MATTERN (NASA, Lewis Research Center; Sverdrup Technology, Inc., Cleveland, OH), and RANDY E. BULLARD (NASA, Lewis Research Center, Cleveland, OH) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 1. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 827-839. Previously announced in STAR as N89-26009. refs (AIAA PAPER 89-3520)

An integrated flight/propulsion control system design is presented for the piloted longitudinal landing task with a modern, statically unstable, fighter aircraft. A centralized compensator based on the Linear Quadratic Gaussian/Loop Transfer Recovery methodology is first obtained to satisfy the feedback loop performance and robustness specificiations. This high-order centralized compensator is then partitioned into airframe and engine sub-controllers based on modal controllability/observability for the compensator modes. The order of the sub-controllers is then reduced using internally-balanced realization techniques and the sub-controllers are simplified by neglecting the insignificant feedbacks. These sub-controllers have the advantage that they can be implemented as separate controllers on the airframe and the engine while still retaining the important performance and stability characteristics of the full-order centralized compensator. Command prefilters are then designed for the closed-loop system with the simplified sub-controllers to obtain the desired system response to airframe and engine command inputs, and the overall system performance evaluation results are presented.

A89-52612*# Georgia Inst. of Tech., Atlanta. THRUST VECTORING EFFECT ON TIME-OPTIMAL 90 DEGREES ANGLE OF ATTACK PITCH UP MANEUVERS OF A HIGH ALPHA FIGHTER AIRCRAFT

HAROLD STALFORD and ERIC HOFFMAN (Georgia Institute of Technology, Atlanta) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 1. Wasnington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 840-846. refs

(Contract NAG1-959)

(AIAA PAPER 89-3521) Copyright

Using thrust vectoring, the problem of pitching up a high alpha fighter aircraft to 90 degrees angle of attack in minimum time is considered. Pontryagin's maximum principle is used together with a two-point boundary value numerical algorithm to derive open-loop controls for various parameterized limits on thrust vectoring angles. Without thrust vectoring, a high alpha fighter with initial conditions 0.6 Mach number and 15,000 feet requires 7.0 seconds to pitch-up to 90 degrees. However, with 20-degree angle thrust vectoring, the pitch-up takes only 1.5 seconds with a final Mach number of 0.47. Also, the gain in altitude is less than 100 feet. More important, additional thrust vectoring yields litle benefit beyond the 20-degree angles. This paper describes control solutions in detail for thrust vectoring angles between 0 and 90 degrees.

A89-52615#

INTELLIGENT FLIGHT MANAGEMENT PERFORMANCE USING DISCRETE-EVENT SIMULATION

JOHN L. VIAN (Boeing Military Airplanes, Wichita, KS) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 2. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 859-864.

(AIAA PAPER 89-3526) Copyright Performance of an intelligent flight management system is evaluated using discrete-event simulation. An intelligence paradigm is formulated for military missions within high threat environments with logic based on mission state, information state, and processing state. The paradigm determines reactive, heuristic, suboptimal, or optimal four-dimensional operating modes for the trajectory generation process of the system. Overall performance is evaluated by determining operating mode as percentage of total mission time. Various aircraft and system processing configurations are evaluated for stochastically simulated threat beddowns. Author

A89-52628*# Mississippi State Univ., Mississippi State. AN OBSERVER-BASED COMPENSATOR FOR DISTRIBUTED DELAYS IN INTEGRATED CONTROL SYSTEMS

ROGELIO LUCK (Mississippi State University, Mississippi State) and ASOK RAY (Pennsylvania State University, University Park) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 2. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 988-996. refs

(Contract NAG3-823)

(AIAA PAPER 89-3541) Copyright

This paper presents an algorithm for compensation of delays that are distributed within a control loop. The observer-based algorithm is especially suitable for compensating network-induced

delays that are likely to occur in integrated control systems of the future generation aircraft. The robustness of the algorithm relative to uncertainties in the plant model have been examined. Author

A89-52642*# Planning Research Corp., Hampton, VA. A MULTILOOP, DIGITAL FLUTTER SUPPRESSION CONTROL LAW SYNTHESIS CASE STUDY

VIVEK MUKHOPADHYAY (Planning Research Corp., Hampton, VA), BOYD PERRY, III, and THOMAS E. NOLL (NASA, Langley Research Center, Hampton, VA) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 2. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 1105-1113. refs (AIAA PAPER 89-3556) Copyright

A methodology for obtaining a digital low-order, multiloop, robust control law for aeroelastic application from a full-state Linear Quadratic Gaussian design is presented. As part of the design methodology, the multivariable system robustness at the plant input and output is evaluated using singular value properties and improved using constrained optimization procedures. To validate the methodology, a digital flutter suppression system has been designed for the full-span Active Flexible Wing (AFW) wind-tunnel model as part of a collaborative effort between the NASA Langley Research Center and Rockwell International. Preliminary results for a low-order discrete, symmetric flutter suppression system design that significantly improved the AFW model stability are provided and the experiences gained during the design process Author are discussed.

A89-52643#

DYNAMIC STABILITY AND ACTIVE CONTROL OF ELASTIC VEHICLES ACTING WITH UNSTEADY AERODYNAMIC FORCES

SHILU CHEN, SHUO TANG, HENGYUAN YAN, and XIUFANG HUO (Northwestern Polytechnical University, Xian, People's Republic of China) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 2. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 1114-1117. refs

(AIAA PAPER 89-3557) Copyright

The present study of the problems posed by elastic vehicle structures' control in unsteady aerodynamic structures derives longitudinal equations of disturbance motions, and a method for the analysis of aeroelastic effects on the stability of these vehicles is proposed which employs a simplified model of unsteady aerodynamic forces. The synthesis of an active control system's optimal design is studied from the viewpoint of the coordination of the design of active feedback controls, and the choice of vehicle control surface positions and gyroscopic sensors, for the most effective vibration suppression. O.C.

A89-52644#

APPLICATION OF TOTAL ENERGY CONTROL FOR HIGH PERFORMANCE AIRCRAFT VERTICAL TRANSITIONS

ANTHONY WARREN (Boeing Advanced Systems, Seattle, WA) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 2. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 1118-1126. refs

(AIAA PAPER 89-3559) Copyright

Energy management guidance algorithms for automated, fast transitions between cruise states are presented. These algorithms use total energy control principles to regulate throttle and flight control inputs. Two principal algorithms are used to perform cruise state transitions: Energy Hold/Altitude Hold - This algorithm consists of two guidance laws which regulate thrust and vertical lift to acquire and maintain a desired height/energy cruise point. Energy Capture - This algorithm regulates flight path angle at fixed throttle to coordinate height/speed transitions to a desired cruise point. It is primarily used for large energy transitions at max or min throttle setting, and requires switching to energy hold/altitude hold as the cruise state is approached. Author

A89-52645#

THRUST LAWS FOR MICROBURST WIND SHEAR PENETRATION

MARK L. PSIAKI (Cornell University, Ithaca, NY) and KIHONG PARK IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 2. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 1127-1138. refs (AIAA PAPER 89-3560) Copyright

Two thrust guidance strategies have been developed and analyzed for the ability that they give aircraft to safely penetrate microburst wind shear during landing approach. These are used in conjuction with a pitch steering strategy that has already been shown to give improved performance by maintaining nominal glide path in the presence of microburst winds. The strategies provide valuable understanding of good thrust policy in a microburst. One of the two strategies is to control the airspeed to its nominal value, and the other strategy is to control the airspeed or the inertial speed, which ever is smaller, to the nominal value. To evaluate these strategies, a simplified 1st-order aircraft model has been used. Headwind/tailwind and downdraft microburst models have been considered separately. The safe-performance limits with respect to ability to track glide path have been plotted and compared with those for optimal trajectories. The thrust laws' performance limits are not as good as those for optimal trajectories, as expected; the thrust guidance laws cannot use the global knowledge of the wind field that the optimal trajectories use. Nevertheless, the ability of the practical strategies to safely penetrate severe microburst wind shear has been demonstrated. The best performing guidance law was that which controlled the minimum of airspeed and inertial speed to a nominal value. This demonstrates the importance of using thrust to keep the inertial speed at or above the nominal value. Author

A89-52646*# Stanford Univ., CA.

OPTIMAL PATHS THROUGH DOWNBURSTS

YIYUAN ZHAO and A. E. BRYSON (Stanford University, CA) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 2. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 1139-1149. refs

(Contract NAG2-191)

(AIAA PAPER 89-3561) Copyright

The control of an aircraft's takeoff path through a downburst is presently formulated as a dynamic optimization problem with minimum-altitude constraint and two different performance measures; a landing path through a downburst is also discussed. Paths are determined which, in addition to maximizing an airspeed/altitude combination immediately after downburst penetration, minimize deviation from the intended flight path. For mild-to-moderate downbursts, the performance strategy maintains altitude at the expense of airspeed loss, while the survival strategy involves a descent of the aircraft to the minimum altitude in order to obtain greater airspeed. For a severe downburst, both optimal paths maintain minimum altitude. 0.0

A89-52659*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

APPLICATION OF VARIABLE-GAIN OUTPUT FEEDBACK FOR HIGH-ALPHA CONTROL

AARON J. OSTROFF (NASA, Langley Research Center, Hampton, VA) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 2. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 1249-1257. refs (AIAA PAPER 89-3576) Copyright

This paper describes a variable-gain optimal discrete output-feedback design approach that is applied to a nonlinear flight regime covering a wide angle-of-attack range that includes stall and poststall. The paper includes brief descriptions of the variable-gain formulation, the discrete-control structure and flight equations used to apply the design approach, and the high performance airplane model used in the application. Both linear

and nonlinear analyses are shown for a longitudinal four-model design case with angles of attack of 5, 15, 35, and 60 deg.

Author

A89-52661#

ROBUST CONTROL SYSTEM DESIGN WITH MULTIPLE MODEL APPROACH AND ITS APPLICATION TO ACTIVE FLUTTER CONTROL

YOSHIKAZU MIYAZAWA (National Aerospace Laboratory, Chofu, Japan) and EARL H. DOWELL (Duke University, Durham, NC) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 2. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 1267-1276. refs

(Contract NSF MSM-85-04105)

(AIAA PAPER 89-3578) Copyright

An approach to the design of a robust control system is proposed to apply to the active flutter control problem. The control system robustness is introduced by considering multiple plant models that represent the uncertain dynamics. Output feedback control with a fixed gain is assumed, and the gain is obtained by minimizing a quadratic performance index. An efficient and reliable computational algorithm based on the penalty function method is proposed. The algorithm is essential in the case when there is no obvious feedback gain that stabilizes all models. Active flutter control of a simple airfoil model in incompressible flow is considered as an example. The flow velocity, location of the center of gravity, and time delay inserted in the control loop are taken into account as uncertain parameters. The numerical results show that the multiple model approach can introduce a robust control system, where the performance is less sensitive to the parameter change considered than single model designs. Author

A89-52662#

ALGEBRAIC LOOP TRANSFER RECOVERY - AN APPLICATION TO THE DESIGN OF A HELICOPTER OUTPUT FEEDBACK CONTROL LAW

C. CHAMPETIER, J. F. MAGNI, and P. APKARIAN (ONERA, Centre d'Etudes et de Recherches de Toulouse, France) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 2. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 1277-1282. (AIAA PAPER 89-3579) Copyright

This paper is concerned with the problem of designing robust minimal order observer-based controllers. A simple and straightforward procedure achieving, in the observer case, the same level of robustness as a given state-feedback control law is derived. The proposed methodology is based on eigenspace techniques and is particularly suited to take into account design objectives expressed in terms of eigenvalues and eigenvectors. The stability robustness is considered at the plant input and thus is related to the corresponding return difference transfer matrix. The technique is applied to a realistic helicopter control problem. The performance and robustness properties of the derived controller are investigated in regard to wide changes in the flight condition. Author

A89-52671#

COMPARISON OF NONLINEAR CONTROLLERS FOR TWIN-LIFT CONFIGURATIONS

J. V. R. PRASAD, D. P. SCHRAGE, and MANOJ MITTAL (Georgia Institute of Technology, Atlanta) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 2. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 1350-1357. refs (AIAA PAPER 89-3591) Copyright

The stability and control problems associated with twin-lift helicopter configurations are analyzed. For the two twin-lift configurations viz. twin-lift with spreader bar and twin-lift without spreader bar, a nonlinear control scheme based on feedback linearization is presented. The performance of the resulting closed-loop systems in terms of trim attitudes and required control travel for carrying out a typical twin-filt mission is evaluated through

nonlinear simulation. Also, the effect of controller and sensor degradations on the overall system performance is discussed. Author

A89-52672#

DEVELOPMENT OF A FLIGHT CONTROL SYSTEM FOR VTOL AIRCRAFT SUPPORTED BY DUCTED FANS

S. NIWA, M. SUZUKI (Nagoya University, Japan), I. SUGIURA (Chubu University, Kasugai, Japan), J. KONDO (Hitachi Zosen Technical Research Institute, Japan), M. MURAKAMI (Hitachi Zosen Corp., Japan) et al. IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 2. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 1358-1365. refs

(AIAA PAPER 89-3592) Copyright

This paper presents a design of automatic flight control system for VTOL research aircraft supported by four ducted fans. Two remotely piloted research models, an electric motor model and an engine model, are developed for the purpose of detailed investigation of ducted fan type VTOL aircrafts. Especially the development of the automatic flight control system is one of the main purposes of this research. Automatic flight control systems which aid remote piloting are designed to control the attitude and altitude of these models. Many kinds of control tests on the test stands were performed to examine the control systems. As the result of a lot of flight tests, fairly well automatic stabilization of attitude and altitude of the reseach models was achieved in hovering and low speed flight condition. Author

A89-52673#

THE FLIGHT CONTROL SYSTEM FOR THE DAEDALUS HUMAN POWERED AIRCRAFT

R. BRYAN SULLIVAN (Orbital Sciences Corp., Fairfax, VA) and STEPHEN L. FINBERG (Charles Stark Draper Laboratory, Inc., Cambridge, MA) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 2. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 1366-1372.

(AIAA PAPER 89-3593) Copyright

The design and testing of an autopilot system for the Daedalus human powered aircraft are reviewed. In particular, attention is given to the airspeed hold system, wing leveler and heading hold system, electrostatic sensors, and the effect of the structural flexibility of the tailboom on the longitudinal and lateral dynamics. Although performance degradation was observed when the flexibility effects were included, adequate performance was achieved by proper augmentation of the feedback compensation. It is noted that the experience gained from the work on the Daedalus autopilot system should prove useful in the design of autopilots for future human powered aircraft. V.L.

A89-52674*# Boeing Commercial Airplane Co., Seattle, WA. DESIGN OF INTEGRATED AUTOPILOT/AUTOTHROTTLE FOR NASA TSRV AIRPLANE USING INTEGRAL LQG METHODOLOGY

ISAAC KAMINER and RUSSELL A. BENSON (Boeing Commercial Airplanes, Seattle, WA) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 2. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 1373-1391. refs

(Contract NAS1-18027)

(AIAA PAPER 89-3595) Copyright

An integrated autopilot/autothrottle control system has been developed for the NASA transport system research vehicle using a two-degree-of-freedom approach. Based on this approach, the feedback regulator was designed using an integral linear quadratic regulator design technique, which offers a systematic approach to satisfy desired feedback performance requirements and guarantees stability margins in both control and sensor loops. The resulting feedback controller was discretized and implemented using a delta coordinate concept, which allows for transient free controller switching by initializing all controller states to zero and provides a simple solution for dealing with throttle limiting cases. VI.

National Aeronautics and Space Administration. A89-52675*# Hugh L. Dryden Flight Research Facility, Edwards, CA. INITIAL FLIGHT QUALIFICATION AND OPERATIONAL MAINTENANCE OF X-29A FLIGHT SOFTWARE

MICHAEL R. EARLS and JOEL R. SITZ (NASA, Flight Research Center, Edwards, CA) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 2. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 1392-1415.

(AIAA PAPER 89-3596) Copyright

This paper is predominantly a nontechnical discussion of some significant aspects of the initial flight qualification and operational maintenance of the flight control system software for the X-29A technology demonstrator. Flight qualification and maintenance of complex, embedded flight control system software poses unique problems. The X-29A technology demonstrator aircraft has a digital flight control system which incorporates functions generally considered too complex for analog systems. Organizational responsibilities, software assurance issues, tools, and facilities are Author discussed.

A89-52685#

ROBUST EIGENSTRUCTURE ASSIGNMENT FOR FLIGHT CONTROL USING THE CTRL-C DESIGN PACKAGE

S. P. BURROWS and R. J. PATTON (York, University, Heslington, England) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 2. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 1489-1494. refs (AIAA PAPER 89-3607) Copyright

Eigenstructure assignment for linear systems is basically an inverse eigenvalue problem. A robust eigenstructure assignment is one such that the eigenvalues of the closed-loop system are made insensitive to perturbations applied to the elements of the system matrices using a linear state feedback control law. Two possible solutions to this are presented here, the second of which is a refinement of an earlier version and performs more reliably when assigning a number of complex eigenvalues. Both have been implemented on the commercially available Ctrl-C Design Package for control system design and analysis. These algorithms use Singular Value Decomposition for the calculation of assignable eigenvector subspaces and are shown to produce robust solutions to the state-feedback pole assignment problem. An aircraft example is included in order to demonstrate the relative strengths of the Author two techniques.

A89-52687*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA. MODAL TECHNIQUES FOR ANALYZING AIRPLANE **DYNAMICS**

P. DOUGLAS ARBUCKLE and STEVEN M. SLIWA (NASA, Langley Research Center, Hampton, VA) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 2. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 1502-1511. refs (AIAA PAPER 89-3609) Copyright

A series of techniques are presented for analyzing airplane control and output characteristics. State-space matrix equations describing the linear perturbation dynamics are transformed from physical coordinates into scaled, modal coordinates. Techniques for analyzing the impacts of system inputs on the fundamental modes of motion and the appearance of these modes in the system outputs are explained. Scaled modal matrices are used to compute steady-state control inputs which optimize the steady-state response of selected system outputs. Graphics which promote quick understanding of the analysis are presented to display the resulting vectors and matrices. The defined analysis techniques are applied to an example airplane model, illustrating the insight which can be acquired using the described modal techniques.

Author

A89-52688*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA

ACTIVE FLUTTER SUPPRESSION USING INVARIANT ZEROS/EIGENSYSTEM ASSIGNMENT

S. SRINATHKUMAR and W. M. ADAMS, JR. (NASA, Langley Research Center, Hampton, VA) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 2. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 1512-1518. refs (AIAA PAPER 89-3610) Copyright

An active control law is synthesized to raise the flutter dynamic pressure boundary of an active flexible wing wind tunnel model. The multi-input/multi-output controller has a two-degree-of-freedom structure consisting of: (1) an output dynamic compensator selected to assign system invariant zeros to shape the multivariable root loci, and (2) an output gain feedback controller, based on eigensystem assignment theory, using the compensator augmented system to stabilize the flutter mode and optimize a specified performance index. Evaluation of a digital implementation of a constant gain controller in a general batch simulation of the system reveals that the feedback system is stable over a dynamic pressure

pressure variations.

A89-52690# A PERFECT EXPLICIT MODEL FOLLOWING CONTROL SOLUTION TO IMPERFECT MODEL FOLLOWING CONTROL PROBLEMS

range of 50-400 psf, indicating robustness of design to dynamic

Author

FREDERICK H. LUTZE (Virginia Polytechnic Institute and State University, Blacksburg) and WAYNE C. DURHAM IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 2. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 1525-1534. refs

(AIAA PAPER 89-3612) Copyright

For cases in which perfect model following is not possible for a particular desired model, a class of candidate models is defined that can be followed perfectly by the given plant. A candidate model that most closely matches the dynamics of the desired model is then determined through constrained parameter optimization. The result is perfect model following of a model that has an eigenstructure that closely resembles that of the desired model. A new variation on perfect model following control law development explicitly displays the feedforward and feedback gains that determine the system error dynamics, which may be arbitrarily selected by conventional pole placement methods if the plant is completely controllable. Author

A89-52692*# Georgia Inst. of Tech., Atlanta.

SINGULAR TRAJECTORIES FOR TIME-OPTIMAL HALF-LOOP MANEUVERS OF A HIGH ALPHA FIGHTER AIRCRAFT

ERIC HOFFMAN and HAROLD STALFORD (Georgia Institute of Technology, Atlanta) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 2. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 1544-1552. refs

(Contract NAG1-59)

(AIAA PAPER 89-3614) Copyright

Consideration is given to the problem of deriving a time-optimal open-loop control for the half-loop maneuver of a high-alpha aircraft, with initial conditions Mach 0.6 and 15,000 feet. Pontriagin's maximum principle is used to derive candidate optimal solutions. Using the two-point boundary-value algorithm, the flight path angle is maximized for various increasing specified final times until a final time of 13.6 sec yields a 180-deg flight-path angle. As the final time increased from 0.0 to 13.6 sec, the optimization process revealed 13 distinct switching structures of the control law, of which 11 contained singular arcs, and two had double singular arcs. Author

A89-52694#

ON OPTIMAL RIGID BODY MOTIONS

EUGENE M. CLIFF, FREDERICK H. LUTZE (Virginia Polytechnic

(Contract F49620-87-C-0116)

(AIAA PAPER 89-3616) Copyright

Optimal rigid body angular motions are studied for the case of the absence of direct control over one of the angular velocity components. Numerical results for the first-order necessary conditions for optimality indicate that over a large range of boundary conditions there are, in general, several distinct extremal solutions. Subfamilies of extremal solutions have been classified, and the domains of existence of the extremal subfamilies are identified. The global optimality of extremal solutions has been determined in relation to a locus of Darboux points. Second-order necessary conditions have also been obtained, verifying local optimality for the candidate minimizers. RR

A89-52718#

LATERAL ELECTRIC FLIGHT CONTROL LAWS OF A CIVIL AIRCRAFT BASED UPON EIGENSTRUCTURE ASSIGNMENT TECHNIQUE

J. FARINEAU (Aerospatiale, Toulouse, France) AIAA, Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989. 16 p.

(AIAA PAPER 89-3594) Copyright

This paper demonstrates an application of the eigenvector theory to the lateral electric flight control law of the A320 aircraft. Consideration is given to the lateral aircraft flight mechanics. The various modes relative to the roll and yaw movements are considered, and the fly-by-wire system structure is described. Some flight test results are presented. 1.5

A89-52989#

ADAPTIVE CONTROL OF HIGH PERFORMANCE UNSTABLE **AIRCRAFT - A REVIEW**

B. S. REDDY, KOTA HARINARAYANA (Aeronautical Development Agency, Bangalore, India), and J. CHANDRASEKHAR (Indian Institute of Technology, Bombay, India) Aeronautical Society of India, Journal (ISSN 0001-9267), vol. 41, Feb. 1989, p. 15-19. refs

Successful implementation of active control technology (ACT) requires a clear definition of critical issues and synthesis techniques for flight-control-system design. The emergence of ACT as a design feature raises several questions in respect of acceptable handling quality, power requirements, and control-law synthesis. This review covers various fundamental issues, design problems, and possible design solutions of adaptive flight-control systems for high-performance unstable aircraft. Author

A89-53301*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

INTEGRATED FLIGHT/PROPULSION CONTROL SYSTEM DESIGN BASED ON A DECENTRALIZED, HIERARCHICAL APPROACH

DUANE MATTERN, SANJAY GARG (NASA, Lewis Research Center; Sverdrup Technology, Inc., Cleveland, OH), and RANDY BULLARD (NASA, Lewis Research Center, Cleveland, OH) AIAA, Guidance, Navigation and Control Conference, Boston, MA. Aug. 14-16, 1989. 13 p. refs

(AIAA PAPER 89-3519) Copyright

A sample integrated flight/propulsion control system design is presented for the piloted longitiudinal landing task with a modern, statistically unstable fighter aircraft. The design procedure is summarized, the vehicle model used in the sample study is described, and the procedure for partitioning the integrated system is presented along with a description of the subsystems. The high-level airframe performance specifications and control design are presented and the control performance is evaluated. The generation of the low-level (engine) subsystem specifications from the airframe requirements are discussed, and the engine

performance specifications are presented along with the subsystem control design. A compensator to accommodate the influence of airframe outputs on the engine subsystem is also considered. Finally, the entire closed loop system performance and stability characteristics are examined. C.D.

A89-53640

STUDY ON A DESIGN METHOD FOR THE LATERAL STABILITY OF THE AIRPLANE BY THE CONDITIONS FOR THE STEADY HORIZONTAL TURN WITH CONTROL SURFACES FIXED

MASAYOSHI NAGASHIMA and KUNIHIKO YAMAUCHI Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 37, no. 426, 1989, p. 337-343. In Japanese, with abstract in English.

Copyright

This report clarifies the relation between the lift coefficient and the dihedral angle of the main wing and the vertical tailplane for an airplane, given a shape of the fuselage and a plane form of the main wing, to be able to turn steadily at a small bank angle and with all control surfaces fixed. Here, the balancing of the moments of air forces about the vertical axis and longitudinal axis is considered. For simplicity, the air forces are assumed to be two-dimensional. From this relation, the suitable values of the dihedral angle and the vertical tail plane area and the position of the airplane to be designed will be evaluated by referring to these values of many excellent airplanes already in practical service.

Author

A89-53955

AN IMPROVED PSEUDO STATE METHOD FOR AIRCRAFT **CONTROLLER DESIGN**

CHIN E. LIN and JIEH-SHIAN YOUNG (National Cheng Kung University, Tainan, Republic of China) IN: 1989 American Control Conference, 8th, Pittsburgh, PA, June 21-23, 1989, Proceedings. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1989, p. 128-133. refs Copyright

An improved method for compensator design in aircraft control applications is presented. A design technique using a pseudo-state equation together with an enlarged system is discussed. This method improves the redesign procedure when the compensator characteristics cannot meet the required specifications. The theoretical basis of the proposed method is investigated, and an algorithm is developed. To prove the effectiveness of the pseudo-state method, an example of an aircraft controller for landing approach is discussed and tested. The simulation results show that the redesign efforts are reduced, and the characteristics I.E. of the designed compensators are improved.

A89-53957* Minnesota Univ., Minneapolis. NONLINEAR LONGITUDINAL CONTROL OF A SUPERMANEUVERABLE AIRCRAFT

WILLIAM L. GARRARD, ANTHONY SNELL (Minnesota, University, Minneapolis), and DALE F. ENNS (Honeywell Systems and Research Center; Minnesota, University, Minneapolis) IN: 1989 American Control Conference, 8th, Pittsburgh, PA, June 21-23, 1989, Proceedings. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1989, p. 142-147. refs (Contract NAG1-821)



A technique is described which can be used for design of feedback controllers for high-performance aircraft operating in flight conditions in which nonlinearities significantly affect performance. Designs are performed on a mathematical model of the longitudinal dynamics of a hypothetical aircraft similar to proposed supermaneuverable flight test vehicles. Nonlinear controller designs are performed using truncated solutions of the Hamilton-Jacobi-Bellman equation. Preliminary results show that the method yields promising results. LE.

A89-53959

FLIGHT CONTROL RECONFIGURATION USING MODEL REFERENCE ADAPTIVE CONTROL

WILLIAM MORSE and KATHLEEN OSSMAN (Ohio State University, Columbus) IN: 1989 American Control Conference, 8th, Pittsburgh, PA, June 21-23, 1989, Proceedings. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1989, p. 159-164. refs

(Contract F49620-88-C-0053)

Copyright

A simplified multivariable model reference adaptive control (MRAC) is shown to provide control reconfiguration for the AFTI/F16 during single, double, triple, and quadruple control surface failures. The simplified MRAC is unique in that it can use a reduced-order model and is applicable to unstable nonminimum-phase plants. The MRAC is capable of implicitly redistributing the control effort among the aircraft's effective surfaces without explicit knowledge of the failure. The resulting control reconfiguration forces the aircraft to approximate the reference model trajectories. The AFTI/F16 model used for simulations incorporated the nonlinear rate and saturation-limited servo dynamics.

A89-53976

LATERAL AXIS AUTOPILOT DESIGN FOR LARGE TRANSPORT AIRCRAFT - AN EXPLICIT MODEL-MATCHING APPROACH

K. DEAN MINTO (GE Control Systems Laboratory, Schenectady, NY), JOE H. CHOW, and JAN BESELER (Rensselaer Polytechnic Institute, Troy, NY) IN: 1989 American Control Conference, 8th, Pittsburgh, PA, June 21-23, 1989, Proceedings. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1989, p. 585-591. refs

Copyright

A description is given of the application of a technique for linear multivariable control law design to an autopilot design problem for large transport aircraft. The method is based on an explicit model-matching approach in the frequency domain, whereby compensator parameters are tuned via a least-squares approach to minimize the error between desired and actual closed-loop frequency responses. Recently, the design method has been overhauled to incorporate some of the latest theoretical advances, including controller parameterization and plant factorization. The resulting design technique has been considerably streamlined and is now implemented within the ISICLE package, a PRO-MATLAB based toolbox. One of the unique features of the ISICLE design package is the ability to deal with constraints on the compensator dynamic order and structure in a straightforward manner. Such constraints often arise in practical problems from the necessity for reduced complexity in the compensator, in order to deal effectively with issues such as gain scheduling and limit protection. I.E.

A89-53977

DESIGN OF LOCALIZER CAPTURE AND TRACK MODES FOR A LATERAL AUTOPILOT USING H(INFINITY) SYNTHESIS

ISAAC KAMINER, GREG ROBEL (Boeing Commercial Airplanes, Seattle, WA), and PRAMOD P. KHARGONEKAR (Minnesota, University, Minneapolis; Boeing Commercial Airplanes, Seattle, WA) IN: 1989 American Control Conference, 8th, Pittsburgh, PA, June 21-23, 1989, Proceedings. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1989, p. 592-601. refs Copyright

Results are presented of a design exercise in which the most recent developments in H(infinity) synthesis theory were applied to the problem of designing a lateral autopilot for a typical transport airplane. The bulk of the engineering effort in applying these results was in the formulation of an appropriate synthesis model. Once this was done, H(infinity) synthesis led to a satisfactory design after only a few iterative adjustments of the weights on the criterion outputs. It is concluded that these developments have made H(infinity) synthesis an effective tool for multivariable control design.

A89-53978

DESIGN OF LOCALIZER CAPTURE AND TRACK USING CLASSICAL CONTROL TECHNIQUES

YAGHOOB S. EBRAHIMI and EDWARD E. COLEMAN (Boeing Commercial Airplanes, Seattle, WA) IN: 1989 American Control Conference, 8th, Pittsburgh, PA, June 21-23, 1989, Proceedings. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1989, p. 602-608. Copyright

A typical localizer mode of the automatic landing system control laws provided in all new Boeing commercial airplanes is discussed. The linear control law diagram of this mode consists of three separate modules: yaw damper, roll inner loop, and localizer outer loop. The yaw damper and roll inner loop are used in conjunction with other modes of the roll axis control laws of the autopilot and are, therefore, predetermined for the localizer mode.

A89-53979

INTEGRAL LQG MODEL FOLLOWING CONTROLLER

EDWARD E. COLEMAN (Boeing Commercial Airplanes, Seattle, WA) IN: 1989 American Control Conference, 8th, Pittsburgh, PA, June 21-23, 1989, Proceedings. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1989, p. 609-614. Copyright

The design of a single autopilot control system to provide both lateral axis stability augmentation and aircraft directional control across the flight envelope is discussed. The autopilot provides heading and ground track heading hold for cruise, and localizer beam capture and hold for landing approach. The approach taken was to use ailerons and rudder to control heading and sideslip independently. The feedback controller was designed to provide stability augmentation and sufficient command response bandwidth to meet the performance requirements. A separate feedforward controller was designed to filter pilot inputs to achieve desired transient responses. An additional outer-loop controller generates heading commands for localizer capture and hold.

A89-53980

A MULTIVARIABLE CONTROL DESIGN FOR THE LATERAL AXIS AUTOPILOT OF A TRANSPORT AIRCRAFT

S. H. JAVID, R. A. HAMMOND, B. R. UMMEL (Boeing Computer Services, Seattle, WA), J. H. CHOW, and M. A. KALE (Rensselaer Polytechnic Institute, Troy, NY) IN: 1989 American Control Conference, 8th, Pittsburgh, PA, June 21-23, 1989, Proceedings. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1989, p. 615-620. refs

Copyright

A lateral axis control problem for a transport aircraft is described. The application of a multivariable control design method to solve this problem is presented. A simulation of the performance of the resulting control design shows a smooth bank and turn without hitting mechanical actuator positions or rate limits. I.E.

A89-53988

ASYMPTOTICALLY DECOUPLED VARIABLE STRUCTURE CONTROL OF SYSTEMS AND LARGE MANEUVER OF AIRCRAFT

SAHJENDRA N. SINGH (Nevada, University, Las Vegas) IN: 1989 American Control Conference, 8th, Pittsburgh, PA, June 21-23, 1989, Proceedings. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1989, p. 717-722. refs (Contract DAAL03-87-G-0004)

Copyright

The author treats the question of control of a class of nonlinear systems that can be decoupled by state variable feedback. Based on variable-structure-system theory, a discontinuous control law is derived which accomplishes asymptotic decoupled output trajectory following in the presence of uncertainty in the system. In the closed-loop system, the trajectories are attracted towards a chosen hypersurface in the state space and then slide along it. During the sliding phase the motion is insensitive to parameter variations. Based on this result, a control law for asymptotically decoupled control of roll angle, angle of attack, and sideslip in rapid, nonlinear

maneuvers is derived. Simulation results are presented to show that large, simultaneous lateral and longitudinal maneuvers can be performed in spite of uncertainty in the stability derivatives.

I.E.

A89-54080

QFT DIGITAL CONTROLLER FOR AN UNMANNED RESEARCH VEHICLE (URV)

S. HAMILTON, I. M. HOROWITZ, and C. H. HOUPIS (USAF, Institute of Technology, Wright-Patterson AFB, OH) IN: 1989 American Control Conference, 8th, Pittsburgh, PA, June 21-23, 1989, Proceedings. Volume 3. New York, Institute of Electrical and Electronics Engineers, 1989, p. 2441-2452. refs Copyright

Quantitative feedback theory (QFT) is used to design the digital flight control system for an unmanned research vehicle (URV). Digital controllers are designed for three outputs which are controlled by seven independent control surfaces. The system is transformed into the w'-domain, and a 3 x 7 plant matrix P of transfer functions relating surface deflections to system outputs incorporating servos is derived. A single set of fixed controllers and prefilters is obtained by QFT; they apply the appropriate feedback to maintain control over the entire range of uncertainty due to surface failures. Single, double, and triple failures are considered. Failed surfaces are considered locked in the trim condition. Fault detection/isolation and scheduling are not required. A modification is made to the controllers to compensate for the addition of more realistic servos and sensors. The resulting design is nearly as robust as the original system. The QFT design controls the A/C despite the uncertainty due to surface failures, and both the continuous and discrete domains satisfy the design objectives. I.E.

A89-54081* Georgia Inst. of Tech., Atlanta. MAXIMUM PRINCIPLE SOLUTIONS FOR TIME-OPTIMAL HALF-LOOP MANEUVERS OF A HIGH ALPHA FIGHTER AIRCRAFT

HAROLD STALFORD and ERIC HOFFMAN (Georgia Institute of Technology, Atlanta) IN: 1989 American Control Conference, 8th, Pittsburgh, PA, June 21-23, 1989, Proceedings. Volume 3. New York, Institute of Electrical and Electronics Engineers, 1989, p. 2453-2458. refs

(Contract NAG1-959)

Copyright

An investigation was conducted of maximum principle solutions for an initial 0.6 Mach number and 15,000-ft altitude. The authors generate these solutions for a family of prescribed final times tf, starting with tf = 0.5 s. Using a nonlinear wind-tunnel model they construct maximum principle solutions. Above tf = 1.2 s some small nonlinear variations in the aerodynamic pitching moment coefficient presented difficulty with respect to numerical convergence. This was circumvented by fitting analytical models to the aerodynamic coefficients of the wind-tunnel model at Mach 0.4. Maximum principle solutions of the analytical model are shown to compare well with those obtained for tf of less than 1.2 s. Using the analytical model the authors extended the prescribed final time to a value of 13.65 s at which time the aircraft completes the half-loop maneuver. This is 0.53 s longer than that obtained using the singular perturbation feedback control law.

A89-54084* Georgia Inst. of Tech., Atlanta. STUDY OF A PURSUIT-EVASION GUIDANCE LAW FOR HIGH PERFORMANCE AIRCRAFT

PEGGY S. WILLIAMS, P. K. A. MENON (Georgia Institute of Technology, Atlanta), ROBERT F. ANTONIEWICZ, and EUGENE L. DUKE (NASA, Flight Research Center, Edwards, CA) IN: 1989 American Control Conference, 8th, Pittsburgh, PA, June 21-23, 1989, Proceedings. Volume 3. New York, Institute of Electrical and Electronics Engineers, 1989, p. 2469-2474. Copyright

The study of a one-on-one aircraft pursuit-evasion guidance scheme for high-performance aircraft is discussed. The research objective is to implement a guidance law derived earlier using

08 AIRCRAFT STABILITY AND CONTROL

differential game theory in conjunction with the theory of feedback linearization. Unlike earlier research in this area, the present formulation explicitly recognizes the two-sided nature of the pursuit-evasion scenario. The present research implements the guidance law in a realistic model of a modern high-performance fighter aircraft. Also discussed are the details of the guidance law, implementation in a highly detailed simulation of a high-performance fighter, and numerical results for two engagement geometries. Modifications of the guidance law for onboard implementation is also discussed.

A89-54347

CONCEPTS FOR CONTROL OF HYPERVELOCITY VEHICLES

JAMES E. SORRELLS (Dynetics, Inc., Huntsville, AL) IN: International Conference on Hypersonic Flight in the 21st Century, 1st, Grand Forks, ND, Sept. 20-23, 1988, Proceedings. Grand Forks. ND, University of North Dakota, 1988, p. 242-246. Research supported by USAF. refs

Copyright

Disturbance-accommodating control (DAC) theory is highly suited to the management of uncertainties encountered in the control tasks of a hypervelocity vehicle. Both parametric and dynamical uncertainties are taken into account into the control law-development algorithms resulting from the application of DAC theory tc this class of problems. DAC theory, due to its generality, allows the designer to anticipate vector disturbance processes; when the problem in question is stated within this framework, standard modern control state space control law design algorithms become candidate methods for designing the individual control actions. O.C.

A89-54371

FLIGHT SYSTEMS DESIGN ISSUES FOR A RESEARCH-ORIENTED HYPERSONIC VEHICLE

PHILIP J. HAMORY (Datamax Computer Systems, Inc., Edwards, CA) IN: International Conference on Hypersonic Flight in the 21st Century, 1st, Grand Forks, ND, Sept. 20-23, 1988, Proceedings. Grand Forks, ND, University of North Dakota, 1988, p. 455-468. refs

Copyright

The impact of flight system design for a research-oriented hypersonic vehicle is examined. The design requirements of the vehicle are discussed, incuding strong onboard processing capability, integrated propulsion and flight controls, and analytic redundancy management. Consideration is given to tradeoffs between synchronization and asynchronization, distributed and centralized architectures, and digital and analog backup systems. A research-oriented hypersonic vehicle structure is proposed which uses nodal network architecture to maximize flight system effectiveness in controlling various tasks. R.B.

A89-54799

A CURSORY STUDY OF F-FACTOR APPLIED TO DOPPLER RADAR

KIMBERLY L. ELMORE and WAYNE R. SAND (National Center for Atmospheric Research, Boulder, CO) IN: International Conference on the Aviation Weather System, 3rd, Anaheim, CA, Jan. 30-Feb. 3, 1989, Preprints. Boston, MA, American Meteorological Society, 1989, p. 130-134. Research supported by the National Center for Atmospheric Research. (Contract DTFA01-82-Y-10513)

Copyright

A method is presented in which single-Doppler radar data is used to calculate the F-factor, which may be used to quantitatively characterize the effect of wind shear on jet performance (Bowles and Targ, 1988). The method calculates the F-factor with a monochromatic sine-wave model fitted to the radar data. The results from this approach are compared to those from the least-sigares estimate. R.B.

N89-28522# Technische Univ., Berlin (Germany, F.R.). Inst. fuer Luft- und Raumfahrt.

STATUS AND DEVELOPMENT POTENTIAL OF THE FLY BY LIGHT TECHNOLOGY IN CIVIL AIRCRAFT [STAND UND ENTWICKLUNGSPOTENTIAL DER FLY-BY-LIGHT TECHNOLOGIE IN ZIVILEN LUFTFAHRZEUGEN] HEINRICH MENSON and RALPH SCHUETTE Apr. 1988

142 p In GERMAN (ILR-MITT-212; ETN-89-94562) Avail: NTIS HC A07/MF A01

Fiber optics communication techniques and their applicability in flight control are reviewed. The design of an optical digital system (communication principle, emitting sources, optical waveguides, receiver element, optical coupling) is outlined. The fundamentals of data communication systems aboard aircrafts, the technical requirements and operational behavior of optical components, and existing fly by light concepts are presented. Fly by light technology is compared with conventional technology. Further application of fiber optics elements in aircrafts are discussed. ESA

09

RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tube facilities; and engine test blocks.

A89-52613#

MAP, OPERATOR, MAINTENANCE STATIONS

RICK POPE (Horizons Technology, Inc., San Diego, CA) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 1. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 847-849.

(AIAA PAPER 89-3523) Copyright

The complexity of mission planning has grown proportionally with the sophistication of the planes that fly the missions. Due to that complexity, mission planning has gravitated to the mainframe computer, creating a physical gap between the development of mission planning data and the application of that data. The Map, Operator, and Maintenance Stations (MOMS), has bridged that gap by allowing the development of mission planning to be carried to the operational area of the aircraft. The MOMS system is three coordinated stations that can generate map data, develop mission plans, and perform integrated maintenance support. Author

A89-53476#

EXCITATION OF AIRCRAFT FOR HARDNESS SURVEILLANCE USING THE AIRCRAFT'S OWN HF ANTENNA

L. O. HOEFT, J. S. HOFSTRA (BDM Corp., Albuquerque, NM), and W. D. PRATHER (USAF, Weapons Laboratory, Kirtland AFB, NM) IN: IEEE 1989 National Symposium on Electromagnetic Compatibility, Denver, CO, May 23-25, 1989, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1989, p. 87-89.

A technique is reported for testing the electromagnetic radiation hardening of aircraft. The electromagnetic excitation of the aircraft is accomplished by driving the aircraft's high-frequency (HF) antenna at the fundamental resonant frequency of the aircraft. Surface magnetic fields in the range of 1 to 10 mA/m were easily produced with 15 W of RF power. In addition to exciting the fundamental resonances, useful surfaces fields from 10 to 100 MHz were also obtained. The technique is called antenna SPEHS (single-point excitation for hardness surveillance). Measurements of the magnetic field at a prescribed distance from the outside and inside surfaces of hardened apertures, such as window screens and gasketed doors, were made using a multiturn loop sensor and a battery-operated field-strength meter. I.E.

A89-54349

AUSTRALIAN HYPERSONIC FACILITIES

VINCENT CAPIZZI (British Aerospace Australia, Ltd., Salisbury, Australia) IN: International Conference on Hypersonic Flight in the 21st Century, 1st, Grand Forks, ND, Sept. 20-23, 1988, Proceedings. Grand Forks, ND, University of North Dakota, 1988, p. 263-266. refs

Copyright

Two Australian free piston-driven shock tunnels are shown to offer high-enthalpy hypervelocity flow to simulate gas effects during the ascent and reentry phases of aerospace vehicles. The primary simulation variables are stagnation enthalpy and the binary scaling parameter; real gas effects are noted, and prospects for the validation of CFD investigations of hypersonic flows are evaluated. Both shock tunnels are currently being used in tests of such hypervelocity vehicle designs as HOTOL, Hermes, and the NASA National Aerospace Plane; one has seen specialized use as a testbed for scramjet propulsion, and the other is developing a CARS optical-diagnostics facility.

A89-54368

FACILITIES AND SUPPORT REQUIREMENTS FOR ADVANCED FLIGHT VEHICLES

MICHAEL G. VENACCIO (USAF, Grand Forks AFB, ND) IN: International Conference on Hypersonic Flight in the 21st Century, 1st, Grand Forks, ND, Sept. 20-23, 1988, Proceedings. Grand Forks, ND, University of North Dakota, 1988, p. 432-436. Copyright

This paper is intended to stimulate discussion and thought on the facilities, support equipment, and spares required to support future aerospace vehicles. The scope of the data presented is based on the requirements needed to support the B-IB. Maintenance facility requirements and construction are discussed in depth along with spares requirements considerations and maintainability and reliability issues. Author

N89-28523# Naval Civil Engineering Lab., Port Hueneme, CA. JOINT SEALANTS FOR AIRPORT PAVEMENTS. PHASE 1: LABORATORY AND FIELD INVESTIGATIONS Final Report, Jul. 1986 - Dec. 1988

C. M. INABA, M. C. HIRONAKA, and T. NOVINSON Dec. 1988 63 p

(Contract DTFA01-86-1-02015)

(DOT/FAA/DS-89/2-PHASE-1) Avail: NTIS HC A04/MF A01

The objectives were to determine the essential characteristics of sealants for joints in Portland cement concrete (PCC) airport pavements that should be incorporated in specifications and select best candidate sealants for field evaluation. Laboratory and field investigations of sealants were performed for data needed to meet these objectives. Major factors that sealants must be resistant to are: chemicals (jet fuel, hydraulic fluid, lubricating oil), physical (elongation, compression, intrusion), and environmental (thermal, sunlight, weathering). In laboratory specification conformance tests, only 3 of 18 (17 percent) of the sealants passed the tests. In field inspection of sealants and discussions with airport personnel, there was no one clearly outstanding performing seal that was identified; however, several airports favored the Dow Corning 888 silicone seal. There is a strong indication of material of specification (or both) deficiencies. Sealants selected for evaluation in Phase 2 have the following material compositions: silicone, polyurethane, coal tar/polyvinyl chloride, and chloroprene. Author

N89-28524# Mitre Corp., McLean, VA. DIRECT USER ACCESS TERMINAL (DUAT) OPERATIONAL CONCEPT Final Report

A. L. SPRINGEN Jun. 1989 36 p

(Contract DTFA01-89-C-00001)

(WP-88W00075; NAS-SR-DUAT; DOT/FAA/DS-89/28) Avail: NTIS HC A03/MF A01

This concept of operations is one of a set that in total describes the operation of the National Airspace System (NAS) when the projected upgrades are completed. The Direct User Access Terminal (DUAT) is a Federal Aviation Administration (FAA) program

that enables pilots to obtain self-briefings and submit flight plans. much as they receive these services from Flight Service Stations (FSSs) and Automated FSSs (AFSSs) today; however, DUAT is provided by the private sector. DUAT Service capabilities and interactions between the user, the DUAT Service, and NAS subsystems are described. It is intended to provide a common perspective for personnel engaged in DUAT-related activities.

Author

N89-28526# National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.

AIRPORT NOISE MEASURING DATA COLLCTION SYSTEM M. H. J. B. VERSTEEG 19 Jan. 1987 12 p Presented at the VMEbus Application Seminar, Antwerp, Belgium, 25 Feb. 1987 (NLR-MP-87006-U; ETN-89-95410) Avail: NTIS HC A03/MF A01

The technical aspects of the central unit of the permanent noise measuring system, are discussed. The measured noise data values are obtained from a set of noise monitoring terminals located near a military airbase on Dutch territory. These values are collected together with time tags, stored on magnetic tape and processed. The central unit of this system is built using versa module eurocard technology, and the controlling software is developed using micro concurrent PASCAL language, whose compiler performs extensive type checking and identifies development errors. The most time consuming part of the software development is the development of the links of the system hardware. The central unit of the noise measuring system is built in such a way as to be fault tolerant. Missing data samples, lost connections or erroneous collected data should not disrupt the operation of the system. FSA

N89-29352# Federal Aviation Administration, Washington, DC. ACCOMPLISHMENTS UNDER THE AIRPORT IMPROVEMENT PROGRAM: FISCAL YEAR 1988 Annual Report No. 7, Fiscal Year ending 30 Sep. 1988 JEAN HETSKO 1988 123 p (AD-A208200; DOT/FAA/RP-89/3) Avail: NTIS HC A06/MF

A01 CSCL 14/2

Section 521 of the Airport and Airway Improvement Act of 1982 (Public Law 97-248) requires that the Secretary of Transportation submit an annual report to Congress describing the accomplishment of the Airport grant program. This report covers activities for the fiscal year ending September 30, 1988. GRA

10

ASTRONAUTICS

Includes astronautics (general); astrodynamics; ground support systems and facilities (space); launch vehicles and space vehicles; space transportation; spacecraft communications, command and tracking; spacecraft design, testing and performance; spacecraft instrumentation; and spacecraft propulsion and power.

A89-52973

SAENGER AEROSPACEPLANE GAINS MOMENTUM

TIM FURNISS Flight International (ISSN 0015-3710), vol. 136, Aug. 12, 1989, p. 39-41.

Copyright

The turboramiet-powered first stage of the Saenger two-stage air-breathing launch vehicle system offers the maximum potential commonality with a prospective hypersonic airliner capable of Mach 5 cruise in civilian passenger-carrying operation, with a capacity of 250 seats and a range of 10,000 km. Flights of such a vehicle from Frankfurt to Tokyo would last only three hours. Attention is presently given to the international participation possibilities that arise in the development of critical technologies for both this first-stage vehicle and its alternative Horus four-crew-manned and Cargus unmanned upper stages. O.C.

A89-54009

OPTIMAL TRAJECTORY GENERATION AND DESIGN TRADES FOR HYPERSONIC VEHICLES

PHILIP D. HATTIS (Charles Stark Draper Laboratory, Inc., Cambridge, MA) and RICHARD K. SMOLSKIS (Rockwell International Corp., Space Transportation Systems Div., Downey, CA) IN: 1989 American Control Conference, 8th, Pittsburgh, PA, June 21-23, 1989, Proceedings. Volume 2. New York, Institute of Electrical and Electronics Engineers, 1989, p. 1125-1130. refs Copyright

A method for determing the optimum-trajectory flight path for an air-breathing single-stage-to-orbit vehicle is presented. A calculus-of-variations direct method of steepest descent is used to determine angle of attack, bank angle, and engine power setting time histories. Trajectory profiles resulting from using both nominal and off-nominal vehicle sytem parameters and environmental conditions are addressed. Design and/or control trades which will become apparent from trajectory study results are identified. Considerations affecting the application of analysis algorithm features to the onboard guidance strategy are also discussed.

I.E.

A89-54085* Georgia Inst. of Tech., Atlanta. A REAL-TIME GUIDANCE ALGORITHM FOR AEROSPACE PLANE OPTIMAL ASCENT TO LOW EARTH ORBIT

A. J. CALISE, G. A. FLANDRO (Georgia Institute of Technology, Atlanta), and J. E. CORBAN IN: 1989 American Control Conference, 8th, Pittsburgh, PA, June 21-23, 1989, Proceedings. Volume 3. New York, Institute of Electrical and Electronics Engineers, 1989, p. 2475-2481. Research supported by General Dynamics Corp. refs (Contract NAG1-784)

Copyright

Problems of onboard trajectory optimization and synthesis of suitable guidance laws for ascent to low Earth orbit of an air-breathing, single-stage-to-orbit vehicle are addressed. A multimode propulsion system is assumed which incorporates turbojet, ramjet, Scramjet, and rocket engines. An algorithm for generating fuel-optimal climb profiles is presented. This algorithm results from the application of the minimum principle to a low-order dynamic model that includes angle-of-attack effects and the normal component of thrust. Maximum dynamic pressure and maximum aerodynamic heating rate constraints are considered. Switching conditions are derived which, under appropriate assumptions, govern optimal transition from one propulsion mode to another. A nonlinear transformation technique is employed to derived a feedback controller for tracking the computed trajectory. Numerical results illustrate the nature of the resulting fuel-optimal climb paths.

A89-54326 North Dakota Univ., Grand Forks.

INTERNATIONAL CONFERENCE ON HYPERSONIC FLIGHT IN THE 21ST CENTURY, 1ST, UNIVERSITY OF NORTH DAKOTA, GRAND FORKS, SEPT. 20-23, 1988, PROCEEDINGS

MARY E. HIGBEA, ED. and JAMES A. VEDDA, ED. (North Dakota, University, Grand Forks) Conference sponsored by NASA, ESA, AIAA, et al. Grand Forks, ND, University of North Dakota, 1988, 545 p. For individual items see A89-54327 to A89-54374. Copyright

The present conference on the development status of configurational concepts and component technologies for hypersonic-cruise and transatmospheric vehicles discusses topics relating to the U.S. National Aerospace Plane program, ESA-planned aerospace vehicles, Japanese spaceplane concepts, the integration of hypersonic aircraft into existing infrastructures, hypersonic airframe designs, hypersonic avionics and cockpit Al systems, hypersonic-regime CFD techniques, the economics of hypersonic vehicles, and possible legal implications of hypersonic flight. Also discussed are Soviet spaceplane concepts, propulsion systems involving laser power sources and hypervelocity launch technologies, and the management of support systems operations for hypersonic vehicles. O.C.

10 ASTRONAUTICS

A89-54327

FORCES FOR CHANGE AND THE FUTURE OF HYPERSONIC FLIGHT IN THE 21ST CENTURY

ROBERT M. WILLIAMS (DARPA, Washington, DC) IN: International Conference on Hypersonic Flight in the 21st Century, 1st, Grand Forks, ND, Sept. 20-23, 1988, Proceedings. Grand Forks, ND, University of North Dakota, 1988, p. 1-27. refs Copyright

A comprehensive evaluation is made of the outstanding organizational, technological, and political problems to be solved en route to the creation of a successful hypersonic cruise/transatmospheric vehicle and its support infrastructure in the early 21st century. The technological problems range over advanced refractory materials, active structural cooling systems, CFD for hypersonic flows, and high power density onboard electrical systems. Attention is given to the prospects for hydrogen fuel derivation from lunar soils via fusion reactor power. The economics and demographics of 21st-century hypersonic vehicle and airbreathing spacecraft launch system operations are also discussed. O.C.

A89-54329

SAENGER: AN ADVANCED SPACE TRANSPORT SYSTEM FOR EUROPE - PROGRAM OVERVIEW AND KEY TECHNOLOGY NEEDS

HERIBERT KUCZERA (Messerschmitt-Boelkow-Blohm GmbH, Munich, Federal Republic of Germany) IN: International Conference on Hypersonic Flight in the 21st Century, 1st, Grand Forks, ND, Sept. 20-23, 1988, Proceedings. Grand Forks, ND, University of North Dakota, 1988, p. 68-77. refs Copyright

The West German Saenger two-stage (manned or unmanned cargo upper stage) launch vehicle employs an airbreathing lower stage that may be employed as a hypersonic-cruise passenger transport vehicle. A development status report for Saenger with a view to the technology-readiness issues of most pressing importance. Three turbomechanical configurations are under consideration for the lower stage's propulsion system: a turbojet-ramjet in parallel arrangement with common inlet and nozzle, a turbojet-ramjet in coaxial arrangement with plug nozzle, and a windmilling turbofan-ramjet. Upper stage design features are also presented. O.C.

A89-54330

HOTOL - A EUROPEAN AEROSPACEPLANE FOR THE 21ST CENTURY

B. R. A. BURNS (British Aerospace, PLC, London, England) IN: International Conference on Hypersonic Flight in the 21st Century, 1st, Grand Forks, ND, Sept. 20-23, 1988, Proceedings. Grand Forks, ND, University of North Dakota, 1988, p. 78-109. Copyright

Rockets are extremely inefficient in the early stages of a launch system's flight trajectory; the HOTOL single-stage-to-orbit launch vehicle eliminates the mass penalty of the heavy LOX tankage requirement in the early stages of flight through the incorporation of an airbreathing feature. The changeover from airbreathing to LOX is in the vicinity of Mach 5-6, at 26-30 km altitude. Due to its low planform loading, which is about 40 percent that of the Space Shuttle Orbiter, HOTOL begins its reentry deceleration at a relatively high altitude; as a result, peak reentry temperatures are of the order of 250 C lower than those of the Space Shuttle Orbiter, and replaceable thermal protection tiles are obviated. O.C.

A89-54331

NAL'S RESEARCH FOR HYPERSONIC FLIGHT

TATSUO YAMANAKA (National Aerospace Laboratory, Chofu, Japan) IN: International Conference on Hypersonic Flight in the 21st Century, 1st, Grand Forks, ND, Sept. 20-23, 1988, Proceedings. Grand Forks, ND, University of North Dakota, 1988, p. 110-116.

Copyright

NAL's hypersonic flight-related research activities, which began in 1966 with the construction of a hypersonic wind tunnel and have encompassed CFD investigations into hypersonic flows, were in 1987 expanded to undertake the conceptual development of aerospaceplanes. Efforts are simultaneously being made toward the development of hypersonic airframes and airbreathing powerplants, with a view to their integration at a more advanced design stage. An unmanned hypersonic experimental aircraft will in due course be built and flight tested to verify the materials, structures, control system, etc., technologies chosen during the current development program. O.C.

A89-54332

PERSPECTIVE ON JAPANESE SPACE PLANE RESEARCH AND DEVELOPMENT

SHIGEO KOBAYASHI, MASATAKA MAITA, TATSUO YAMANAKA, and YOSHIAKI OHKAMI (National Aerospace Laboratory, Chofu, Japan) IN: International Conference on Hypersonic Flight in the 21st Century, 1st, Grand Forks, ND, Sept. 20-23, 1988, Proceedings. Grand Forks, ND, University of North Dakota, 1988, p. 117-124. refs

Copyright

The organization of the long-range goal-oriented activities of the Japanese aerospaceplane R&D establishment, encompassing the NAL, NASDA, and ISAS, is presented. Both airbreathing launchers and hypersonic cruise aircraft and propulsion systems are under consideration; single-stage-to-orbit and two-stage-to-orbit configurations will be investigated for spacecraft launch services. An account is given of the development timetable for aerospacecraft spanning from the present to 2010 and beyond.

O.C.

A89-54340

THERMAL STRESS ANALYSIS OF THE NASA DRYDEN HYPERSONIC WING TEST STRUCTURE

GLENN MORRIS (General Dynamics Corp., Fort Worth, TX) IN: International Conference on Hypersonic Flight in the 21st Century, 1st, Grand Forks, ND, Sept. 20-23, 1988, Proceedings. Grand Forks, ND, University of North Dakota, 1988, p. 180-188. Copyright

While there are numerous texts and papers on thermal stress analysis, practical examples and experience on light gage aircraft structures are limited. A research program has been undertaken to demonstrate the present state of the art, verify methods of analysis, gain experience in their use, and develop engineering judgement in thermal stress analysis. The approach for this project has been to conduct a series of analyses of this sample problem and compare analysis results with test data. Author

A89-54355

'SPACEPLANES' AND THE RISE OF 'ULTRA TECH'

JOHN GUTHRIE IN: International Conference on Hypersonic Flight in the 21st Century, 1st, Grand Forks, ND, Sept. 20-23, 1988, Proceedings. Grand Forks, ND, University of North Dakota, 1988, p. 311-315.

Copyright

A development history is presented for high speed aircraft capable of edge-of-space cruise performance, from World War II's (fortunately only conceptual) Saenger-Bredt 'Antipodal Bomber', capable of intercontinental hypersonic cruise in the interest of military superiority, to the NASA National Aerospace Plane (NASP), which has entered its technology-development and configurationaldesign phase. It is noted that NASP will engender the development of endoatmospheric hypersonic-cruise commercial aircraft, which can proceed with greater assurance of the technological and economic risks involved. O.C.

A89-54359

THE TRISONIC AEROSPACE MOTOR - PROPULSION VEHICLE FOR THE 21ST CENTURY

C. E. JANEKE (Janeke and Cumming, Pretoria, Republic of South Africa; Adaptive Resources, Inc., Claremont, CA) IN: International Conference on Hypersonic Flight in the 21st Century, 1st, Grand Forks, ND, Sept. 20-23, 1988, Proceedings. Grand Forks, ND, University of North Dakota, 1988, p. 335-352, Copyright

This paper discusses the features of the Trisonic, a proposed transatmospheric aerospace propulsion engine, which encompasses all the elements of the subsonic, supersonic, and hypersonic propulsion and rocket-propulsion technology. Special attention is given to the Trisonic propulsion scheme, the algorithmic modeling of various Trisonic regimes, and the computational analysis of the propulsive power. Results of case studies, conducted to determine the parametric ranging and propulsive power of Trisonic-concept planforms are discussed. 15

11

CHEMISTRY AND MATERIALS

Includes chemistry and materials (general); composite materials; inorganic and physical chemistry; metallic materials; nonmetallic materials; and propellants and fuels.

A89-51860

TURBULENT REACTIVE FLOWS

R. BORGHI, ED. (Rouen, Universite, Mont-Saint-Aignan, France) and S. N. B. MURTHY, ED. (Purdue University, West Lafayette, New York, Springer-Verlag (Lecture Notes in Engineering. IN) Volume 40), 1989, 958 p. For individual items see A89-51861 to A89-51886. Copyright

Various papers on turbulent reactive flows are presented. Some

of the individual topics discussed include: measurement of the topology of large-scale structures in turbulent reacting flows; structure of jet diffusion flames; comparison between two highly turbulent flames having very different laminar burning velocities; structure of turbulent premixed flames as revealed by spectral analysis: turbulent flow field and front position statistics in V-shaped premixed flame with and without confinement; structure of flamelets in turbulent reacting flows and influences of combustion on turbulence fields; flamelet library for turbulent wrinkled flames; length and time scales in turbulent combustion; model for reactions in turbulent jets, including the effects of Reynolds, Schmidt, and Damkoehler numbers; fractal description of flamelets; and interaction of a flame front with vortices. C.D.

A89-52022

AEROSPACE INVESTMENT CASTING IN THE U.S.A. 1988

THIERRY N. THYS (Precision Founders, Inc., San Leandros, CA) IN: High integrity castings; Proceedings of the Conference on Advances in High Integrity Castings, Chicago, IL, Sept. 24-30, 1988. Metals Park, OH, ASM International, 1988, p. 45-49. Copyright

The history of the investment casting industry is reviewed, and attention is given to the beginning of aerospace quality castings. Aluminum castings, vacuum-cast superalloys, and titanium structural castings are also considered. It is expected that turbine engines will continue to increase their use of investment castings. B.J.

A89-52775

DENORMALIZED PRODUCT OF THE ADSORPTIVE ZEOLITE **EXTRACTION OF PARAFFINS AS A JET FUEL COMPONENT** [DENORMALIZAT ADSORBTSIONNOGO VYDELENIIA PARAFINOV NA TSEOLITAKH KAK KOMPONENT **REAKTIVNYKH TOPLIV**

B. A. ENGLIN, M. V. KHOKHLACHEVA, E. M. BUSHUEVA, and M. V. PEREZHIGINA (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Neftianoi Promyshlennosti, Moscow, USSR) Khimiia i Tekhnologiia Topliv i Masel (ISSN 0023-1169), no. 7, 1989, p. 5-7. In Russian. Copyright

The paper is concerned with the possibility of using the denormalized product of the adsorptive extraction of paraffins on

11 CHEMISTRY AND MATERIALS

zeolites as a component of highly thermally stable RT and T-8V jet fuels with a final boiling temperature of not higher than 280 and 300 C. The factors limiting the amount of the denormalized product that can be added to the fuel are examined, and maximum contents of the denormalized product are determined in relation to the properties of the latter. The properties of experimental samples of RT and T-8V jet fuels containing the denormalized product of paraffin extraction are presented. VI

A89-52827

RECOVERY OF THE FATIGUE STRENGTH OF STRUCTURAL ELEMENTS OF ALUMINUM ALLOYS BY SURFACE HARDENING [VOSSTANOVLENIE SOPROTIVLENIIA USTALOSTI ELEMENTOV KONSTRUKTSII IZ ALIUMINIEVYKH SPLAVOV POVERKHNOSTNYM NAKLEPOM

M. N. STEPNOV, S. P. EVSTRATOVA, V. V. LOGVINENKO, and V. V. MOZALEV (Moskovskii Aviatsionnyi Tekhnologicheskii Institut, Moscow, USSR) Problemy Prochnosti (ISSN 0556-171X), Aug. 1989, p. 16-19. In Russian.

Copyright

An analysis is made of fatigue test data obtained for specimens of AK6 aluminum alloy which were subjected to repeat surface hardening after their useful life had been partially exhausted. It is shown that surface hardening through plastic surface working (e.g., roller burnishing, vibrational hardening, and shot peening) makes it possible to completely restore the safe service life of structural elements of AK6 alloy. The restoration of the service life of the structural elements can be conducted repeatedly. V.L.

A89-52830

FATIGUE LIFE OF ZHS6U ALLOY WITH PROTECTIVE COATINGS UNDER THERMAL CYCLING LOADING [DOLGOVECHNOST' SPLAVA ZHS6U S ZASHCHITNYMI POKRYTIIAMI PRI TERMOTSIKLICHESKOM NAGRUZHENII]

K. P. BUISKIKH and V. G. BARILO (AN USSR. Institut Problem Prochnosti, Kiev, Ukrainian SSR) Problemy Prochnosti (ISSN 0556-171X), Aug. 1989, p. 42-47, In Russian, refs Copyright

Empirical equations are obtained which relate the fatigue life of ZhS6U, a turbine blade alloy, to the parameters of the thermal and stress-strain states. The equations obtained here provide a way to predict the thermal cycling fatigue life of ZhS6U alloy with different coatings under conditions of inhomogeneous stressed state in the temperature range 1040-1100 C and thermal stress range 220-470 MPa. V.L.

A89-52994#

ENVIRONMENTAL EFFECTS ON COMPOSITE STRUCTURES

R. GOPALAN and RAMESH CHANDRA (National Aeronautical Laboratory, Bangalore, India) Aeronautical Society of India, Journal (ISSN 0001-9267), vol. 41, Feb. 1989, p. 55-59. refs

Environmental effects on the degradation of the strength and stiffness of both GFRP test coupons and an actual composite structure (Radome) of a wing mounted store of a military aircraft were experimentally determined. The experimental investigation revealed that the GFRP composite absorbs 1.2 percent moisture when exposed to water at 343 K for 20 days. The degradation on the ultimate tensile strength and Young's modulus was 19 percent and 14.7 percent, respectively. A GFRP radome fabricated at NAL was subjected to various environmental tests as per MIL and JSS specification. Static tests were carried out on the radome before and after exposure to various environmental tests. The radome withstood the design load without failure but with an increase in the tip deflection of 20 percent and 45 percent at limit load and at ultimate load, respectively. Author

A89-53310#

HIGH-PERFORMANCE FIBER COMPOSITE MATERIALS WITH THERMOPLASTIC MATRIX [HOCHLEISTUNGS-FASERVERBUNDWERKSTOFFE MIT

THERMOPLASTMATRIX

H. RICHTER (Messerschmitt-Boelkow-Blohm GmbH, Ottobrunn, Federal Republic of Germany) Fachtagung ueber polymere

11 CHEMISTRY AND MATERIALS

Hochleistungswerkstoffe in der technischen Anwendung, Wuerzburg, Federal Republic of Germany, May 31, June 1, 1989, Paper. 15 p. In German. (MBB-Z-0257-89-PUB)

The use of thermoplastics in fiber composite materials for aircraft technology is discussed. Thermoplastic semifinished materials are addressed, and processing aspects of thermoplastic fiber composite materials are examined. The characteristics of the resulting materials and their applications are considered. C.D.

Virginia Polytechnic Inst. and State Univ., A89-53355*# Blacksburg.

PLASMA TORCH IGNITER FOR SCRAMJETS

TIMOTHY C. WAGNER, WALTER F. O'BRIEN (Virginia Polytechnic Institute and State University, Blacksburg), G. BURTON NORTHAM, and JAMES M. EGGERS (NASA, Langley Research Center, Hampton, VA) Journal of Propulsion and Power (ISSN 0748-4658), vol. 5, Sept.-Oct. 1989, p. 548-554. Previously announced in STAR as N87-23789. refs

Copyright

A small, uncooled plasma torch was developed and used in combination with an injector designed to study ignition and flameholding in hydrogen-fueled supersonic flows. The plasma torch was operated on mixtures of hydrogen and argon with total flows of 10 to 70 scfh. The fuel injector design consisted of five small upstream pilot fuel injectors, a rearward facing step for recirculation, and three main fuel injectors downstream of the step. The plasma torch was located in the recirculation region, and all injection was perpendicular to the Mach 2 stream. Both semi-freejet and ducted tests were conducted. The experimental results indicate that a low power plasma torch operating on a 1:1 volumetric mixture of hydrogen and argon and located in the recirculation zone fueled by the upstream pilot fuel injectors is a good igniter for flow conditions simulating a flight Mach number of 3.7. The total temperature required to autoignite the hydrogen fuel for this injector geometry was 2640 R. The injector configuration was shown to be a good flameholder over a wide range of total temperature. Spectroscopic measurements were used to verify the presence of air total temperatures below 1610 R. Author

A89-53658

INJECTION MOULDED CERAMIC ROTORS - COMPARISON OF SIC AND SI3N4

K. HUNOLD (Elektroschmelzwerk Kempten GmbH, Federal Republic of Germany), J. GREIM, and A. LIPP Powder Metallurgy International (ISSN 0048-5012), vol. 21, Aug. 1989, p. 17, 18, 21-23. Research supported by BMFT. refs Copyright

The manufacturing process of silicon carbide and silicon nitride ceramic rotors used in turbocharged engines is described. A suitable injection molding compound is developed for each basic powder additive and adapted to the ceramic powder in its organic bonding content as well as its chemical mixture of plasticizers. Injection molding of the rotors is carried out in microprocessorcontrolled and regulated screw injection molding machines. The rotors are heated up in temperature-controlled dewaxing furnaces and then pressurelessly sintered under vacuum or protective gas atmospheres in high-temperature kilns at approx. 2100 C. After sintering, the rotors' external contour is machined on a CNC cylindrical grinder using resin-bonded diamond wheels. In-process nondestructive testing is applied to all manufacturing stages through microfocus X-ray analysis. Thermal shock resistance test, strength test, proof test, and vehicle test are finally performed to confirm the expected advantages of ceramic rotors. Although the material SiC displayed worse results than Si3N4, one factor must be considered: SSiC retains its strength to temperatures greater than 1500 K and, in addition, displays better resistance to corrosion and creep than Si3N4. This could be a decisive advantage in application over a longer period of time at extremely high CF temperatures.

A89-54255

COMPARATIVE DURABILITY OF SIX COATING SYSTEMS ON FIRST-STAGE GAS TURBINE BLADES IN THE ENGINES OF A LONG-RANGE MARITIME PATROL AIRCRAFT

J. L. COCKING, P. G. RICHARDS, and G. R. JOHNSTON (Department of Defence, Materials Research Laboratory, Maribyrnong, Australia) IN: Metallurgical coatings 1988; Proceedings of the Fifteenth International Conference, San Diego, CA, Apr. 11-15, 1988. Volume 1. London and New York, Elsevier Applied Science, 1988, p. 37-47. Copyright

The behavior of six coatings on first-stage high pressure blades in the engines of two long-range maritime patrol aircraft is studied. The trial engines contain blades coated with each of the coatings to allow comparison of their relative performances under identical operating conditions. The trial is aimed to find a coating which will last for 4000 engine operating hours, because the current coating, a conventional nickel aluminide, has a greater than 60 percent rejection rate after 2000 hours. Blades extracted from the trial engines after 500 and 1000 operating hours, already show noticeable trends in the behavior of the different coating systems. The two aluminides modified with precious metals and the conventional nickel aluminide coatings are in much better condition than the aluminide coatings modified with either silicon or chromium plus manganese. C.E.

A89-54426

INTERLAMINAR FRACTURE TOUGHNESS AND TOUGHENING OF LAMINATED COMPOSITE MATERIALS - A REVIEW

N. SELA (Israel Aircraft Industries, Ltd., Tel Aviv) and O. ISHAI (Technion - Israel Institute of Technology, Haifa) Composites (ISSN 0010-4361), vol. 20, Sept. 1989, p. 423-435. refs Copyright

A review of the state of the art in the subject of interlaminar fracture toughness (IFT), its relation to structural performance and the damage tolerance of polymeric composite materials is presented. The sources of low IFT (high brittleness) of existing materials and methods to improve it by introducing tough interlayers or by using thermoplastic matrices are discussed. The IFT test methods, their analytical basis and utilization are described. Comprehensive IFT data for G(Ic) and G(IIc) for different composite systems and test methods, which were extracted from numerous publications, are presented. Author

A89-54429

A PROPOSED COMPOSITE REPAIR METHODOLOGY FOR **PRIMARY STRUCTURE**

S. R. HALL, M. D. RAIZENNE, and D. L. SIMPSON (National Aeronautical Establishment, Ottawa, Canada) Composites (ISSN 0010-4361), vol. 20, Sept. 1989, p. 479-483. refs Copyright

Advanced composite materials are used extensively in aircraft structures. A major problem with the use of these materials is that of structural repair. Composite structures require different repair techniques than do their metal counterparts. Presently, there is very little data available which permits composite structural repairs to be designed and evaluated. This paper details the steps that are required to generate an aircraft composite repair capability for primary structures. Author

A89-54671

SELECTING HIGH-TEMPERATURE STRUCTURAL **INTERMETALLIC COMPOUNDS - THE MATERIALS SCIENCE** APPROACH

ROBERT L. FLEISCHER and ALAN I. TAUB (GE Corporate Research and Development Center, Schenectady, NY) JOM (ISSN 0148-6608), vol. 41, Sept. 1989, p. 8-11. refs (Contract N00014-86-C-0353)

Copyright

The problem of overcoming the limited ductility of intermetallic materials so that these materials can be used for high-temperature turbines and engines of the future is addressed. The most likely candidates for these applications can be identified on the basis

of melting temperature and density and by considering the effects of composition and crystal structure. The results of the present study suggest that, if single-phase materials are to be found with useful mechanical properties at temperatures as high as 1300 C, they will most likely come from the Re30Ru20Ti50 class of materials. K.K.

A89-54982* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

TRIBOLOGICAL PROPERTIES OF ALUMINA-BORIA-SILICATE FABRIC FROM 25 C TO 850 C

CHRISTOPHER DELLACORTE (NASA, Lewis Research Center, Cleveland, OH) STLE Tribology Transactions (ISSN 0569-8197), vol. 32, July 1989, p. 325-330. Previously announced in STAR as N88-18726. refs

Copyright

Demanding tribological properties are required of the materials used for the sliding seal between the sidewalls and the lower wall of the variable area hypersonic engine. Temperatures range from room temperature and below to operating temperatures of 1000 C in an environment of air, hydrogen, and water vapor. Candidate sealing materials for this application are an alumina-boria-silicate, ceramic, fabric rope sliding against the engine walls which may be made from copper- or nickel-based alloys. Using a pin-on-disk tribometer, the friction and wear properties of some of these potential materials and possible lubrication methods are evaluated. The ceramic fabric rope displayed unacceptably high friction coefficients (0.6 to 1.3) and, thus, requires lubrication. Sputtered thin films of gold, silver, and CaF2 reduced the friction by a factor of two. Sprayed coatings of boride nitride did not effectively lubricate the fabric. Static heat treatment tests at 950 C indicate that the fabric is chemically attacked by large quantities of silver, CaF2, and boron nitride. Sputtered films or powder impregnation of the fabric with gold may provide adequate lubrication up to 1000 C without showing any chemical attack. Author

A89-54986

MICROCOMPUTER SIMULATION OF LUBRICANT DEGRADATION IN TURBINE ENGINES USING LABORATORY DATA

F. DEAN PRICE and PHILLIP W. CENTERS (USAF, Aero Propulsion Laboratory, Wright-Patterson AFB, OH) STLE Tribology Transactions (ISSN 0569-8197), vol. 32, July 1989, p. 405-409. refs

Copyright

A FORTRAN, MS-DOS operating system algorithm was constructed and implemented to predict ester-based lubricant behavior in a turbine engine. Input data consists of selected lubricant flow rates, bulk lubricant and bearing temperatures, and laboratory generated data. Execution of the program uses lubricant property data as a function of time at several temperatures to produce mathematical functions describing total acid number, viscosity change and evaporation as a function of temperature at selected times. Static coker data are employed to estimate coking at the hot end bearing cover. The program output data are predicted values of critical lubricant properties as a function of engine hours, reflecting lubricant additions to the system because of evaporative and seal losses and also degradation predicted to occur during cool-down cycles. Computer-generated data are compared with actual engine data; the benefits and limitations of the program are identified. Author

N89-28574# Naval Postgraduate School, Monterey, CA. Dept. of Mechanical Engineering. COMPOSITE MATERIAL REPAIR AND RELIABILITY M.S.

Thesis

SHMUEL MAMAN Mar. 1989 160 p (AD-A209150) Avail: NTIS HC A08/MF A01 CSCL 11/4

Composite structure repair methodology has been developed to specific applications (typically in small area and limited to secondary structure) and is being extended to Large Area Composite Structure Repair (with target extension to primary structures). Therefore, the repair becomes more critical because we get redistribution of stresses that can also affect the zones outside of the repair area. For this reason, an analytic evaluation of the repair's reliability has to be performed to define a parameter which reflects on the effectiveness of the repair. In this work, we establish a principal guideline to evaluate the redundancy and compare the reliability of the repair to the reliability of the parent structure (i.e., the structure in the undamaged state). The approach adopted is to utilize structural finite element analysis to compute the state and of the candidate repaired state. The reliability of these two spatially non-uniform stresses is computed by a probabilistic failure criterion. Thus, we can optimize the repair configuration by varying the strength and the stiffness of any element in the repair site by varying the lamination angles, and selectively using hybrid materials. GRA

N89-28579*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA. FIVE YEAR GROUND EXPOSURE OF COMPOSITE

MATERIALS USED ON THE BELL MODEL 206L FLIGHT SERVICE EVALUATION

DONALD J. BAKER (Army Aviation Research and Development Command, Hampton, VA.) Jul. 1989 93 p

(NASA-TM-101645; NAS 1.15:101645; AVSCOM-TM-89-B-007) Avail: NTIS HC A05/MF A01 CSCL 11/4

Part of the results of a U.S. Army/NASA-Langley sponsored research program to establish the long term-term effects of realistic ground based exposure on advanced composite materials is presented. Residual strengths and moisture absorption as a function of exposure time and exposure location are reported for four different composite material systems that were exposed for five years on the North American Continent. Author

N89-28588# Bailey Controls Co., Wickliffe, OH. ENGINE COMBUSTION OPTIMIZATION BY EXHAUST ANALYSIS Final Report, Dec. 1986 - Jul. 1988

R. K. JAHN, D. J. LEE, S. P. CREMEAN, and R. A. BAYLESS (Columbia Gas System Service Corp., Columbus, OH.) Jan. 1989 186 p

(Contract GRI-5083-231-0956)

(PB89-195788; GRI-88/0312) Avail: NTIS HC A09/MF A01 CSCL 21/2

The application of an air/fuel ratio analyzer and trim control system to a two-cycle turbocharged compressor engine is documented. The trim control strategy is based upon both oxygen and combustibles in the exhaust gases. The use of exhaust gas analysis demonstrated that an improvement in combustion efficiency on two-cycle turbocharged engines is possible. However, the prevention of detonation must be demonstrated with further testing before these controls can be satisfactorily applied to turbocharged engines. The application of the controls on naturally aspirated engines is thought to be more feasible at this time. The potential benefits justify the continuation of work to develop fully operational systems for both turbocharged and naturally aspirated engines. GRA

N89-28610# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (Germany, F.R.). Inst. fuer Antriebstechnik

SUPERSONIC COMBUSTION AT THE DFVLR: RESULTS AND EXPERIENCES [UEBERSCHALLVERBRENNUNG IN DER DFVLR. ERGEBNISSE UND ERFAHRUNGEN]

G. WINTERFELD 1988 11 p In GERMAN (DFVLR-88-044; ETN-89-94381) Avail: NTIS HC A03/MF A01

The research activities of the DFVLR Institute of Jet Engines in the field of supersonic combustion are reviewed. The ignition and stabilization of hydrogen-air diffusion flames are investigated. Many qualitative and quantitative results on the essential effects on thermal self ignition are obtained, which together with the obtained reaction-kinetics data allow a satisfactory calculation of induction lengths during parallel injection of H2. The possibilies of improving thermal self-ignition by catalytic effects or precombustion, as well as the self-ignition characteristics of several hydrocarbons are studied. With a view to flame stabilization by recirculation

11 CHEMISTRY AND MATERIALS

domains in the supersonic flow at low temperatures, quantitative data on the characteristic test time at the boundary of the recirculation domain are obtained. The importance of interactions between supersonic flow and local subsonic domains in combustion zones is demonstrated. ESA

N89-28643# Hughes Aircraft Co., El Segundo, CA. Electro-Optical and Data Systems Group.

HIGH TEMPERATURE ADHESIVE SYSTEMS Final Report, 25

Sep. 1985 - 24 Apr. 1989 E. H. CATSIFF, T. K. DOUGHERTY, W. E. ELIAS, D. J. VACHON, G. ANGSTEN, R. W. SEIBOLD, W. G. KNAUSS, S. SHIMABUKURO, and K. M. LIECHTI (Texas Univ., Austin.) Apr. 1989 224 p

(Contract N00014-85-C-0881)

(AD-A209166; HAC-REF-F7896-F) Avail: NTIS HC A10/MF A01 CSCL 11/1

Projected requirements for future high-performance jet engine, missile, and fighter aircraft structures will necessitate extensive use of high temperature structural adhesives. For example, many advanced jet engine and tactical aircraft components will need to perform for hundreds of hours at 700 F (371 C) and above. For advanced air-to-air tactical missiles and air-launched stand-off missiles, composite airframe structures capable of maintaining strength for short periods (minutes) at 1000 F (538 C) and above will be needed. Other needs for adhesives capable of performing at high temperatures include bonding of structures for extended range cruise missiles, bonding of specialty materials for stealth applications, and, potentially, joining of aerospace plane structures. Under this program, a comprehensive technical effort was undertaken with the goal of developing high-temperature adhesive systems with inherent processibility and toughness. The approach was to perform a multidisciplinary integrated research effort involving a combination of polymer chemistry, moisture diffusion analysis, and fracture mechanics to tailor, characterize, and qualify tough adhesive systems for bonding to titanium and ferrous allovs. GRA

N89-28661# Southwest Research Inst., San Antonio, TX. Fuels and Lubricants Research Facility.

A SURVEY OF JP-8 AND JP-5 PROPERTIES Interim Report. Oct. 1987 - Sep. 1988

J. N. BOWDEN, S. R. WESTBROOK, and M. E. LEPERA (Army Research and Development Lab., Fort Belvoir, VA.) Sep. 1988 111 p

(Contract DAAK70-87-C-0043; DA PROJ. 1L2-63001-D-150) (AD-A207721; BFLRF-253) Avail: NTIS HC A06/MF A01 CSCL 21/4

With the help of the Defense Fuel Supply Center, JP-8, Jet A-1, and JP-5 samples from worldwide sources, representing tenders of products destined for Department of Defense bases, have been received at Belvoir Fuels and Lubricants Research Facility at Southwest Research Institute for evaluation. Inspection data for each sample on DD Form 250 or other data reporting form were also received and entered into a data base. The evaluation of these samples consisted of a few inspection tests for comparison with the data provided by the supplier, and tests related to the use of these fuels in diesel engines, which were measured cetane number, calculated cetane indices by two methods, net heat of combustion, and kinematic viscosity measurements at 40 and 70 C. GRÁ

N89-29490*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

INTERMETALLIC AND CERAMIC MATRIX COMPOSITES FOR 815 TO 1370 C (1500 TO 2500 F) GAS TURBINE ENGINE APPLICATIONS

JOSEPH R. STEPHENS 1989 11 p Proposed for presentation at the Advanced Metal and Ceramic Matrix Composites, Anaheim, CA, 19-22 Feb. 1990; sponsored by The Minerals, Metals and Materials Society and ASM International

(NASA-TM-102326; E-5027; NAS 1.15:102326) Avail: NTIS HC A03/MF A01 CSCL 11/4

Light weight and potential high temperature capability of intermetallic compounds, such as the aluminides, and structural ceramics, such as the carbides and nitrides, make these materials attractive for gas turbine engine applications. In terms of specific fuel consumption and specific thrust, revolutionary improvements over current technology are being sought by realizing the potential of these materials through their use as matrices combined with high strength, high temperature fibers. The U.S. along with other countries throughout the world have major research and development programs underway to characterize these composites materials; improve their reliability; identify and develop new processing techniques, new matrix compositions, and new fiber compositions; and to predict their life and failure mechanisms under engine operating conditions. The status is summarized of NASA's Advanced High Temperature Engine Materials Technology Program (HITEMP) and the potential benefits are described to be gained in 21st century transport aircraft by utilizing intermetallic and ceramic matrix composite materials, Author

N89-29497# Colorado State Univ., Fort Collins. Dept. of Chemistry.

SUPERSONIC JET STUDIES OF FLUORENE CLUSTERED WITH WATER, AMMONIA AND PIPERIDINE

H. S. IM, V. H. GRASSIAN, and E. R. BERNSTEIN 1 Jun. 1989 37 p Submitted for publication

(Contract N00014-79-C-0647)

(AD-A209562; AD-E900860; TR-54) Avail: NTIS HC A03/MF A01 CSCL 07/4

Mass resolved excitation spectroscopy and dispersed emission spectroscopy are employed to study van der Waals (vdW) clusters of jet cooled fluorene with ammonia, water and piperidine. For fluorene (H2O)1 and fluorene (NH3)1 clusters, cluster geometries and binding energies can be suggested based on the experimental results and Lennard-Jones (LJ) potential (6-12-1) energy calculations. As the number of solvent molecules in the cluster is increased, spectra of the clusters become more complex and broad, probably due to the many possible stable configurations for these vdW clusters. Although the pKa for fluorene in its first excited singlet state (Forster cycle calculations) is quite acidic (-8.6), and solvent molecules can coordinate to the aliphatic hydrogens of the fluorene molecule in at least some cluster configurations, no direct evidence is found for the occurrence of proton transfer in S1 in these systems. GRA

12

ENGINEERING

Includes engineering (general); communications; electronics and electrical engineering; fluid mechanics and heat transfer; instrumentation and photography; lasers and masers; mechanical engineering; quality assurance and reliability; and structural mechanics.

A89-51680

THE EFFECTS OF LONGITUDINAL VORTICES ON HEAT TRANSFER OF LAMINAR BOUNDARY LAYERS

KAHORU TORII and JURANDIR ITIZO YANAGIHARA (Yokohama National University, Japan) JSME International Journal, Series II (ISSN 0914-8817), vol. 32, Aug. 1989, p. 395-402. refs Copyright

The isolated influence of longitudinal vortices 'far enough' from a half-delta wing vortex generator on heat transfer of an otherwise laminar boundary layer was experimentally investigated. The heat transfer measurements were performed using a constant heat-flux surface with 96 embedded thermocouples. The vortex generator's height and angle of attack were varied to account for the influence of the vortex size, position and strength. A large increase in the heat transfer coefficient was found to be associated with the onset of the transition to turbulence rather than to vortical motion. The

longitudinal vortices generated inside and outside the boundary layer showed different effects on heat transfer. When the transition did not occur, it was observed that the higher heat transfer coefficients were associated with the downwash region of the vortex, because of the local thinning of the boundary layer. The transition started in the upwash region of the vortex, where the instability was larger. Author

A89-51692* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

CURRENT RESEARCH IN COMPOSITE STRUCTURES AT NASA'S LANGLEY RESEARCH CENTER

MICHAEL F. CARD and JAMES H. STARNES, JR. (NASA, Langley Research Center, Hampton, VA) IN: Composite materials and structures. Bangalore, Indian Academy of Sciences, 1988, p. 5-26. refs

Copyright

Research on the mechanics of composite structures at NASA's Langley Research Center is discussed. The advantages and limitations of special purpose and general purpose analysis tools used in research are reviewed. Future directions in computational structural mechanics are described to address analysis short-comings. Research results on the buckling and postbuckling of unstiffened and stiffened composite structures are presented. Recent investigations of the mechanics of failure in compression and shear are reviewed. Preliminary studies of the dynamic response of composite structures due to impacts encountered during crash-landings are presented. Needs for future research are discussed. Author

A89-51755

PSEUDO-SPECTRAL AND ASYMPTOTIC SENSITIVITY INVESTIGATION OF COUNTER-ROTATING VORTICES

A. DAGAN (Ministry of Defence, Scientific Dept., Haifa, Israel) Computers and Fluids (ISSN 0045-7930), vol. 17, no. 4, 1989, p. 509-525. refs

Copyright

An asymptotic analysis of the two-dimensional counter rotating vortices is presented in this work, assuming small ratio between vortex core radius and the initial vortex spacing. This analysis indicates that for the short time span the numerical solution is of a fluctuating nature resulting from the distribution of the initial condition. This short time period is proportional to the ratio between the initial vortex core area and the kinematic viscosity. In the limit case the asymptotic analysis yields a vorticity distribution that does not exhibit these fluctuations and can be used as a modified approximation of the numerical initial condition. In order to verify this conclusion, the sensitivity of the numerical problem is checked against the traditional initial condition (Oseen solution), in which a pseudo-spectral approach is chosen as a numerical algorithm. The pseudo-spectral method is shown to be an efficient means of handling the numerical boundary conditions and for validating the conclusions that have been obtained by the asymptotic analysis. Author

A89-52105

ANALYSIS OF ABSORBING CHARACTERISTICS OF THIN-TYPE ABSORBER FOR GENERALIZED CONDITIONS OF INCIDENT WAVE

YASUHIRO KAKIMI, NORINOBU YOSHIDA, and ICHIRO FUKAI (Hokkaido University, Sapporo, Japan) IEEE Transactions on Electromagnetic Compatibility (ISSN 0018-9375), vol. 31, Aug. 1989, p. 323-328. refs

Copyright

The treatment of a thin absorber as a boundary condition, taking the arbitrary thickness of the absorber into account, is presented. To verify this approach, the equivalent circuit is applied to the terminal model of a coaxial line and rectangular waveguides. Its validity is verified by changing the medium constant, frequency, and angle and polarization of the obliquely incident wave. To illustrate the application of the approach to a complicated structure, the reflecting and scattering characteristics of an aircraft model are presented.

A89-52507

SEPARATED FLOW PAST THREE-DIMENSIONAL BODIES AS A SINGULAR PERTURBATION PROBLEM

P. BASSANINI (Roma I, Universita, Rome, Italy) and A. R. ELCRAT (Wichita State University, KS) Journal of Engineering Mathematics (ISSN 0022-0833), vol. 23, June 1989, p. 187-202. Research supported by MPI. refs

(Contract CNR-86,02073,01; CNR-87,01011,01;

AF-AFOSR-86-0274)

Copyright

This paper proposes a method for computing steady wake flows of an inviscid fluid over a three-dimensional body with polygonal cross-section and arbitrary plan-form. The method is based on the technique of matched asymptotic expansions, assuming a large 'aspect ratio'. The far-field velocity potential is given essentially by a lifting line and a line source. The near-field, treated as two-dimensional, is solved by a suitable version of Tulin's double spiral vortex model which incorporates a downwash correction and an underpressure in the near-wake. The latter is related to the Reynolds number of the corresponding real flow using recent results by Tulin and Hsu and the authors. Numerical results for a few prototype problems (flat-plate airfoil with separation at both the leading edge and upper surface, flat-plate wing with full or partial spoiler) are presented. The method can be efficiently implemented on a parallel computer. Author

A89-52943

TURBULENT SHEAR FLOWS 6; INTERNATIONAL SYMPOSIUM, 6TH, UNIVERSITE DE TOULOUSE III, FRANCE, SEPT. 7-9, 1987, SELECTED PAPERS

JEAN-CLAUDE ANDRE, ED. (Centre National de Recherches Meteorologiques, Toulouse, France), JEAN COUSTEIX, ED. (ONERA, Centre d'Etudes et de Recherches, Toulouse, France), FRANZ DURST, ED. (Erlangen-Nuernberg, Universitaet, Erlangen, Federal Republic of Germany), BRIAN E. LAUNDER, ED. (Manchester, Victoria University, England), FRANK W. SCHMIDT, ED. (Pennsylvania State University, University Park) et al. Symposium sponsored by USAF, U.S. Navy, U.S. Army, CNRS, et al. Berlin and New York, Springer-Verlag, 1989, 462 p. For individual items see A89-52944 to A89-52949.

Copyright

The conference presents papers on scalar transport and geophysical flows, aerodynamic flows, complex flows, and numerical simulation. Particular attention is given to an eigenfunction analysis of turbulent thermal convection, turbulent diffusion behind a heated line source in a nearly homogeneous turbulent shear flow, and the evolution of axisymmetric wakes from attached and separated flows. Other topics include the vortex street and turbulent wakes behind a circular cylinder placed inside a rotating rectangular channel and a numerical study of a stably stratified mixing layer.

A89-52961

PHENOMENA AND MODELLING OF FLOW-INDUCED VIBRATIONS OF BLUFF BODIES

GEOFFREY PARKINSON (British Columbia, University, Vancouver, Canada) Progress in Aerospace Sciences (ISSN 0376-0421), vol. 26, no. 2, 1989, p. 169-224. refs

Copyright

A detailed treatment is undertaken of the transverse vibrations of single long bodies of bluff section in steady incident flow normal to their span. 'Bluff section' is understood to refer to one from which the flow separates, producing two shear layers that bound a relatively broad wake. The transverse vibrations are galloping and vortex-induced. Galloping is a self-excited vibration in the conventional sense and is potentially catastrophic due to the continuous increase in amplitude with flow velocity above a critical value. Vortex-induced vibration is a form of nonlinear resonance occurring only over a limited range of flow velocities; the resulting vibration amplitudes are self-limiting. O.C.

12 ENGINEERING

A89-53254#

A COMPARISON OF MIXED AND PENALTY FINITE ELEMENT METHODS IN ANALYSIS OF HEAT EXCHANGERS

V. D. MURTY (Portland, University, OR), D. B. PAUL, and M. E. PAJAK (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, OH) IN: ASME 1988 National Heat Transfer Conference, Houston, TX, July 24-27, 1988, Proceedings. Volume 1. New York, American Society of Mechanical Engineers, 1988, p. 137-143. refs Copyright

Heat transfer and fluid flow through pin fin heat exchangers are studied numerically using the penalty and mixed finite element methods. The penalty parameter is varied from 10 to the 6th to 10 to the 15th. It is found that for low values of the penalty parameter (up to 10 to the 14th), it took six iterations for the numerical method to converge; however, for 10 to the 15th, the method did not converge in 20 iterations. The values of pitch to diameter ratio used in this study are 1.25, 1.5, and 1.75, and the values of Prandtl number used are 0.005, 0.7, 5, and 100. Results are presented for various values of Reynolds number up to 400. The predictions of heat transfer rates agree reasonably well with values reported in the literature.

A89-53274#

AN EXPERIMENTAL INVESTIGATION OF HEAT TRANSFER COEFFICIENTS AND FRICTION FACTORS IN PASSAGES OF DIFFERENT ASPECT RATIOS ROUGHENED WITH 45 DEG TURBULATORS

M. E. TASLIM (Northeastern University, Boston, MA) and S. D. SPRING (General Electric Co., Lynn, MA) IN: ASME 1988 National Heat Transfer Conference, Houston, TX, July 24-27, 1988, Proceedings. Volume 1. New York, American Society of Mechanical Engineers, 1988, p. 661-668. refs

Copyright

Nusselt numbers and friction factors in cooling passages of different aspect ratios roughened on one or two sides with 45 deg turbulators with different geometries and orientations are measured. Passage aspect ratios ranging from 0.5 to 3.5 are tested over a Reynolds number range of 15,000 to 180,000. Each aspect ratio is tested for several turbulator spacings and blockage ratios. The results indicate that the overall heat transfer coefficient on surfaces roughened with 45 deg turbulators is greater than that on surfaces roughened with 90 deg turbulators. Although the two-side-turbulated passages produce a higher overall heat transfer coefficient and pressure drop, local heat transfer coefficients are lower than those for one-side-turbulated passages. Local heat transfer coefficients on surfaces roughened with 45 deg turbulators show a considerable variation in the spanwise direction, suggesting other geometries would further enhance heat transfer in blade cooling passages. C.D.

A89-53282*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

HEAT TRANSFER IN AEROSPACE PROPULSION

R. J. SIMONEAU, R. C. HENDRICKS, and H. J. GLADDEN (NASA, Lewis Research Center, Clevelend, OH) IN: ASME 1988 National Heat Transfer Conference, Houston, TX, July 24-27, 1988, Proceedings. Volume 3. New York, American Society of Mechanical Engineers, 1988, p. 1-22. Previously announced in STAR as N88-23957. refs

Copyright

Presented is an overview of heat transfer related research in support of aerospace propulsion, particularly as seen from the perspective of the NASA Lewis Research Center. Aerospace propulsion is defined to cover the full spectrum from conventional aircraft power plants through the Aerospace Plane to space propulsion. The conventional subsonic/supersonic aircraft arena, whether commercial or military, relies on the turbine engine. A key characteristic of turbine engines is that they involve fundamentally unsteady flows which must be properly treated. Space propulsion is characterized by very demanding performance requirements which frequently push systems to their limits and demand tailored designs. The hypersonic flight propulsion systems are subject to severe heat loads and the engine and airframe are truly one entity. The impact of the special demands of each of these aerospace propulsion systems on heat transfer is explored. Author

A89-53286*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

UNSTEADY HEAT TRANSFER IN TURBINE BLADE DUCTS -FOCUS ON COMBUSTOR SOURCES

K. J. BAUMEISTER (NASA, Lewis Research Center, Cleveland, OH) and R. HUFF (Huff and Associates, Cleveland, OH) IN: ASME 1988 National Heat Transfer Conference, Houston, TX, July 24-27, 1988, Proceedings. Volume 3. New York, American Society of Mechanical Engineers, 1988, p. 319-328. Previously announced in STAR as N88-18870. refs Copyright

Thermal waves generated by either turbine rotor blades cutting through nonuniform combustor temperature fields or unsteady burning could lead to thermal fatigue cracking in the blades. To determine the magnitude of the thermal oscillation in blades with complex shapes and material compositions, a finite element Galerkin formulation has been developed to study combustor generated thermal wave propagation in a model two-dimensional duct with a uniform plug flow profile. The reflection and transmission of the thermal waves at the entrance and exit boundaries are determined by coupling the finite element solutions at the entrance and exit to the eigenfunctions of an infinitely long adiabatic duct. Example solutions are presented. In general, thermal wave propagation from an air passage into a metallic blade wall is small and not a problem. However, if a thermal barrier coating is applied to a metallic surface under conditions of a high heat transfer, a good impedance match is obtained and a significant portion of the thermal wave can pass into the blade material. Author

A89-53289#

HIGH-RESOLUTION LIQUID-CRYSTAL HEAT-TRANSFER MEASUREMENTS ON THE ENDWALL OF A TURBINE PASSAGE WITH VARIATIONS IN REYNOLDS NUMBER

S. A. HIPPENSTEELE and L. M. RUSSELL (NASA, Lewis Research Center, Cleveland, OH) IN: ASME 1988 National Heat Transfer Conference, Houston, TX, July 24-27, 1988, Proceedings. Volume 3. New York, American Society of Mechanical Engineers, 1988, p. 443-453. Previously announced in STAR as N89-18664. refs Copyright

Local heat-transfer coefficients were experimentally mapped on the end-wall surface of a three-times turbine vane passage in a static, single-row cascade operated with room-temperature inlet air over a range of Reynolds numbers. The test surface was a composite of commercially available materials: a Mylar sheet with a layer of cholesteric liquid crystals, which change color with temperature, and a heater made of a polyester sheet coated with vapor-deposited gold, which produces uniform heat flux. After the initial selection and calibration of the composite sheet, accurate, quantitative, and continuous heat-transfer coefficients were mapped over the end-wall surface. The local heat-transfer coefficients (expressed as nondimensional Stanton number) are presented for inlet Reynolds numbers (based on vane axial chord) from 0.83 x 10(5) to 3.97 x 10(5).

A89-53307*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

CFD IN THE CONTEXT OF IHPTET - THE INTEGRATED HIGH PERFORMANCE TURBINE ENGINE TECHNOLOGY PROGRAM ROBERT J. SIMONEAU (NASA, Lewis Research Center, Cleveland, OH) and DALE A. HUDSON (USAF, Wright Research and Development Center, Wright-Patterson AFB, OH) AIAA, ASME, SAE, and ASEE, Joint Propulsion Conference, 25th, Monterey, CA, July 10-12, 1989. 20 p. Previously announced in STAR as N89-26174. refs

(AIAA PAPER 89-2904) Copyright

The Integrated High Performance Turbine Engine Technology (IHPTET) Program is an integrated DOD/NASA technology program designed to double the performance capability of today's most advanced military turbine engines as we enter the twenty-first century. Computational Fluid Dynamics (CFD) is expected to play an important role in the design/analysis of specific configurations within this complex machine. In order to do this, a plan is being developed to ensure the timely impact of CFD on IHPTET. The developing philosophy of CFD in the context of IHPTET is discussed. The key elements in the developing plan and specific examples of state-of-the-art CFD efforts which are IHPTET turbine engine relevant are discussed. Author

A89-53322

AE MONITORING OF AIRFRAME STRUCTURE DURING FULL SCALE FATIGUE TEST

D. BOZZETTI, A. SALA (CISE S.p.A., Milan, Italy), G. BORZACCHIELLO, and C. SABATINO (Aeritalia S.p.A., Pomigliano d'Arco, Italy) International Acoustic Emission Symposium, 9th, Kobe, Japan, Nov. 14-17, 1988, Paper. 9 p. Copyright

The acoustic emission (AE) technique was used in a long-term fatigue test simulating various flight conditions, on a full scale airframe-structure. The rear bulkhead of the airframe is monitored by six AE sensors, 1300 cycles are performed for more than 7000 flights, and the main characteristics of AE events are recorded. A microprocessor performs the preconditioning of the AE data and controls the data logging. The data are subsequently analyzed off-line by special software programs implemented on a minicomputer. The AE technique accuracy test to detect and locate the AE sources in a wide area and a noisy environment resulted in the use of wide-band sensors for a more accurate measurement of event features.

A89-53353# NONCIRCULAR JET DYNAMICS IN SUPERSONIC COMBUSTION

E. GUTMARK, K. C. SCHADOW, and K. J. WILSON (U.S. Navy, Naval Weapons Center, China Lake, CA) Journal of Propulsion and Power (ISSN 0748-4658), vol. 5, Sept.-Oct. 1989, p. 529-533. Research supported by the U.S. Navy. Previously cited in issue 20, p. 3229, Accession no. A87-47005. refs

A89-53364*# Akron Univ., OH. COMPUTERIZED LIFE AND RELIABILITY MODELING FOR TURBOPROP TRANSMISSIONS

M. SAVAGE (Akron, University, OH), K. C. RADIL, D. G. LEWICKI (U.S. Army, Aviation Research and Technology Activity, Cleveland, OH), and J. J. COY (NASA, Lewis Research Center, Cleveland, OH) Journal of Propulsion and Power (ISSN 0748-4658), vol. 5, Sept.-Oct. 1989, p. 610-614. Previously cited in issue 20, p. 3364, Accession no. A88-48031. refs Copyright

A89-53499

FINITE ELEMENT ANALYSIS OF GYROSCOPIC EFFECTS

GERHARD SAUER (Bayern, Technischer Ueberwachungsverein, Munich, Federal Republic of Germany) and MICHAEL WOLF (Muenchen, Fachhochschule, Munich, Federal Republic of Germany) Finite Elements in Analysis and Design (ISSN 0168-874X), vol. 5, July 1989, p. 131-140. refs Copyright

An approach which considers gyroscopic effects when analyzing the dynamic response of rotating structures using the finite element method is presented. The equation of motion for linear continuous structures containing gyroscopic effects is formulated and a consistent gyroscopic beam matrix for analysis with the FEM is derived. An analytical eigenfrequency formula to test the consistent gyroscopic matrix is given and a method to calculate the critical numbers of revolution is outlined. The influence of gyroscopic effects on eigenfrequencies and motion behavior under base excitation is shown for a rotating pump motor rotor.

A89-54119

FATIGUE LIFE OF DOVETAIL JOINTS - VERIFICATION OF A SIMPLE BIAXIAL MODEL

M. J. HE (Nanjing Aeronautical Institute, People's Republic of China)

and C. RUIZ (Oxford, University, England) Experimental Mechanics (ISSN 0014-4851), vol. 29, June 1989, p. 126-131. Research supported by Rolls-Royce, PLC and Ministry of Defence. refs Copyright

A biaxial fatigue specimen, designed to model the state of stress of the blade to disk joint in a typical gas turbine, has been analyzed and tested. The method of analysis was shown to predict the location of the worst damage and of crack initiation. This paper describes the analysis and testing of a simplified model that may be used in preference to the previous one. Author

A89-54348

FLASH LAMP PLANAR IMAGING

A. J. SABER, MICHAEL GEORGALLIS, U. KOREN, and MICHAEL SCHENKE (Concordia University, Montreal, Canada) IN: International Conference on Hypersonic Flight in the 21st Century, 1st, Grand Forks, ND, Sept. 20-23, 1988, Proceedings. Grand Forks, ND, University of North Dakota, 1988, p. 257-262. Research supported by NSERC. refs Copyright

The development of flash lamp light slicing (planar imaging) and its employment in gas flow visualization is discussed. A 30 Joule xerion flash lamp pulsing over about 1 microsec provides abundant broad spectrum light. The system is illustrated using transient gas jets discharging into the atmosphere and the gas dynamics and mixing are observed. Gas flow Mach numbers for discharges of air into the atmosphere are about 0.4. The technique is well-suited for investigations of hypersonic flows, including those associated with engine intakes. Author

A89-54424*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

HIGH SPEED CORNER AND GAP-SEAL COMPUTATIONS USING AN LU-SGS SCHEME

WILLIAM J. COIRIER (NASA, Lewis Research Center, Cleveland, OH) AIAA, ASME, SAE, and ASEE, Joint Propulsion Conference, 25th, Monterey, CA, July 10-12, 1989. 15 p. Previously announced in STAR as N89-27103. refs

(AIAA PAPER 89-2669) Copyright

The hybrid Lower-Upper Symmetric Gauss-Seidel (LU-SGS) algorithm was added to a widely used series of 2D/3D Euler/Navier-Stokes solvers and was demonstrated for a particular class of high-speed flows. A limited study was conducted to compare the hybrid LU-SGS for approximate Newton iteration and diagonalized Beam-Warming (DBW) schemes on a work and convergence history basis. The hybrid LU-SGS algorithm is more efficient and easier to implement than the DBW scheme originally present in the code for the cases considered. The code was validated for the hypersonic flow through two mutually perpendicular flat plates and then used to investigate the flow field in and around a simplified scramjet module gap seal configuration. Due to the similarities, the gap seal flow was compared to hypersonic corner flow at the same freestream conditions and Reynolds number.

Author

A89-54488#

CONSTANT MONITORING OF THE FATIGUE DAMAGE OF AIRCRAFT LIFTING STRUCTURES [CIAGLA OCENA ZUZYCIA ZMECZENIOWEGO STRUKTUR NOSNYCH SAMOLOTOW]

MAREK DEBSKI Technika Lotnicza i Astronautyczna (ISSN 0040-1145), vol. 44, Feb. 1989, p. 17-20. In Polish. A technique for measuring the fatigue damage of lifting

A technique for measuring the fatigue damage of lifting structures is presented along with the equipment for performing these measurements during aircraft operation. A technique for the constant monitoring of fatigue damage (and thus the evaluation of service life) is proposed which is based not on the number of flight hours logged but on the degree of fatigue damage assumed for the structure. B.J.

A89-54585

A STUDY OF THE STRESS-STRAIN STATE OF CONNECTIONS IN AN ORTHOTROPIC MATERIAL [ISSLEDOVANIE NAPRIAZHENNO-DEFORMIROVANNOGO SOSTOIANIIA SOEDINENII IZ ORTOTROPNOGO MATERIALA]

V. I. GRISHIN, T. K. BEGEEV, and V. B. LITVINOV (Ukhtomskii Vertoletnyi Zavod, Ukhta, USSR) Mekhanika Kompozitnykh Materialov (ISSN 0203-1272), July-Aug. 1989, p. 650-654. In Russian. refs

Copyright

A method is proposed for calculating the stress-strain state of connections between parts in aircraft structures that are in direct contact. The method involves the use of a specialized set of strength analysis software, FITTING-1. The stress-strain state of a typical connection made by the winding of an orthotropic material over a metal bushing is analyzed as an example. VI.

A89-54611

SOLUTION OF THE INVERSE BOUNDARY VALUE PROBLEM OF AEROHYDRODYNAMICS WITH ALLOWANCE FOR THE BOUNDARY LAYER [RESHENIE OBRATNOI KRAEVOI ZADACHI AEROGIDRODINAMIKI S UCHETOM POGRANICHNOGO SLOIA1

A. N. IL'INSKII and A. V. POTASHEV Akademiia Nauk SSSR, Izvestija, Mekhanika Zhidkosti i Gaza (ISSN 0568-5281), July-Aug. 1989, p. 28-32. In Russian. refs

Copyright

The problem of the construction of a wing profile in the path of a flow of a viscous (incompressible and compressible) fluid from a specified velocity distribution as a function of the arc abscissa is solved in the approximation of the boundary layer theory. Solvability conditions are obtained. From the velocity distributions corresponding to nonseparated flow, wing profile contours are determined. The effect of viscosity and compressibility on the solution is examined. VI

A89-54890

DETERMINING CURE CYCLES FOR THERMOSETTING EPOXY RESINS

JACQUELINE B. PAYNE (Beech Aircraft Corp., Wichita, KS) Society of Manufacturing Engineers, Fabricating Composites '88 Conference, Philadelphia, PA, Sept. 12-15, 1988. 11 p.

(SME PAPER EM88-533) Copyright

The techniques used by Beech Aircraft to determine the optimum cure cycles for the advanced composites used in the fabrication of a turboprop business aircraft, Starship 1, are discussed. A new method for determining the cure cycle that will crosslink the polymeric resin system by heat and pressure is investigated. The Rheometrics Dynamic Spectrometer (RDS) is used in formulating the cure cycle, to measure the viscous and elastic characteristics of graphite/epoxy prepregs. Many important variables considered include thickness and temperature gradients of parts and tools, part construction, gas evolution temperature, minimum viscosity, and gel point. C.E.

A89-54900

ULTRASONIC EVALUATION OF MATRIX CRACKING IN **GRAPHITE BMI**

MICHAEL D. FULLER (Martin Marietta Aero and Naval Systems, Baltimore, MD) Society of Manufacturing Engineers, Fabricating Composites '88 Conference, Philadelphia, PA, Sept. 12-15, 1988. 14 p. refs

(SME PAPER EM88-549) Copyright

Two NDE methods developed and deployed for reliable, accurate detection and quantification of microcracking in the radii of precooler ducts made of graphite and Nextel bismaliimide (BMII) fibers are dicussed. The first makes use of guided ultrasonic waves or Lamb waves; the other resembles traditional approaches made possible by zero impedance matching at the probe-duct interface. Conventional nondestructive testing techniques are shown to be inapplicable to this problem of fabric composite construction and the geometric constraints imposed by the radii. Acceptance criteria and reference standards are the most suitable means to meet

A89-54981

ESTIMATE OF SURFACE TEMPERATURES DURING ROLLING CONTACT

J. W. KANNEL and S. A. BARBER (Battelle Columbus Laboratories, STLE Tribology Transactions (ISSN 0569-8197), vol. 32, OH) July 1989, p. 305-310. refs

(Contract F33615-86-C-2623)

Copyright

simple model for estimating the accumulative Α surface-temperature rise of contacts in rolling element bearings during ball or roller slippage is presented. The analysis assumes a single dimensional heat flow into the rolling element and a convective heat transfer from the element. Results of calculations indicate that the surface temperature of a solid lubricated air-cooled angular-contact bearing designed for use in a man-rated turbine engine may exceed the temperature capabilities of all known structural materials used for bearings. It is suggested that an alternative concept of a 'minimum cooled bearing', using liquid lubrication and air cooling, may exhibit considerably lower temperatures when used in this application. LS.

Scientific Research Associates, Inc., Glastonbury, N89-28754# CT.

HYPERSONIC VEHICLE ENVIRONMENT SIMULATION, PHASE

1 Final Report, 1 Aug. 1988 - 31 Mar. 1989 F. J. DEJONG, J. S. SABNIS, and H. MCDONALD May 1989 41 p

(Contract DAAL03-88-C-0028)

(AD-A209030; ARO-26239.1-EG-SBI) Avail: NTIS HC A03/MF CSCL 20/4 A01

The hypersonic, viscous, chemically reacting flow around a vehicle in the upper layers of the atmosphere influences vehicle performance, thermal environment, and sensor visibility. Under the Phase 1 effort, a unique hybrid Navier-Stokes/Monte Carlo method has been successfully developed for the simulation of said hypersonic flows. This method combines a continuum description of the gas mixture with a statistical (or particle) description of the species transport and the chemical reactions, thereby allowing easy use of available chemical kinetics data. As such, the hybrid approach is capable of exploiting both the efficiency of a continuum approach for the fluid dynamic calculations and the benefits in physical modeling of the Monte Carlo approach for chemical reactions. The viability of this hybrid approach for practical hypersonic flow calculations has been demonstrated in the Phase 1 effort via the calculation of the chemically reacting flow field over an axisymmetric cone. A proposed Phase 2 effort would continue the development of this method by improving the numerical efficiency of the particle transport scheme, and by incorporating physical models for catalytic walls, recombination reactions, and ionization. In addition, radiation would be included via a radiation transport model. GRA

N89-28755# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.

WAKE DISSIPATION AND TOTAL PRESSURE LOSS IN A TWO-DIMENSIONAL COMPRESSOR CASCADE WITH **CRENULATED TRAILING EDGES M.S. Thesis**

JANET LYLE VEESART Jun. 1989 92 p (AD-A209176; AFIT/GAE/ENY/89J-3) Avail: NTIS HC A05/MF CSCL 20/4 A01

Wake dissipation and total pressure loss in a two-dimensional, subsonic, compressor cascade with crenulated trailing edges were investigated in the Cascade Test Facility. Three blade configurations, a baseline NACA 64-905 airfoil and two crenulated edge patterns were used. Hot wire anemometry and a total pressure rake were used to collect the flow data. The smaller crenulation configuration exhibited the greatest turning angle and the least total pressure losses. The most rapid wake dissipation was generated by the larger crenulations' counterrotating vortices accompanied by slightly higher pressure losses than those created by the small crenulations. Both crenulated blade configurations had better wake dissipation, increased turning angles, and smaller pressure loss coefficients than the uncrenulated baseline blade.

GRA

N89-28765# National Aerospace Lab., Tokyo (Japan). V/STOL Aircraft Research Group.

FINITE ELEMENT ANALYSIS OF INCOMPRESSIBLE VISCOUS FLOWS AROUND SINGLE AND MULTI-ELEMENT AEROFOILS IN HIGH REYNOLDS NUMBER REGION MASASHI SHIGEMI Dec. 1988 18 p

(NAL-TR-1010T; ISSN-0389-4010) Avail: NTIS HC A03/MF A01 Incompressible viscous flows around aerofoils are solved by a finite element method. This finite element method makes use of the penalty function method as well as the streamline-upwind Petrov-Galerkin (SUPG) method and, therefore, it can be applied to the computations of the flow at a high Revnolds number. In unsteady formulations, pressure distributions are evaluated by solving Poisson's equation with regard to pressure, rather than by direct application of the penalty function equation, since the latter tends to introduce violent oscillations in the solution. Though the present computation assumes that the flows are laminar, good agreement is obtained with experimentally measured results, particularly when the flow shows laminar separation. It is shown that this method can be applied to problems of flow around complicated geometries, and it is stated that the extension of the method to three-dimensional problems is promising. Author

N89-28774# Institut Franco-Allemand de Recherches, Saint-Louis (France).

LASER VELOCIMETRY IN THE CLOSE WAKE OF AN AXISYMMETRIC REAR BODY [MESURES DE VELOCIMETRIE LASER DANS LE SILLAGE PROCHE D'ARRIERE-CORPS A SYMETRIE DE REVOLUTION

C. BERNER, V. PETITDAMAGE, and J. P. DUPEROUX 24 Jun. 1987 48 p In FRENCH

(ISL-R-114/87; ETN-89-94855) Avail: NTIS HC A03/MF A01

Experimental data were obtained with axisymmetric specimens placed in a cold jet for Mach number = 0.35. The velocimeter is a two dimensional argon laser (two colors, three beams, 5W). The analysis of the average velocity and turbulent fluctuations show strong variations with the geometry of the body with strong velocity gradients and large shear stress causing turbulent flow in the mixing zone. The Reynolds tensions are 30 percent lower than indicated in the literature. ESA

N89-28800# Technische Univ., Berlin (Germany, F.R.). Inst. fuer Luft- und Raumfahrt.

PIEZOELECTRIC FOILS AS SENSORS IN EXPERIMENTAL FLOW MECHANICS Final Report [PIEZOELEKTRISCHE FOLIEN ALS SENSOR IN DER EXPERIMENTELLEN STROEMUNGSMECHANIK]

WOLFGANG NITSCHE Oct. 1988 23 p In GERMAN (ILR-MITT-214; FIP-12/10; ETN-89-94563) Avail: NTIS HC A03/MF A01

The use of piezoelectric foils as sensors for the analysis of complex aerodynamic flow fields is discussed. The sensors consist of a thin (9 to 100 micrometer) and highly elastic thermoplastic film. It can be mounted, trouble-free, on the surface of very complex flow configurations, and is thus a completely covering array of sensors, allowing large-scale surface force determination. The piezofoil is an active signal source which only requires a suitable amplifier. Wind tunnel tests on wing profiles show that flow instabilities and the characteristics of laminar-turbulent boundary layer transition can be determined. These results were confirmed by free flight tests, which also demonstrate the possibility of on-line data evaluation. Examples of the use of piezoelectric matrix, and taster sensors for the recognition of global flow structures, are given. ESA

N89-28835# Dayton Univ., OH. Research Inst. LUBRICANT EVALUATION AND PERFORMANCE Final Technical Report, Jan. 1987 - Jun. 1988

COSTANDY S. SABA, HOOVER A. SMITH, MICHAEL A. KELLER, ROBERT E. KAUFFMAN, and VINOD K. JAIN Apr. 1989 553 p

(Contract F33615-85-C-2507)

(AD-A208925; UDR-TR-88-95; AFWAL-TR-89-2008) Avail: NTIS HC A24/MF A01 CSCL 11/8

The development of improved methods for defining and measuring turbine engine lubricant performance is examined along with the development of improved techniques for lubricant monitoring, lubrication system health monitoring, investigating antiwear characteristics and load carrying capacities of lubricants. Arrhenius plots were developed for describing the effective life of MIL-L-7808, MIL-L-23699 and 4 cSt viscosity candidate lubricants as a function of time and temperature for selected limiting values of changes in physical and chemical properties. Significant improvement in AE spectrometer sensitivity for analyzing wear metal particles was achieved when using a cup-tip electrode with the reversible polarity pin stand. The COBRA, a dielectric constant (DC) tester and a dielectric breakdown strength device were evaluated as lubricant monitoring devices. An assessment of the literature on lubricant load carrying capacity (LCC) test methods was made. A software system was developed and implemented on the Zenith Z-100 microcomputer for storage, retrieval and correlation of MIL-L-7808 lubricant qualification data. Finally, the remaining useful life of a lubricant evaluation rig (RULLER) was developed for MIL-L-7808 and MIL-L-23699 type lubricants and was based on reductive cyclic voltammetry. GRA

N89-28839# Creare, Inc., Hanover, NH.

SUPERCONDUCTING MEISSNER EFFECT BEARINGS FOR CRYOGENIC TURBOMACHINES, PHASE 1 Final Report, Sep. 1988 - Mar. 1989

VICTOR IANNELLO, JEFFREY S. MARSHALL, and W. D. STACY May 1989 52 p

(Contract F49620-88-C-0137)

(AD-A209875; CREARE-TM-1352; AFOSR-89-0825TR) Avail: NTIS HC A04/MF A01 CSCL 20/3

State of the art miniature expansion turbines and centrifugal compressors used in spaceborne sensor cryocoolers employ self-acting gas bearings to achieve high reliability and long operating life. Because these bearings must run at room temperature to achieve adequate stiffness and stability, they result in an avoidable source of heat leak to the process gas, thereby lowering overall cycle efficiency and increasing the system launch weight. This report shows that the gas bearings can be replaced by Meissner effect bearings fabricated from high temperature superconducting materials. Analyses are presented to predict Meissner bearing performance, and a preliminary design of a miniature expansion incorporating Meissner bearings is conceptualized. Because these bearings operate at cryogenic temperatures, a substantial reduction in heat leak to the process gas can be achieved. For a typical cryocooler providing 1 watt of cooling at 10 K, a 40 percent reduction in input cycle power can be achieved by replacing the self-acting gas bearings by Meissner bearings in the cold expansion turbine. GRA

N89-28841*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

TURBOMACHINERY ROTOR SUPPORT WITH DAMPING Patent Application

GEORGE L. VONPRAGENAU, inventor (to NASA) 26 May 1989 19 p

(NASA-CASE-MFS-28345-1; NAS 1.71:MFS-28345-1;

US-PATENT-APPL-SN-364743) Avail: NTIS HC A03/MF A01 CSCL 13/9

Damping seals, damping bearings, and a support sleeve are presented for the ball bearings of a high speed rotor. The ball bearings consist of a duplex set having the outer races packaged tightly within the sleeve while the sleeve provides a gap with a support member so that the bearings may float with the sleeve.

12 ENGINEERING

The sleeve has a web extending radially between the pair of out races and acts in conjunction with one or more springs to apply an axial preload to the outer races. The sleeves have a series of slits which provide the sleeve with a spring-like quality so that the spring acts to center the rotor upon which the bearings are mounted during start up and shut down. A damping seal or a damping bearing may be used in conjunction with the ball bearings and supporting sleeve, the damping seal and damping bearing having rotor portions including rigid outer surfaces mounted within the bore of a stator protion having triangular shaped pockets on the surface facing the rotor. Axial gates are provided between adjacent pockets in sections of the stator permitting fluid to flow with less resistance axially relative to the flow of fluids circumferentially between the rotor and the stator. NASA

N89-28870*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

ONE-DEGREE-OF-FREEDOM MOTION INDUCED BY MODELED VORTEX SHEDDING

L. A. YATES, A. UNAL (Army Aviation Research and Development Command, Moffett Field, CA.), M. SZADY, and G. T. CHAPMAN Jul. 1989 50 p

(NASA-TM-101038; A-88302; NAS 1.15:101038) Avail: NTIS HC À03/MF A01 CSCL 20/11

The motion of an elastically supported cylinder forced by a nonlinear, quasi-static, aerodynamic model with the unusual feature of a motion-dependent forcing frequency was studied. Numerical solutions for the motion and the Lyapunov exponents are presented for three forcing amplitudes and two frequencies (1.0 and 1.1 times the Strouhal frequency). Initially, positive Lyapunov exponents occur and the motion can appear chaotic. After thousands of characteristic times, the motion changes to a motion (verified analytically) that is periodic and damped. This periodic, damped motion was not observed experimentally, thus raising questions concerning the modeling. Author

Aeronautical Research Labs., Melbourne N89-28871# (Australia).

STRESSES AND STRAINS IN A COLD-WORKED ANNULUS G. S. JOST Sep. 1988 52 p

(AR-005-548; ARL-STRUC-R-434) Copyright Avail: NTIS HC A04/MF A01

Analytically-derived plane strain stresses and strains in an annulus pressurized sufficiently to cause plastic flow are given. Unloading giving rise to reyielding around the bore is then examined, along with the effect of reaming. Cold-working is then included in the analysis in terms of interference between mandrel and hole. Finally, comparisons of stress and strain predictions are made with those from a finite element analysis. Author

Air Force Wright Aeronautical N89-29310# Labs.. Wright-Patterson AFB, OH.

AEROTHERMODYNAMIC INSTRUMENTATION

RICHARD D. NEUMANN In AGARD, Special Course on Aerothermodynamics of Hypersonic Vehicles 40 p Jun. 1989 Copyright Avail: NTIS HC A15/MF A01

The features of thermal instrumentation, thermal model simplifications implicit in thermal instrumentations, thermal gage definition, thermal gages, and the products of simplifications are discussed. Author

Office National d'Etudes et de Recherches N89-29698# Aerospatiales, Paris (France).

PHYSICAL MECHANISMS AND DISTURBANCES RELATED TO THE ATTACHMENT OF AN ELECTRIC ARC TO A

CONDUCTIVE CYLINDER Ph.D. Thesis - Paris VI Univ.

PATRICK LEVESQUE 1988 193 p In FRENCH; ENGLISH Original report will also be announced as translation summary (ESA-TT-1168)

(ONERA-NT-1988-2; ISSN-0078-3781; ETN-89-95288) Avail: NTIS HC A09/MF A01

The physics of the interaction between medium length electric arcs (5 to 35 cm) and a structure simulating an aircraft fuselage

on a small scale are discussed. The classical physical analysis of electrical discharges is reviewed. A certain number of typical discharge configurations in air, over small and large distances are presented. The electrical characteristics of the experimental device and the various electrical and optical diagnostic systems used are described. The main experimental results are given. A critical analysis and a physical interpretation of the different phases of the phenomena is provided. The special role of high current streamers and of the propagation of high conductivity leaders is outlined. A qualitative analysis of the correlations between the different phases of the arc-over and the voltages induced inside the simulated aircraft structure summarizes the results. ESA

N89-29726*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

TIME DOMAIN NUMERICAL CALCULATIONS OF UNSTEADY VORTICAL FLOWS ABOUT A FLAT PLATE AIRFOIL

S. I. HARIHARAN, PING YU (Akron Univ., OH.), and J. R. SCOTT Sep. 1989 24 p (Contract C99066G)

(NASA-TM-102318; E-5014; ICOMP-89-19; NAS 1.15:102318) Avail: NTIS HC A03/MF A01 CSCL 20/4

A time domain numerical scheme is developed to solve for the unsteady flow about a flat plate airfoil due to imposed upstream, small amplitude, transverse velocity perturbations. The governing equation for the resulting unsteady potential is a homogeneous, constant coefficient, convective wave equation. Accurate solution of the problem requires the development of approximate boundary conditions which correctly model the physics of the unsteady flow in the far field. A uniformly valid far field boundary condition is developed, and numerical results are presented using this condition. The stability of the scheme is discussed, and the stability restriction for the scheme is established as a function of the Mach number. Finally, comparisons are made with the frequency domain calculation by Scott and Atassi, and the relative strengths and weaknesses of each approach are assessed. Author

N89-29789*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

NAŠA WORKSHOP ON COMPUTATIONAL STRUCTURAL MECHANICS 1987, PART 2

NANCY P. SYKES, ed. (Analytical Services and Materials, Inc., Hampton, VA.) Feb. 1989 374 p Workshop held in Hampton, VA, 18-20 Nov. 1987; sponsored by NASA, Langley Research Center, Hampton, VA, and NASA, Lewis Research Center, Cleveland, OH

(NASA-CP-10012-PT-2; NAS 1.55:10012-PT-2) Avail: NTIS HC A16/MF A01 CSCL 20/11

Advanced methods and testbed/simulator development topics are discussed. Computational Structural Mechanics (CSM) testbed architecture, engine structures simulation, applications to laminate structures, and a generic element processor are among the topics covered.

National Aeronautics and Space Administration. N89-29792*# Lewis Research Center, Cleveland, OH.

COMPUTATIONAL STRUCTURAL MECHANICS ENGINE STRUCTURES COMPUTATIONAL SIMULATOR

C. C. CHAMIS /n NASA, Langley Research Center, NASA Workshop on Computational Structural Mechanics 1987, Part 2 p 459-485 Feb. 1989

Avail: NTIS HC A16/MF A01 CSCL 20/11

The Computational Structural Mechanics (CSM) program at Lewis encompasses: (1) fundamental aspects for formulating and solving structural mechanics problems, and (2) development of integrated software systems to computationally simulate the performance/durability/life of engine structures. Author

N89-29793*# Sverdrup Technology, Inc., Cleveland, OH. INTERFACING MODULES FOR INTEGRATING DISCIPLINE SPECIFIC STRUCTURAL MECHANICS CODES

NED M. ENDRES In NASA, Langley Research Center, NASA Workshop on Computational Structural Mechanics 1987, Part 2 p 487-519 Feb. 1989

Avail: NTIS HC A16/MF A01 CSCL 20/11

An outline of the organization and capabilities of the Engine Structures Computational Simulator (Simulator) at NASA Lewis Research Center is given. One of the goals of the research at Lewis is to integrate various discipline specific structural mechanics codes into a software system which can be brought to bear effectively on a wide range of engineering problems. This system must possess the qualities of being effective and efficient while still remaining user friendly. The simulator was initially designed for the finite element simulation of gas jet engine components. Currently, the simulator has been restricted to only the analysis of high pressure turbine blades and the accompanying rotor assembly, although the current installation can be expanded for other applications. The simulator presently assists the user throughout its procedures by performing information management tasks, executing external support tasks, organizing analysis modules and executing these modules in the user defined order while maintaining processing continuity. Author

N89-29794*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

CSM RESEARCH: METHODS AND APPLICATION STUDIES NORMAN F. KNIGHT, JR. *In its* NASA Workshop on Computational Structural Mechanics 1987, Part 2 p 521-570 Feb.

1989 Avail: NTIS HC A16/MF A01 CSCL 20/11

Computational mechanics is that discipline of applied science and engineering devoted to the study of physical phenomena by means of computational methods based on mathematical modeling and simulation, utilizing digital computers. The discipline combines theoretical and applied mechanics, approximation theory, numerical analysis, and computer science. Computational mechanics has had a major impact on engineering analysis and design. When applied to structural mechanics, the discipline is referred to herein as computational structural mechanics. Complex structures being considered by NASA for the 1990's include composite primary aircraft structures and the space station. These structures will be much more difficult to analyze than today's structures and necessitate a major upgrade in computerized structural analysis technology. NASA has initiated a research activity in structural analysis called Computational Structural Mechanics (CSM). The broad objective of the CSM activity is to develop advanced structural analysis technology that will exploit modern and emerging computers, such as those with vector and/or parallel processing capabilities. Here, the current research directions for the Methods and Application Studies Team of the Langley CSM activity are described. Author

N89-29800*# Pratt and Whitney Aircraft, East Hartford, CT. Commerical Engine Business.

BOUNDARY ELEMENTS FOR STRUCTURAL ANALYSIS

In NASA. Langley Research Center, NASA Workshop on Computational Structural Mechanics 1987, Part 3 p 763-829 Feb. 1989

Avail: NTIS HC A18/MF A01 CSCL 20/11

The intent here is to discuss the status of the boundary element method (BEM) for structural analysis, both in terms of the present and anticipated capabilities of the method and in terms of the incorporation of the method in the design/analysis process, particularly for gas turbine engine components. Author

N89-29804*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

THE 3-D INELASTIC ANALYSES FOR COMPUTATIONAL STRUCTURAL MECHANICS

D. A. HOPKINS and C. C. CHAMIS *In* NASA. Langley Research Center, NASA Workshop on Computational Structural Mechanics 1987, Part 3 p 943-979 Feb. 1989

Avail: NTIS HC A18/MF A01 CSCL 20/11

The 3-D inelastic analysis method is a focused program with the objective to develop computationally effective analysis methods and attendant computer codes for three-dimensional, nonlinear time and temperature dependent problems present in the hot section of turbojet engine structures. Development of these methods was a major part of the Hot Section Technology (HOST) program over the past five years at Lewis Research Center.

Author

13

GEOSCIENCES

Includes geosciences (general); earth resources; energy production and conversion; environment pollution; geophysics; meteorology and climatology; and oceanography.

A89-54363

A STUDY OF THE SENSITIVITY OF STRATOSPHERIC OZONE TO HYPERSONIC AIRCRAFT EMISSIONS

DOUGLAS E. KINNISON, DONALD J. WUEBBLES (Lawrence Livermore National Laboratory, Livermore, CA), and HAROLD S. JOHNSTON (California, University, Berkeley) IN: International Conference on Hypersonic Flight in the 21st Century, 1st, Grand Forks, ND, Sept. 20-23, 1988, Proceedings. Grand Forks, ND, University of North Dakota, 1988, p. 389-394. refs (Contract W-7405-ENG-48; DE-AC03-76SF-00098) Copyright

The sensitivity of stratospheric ozone to NO(x), HO(x), and CIX emissions is examined in order to study the possible environmental impact of emissions from hypersonic aircraft. The one- and two-dimensional chemical-radiative transport models used in the study are described. The sensitivity of the models to emissions with various magnitudes, altitudes, and latitudes is tested. It is found that significant decreases in the total ozone column may result from stratospheric NO(x) emissions, if the global emission rate is large enough. The effects of emissions on total ozone increase with increasing altitude, up to a maximum injection altitude of about 30 km.

A89-54776

INTERNATIONAL CONFERENCE ON THE AVIATION WEATHER SYSTEMS, 3RD, ANAHEIM, CA, JAN. 30-FEB. 3, 1989, PREPRINTS

Conference sponsored by the American Meteorological Society and World Meteorological Organization. Boston, MA, American Meteorological Society, 1989, 505 p. For individual items see A89-54777 to A89-54868.

Copyright

Papers on aviation meteorology are presented covering topics such as the detection of microbursts and low-level wind shear, an algorithm for gust front detection, satellite soundings to determine microburst storm conditions, a low-level wind shear alert system, airport surveillance radars, and meteorological support to range and aerospace systems. Other topics include Shuttle lightning threat analysis, wind profiling radars for Shuttle launch support, automated weather observations, snowstorm observations, forecasts for runway surfaces, forecasts of icing conditions, experimental nowcasting concepts, forecasting clear air turbulence probability, and aviation weather training and education. Additional subjects are wind profile temporal variability, Monte Carlo turbulence simulation for Shuttle reentry, GOES water vapor imagery for thunderstorm forecasting, lightning detection, FAA aviation weather systems, legal aspects of aviation weather forecasting, and aviation weather information systems. R.B.

A89-54777*

A RELATIONSHIP BETWEEN PEAK TEMPERATURE DROP AND VELOCITY DIFFERENTIAL IN A MICROBURST

FRED H. PROCTOR (MESO, Inc., Hampton, VA) IN: International Conference on the Aviation Weather System, 3rd, Anaheim, CA, Jan. 30-Feb. 3, 1989, Preprints. Boston, MA, American

13 GEOSCIENCES

Meteorological Society, 1989, p. 5-8. refs (Contract NAS1-18336) Copyright

Results from numerical microburst simulations using the Terminal Area Simulation System (Proctor, 1987) are used to develop a relationship between wind velocity differential and peak temperature drop. The numerical model and the relationships derived from the model are described. The relationship between peak temperature drop and differential wind velocity is shown to be valid during microburst development, for all precipitation shaft intensities and diameters. It is found that the relationship is not valid for low-reflectivity microburst events or in the presence of ground-based stable layers. The use of the relationship in IR wind shear detection systems is considered. RR

A89-54779

DALLAS MICROBURST STORM ENVIRONMENTAL CONDITIONS DETERMINED FROM SATELLITE SOUNDINGS

GARY ELLROD (NOAA, Satellite Applications Laboratory, IN: International Conference on the Aviation Washington, DC) Weather System, 3rd, Anaheim, CA, Jan. 30-Feb. 3, 1989, Preprints. Boston, MA, American Meteorological Society, 1989, p. 15-20. refs

Copyright

The environmental conditions of the thunderstorm that lead to the commercial airliner crash at the Dallas-Ft. Worth Airport on August 2, 1985 are analyzed. The conditions are derived from GOES VAS data in 12 spectral bands, including three water vapor absorption channels. The synoptic setting, air mass contrast, and midtropospheric moisture associated with the storm are described. The various stages of storm development are examined, showing that none of the VAS-derived parameters alone could have forecast the storm accurately. Consideration is given to the possibility of combining satellite and conventional data to improve forecasts of storms that occur within a very short time span. R.B.

A89-54780

THE DETECTION OF LOW LEVEL WINDSHEAR WITH AIRPORT SURVEILLANCE RADAR

DAVID ATLAS IN: International Conference on the Aviation Weather System, 3rd, Anaheim, CA, Jan. 30-Feb. 3, 1989, Preprints. Boston, MA, American Meteorological Society, 1989, p. 21-24. Copyright

A method is presented for detecting hazardous low-level wind shear windshear using wide fan beam airport surveillance radars, such as the ASR-9. The method provides the wind speed components at the null and near the surfaces. These wind speed components are used to determine the various components of wind shear. Consideration is given to the sensitivity and accuracy of the method and to clutter discrimination. The advantages and limitations of the method are outlined. R R

A89-54783

MICROBURST DETECTION FROM MESONET DATA

LARRY B. CORNMAN and F. WELSEY WILSON, JR. (National Center for Atmospheric Research, Boulder, CO) IN: International Conference on the Aviation Weather System, 3rd, Anaheim. CA. Jan. 30-Feb. 3, 1989, Preprints. Boston, MA, American Meteorological Society, 1989, p. 35-40. Research supported by NSF. refs

(Contract DTFA01-82-7-10513)

Copyright

A procedure is presented for the automatic detection of microbursts using an anemometer mesonet. The procedure is based on the numerical estimation of divergence in the horizontal wind field. Numerical methods have been developed for computing divergence and thresholding for microburst detection from anemometer data on an irregular grid. The methods are described and examples are presented, demonstrating the application of the methodology to the Low-Level Wind Shear Alert System and the Terminal Doppler Weather Radar. R.B.

A89-54784

EVALUATION OF THE 12-STATION ENHANCED LOW LEVEL WIND SHEAR ALERT SYSTEM (LLWAS) AT DENVER STAPLETON INTERNATIONAL AIRPORT

GLENN R. SMYTHE (Data Transformation Corp., Atlantic City, NJ) IN: International Conference on the Aviation Weather System. 3rd, Anaheim, CA, Jan. 30-Feb. 3, 1989, Preprints. Boston, MA, American Meteorological Society, 1989, p. 41-46. Copyright

Results are presented from an operational test and evaluation of the 12-sensor enhanced Low-Level Wind Shear Alert System (LLWAS) conducted at Denver Stapleton International Airport between August 3 and September 4, 1987. The enhancements to the LLWAS are described, including the centerfield average (CFA) algorithm and a wind shear and microburst detection (WSMD) algorithm. The performance of the system is assessed and examples of specific weather events are described. It is found that the WSMD algorithm outperformed the CFA algorithm in wind shear and microburst detection and in the reduction of false alarms. RR

A89-54785

MICROBURST DETECTION AND DISPLAY BY TOWR - SHAPE. EXTENT, AND ALARMS

KRISTI BRISLAWN, F. WESLEY WILSON, JR., WILLIAM MAHONEY, GERRY WIENER, KENT GOODRICH (National Center for Atmospheric Research, Boulder, CO) et al. IN: International Conference on the Aviation Weather System, 3rd, Anaheim, CA, Jan. 30-Feb. 3, 1989, Preprints. Boston, MA, American Meteorological Society, 1989, p. 47-52. Research supported by NSF.

(Contract DTFA01-82-Y-10513) Copyright

The production of alarms associated with microburst wind shear for the Terminal Doppler Weather Radar program is described. The algorithms which determine microburst shapes on the geographical situation display are examined. The creation of the alphanumeric message which is relayed to pilots by air traffic controllers is discussed, emphasizing the algorithm responsible for the content of the message. Examples of specific microburst events are presented to demonstrate the use of the algorithms.

R.B.

A89-54786

DIVERGENCE ESTIMATION BY A SINGLE DOPPLER RADAR F. WESLEY WILSON, JR., KRISTI BRISLAWN, and R. KENT GOODRICH (National Center for Atmospheric Research, Boulder, CO) IN: International Conference on the Aviation Weather System, 3rd, Anaheim, CA, Jan. 30-Feb. 3, 1989, Preprints. Boston, MA, American Meteorological Society, 1989, p. 53-56. Research supported by the National Center of Atmospheric Research. (Contract DTFA01-82-Y-10503)

Copyright

Two approaches for determining the outflow segments of the microburst detection algorithm (Merritt, 1987) of the Terminal Doppler Weather Radar program are compared. The loss-based approach seeks a nearly sustained increase of radial velocity along the radar beam. The shear-based approach is based on the requirement that the velocity gradient exceed a positive threshold at most gates. An algorithm is presented for determining outflow segments using a shear criterion. Examples using both of the approaches are given. It is suggested that the shear-based approach may locate hazards more accurately. R.B.

A89-54787

ESTIMATION OF MICROBURST ASYMMETRY WITH A SINGLE DOPPLER RADAR

MICHAEL D. EILTS (NOAA, National Severe Storms Laboratory, Norman, OK) IN: International Conference on the Aviation Weather System, 3rd, Anaheim, CA, Jan. 30-Feb. 3, 1989, Preprints. Boston, MA, American Meteorological Society, 1989, p. 57-61. refs (Contract DTFA01-80-Y-10524) Copyright

Preliminary results are presented from a study on the estimation of microburst asymmetry using single Doppler radar data. Various techniques for estimating microburst asymmetry are reviewed and the process of estimating the two-dimensional wind field with a single Doppler radar is described. Horizontal vector wind field estimates from single Doppler radar data are compared with those obtained from dual-Doppler wind fields using the reflectivity gradient technique. The results suggest that the proposed method estimates the angle and magnitude of the maximum shear axis fairly well when the shear axis is less than 60 deg from the radial azimuth. However, the method does not seem to model microburst wind fields well enough to estimate wind shears along individual flight paths. R.B.

A89-54788

NUMERICAL SIMULATION OF MICROBURSTS - AIRCRAFT TRAJECTORY STUDIES

MICHAEL R. BABCOCK and KELVIN K. DROEGEMEIER (Oklahoma, University, Norman) IN: International Conference on the Aviation Weather System, 3rd, Anaheim, CA, Jan. 30-Feb. 3, 1989, Preprints. Boston, MA, American Meteorological Society, 1989, p. 62-67. refs

(Contract NSF ATM-87-57013)

Copyright

The problem of providing wind shear scenarios in flight simulators is examined with simulations of microburst evalution using a fully time-dependent cloud model. The time sequence of meteorological parameters are measured along a prescribed flight path. Simulations of 16 microbursts are used to study the relationship of meteorological conditions along the flight path to variations in time, location, slope, and penetration speed. Also, correlations between quantities observed at the aircraft and those ahead of the aircraft are determined in order to identify signals for severe wind shears. The applications of the results for the development of on-board detection devices and full-motion simulators are discussed. R.B.

A89-54789

WEATHER SENSING WITH AIRPORT SURVEILLANCE RADARS

MARK E. WEBER (MIT, Lexington, MA) IN: International Conference on the Aviation Weather System, 3rd, Anaheim, CA, Jan. 30-Feb. 3, 1989, Preprints. Boston, MA, American Meteorological Society, 1989, p. 68-74. Research sponsored by FAA. refs

Copyright

The use of six-level weather reflectivity reports from the ARS-9 airport surveillance radars to control airport terminal regions is discussed. The design of the ASR-9 six-level reflectivity processor is described. Consideration is given to the statistical stability of the displayed weather regions, the ASR-9 method for ground clutter suppression, and the system's fan-shaped elevation beam pattern. A possible processor upgrade to enable airport surveillance radars to measure the velocity of precipitation wind tracers and to detect regions of hazardous low altitude wind shear. Results from experiments testing the capabilities of ARS-9 are reviewed. R.B.

A89-54795

IMPACT OF AUTOMATED WEATHER OBSERVING SYSTEMS ON AVIATION

KENNETH KRAUS (FAA, Washington, DC) and LARRY MAYOU (Martin Marietta Corp., Washington, DC) IN: International Conference on the Aviation Weather System, 3rd, Anaheim, CA, Jan. 30-Feb. 3, 1989, Preprints. Boston, MA, American Meteorological Society, 1989, p. 108-111.

Copyright

The implementation of the Automated Weather Observing System (AWOS) into the Federal Aviation Regulations is discussed. The development of the AWOS and the AWOS acquisition programs are reviewed. The advantages of the AWOS and the possibility of creating national weather communication networks are examined. The requirements for automated observations are noted, focusing on the certification procedure under FAA Advisory Circular 150/5220-16. Also, consideration is given to the Automated Surface Observing System and the AWOS Data Acquisition System. R.B.

A89-54797

A 3-HOUR MESOSCALE ASSIMILATION SYSTEM USING ACARS AIRCRAFT DATA COMBINED WITH OTHER OBSERVATIONS

STANLEY G. BENJAMIN, KEITH A. BREWSTER, RENATE BRUMMER, BRIAN F. JEWETT, THOMAS W. SCHLATTER (NOAA, Environmental Research Laboratories, Boulder, CO) et al. IN: International Conference on the Aviation Weather System, 3rd, Anaheim, CA, Jan. 30-Feb. 3, 1989, Preprints. Boston, MA, American Meteorological Society, 1989, p. 117-122. refs Copyright

The development of the Mesoscale Analysis and Prediction System (MAPS) is discussed. MAPS is planned to provide frequent and detailed analyses of diverse surface and tropospheric data over the U.S. in addition to very short-term numerical forecasts. Emphasis is placed on the MAPS 3-h data assimilation cycle configured in isentropic coordinates. The assimilated data include rawinsonde data, aircraft reports, wind profiler observations, and surface observations. The aircraft data are obtained through ACARS, a communications addressing and reporting system. Consideration is given to quality control of the observations and the isentropic forecast model in the MAPS assimilation cycle. The influence of aircraft and profiler observations in the assimilation cycle is examined by comparing results of the 3-h cycle with a 12-h model. R.B.

A89-54801

LDIS (LIGHTNING DATA AND INFORMATION SYSTEMS) - A NEW RESOURCE FOR AVIATION METEOROLOGY

W. A. LYONS, K. G. BAUER, D. A. BRYAN, D. A. MOON, N. J. PETIT (R-Scan Corp., Minnesota Supercomputer Center, Minneapolis) et al. IN: International Conference on the Aviation Weather System, 3rd, Anaheim, CA, Jan. 30-Feb. 3, 1989, Preprints. Boston, MA, American Meteorological Society, 1989, p. 140-145. refs

Copyright

Consideration is given to the development of Lightning Data and Information Systems (LDIS), which use remote sensing data to detect, locate, and track electrically active convective storms throughout the U.S. The establishment of the National Lightning Detection Network to integrate LDIS data for the continental U.S. is discussed. The methods for obtaining and using real-time lightning data for forecasting are examined. Also, the aviation applications of LDIS technology are noted. R.B.

A89-54806

A COOPERATIVE STUDY ON WINTER ICING CONDITIONS IN THE DENVER AREA

WAYNE R. SAND, MARCIA K. POLITOVICH (National Center for Atmospheric Research, Boulder, CO), JOHN MCGINLEY (NOAA, Boulder. CO), and LEON OSBORNE (North Dakota, University, Grand Forks) IN: International Conference on the Aviation Weather System, 3rd, Anaheim, CA, Jan. 30-Feb. 3, 1989, Preprints. Boston, MA, American Meteorological Society, 1989, p. 169-172. Research supported by the National Center for Atmospheric Research and NSF.

(Contract DTFA01-87-C-00019; DTFA01-82-Y-10513) Copyright

Preliminary results are presented from a study in which in situ and remote icing environment measurements were combined to study the problem of aircraft icing. The study was conducted in the area surrounding Denver, CO, between November 1987 and April 1988. The data include 5- and 10-cm Doppler radar, microwave radiometers, and laser ceilometer measurements combined with integrated NWS observations, satellite visible and IR imagery, NOAA radiometer and wind profiler measurements, and mesonet surface weather data. The resulting data set is described. R.B.

13 GEOSCIENCES

A89-54809

USING FEATURES ALOFT TO IMPROVE TIMELINESS OF **TOWR HAZARD WARNINGS**

STEVEN D. CAMPBELL and MARK A. ISAMINGER (MIT, IN: International Conference on the Aviation Lexinaton, MA) Weather System, 3rd, Anaheim, CA, Jan. 30-Feb. 3, 1989, Preprints. Boston, MA, American Meteorological Society, 1989, p. 184-189. Research supported by FAA. refs

Copyright

Results are presented that demonstrate the ability of the prototype microburst recognition algorithm of the Terminal Doppler Weather Radar (TDWR) to recognize features aloft for microburst events observed at Huntsville, Alabama, in 1986 and Denver, Colorado in 1987. Five days of data from each location were used, and ground truth was established for 126 microburst events. Of these, seven high-reflectivity events were tested for the effect of using features aloft on the alarm timeliness. The average precursor warning time for the seven events was 6.2 min, which corresponds well with the conceptual model for high-reflectivity events proposed by Roberts and Wilson (1986). The use of features aloft was found to increase the alarm timeliness for these events by 1.3 minutes. 1.S.

A89-54813

EVALUATION OF MICROBURST NOWCASTING DURING TDWR 1987

RITA D. ROBERTS and MARK R. HJELMFELT (National Center for Atmospheric Research, Boulder, CO) IN: International Conference on the Aviation Weather System, 3rd, Anaheim, CA, 30-Feb. 3, 1989, Preprints. Boston, MA, American Jan. Meteorological Society, 1989, p. 206-211. Research supported by the National Center for Atmospheric Research and NSF. refs (Contract DTFA01-82-Y-10513)

Copyright

This paper presents the results of a nowcasting exercise carried out in Denver, Colorado, to test the ability of the Terminal Doppler Weather Radar (TDWR) to provide air traffic controllers and pilots with warnings of microburst hazards. The TDRW radar mesonetwork at the Denver Stapleton Airport and the instrumentation used are described, together with the operational procedure of nowcasting, the nowcasting forms, and the nowcasting statistics. Results are presented on radar signatures obtained for 57 low, moderate, and high-reflectivity storms when correct and incorrect microburst nowcasts were issued. High probability of detection, low false-alarm ratio, and reasonable critical success index scores were found, demonstrating the potential of the TDWR for warning of an impending microburst occurrence. LS.

A89-54817

MET 90. A PROJECT FOR THE DEVELOPMENT OF THE FUTURE SWEDISH AVIATION WEATHER SYSTEM

BJORN HELLROTH and ESBJORN OLSSON (Sveriges Meteorologiska och Hydrologiska Institut, Norrkoping, Sweden) IN: International Conference on the Aviation Weather System, 3rd, Anaheim, CA, Jan. 30-Feb. 3, 1989, Preprints. Boston, MA, American Meteorological Society, 1989, p. 228-232. Copyright

A89-54824

VERIFICATION OF AERODROME FORECASTS

NEIL D. GORDON (New Zealand Meteorological Service, Wellington) IN: International Conference on the Aviation Weather System, 3rd, Anaheim, CA, Jan. 30-Feb. 3, 1989, Preprints. Boston, MA, American Meteorological Society, 1989, p. 264-269. refs Copyright

The procedure of the objective verification of airport forecasts in the international standard TAF format is considered. The airport forecasts are in well-defined format, but contain information about temporal fluctuations of the elements in a form which is not readily verified from conventional airport observations (METARs and SPECI). To verify temporal fluctuations, the TAFs must be converted to probability forecasts. Techniques for automatically interpreting the temporal fluctuation characteristics of airport

870

forecasts in standard TAF code are described and are illustrated with sample verifications from three New Zealand airports for the winter of 1988. IS.

A89-54825

ANALYSIS OF VERIFICATION PARAMETERS FOR NON-CONVECTIVE SIGMETS

ROGER M. WILLIAMS (U.S. National Weather Service, Kansas City, MO) IN: International Conference on the Aviation Weather System, 3rd, Anaheim, CA, Jan. 30-Feb. 3, 1989, Preprints. Boston, MA, American Meteorological Society, 1989, p. 270-273. Copyright

This paper describes a program designed to verify nonconvective Sigmets ('significant meteorology' to pilots) issued by the National Aviation Weather Advisory Unit. In this program, Sigmets issued for 508 Sigmet areas were correlated with 4,045 pilot reports for January, February, and March of 1986, using a manual data reduction process in the analysis. It was found that, of the 508 Sigmet areas, 114 were nonverifiable; the average SII for the three months was 2.14. However, it is noted that there were limitations to this program due both to the nature of the reporting procedures of pilot reports and to the limited data base of the pilot reports used in the analysis. Thus, pilot reports describing conditions as 'light or smooth' turbulence of 'light or trace' icing were not plotted. It is suggested that the process of accounting for pilot reports is automated, thus making it possible to account for all pilot reports. This would reduce the number of unverifiable Sigmets. LS.

A89-54827

THE WORLD AREA FORECAST SYSTEM

JERALD UECKER and ESTHER L. MCKAY (U.S. National Weather Service, Silver Spring, MD) IN: International Conference on the Aviation Weather System, 3rd, Anaheim, CA, Jan. 30-Feb. 3, 1989, Preprints. Boston, MA, American Meteorological Society, 1989, p. 280-283.

Copyright

The history of establishing the World Area Forecast System (WAFS) is discussed, with special attention given to the development of various forecast centers. The WAFS network consists of two World Area Forecast Centers (WAFCs), one in Washington and one in London; a number of regional area forecast centers (RAFCs) associated with one or the other WAFC (there are eight RAFCs associated with London and seven with Washington), and the communications links for the transmission of large volumes of grid-point data in digital form between the two WAFCs and between each WAFC and its associated RAFCs. The two ongoing major efforts underway in WAFS include one concerned with the dissemination of data via satellite broadcast systems and the second with the automation of data on the significant weather elements. 1.S.

A89-54831

VERY SHORT-RANGE AERODROME FORECASTS USING **REGRESSION TECHNIQUES**

JIM RENWICK (New Zealand Meteorological Service, Wellington) IN: International Conference on the Aviation Weather System, 3rd, Anaheim, CA, Jan. 30-Feb. 3, 1989, Preprints. Boston, MA, American Meteorological Society, 1989, p. 297-300. Copyright

This paper describes a modified model-output-statistics (MOS) system that combines information from an unsophisticated numerical weather prediction (NWP) model with that from current in situ observations. Data on wind speed, the u and v wind components, horizontal visibility, ceiling, air temperature, relative humidity, dewpoint temperature, and mean sea-level pressure were New-Zealand-Meteorological-Service extracted from the climatological archive for the Christchurch airport, using reports for every hour between January 1, 1979 and December 31, 1986. Of these, the first six years were used as dependent data for the derivation of forecast equations, and the remaining two years were used for testing. The modified MOS technique was found to perform well against two sets of control forecasts for prognosis periods from one to thirteen hours. I.S.

A89-54840

DOPPLER WEATHER RADAR SERVICE AT THE CHIANG KAI-SHEK INTERNATIONAL AIRPORT

HUNG-PENG CHU and YEONG-JHY TSAI (Civil Aviation Administration of China, Air Navigation and Weather Services, Taipei, Republic of China) IN: International Conference on the Aviation Weather System, 3rd, Anaheim, CA, Jan. 30-Feb. 3, 1989, Preprints. Boston, MA, American Meteorological Society, 1989, p. 335-338. Copyright

A89-54841

AN INDEX FOR CLEAR AIR TURBULENCE BASED ON HORIZONTAL DEFORMATION AND VERTICAL WIND SHEAR

GARY P. ELLROD (NOAA, Satellite Applications Laboratory, Washington, DC) IN: International Conference on the Aviation Weather System, 3rd, Anaheim, CA, Jan. 30-Feb. 3, 1989, Preprints. Boston, MA, American Meteorological Society, 1989, p. 339-344. refs

Copyright

This paper describes an objective clear-air-turbulence (CAT) index which can be computed quickly using either numerical model winds or winds from remote sensors. The turbulence index, which is based on the product of horizontal deformation and vertical wind shear, was found to provide a fairly reliable indication of CAT potential. When derived from the Nested Grid Model described by Hoke (1984) over the United States on 33 days, the specific CAT index was found to correctly analyze significant areas of CAT about 70 percent of the time, with a false alarm ratio of 20 percent.

A89-54844

IMPROVEMENT OF THE PERFORMANCE OF SENSORS IN THE LOW-LEVEL WIND SHEAR ALERT SYSTEM (LLWAS)

KENNETH D. JAFFE (Data Transformation Corp., Atlantic City, NJ) IN: International Conference on the Aviation Weather System, 3rd, Anaheim, CA, Jan. 30-Feb. 3, 1989, Preprints. Boston, MA, American Meteorological Society, 1989, p. 356-361. refs Copyright

A low-level wind shear alert system (LLWAS) commonly consists of a network of six anemometers, one near the center of the airport, and five remote sensors scattered around its periphery, usually 2 miles or more apart. Data from many LLWAS installed nationwide revealed a loss in performance due to the sheltering phenomenon at many sensor locations, caused by surrounding obstructions. This paper discusses the methods used for the LLWAS site evaluation, the means used to determine the sensor height required to reduce sheltering by an upwind obstruction, and the minimal distance for the sensor from an obstruction. Special attention is given to the enhanced LLWAS network comprised of a dense array of ten sensors, which is being installed at the Denver Stapleton Airport, and to ground rules that are involved in the search for enhanced LLWAS sites. I.S.

A89-54846

A CASE STUDY OF LOCAL SEVERE WEATHER AT CHANG KAI SHEK INTERNATIONAL AIRPORT

KOUNG-YING LIU and TIAN-YOW SHYU (Chinese Air Force, Taipei, Republic of China) IN: International Conference on the Aviation Weather System, 3rd, Anaheim, CA, Jan. 30-Feb. 3, 1989, Preprints. Boston, MA, American Meteorological Society, 1989, p. 370-375. Research supported by the National Science Council of the Republic of China.

Copyright

A89-54852

GUST FRONT DETECTION ALGORITHM FOR THE TERMINAL DOPPLER WEATHER RADAR. II - PERFORMANCE ASSESSMENT

DIANA KLINGE-WILSON, STEPHEN H. OLSON (MIT, Lexington,

MA), WESLEY WILSON, WILLIAM P. MAHONEY, III (National Center for Atmospheric Research, Boulder, CO), STEVEN D. SMITH, ARTHUR WITT (NOAA, National Severe Storms Laboratory, Norman, OK) et al. IN: International Conference on the Aviation Weather System, 3rd, Anaheim, CA, Jan. 30-Feb. 3, 1989, Preprints. Boston, MA, American Meteorological Society, 1989, p. 398-402. Research supported by FAA. refs Copyright

This paper describes the Gust Front Algorithm for the detection of gust front and wind shift, designed for use in the Terminal Doppler Weather Radar (TDWR) system, and the results of its performance assessment during the 1988 TDWR Operational Test and Evaluation, conducted near Denver, Colorado. Special attention is given to the data-editing, product-generation, ground-truth, and scoring issues. Scoring results are presented, and problems identified during the test are discussed.

A89-54854

THE FEDERAL AVIATION ADMINISTRATION'S LOW LEVEL WINDSHEAR ALERT SYSTEM - A PROJECT MANAGEMENT PERSPECTIVE

CRAIG R. GOFF (FAA, Washington, DC) and RICHARD H. GRAMZOW (Martin Marietta Corp., Washington, DC) IN: International Conference on the Aviation Weather System, 3rd, Anaheim, CA, Jan. 30-Feb. 3, 1989, Preprints. Boston, MA, American Meteorological Society, 1989, p. 408-413. refs Copyright

The Low-Level Windshear Alert System (LLWAS) is a network of conventional wind sensing devices linked by radio to a central computer which issues wind-shear advisories to air-traffic controllers. This paper discusses the first significant improvements since the initial LLWAS was installed in 1977, which consist of increasing the network density by adding new wind sensor sites to the original six; making software and network design enhancements to distinguish microburst windshears from other types of shear, provide the air-traffic controllers and pilots with runway-oriented windshear information, and provide shear detection capability at centerfield.

A89-54855

THE FAA TERMINAL DOPPLER WEATHER RADAR (TDWR) PROGRAM

DONALD TURNBULL (FAA, Washington, DC) and JOHN MCCARTHY (National Center for Atmospheric Research, Boulder, CO) IN: International Conference on the Aviation Weather System, 3rd, Anaheim, CA, Jan. 30-Feb. 3, 1989, Preprints. Boston, MA, American Meteorological Society, 1989, p. 414-419. Research supported by FAA. refs

Copyright

The FAA Terminal Doppler Weather Radar (TDWR) program was initiated to design a reliable automated system for detecting low-altitude wind shear in the aircraft's approach-and-departure corridor and to provide timely warnings to pilots of its presence and its relative severity. This paper describes the history of the TDWR development, the user needs, the TDWR processing equipment and the automatic detection algorithm, and the planned TDWR products, initial and future. Results are presented for the 1988 testing of TDWR in the Denver, Colorado, area. The system was found to detect 90 percent of all microbursts with wind changes greater than 10 m/s, and 97 percent of microbursts with wind shears greater than 15 m/s.

A89-54856

GROUND BASED WEATHER RADAR FOR AVIATION

ARTHUR L. HANSEN (FAA, Washington, DC) IN: International Conference on the Aviation Weather System, 3rd, Anaheim, CA, Jan. 30-Feb. 3, 1989, Preprints. Boston, MA, American Meteorological Society, 1989, p. 420, 421. Copyright

The operational requirements for aviation weather are discussed together with the use of weather radar data for flight planning support. The weather radar can help to determine the temporal and spatial scales of weather parameters of greatest concern for

13 GEOSCIENCES

aviation safety, such as wind, wind shear, turbulence, hail, lightning, and visibility, as these are related to the various phases of flight. Because of the rapid descent of the microburst and the subsequent generation of low-level wind shear, high-speed computers are needed to process the data. The installation (in 1994) of the FAA's Real-Time Weather Processor will add alphanumeric notations, graphic outlines, and symbols to the radar products forwarded by the Central Weather Service Units to the air traffic controllers and traffic-management specialists.

A89-54857

THE STATUS OF THE FAA CENTRAL WEATHER PROCESSOR (CWP) PROGRAM

ERIC MANDEL, KEVIN YOUNG (FAA, Washington, DC), DAVID PANZER, and HAL LUDWIG (Stanford Telecommunication, Inc., Washington, DC) IN: International Conference on the Aviation Weather System, 3rd, Anaheim, CA, Jan. 30-Feb. 3, 1989, Preprints. Boston, MA, American Meteorological Society, 1989, p. 422-425. refs

Copyright

This paper describes the FAA Central Weather Processor (CWP) system that is to be deployed in 1994, together with its two complementary subsystems, the Real-Time Weather Processor and the Meteorologist Weather Processor, with special attention given to the upgraded weather-data-collection, processing, and distribution facilities. This integrated system will provide weather data distribution, processing, and services tailored to all of the personnel responsible for meteorology within the NAS. I.S.

A89-54860

THE DEVELOPMENT OF NUMERICALLY-BASED AND EXPERT SYSTEM APPROACHES FOR AIRFIELD NOWCASTING/VERY SHORT RANGE FORECASTING

DONALD A. CHISHOLM, ALAN R. BOHNE, and ROSEMARY M. DYER (USAF, Geophysics Laboratory, Hanscom AFB, MA) IN: International Conference on the Aviation Weather System, 3rd, Anaheim, CA, Jan. 30-Feb. 3, 1989, Preprints. Boston, MA, American Meteorological Society, 1989, p. 433-436. refs Copyright

The new capabilities planned for the weather-report locations supporting the Air-Force and Army operations are NEXRAD Doppler weather radar, DMSP and GOES satellite imagery and soundings, conventional observations and model-generated analyses, and forecasted gridded fields via the Automated Weather Distribution System. To manage the large amounts of data into an integrated information processing system, the program called Advanced Meteorological Processing System (AMPS) was initiated, which will extrapolation procedures and/or GOES imagery, provide modules for the to nowcast/forecast NEXRAD and/or the numerically-based prediction models dealing with the processes of convective initiation and with nonconvective cloud and precipitation systems, and artificial intelligence. This paper discusses the AMPS experimental facility and the development 1.S. program.

A89-54862

AN OVERVIEW OF THE NATIONAL PROGRAM TO IMPROVE AIRCRAFT ICING FORECASTS

JOHN W. HINKELMAN, JR. (National Center for Atmospheric Research, Boulder, CO) IN: International Conference on the Aviation Weather System, 3rd, Anaheim, CA, Jan. 30-Feb. 3, 1989, Preprints. Boston, MA, American Meteorological Society, 1989, p. 443-445.

Copyright

This paper outlines the National Plan (OFCM 1986) for developing the capability to detect, monitor, and forecast aircraft icing conditions through the use of research aircraft, and new remote sensing technology. The plan objective is the timely, accurate delineation of actual and expected icing areas by location, altitude, duration, and potential severity. Author

A89-54865 FEDERAL PLANS TO SATISFY AVIATION WEATHER INFORMATION REQUIREMENTS IN THE 1990'S

MICHAEL A. TOMLINSON (U.S. National Weather Service, Silver Spring, MD) IN: International Conference on the Aviation Weather System, 3rd, Anaheim, CA, Jan. 30-Feb. 3, 1989, Preprints. Boston, MA, American Meteorological Society, 1989, p. 459-462. Copyright

New aviation weather services provided by the National Weather Service (NWS) and FAA use the data and data-analysis capabilities provided by new sensors and interactive workstations. As the new technology of the Next Generation Weather Radar, next generation weather satellites, Automated Surface Observation Systems and other remote sensing systems, and the next-generation supercomputer for NMC become available, the NWS forecasters will require an advanced interactive processing and display system to fully utilize the new data sets and high-resolution information. These requirements will be met by the Advanced Weather Interactive Processing System for the 1990s (AWIPS-90). I.S.

A89-54866 WEATHER INFORMATION SYSTEMS FOR PILOTS - THE MINNESOTA EXPERIENCE

DEAN C. LARSON (Minnesota Dept. of Transportation, Saint Paul) IN: International Conference on the Aviation Weather System, 3rd, Anaheim, CA, Jan. 30-Feb. 3, 1989, Preprints. Boston, MA, American Meteorological Society, 1989, p. 463-465. Copyright

The Minnesota weather information system for pilots, designed by the Office of Aeronautics of the Minnesota Department of Transportation is described, with special attention given to the Minnesota Weather Access System (MnWAS) program. Presently, the information obtained from 14 Supplemental Aviation Weather Reporting Stations in Minnesota is sent at 20-min intervals, via a computer-phone linkup, to the National Weather Service (NWS) in Kansas City, Missouri, which then distributes this information nationally over the NWS/FAA weather circuits. The MnWAS is a weather information distribution program with 77 computer terminals installed in 52 airports, which are linked via phone line to a control data computer. The control data computer operates 24 hours a day as a server, collecting data from the NWS/FAA weather circuits and other sources, formatting the data and distributing them upon phone request to the MnWAS terminals. The terminals provide paper printouts of the weather data and maps for pilots. 18

A89-54868

TECHNIQUES FOR THE DETECTION OF MICROBURST EVENTS USING AIRPORT SURVEILLANCE RADARS -CROSS-SPECTRAL VELOCITY ESTIMATION

JOHN R. ANDERSON and ROBERT N. GIFFORD (Wisconsin, University, Madison) IN: International Conference on the Aviation Weather System, 3rd, Anaheim, CA, Jan. 30-Feb. 3, 1989, Preprints. Boston, MA, American Meteorological Society, 1989, p. 489-492. Research supported by FAA. Copyright

This paper describes a cross-spectral velocity estimation technique for the detection of microburst events with airport surveillance radars, which exploits the elevation-dependent phase differences between two beams. It is shown that the cross-spectral velocity estimator can be derived in a form similar to the traditional mean velocity angle equation, but involves a weighting function which is designed to minimize the contributions of velocity components which have phase angles not consistent with low elevation angles. A sample result is presented, showing the measurement of wind fields associated with a shallow microburst outflow at a range of 19 km from the radar.

15 MATHEMATICAL AND COMPUTER SCIENCES

MATHEMATICAL AND COMPUTER SCIENCES

Includes mathematical and computer sciences (general); computer operations and hardware; computer programming and software; computer systems; cybernetics; numerical analysis; statistics and probability; systems analysis; and theoretical mathematics.

A89-52564*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

INTEGRATED STRUCTURE/CONTROL LAW DESIGN BY MULTILEVEL OPTIMIZATION

MICHAEL G. GILBERT (NASA, Langley Research Center, Hampton, VA) and DAVID K. SCHMIDT (Arizona State University, Tempe) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 1. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 376-385. Previously announced in STAR as N89-26623. refs

(AIAA PAPER 89-3470) Copyright

A new approach to integrated structure/control law design based on multilevel optimization is presented. This new approach is applicable to aircraft and spacecraft and allows for the independent design of the structure and control law. Integration of the designs is achieved through use of an upper level coordination problem formulation within the multilevel optimization framework. The method requires the use of structure and control law design sensitivity information. A general multilevel structure/control law design problem formulation is given, and the use of Linear Quadratic Gaussian (LQG) control law design and design sensitivity methods within the formulation is illustrated. Results of three simple integrated structure/control law design examples are presented. These results show the capability of structure and control law design tradeoffs to improve controlled system performance within the multilevel approach.

A89-52585#

A SURROGATE SYSTEM APPROACH TO ROBUST CONTROL DESIGN

SIVA S. BANDA, HSI-HAN YEH, and SHARON A. HEISE (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, OH) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 1. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 576-582. refs (AIAA PAPER 89-3492)

The design of robust control systems in the presence of real-parameter uncertainty and high frequency unmodelled dynamics is considered. Concepts of applying H(infinity) and LQG optimizations to a surrogate system representation of an uncertain system are discussed. An algorithm is explicitely stated detailing the design of control laws guaranteeing both robust stability and robust performance for the uncertain system. Advantages and limitations to this design procedure are outlined, and possible directions for future research are revealed. Author

A89-52603*# Mississippi State Univ., Mississippi State. EXTENDED OBSERVABILITY OF LINEAR TIME-INVARIANT SYSTEMS UNDER RECURRENT LOSS OF OUTPUT DATA

ROGELIO LUCK (Mississippi State University, Mississippi State), ASOK RAY (Pennsylvania State University, University Park), and YORAM HALEVI (Technion - Israel Institute of Technology, Haifa) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 1. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 741-748. refs

(Contract NAG3-823; NSF DMC-87-07648) (AIAA PAPER 89-3510) Copyright

Recurrent loss of sensor data in integrated control systems of an advanced aircraft may occur under different operating conditions that include detected frame errors and queue saturation in computer networks, and bad data suppression in signal processing. This paper presents an extension of the concept of observability based on a set of randomly selected nonconsecutive outputs in finite-dimensional, linear, time-invariant systems. Conditions for testing extended observability have been established. Author

A89-52657#

OPTIMAL OUTPUT FEEDBACK FOR LINEAR TIME-PERIODIC SYSTEMS

ANTHONY J. CALISE, DANIEL P. SCHRAGE (Georgia Institute of Technology, Atlanta), and MARK E. WASIKOWSKI IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 2. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 1232-1237. refs

(Contract DAAL03-88-C-0003)

(AIAA PAPER 89-3574) Copyright

An approach is developed for applying optimal output feedback control theory to the design of fixed gain controllers for time periodic systems. Constant feedback gains based on available plant outputs are calculated by minimizing a linear quadratic performance cost functional. The envelope of the periodic system state and control response are penalized in the cost functional, with the objective of improving modal damping. A computationally efficient algorithm is developed using Floquet-Liapunov theory and a generalized harmonic expansion technique. The theory is applied to the control of a helicopter rotor blade in forward flight. It is shown that constant gain output feedback can be used to augment the stability of time-periodic systems. Thus, the implementation complexity associated with active control of periodic systems is reduced considerably.

A89-52658*# Information and Control Systems, Inc., Hampton, VA.

A VARIABLE-GAIN OUTPUT FEEDBACK CONTROL DESIGN APPROACH

NESIM HAYLO (Information and Control Systems, Inc., Hampton, VA) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 2. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 1238-1248. refs (Contract NAS1-17493)

(AIAA PAPER 89-3575) Copyright

A multi-model design technique to find a variable-gain control law defined over the whole operating range is proposed. The design is formulated as an optimal control problem which minimizes a cost function weighing the performance at many operating points. The solution is obtained by embedding into the Multi-Configuration Control (MCC) problem, a multi-model robust control design technique. In contrast to conventional gain scheduling which uses a curve fit of single model designs, the optimal variable-gain control law stabilizes the plant at every operating point included in the design. An iterative algorithm to compute the optimal control gains is presented. The methodology has been successfully applied to

A89-52715*# Arizona State Univ., Tempe. ON THE CONTROL OF ELASTIC VEHICLES - MODEL SIMPLIFICATION AND STABILITY ROBUSTNESS

DAVID K. SCHMIDT (Arizona State University, Tempe) and BRETT NEWMAN AIAA, Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989. 22 p. refs (Contract NAG1-758)

reconfigurable aircraft flight control and to nonlinear flight control

(AIAA PAPER 89-3558) Copyright

systems

Quantitative criteria are presented for model simplification, or order reduction, such that the reduced order model may be used to synthesize and evaluate a control law, and the stability and stability robustness obtained using the reduced-order model will be preserved when controlling the full-order system. The error introduced due to model simplification is treated as modeling uncertainty, and some of the results from multivariable robustness theory are brought to bear on the model simplification problem. A

Author

15 MATHEMATICAL AND COMPUTER SCIENCES

numerical procedure developed previously is shown to lead to results that meet the necessary criteria. The procedure is applied to reduce the model of a flexible aircraft. Also, the importance of the control law itself, in meeting the modeling criteria, is underscored. An example is included that demonstrates that an apparently robust control law actually amplifies modest modeling errors in the critical frequency region, and leads to undesirable results. The cause of this problem is identified to be associated with the canceling of lightly-damped transmission zeroes in the plant. Author

A89-52802

ASYMPTOTIC SOLUTION OF A NONLINEAR BOUNDARY VALUE PROBLEM WITH A PARTLY UNKNOWN BOUNDARY [ASIMPTOTICHESKOE RESHENIE NELINEINOI KRAEVOI ZADACHI S CHASTICHNO NEIZVESTNOI GRANITSEI]

A. M. ANTONOVA and L. I. DZVONIK (Kievskii Gosudarstvennyi Universitet, Kiev, Ukrainian SSR) Matematicheskaia Fizika i Nelineinaia Mekhanika (ISSN 0233-7568), no. 11, 1989, p. 36-40. In Russian.

Copyright

The three-dimensional problem of flow of a gas at high supersonic velocities past a plane delta wing is analyzed for the case of intensive mass transfer at the wing surface. A nonlinear boundary value problem is stated for an injection region with a partly unknown boundary. An asymptotic solution is obtained for the principal gasdynamic parameters, and the boundary shape is determined for power-law injection. V.L.

A89-53152*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA. SUPERCOMPUTER REQUIREMENTS FOR SELECTED

DISCIPLINES IMPORTANT TO AEROSPACE

VICTOR L. PETERSON, JOHN KIM, TERRY L. HOLST, GEORGE S. DEIWERT, DAVID M. COOPER, ANDREW B. WATSON, and F. RON BAILEY (NASA, Ames Research Center, Moffett Field, CA) IEEE, Proceedings (ISSN 0018-9219), vol. 77, July 1989, p. 1038-1055. refs

Speed and memory requirements placed on supercomputers by five different disciplines important to aerospace are discussed and compared with the capabilities of various existing computers and those projected to be available before the end of this century. The disciplines chosen for consideration are turbulence physics, aerodynamics, aerothermodynamics, chemistry, and human vision modeling. Example results for problems illustrative of those currently being solved in each of the disciplines are presented and discussed. Limitations imposed on physical modeling and geometrical complexity by the need to obtain solutions in practical amounts of time are identified. Computational challenges for the future, for which either some or all of the current limitations are removed, are described. Meeting some of the challenges will require computer speeds in excess of exaflop/s (10 to the 18th flop/s) and memories in excess of petawords (10 to the 15th words). Ι.E.

A89-53416

AN OPTIMAL MATERIAL REMOVAL STRATEGY FOR AUTOMATED REPAIR OF AIRCRAFT CANOPIES

DENNIS J. WENZEL and DAVID S. MCFALLS (Southwest Research Institute, San Antonio, TX) IN: 1989 IEEE International Conference on Robotics and Automation, Scottsdale, AZ, May 14-19, 1989, Proceedings. Volume 1. Washington, DC, IEEE Computer Society Press, 1989, p. 370-376. refs (Contract F42650-86-C-3276)

Copyright

A description is given of the Robotic Canopy Polishing System (RCPS). The RCPS work cell contains three robotic arms that are used to assist an expert canopy polisher in inspecting and reworking plastic aircraft canopy transparencies. Particular attention is given to the methodology by which the RCPS determines where best to remove plastic from the canopy, given the raw data indicating flaw positions and severity. This process is driven by the following requirements: to completely remove the flaws; to minimize the

number of grinding patterns laid on the canopies; and to minimize the distortion by overlapping grinding patterns. The features of the template-mismatch technique used are described. I.E.

A89-53951

1989 AMERICAN CONTROL CONFERENCE, 8TH, PITTSBURGH, PA, JUNE 21-23, 1989, PROCEEDINGS. VOLUMES 1, 2, & 3

Conference sponsored by the American Automatic Control Council. New York, Institute of Electrical and Electronics Engineers, 1989, p. Vol. 1, 1017 p.; vol. 2, 931 p.; vol. 3, 1029 p. For individual items see A89-53952 to A89-54007, A89-54009 to A89-54117. Copyright

Papers are presented on such topics as the robust control of robotic manipulators, aircraft control, intelligent control systems, computer networking for real-time control, robust adaptive control, and nonlinear process control. Consideration is also given to advances in distributed detection, control issues for large flexible manipulators, aerospace guidance and control, optimization in biochemical engineering, advanced robotics, fuzzy logic and process control, vibration control, and special architectures in real-time control systems.

A89-53970

A KNOWLEDGE BASED TOOL FOR FAILURE PROPAGATION ANALYSIS

P. S. NESS, D. BEREKET, M. HAKIMI, T. UTHUS, and A. CHAKRAVARTY (Boeing Commercial Airplanes, Seattle, WA) IN: 1989 American Control Conference, 8th, Pittsburgh, PA, June 21-23, 1989, Proceedings. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1989, p. 344-348. Copyright

A knowledge-based tool for failure propagation analysis is discussed. The first version of the computer program simulated the propagation of a single avionics or electrical power failure through a network of avionics systems. Recent work focuses on two program modifications. The first expands the failure propagation capability to simulate failures of multiple avionics line replaceable units. The second adds a backchaining (diagnostic) function to the program. This function enables the Avionics Failure Propagation Analysis Tool to deduce the source of a failure propagation from a set of flight deck failure effects.

A89-53975

LINEAR TOKEN PASSING BASED BUS INTERFACE UNIT FOR A FAULT TOLERANT MULTIPROCESSOR TESTBED

DANIEL B. THOMPSON (USAF, Wright Research and Development Center, Wright-Patterson AFB, OH) IN: 1989 American Control Conference, 8th, Pittsburgh, PA, June 21-23, 1989, Proceedings. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1989, p. 507-510.

Copyright

An inhouse testbed based on the concepts developed in the Advanced Multiprocessor Control Architecture Development (AMCAD) project is discussed. The author addresses the design of the bus interface unit (BIU) used to connect each processing module to a linear token-passing bus based network. This network comprises four independent buses and is implemented using MC68824 IEEE 802.4 bus controller chips. The concepts of the AMCAD project, as well as the functional composition of the BIU design, are described.

A89-54007

FAULT-TOLERANT SENSOR AND ACTUATOR SELECTION FOR CONTROL OF FLEXIBLE STRUCTURES

WILLIAM N. MCCASLAND (USAF, Washington, DC) IN: 1989 American Control Conference, 8th, Pittsburgh, PA, June 21-23, 1989, Proceedings. Volume 2. New York, Institute of Electrical and Electronics Engineers, 1989, p. 1111-1116. refs Copyright

Consideration is given to sensor and actuator placement for structural control with the possibility of failures. Norms on controllability or observability gramians are selected as a performance measure and algorithms are developed. Scaling of the state space is based on selection of a throughput path. Examples are shown for a simply supported beam and a large-scale finite-element model.

A89-54022

IDENTIFICATION OF STATE-SPACE PARAMETERS IN THE PRESENCE OF UNCERTAIN NUISANCE PARAMETERS

JOHN P. GARNER (Computational Engineering, Inc., Laurel, MD) and JAMES C. SPALL (Johns Hopkins University, Laurel, MD) IN: 1989 American Control Conference, 8th, Pittsburgh, PA, June 21-23, 1989, Proceedings. Volume 2. New York, Institute of Electrical and Electronics Engineers, 1989, p. 1226-1230. refs (Contract N00039-87-C-5301)

Copyright

A methodology is presented to account for the uncertainty in maximum-likelihood estimates of state-space parameters in the presence of uncertain nuisance parameters. The technique uses the asymptotic normality of the uncertainty in the estimates and the implicit function theorem to determine a correction to the estimate uncertainty evaluated from the Fisher information matrix. Efficient evaluation of the correction using Kalman filtering is discussed, and a numerical example for the X-22A aircraft is presented.

A89-54024

A SYSTEMATIC APPROACH TO GAIN SUPPRESSION USING EIGENSTRUCTURE ASSIGNMENT

K. M. SOBEL, W. YU (City College, New York), and E. Y. SHAPIRO (HR Textron, Inc., Valencia, CA) IN: 1989 American Control Conference, 8th, Pittsburgh, PA, June 21-23, 1989, Proceedings. Volume 2. New York, Institute of Electrical and Electronics Engineers, 1989, p. 1292-1294. refs Copyright

The authors derive expressions for the partial derivatives of the eigenvectors with respect to the gains and use them to compute the expected shift in the eigenvectors if the ij-th gain were suppressed to zero. This establishes a complete systematic method for designing constrained output feedback controllers by a priori choosing to set those gains to zero which have the smallest influence on the system eigenstructure. The authors illustrate this approach by designing control laws a highly-augmented fighter aircraft.

A89-54106

EXPERIENCE WITH IMPLEMENTATION OF A TURBOJET ENGINE CONTROL PROGRAM ON A MULTIPROCESSOR

PHILLIP L. SHAFFER (General Electric Co., Schenectady, NY) IN: 1989 American Control Conference, 8th, Pittsburgh, PA, June 21-23, 1989, Proceedings. Volume 3. New York, Institute of Electrical and Electronics Engineers, 1989, p. 2715-2720. refs Copyright

A control program for turbojet engines has been implemented on a four-processor bus-based multiprocessor with private memory for each processor's code and data, and shared memory for data passed between processors. A speedup of 3.38 times the speed of a sequential version of the same program on a single processor has been achieved. The concurrent program was produced by subjecting a sequential program to global, hierarchical interprocedural data-flow analysis and timing measurements. A static schedule for the constituent tasks of the control program on the four processors was determined using a heuristic algorithm based on the critical path method. An application-independent supervisor program on each processor controls the execution of tasks by ensuring that all data dependencies are met, copying values from shared memory before execution of each task, and then copying values to shared memory and notifying tasks on the other processors after a task has completed execution. IF.

15 MATHEMATICAL AND COMPUTER SCIENCES

A89-54540

FIXED-SIGN CONDITION FOR INTEGRAL QUADRATIC FORMS AND STABILITY OF SYSTEMS WITH DISTRIBUTED PARAMETERS [USLOVIE ZAKONOOPREDELENNOSTI INTEGRAL'NYKH KVADRATICHNYKH FORM I USTOICHIVOST' SISTEM S RASPREDELENNYMI PARAMETRAMI]

F. D. BAIRAMOV and T. K. SIRAZETDINOV Prikladnaia Matematika i Mekhanika (ISSN 0032-8235), vol. 53, July-Aug. 1989, p. 567-575. In Russian. refs

Copyright

An approach to the stability analysis of distributed-parameter systems described by linear partial differential equations is proposed whereby new variables are introduced into the initial equations in order to reduce them to first-order equations with respect to time and spatial coordinates. Liapunov functions in this case are constructed in the form of single integral expressions. New necessary and sufficient conditions for the fixed sign of these expressions are obtained. These criteria are then used to obtain sufficient stability conditions for systems with distributed parameters. The stability of the torsional vibrations of an aircraft wing is examined as an example.

A89-54858* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

JPL REALTIME WEATHER PROCESSOR SYSTEM DEVELOPED FOR FAA

PHILIP C. CHEN (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) IN: International Conference on the Aviation Weather System, 3rd, Anaheim, CA, Jan. 30-Feb. 3, 1989, Preprints. Boston, MA, American Meteorological Society, 1989, p. 426-429.

Copyright

Modifications made to the Central Weather Processor (CWP) project are discussed. In 1987, the development plan was revised and the CWP was split into the following parts: a meteorological weather processor and a realtime weather processor (RWP). The JPL is in charge of RWP development. Consideration is given to the major product categories (NEXRAD products, alphanumeric weather products, binary encoded products, graphic products), and the system architecture (the individual radar processor, the radar mosaic processor, and the communication and control processor). K.K.

A89-54904* Stanford Univ., CA.

REPRESENTATION AND DISPLAY OF VECTOR FIELD TOPOLOGY IN FLUID FLOW DATA SETS

JAMES HELMAN and LAMBERTUS HESSELINK (Stanford University, CA) Computer (ISSN 0018-9162), vol. 22, Aug. 1989, p. 27-36. refs

(Contract NAG2-489)

Copyright

The visualization of physical processes in general and of vector fields in particular is discussed. An approach to visualizing flow topology that is based on the physics and mathematics underlying the physical phenomenon is presented. It involves determining critical points in the flow where the velocity vector vanishes. The critical points, connected by principal lines or planes, determine the topology of the flow. The complexity of the data is reduced without sacrificing the quantitative nature of the data set. By reducing the original vector field to a set of critical points and their connections, a representation of the topology of a two-dimensional vector field that is much smaller than the original data set but retains with full precision the information pertinent to the flow topology is obtained. This representation can be displayed as a set of points and tangent curves or as a graph. Analysis (including algorithms), display, interaction, and implementation aspects are discussed. I.E.

A89-54907* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA. SCIENTIFIC VISUALIZATION IN COMPUTATIONAL AERODYNAMICS AT NASA AMES RESEARCH CENTER

15 MATHEMATICAL AND COMPUTER SCIENCES

GORDON V. BANCROFT, TODD PLESSEL, FERGUS MERRITT, PAMELA P. WALATKA, and VAL WATSON (NASA, Ames Research Center, Moffett Field, CA) Computer (ISSN 0018-9162), vol. 22, Aug. 1989, p. 89-95. refs

Copyright

The visualization methods used in computational fluid dynamics research at the NASA-Ames Numerical Aerodynamic Simulation facility are examined, including postprocessing, tracking, and steering methods. The visualization requirements of the facility's three-dimensional graphical workstation are outlined and the types hardware and software used to meet these requirements are discussed. The main features of the facility's current and next-generation workstations are listed. Emphasis is given to postprocessing techniques, such as dynamic interactive viewing on the workstation and recording and playback on videodisk, tape, and 16-mm film. Postprocessing software packages are described, including a three-dimensional plotter, a surface modeler, a graphical animation system, a flow analysis software toolkit, and a real-time interactive particle-tracer.

N89-29032*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH. A REAL TIME MICROCOMPUTER IMPLEMENTATION OF

A REAL TIME MICROCOMPUTER IMPLEMENTATION OF SENSOR FAILURE DETECTION FOR TURBOFAN ENGINES JOHN C. DELAAT and WALTER C. MERRILL Aug. 1989 27 p (NASA-TM-102327; E-5029; NAS 1.15:102327) Avail: NTIS HC A03/MF A01 CSCL 09/2

An algorithm was developed which detects, isolates, and accommodates sensor failures using analytical redundancy. The performance of this algorithm was demonstrated on a full-scale F100 turbofan engine. The algorithm was implemented in real-time on a microprocessor-based controls computer which includes parallel processing was used to achieve the required computational power for the real-time implementation. High order language programming was used in order to reduce the programming and maintenance costs of the algorithm implementation software. The sensor failure algorithm to give a complete control implementation with sensor analytical redundancy. The real-time microprocessor implementation of the algorithm which resulted in the successful completion of the algorithm engine demonstration, is described.

16

PHYSICS

Includes physics (general); acoustics; atomic and molecular physics; nuclear and high-energy physics; optics; plasma physics; solid-state physics; and thermodynamics and statistical physics.

A89-53932#

NOZZLE GEOMETRY EFFECTS ON SUPERSONIC JET INTERACTION

R. W. WLEZIEN (McDonnell Douglas Research Laboratories, Saint Louis, MO) AIAA Journal (ISSN 0001-1452), vol. 27, Oct. 1989, p. 1361-1367. Research supported by McDonnell Douglas Independent Research and Development Program. Previously cited in issue 04, p. 569, Accession no. A88-16548. refs Copyright

A89-53945#

USE OF THE KIRCHHOFF METHOD IN ACOUSTICS

A. S. LYRINTZIS and A. R. GEORGE (Cornell University, Ithaca, NY) AIAA Journal (ISSN 0001-1452), vol. 27, Oct. 1989, p. 1451-1453. Research supported by McDonnell Douglas Helicopter Co. Previously cited in issue 06, p. 864, Accession no. A88-20178. refs Copyright

A89-54487#

NOISE PRODUCED BY A JET AIRCRAFT DURING THE ENGINE TEST RUN [HALAS WYTWARZANY PRZEZ SAMOLOT ODRZUTOWY PODCZAS PROBY SILNIKA]

KAZIMIERZ JANUSIAK and STEFAN SZCZECINSKI Technika Lotnicza i Astronautyczna (ISSN 0040-1145), vol. 44, Jan. 1989, p. 17, 18. In Polish.

The paper presents results of noise measurements conducted on the TS-11 aircraft during the engine test run. Recommendations essential to engine-test personnel are formulated on the basis of an analysis of acoustic spectra and the directional distribution of noise as a function of frequency and engine rpm. B.J.

N89-29152*# United Technologies Research Center, East Hartford, CT.

NOISE PRODUCED BY TURBULENT FLOW INTO A ROTOR: USERS MANUAL FOR NOISE CALCULATION Final Report

R. K. AMIET, C. G. EGOLF, and J. C. SIMONICH Jun. 1989 38 p

(Contract NAS1-17763)

(NASA-CR-181790; NAS 1.26:181790) Avail: NTIS HC A03/MF A01 CSCL 20/1

A users manual for a computer program for the calculation of noise produced by turbulent flow into a helicopter rotor is presented. These inputs to the program are obtained from the atmospheric turbulence model and mean flow distortion calculation, described in another volume of this set of reports. Descriptions of the various program modules and subroutines, their function, programming structure, and the required input and output variables are included. This routine is incorporated as one module of NASA's ROTONET helicopter noise prediction program. Author

N89-29154*# United Technologies Research Center, East Hartford, CT.

NOISE PRODUCED BY TURBULENT FLOW INTO A ROTOR: USERS MANUAL FOR ATMOSPHERIC TURBULENCE PREDICTION AND MEAN FLOW AND TURBULENCE CONTRACTION PREDICTION Final Report

J. C. SIMONICH and B. CAPLIN Jun. 1989 43 p (Contract NAS1-17763)

(NASA-CR-181791; NÁS 1.26:181791) Avail: NTIS HC A03/MF A01 CSCL 20/1

A users manual for a computer program for predicting atmospheric turbulence and mean flow and turbulence contraction as part of a noise prediction scheme for nonisotropic turbulence ingestion noise in helicopters is described. Included are descriptions of the various program modules and subroutines, their function, programming structure, and the required input and output variables. This routine is incorporated as one module of NASA's ROTONET helicopter noise prediction program. Author

N89-29155*# Southwest Research Inst., San Antonio, TX. AIRCRAFT PROPELLER INDUCED STRUCTURE-BORNE NOISE

JAMES F. UNRUH Washington Oct. 1989 113 p (Contract NAS1-17921)

(NASA-CR-4255; NAS 1.26:4255; SRI-04-8542-1) Avail: NTIS HC A06/MF A01 CSCL 20/1

A laboratory-based test apparatus employing components typical of aircraft construction was developed that would allow the study of structure-borne noise transmission due to propeller induced wake/vortex excitation of in-wake structural appendages. The test apparatus was employed to evaluate several aircraft installation effects (power plant placement, engine/nacelle mass loading, and wing/fuselage attachment methods) and several structural response modifications for structure-borne noise control (the use of wing blocking mass/fuel, wing damping treaments, and tuned mechanical dampers). Most important was the development of in-flight structure-borne noise transmission detection techniques using a combination of ground-based frequency response function testing and in-flight structural response measurement. Propeller wake/vortex excitation simulation techniques for improved ground-based testing were also developed to support the in-flight structure-borne noise transmission detection development. Author

N89-29156 Forschungsinstitut fuer Hochfrequenzphysik, Werthhoven (Germany, F.R.).

ACOUSTICAL TRACKING OF FAST MANEUVERING AIRCRAFT BY DISTRIBUTED SENSORS

F. DOMMERMUTH Aug. 1988 41 p In GERMAN; ENGLISH summarv

(Contract BMVG-T/RF-31/G-0022/G-1312)

(REPT-6-88: LFD-275; ETN-89-94401) Copyright Avail: Forschungsinstitut fuer Hochfrequenzphysik,

Wachtberg-Werthhoven, Fed. Republic of Germany

A method for the aeroacoustic tracking of nearly arbitrarily maneuvering subsonic sound sources is presented. With the proposed procedure, the target position can be determined at any instant, if the measured data of at least two acoustical sensors (consisting of three or four microphones each) are available. The pertaining error covariance matrix is given. The application to simulated data shows that even very fast maneuvering targets can be tracked reliably. A data update rate of 5 Hz allows a near real time tracking, including the extensive measuring data treatment of four sensors. The application to real data is shown to have good results. **FSA**

N89-29158# Southampton Univ. (England). Inst. of Sound and Vibration Research.

THE ACOUSTIC CALIBRATION OF AIRCRAFT FUSELAGE **STRUCTURES, PART 1**

J. M. MASON and F. J. FAHY 23 Jan. 1989 35 p Sponsored by the Department of Trade and Industry, London, United Kingdom

(ISVR-TR-169-PT-1: ETN-89-94961) Avail: NTIS HC A03/MF A01

A new technique for calibrating a fuselage as a transducer of pressure from the external surface to the interior is described. The data generated may be combined with any impinging sound field to obtain a prediction of cabin sound pressure level. As a preliminary to tests on scale model fuselage structures, the technique is validated for sound transmission through flat panels attached to a rigid walled box. The results of these tests are described. **FSA**

N89-29193# Dayton Univ., OH. Research Inst. DISPLAY CHARACTERISTICS OF EXAMPLE LIGHT-VALVE PROJECTORS Final Technical Report, Mar. 1987 - Feb. 1989 CELESTE M. HOWARD Jun. 1989 78 p

(Contract F33615-84-C-0066; F33615-87-C-0012)

(AD-A209580: UDR-TR-88-124: AFHRL-TR-88-44) Avail: NTIS HC A05/MF A01 CSCL 20/6

Quantitative data is provided on performance characteristics of light valve projectors in simulator displays as well as in optimal laboratory conditions. Two types of light valve projectors are discussed: a single light-valve projector (also called Talaria) and a multiple light-valve projector. The data show that: (1) these projectors do not achieve brightnesses above the mesopic level in large screen simulator displays, (2) color output includes a dark-field haze which must be dealt with like ambient illumination, and (3) light/dark ratios (L/D) above 5:1 are obtainable only when the light region is white or yellow-green. GRA

17

SOCIAL SCIENCES

Includes social sciences (general); administration and management; documentation and information science; economics and cost analysis; law and political science; and urban technology and transportation.

A89-52024

THE IMPORTANCE OF WEIGHT IN A CHANGING COST ESTIMATING ENVIRONMENT

LOU GORDON (Lockheed Aeronautical Systems Co., Marietta, SAWE, Annual Conference, 47th, Plymouth, MI, May 23, GA) 24, 1988, 21 p.

(SAWE PAPER 1854) Copyright

Until recently, bottoms-up has been the primary method of cost estimating in the aerospace industry. Parametric estimates were used internally only for trade studies and should-cost analyses and were not submitted with the proposal. Lockheed is working to reverse the cost estimating process, i.e., parametric as the primary method and bottoms-up as the last resort. This paper presents one such method. The process focuses primarily on engineering labor costs for a new aircraft, but touches briefly on production costs. The presentation addresses why bottoms-up estimating is being diminished and how yesterday's databases can be adjusted for today's technology. This paper is intended to demonstrate that parametric cost estimating is being implemented as a primary method and, as a result, weight as a cost driver is extremely important. Author

A89-53330* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

TECHNICAL COMMUNICATION IN AERONAUTICS - RESULTS OF AN EXPLORATORY STUDY

THOMAS E. PINELLI (NASA, Langley Research Center, Hampton, VA), MYRON GLASSMAN (Old Dominion University, Norfolk, VA), WALTER E. OLIU (U.S. Nuclear Regulatory Commission, Washington, DC), and REBECCA O. BARCLAY (Rensselaer Polytechnic Institute, Troy, NY) IN: International Technical Communication Conference, 36th, Chicago, IL, May 14-17, 1989, Proceedings. San Diego, CA, Univelt, Inc., 1989, p. RT-42 to RT-45.

Copyright

A study was undertaken that explored several aspects of technical communications in aeronautics. The study utilized survey research. A self-administered mail guestionnaire was sent to 2,000 randomly selected members of the American Institute of Aeronautics and Astronautics (AIAA) in the U.S. with academic, government, or industrial affiliations. Six hundred and six (606) usable questionnaires were received. The findings add considerable information to the knowledge of technical communications among aeronautical engineers and scientists; reinforce some of the conventional wisdom about technical communications and question other widely-held notions; and hold significant implications for technical communicators, information managers, research and development managers, and curriculum developers. Author

A89-54337

SST/CONCORDE - LESSONS FOR HYPERSONIC PROGRAMS

ROBERT L. BLEDSOE and JOAN JOHNSON-FREESE (Central Florida, University, Orlando, FL) IN: International Conference on Hypersonic Flight in the 21st Century, 1st, Grand Forks, ND, Sept. 20-23, 1988, Proceedings. Grand Forks, ND, University of North Dakota, 1988, p. 159-165. refs

Copyright

The development of hypersonic aircraft in the coming years will involve great technological complexity, unforseeable development costs, and as yet unclear definitions of project goals. Given current Federal budgetary constraints, it becomes conceivable that the U.S. Government and/or the aerospace

17 SOCIAL SCIENCES

industry will seek a collaborative arrangement for the development of a second-generation SST and/or some type of hypersonic cruise-capable aircraft. Attention is presently given to the collaborative development and manufacturing management experience gained by French and British industry in the course of the Concorde SST program. O.C.

A89-54351

ECONOMICS OF HYPERSONIC FLIGHT

ROBERT P. LACALLI and HENRY OMAN (Boeing Aerospace, Seattle, WA) IN: International Conference on Hypersonic Flight in the 21st Century, 1st, Grand Forks, ND, Sept. 20-23, 1988, Proceedings. Grand Forks, ND, University of North Dakota, 1988, p. 284-289. refs

Copyright

On the assumptions that hydrogen fuel produced electrolytically by off-peak hydroelectric power will in due course become available, and that the HST vehicle design ultimately developed will cruise with an efficiency requiring 750 lbs of LH2/passenger, for a fuel cost of \$410, the present comparative study of alternative transportation modes shows that hypersonic travel costs need not be prohibitive. It is noted that even a small, 100-passenger Mach 10-cruise HST is capable of displacing two B 747s for the U.S. West Coast-Japan route; crew costs are also significantly reduced through speed enhancements on this scale. O.C.

A89-54352

HYPERSONIC FLIGHT AND WORLD TOURISM

RICHARD D. WOOD (U.S. Naval Postgraduate School, Monterey, CA) IN: International Conference on Hypersonic Flight in the 21st Century, 1st, Grand Forks, ND, Sept. 20-23, 1988, Proceedings. Grand Forks, ND, University of North Dakota, 1988, p. 290-300. refs

Copyright

An economic, political, and social evaluation is made of the consequences for the Pacific Rim community (encompassing Australasia, the Far East, and the west coasts of North and South America) of SST and HST air-travel systems. Attention is given to the markets that might emerge for tourism as well as to the prospects for travel and overseas settlement by affluent retirees. The analysis presented differentiates between customer lifestyles characterized in marketing terms and those characterized in cultural terms. O.C.

A89-54353

HYPERSONIC FLIGHT - FUTURE COMMERCIAL POTENTIAL

H. ROBERT WASIUTA (North Dakota, University, Grand Forks) IN: International Conference on Hypersonic Flight in the 21st Century, 1st, Grand Forks, ND, Sept. 20-23, 1988, Proceedings. Grand Forks, ND, University of North Dakota, 1988, p. 301-306. refs

Copyright

Determining what potential economic markets exist for the NASP is the central focus of this paper. The thesis of this work suggests that hypersonic aircraft will fly at Mach 25 only if there is a commercial market willing to absorb the costs of producing such a vehicle. Subsequently, this paper will outline political and economic factors that contribute to establishing the infrastructure capable of servicing commercial aviation, the space program, and the national security requirements of the nation. Author

A89-54354

THE U.S. SUPERSONIC TRANSPORT - THREE LESSONS FOR NASP FROM HISTORY

ARNOLD GOLDBURG IN: International Conference on Hypersonic Flight in the 21st Century, 1st, Grand Forks, ND, Sept. 20-23, 1988, Proceedings. Grand Forks, ND, University of North Dakota, 1988, p. 307-310. refs

Copyright

The present assessment of the relevance of 1968 experiences with the U.S. SST program to current interest in the commercial development of the National Aerospace Plane notes that collaborative work should be undertaken with the academic/public interest advisory establishment, in which the most compelling opposition can arise, from the outset. It is further recommended that the aerospace industry be provided with a cadre of highly expert commentators capable of instilling a sense of such advanced transportation technologies' importance, and that the development of such technology be firmly embedded in an international framework in order to cushion it from the political vicissitudes of national policy. O.C.

A89-54356

TRANSNATIONAL LEGAL PROBLEMS FOR COMMERCIAL HYPERSONIC FLIGHT

NATHAN C. GOLDMAN IN: International Conference on Hypersonic Flight in the 21st Century, 1st, Grand Forks, ND, Sept. 20-23, 1988, Proceedings. Grand Forks, ND, University of North Dakota, 1988, p. 316-318. refs

Copyright

The National Aerospace Plane's (NASP) hypersonic flight will break more than the sound barrier when it flies in the 1990s: it will break the technological and legal barriers between air and space. This paper narrowly focusses on the legal issues. Indeed, narrowing the subject further, the paper will deal specifically with the problems and possible solutions raised by flight and landing rights for a U.S. Aerospace plane in foreign territories. Author

A89-54357

THE ORIENT EXPRESS - THE EMPEROR'S NEW AIRPLANE

THEODORE R. HARPER (Graham and James, Los Angeles, CA) IN: International Conference on Hypersonic Flight in the 21st Century, 1st, Grand Forks, ND, Sept. 20-23, 1988, Proceedings. Grand Forks, ND, University of North Dakota, 1988, p. 319-325. refs

Copyright

The legal aspects of the development of the Orient Express, a commercial aircraft based on X-30 spinoff technology, is discussed. The regulations that could affect the development and operation of a high-speed civil transport are examined, including regulations dealing with aircraft noise, sonic booms, ozone degradation, the use of dangerous fuels, technology exports, and weight, size, and the use of existing airport facilities. Consideration is given to the sources of these regulations and the possibility of future changes in regulations. R.B.

A89-54358

HYPERSONIC FLIGHT AND THE WARSAW CONVENTION

WILLIAM E. THOMS (North Dakota, University, Grand Forks) IN: International Conference on Hypersonic Flight in the 21st Century, 1st, Grand Forks, ND, Sept. 20-23, 1988, Proceedings. Grand Forks, ND, University of North Dakota, 1988, p. 333, 334. refs Copyright

The relationship between the 1929 Warsaw Convention laws on tort liability and the development of hypersonic commercial aircraft is considered. Problems associated with the the Warsaw agreement limitations on liability are discussed. The applicability of the Warsaw Convention to hypersonic flight is examined, including the question of whether or not hypersonic flight is 'carriage by air' or 'carriage by space'. R.B.

A89-54364

HYPERSONIC FLIGHT, DOMESTIC MILITARY POLICY, AND INTERNATIONAL RELATIONS

PAUL W. HOAG (Wichita State University, KS) IN: International Conference on Hypersonic Flight in the 21st Century, 1st, Grand Forks, ND, Sept. 20-23, 1988, Proceedings. Grand Forks, ND, University of North Dakota, 1988, p. 395-402. refs Copyright

The military implications of hypersonic flight are examined, including enhanced ocean surveillance capability, changes in antisatellite forces, strengthened strategic bomber capability, the weaponization of space, and versatile and quick strategic reconnaissance. Other possible military applications include rapid deployment and resupply, dominance in tactical air operations, less need for forward deployed tactical air forces, lowering of the nuclear threshold, and flexible basing. The possibility that there is a specific military objective of the National Aerospace Plane (NASP) program is discussed. The effect of the military potential of the NASP program on international relations is considered. R.B.

A89-54863

WEATHER TESTIMONY IN LITIGATION

WILLIAM H. HAGGARD (Climatological Consulting Corp., Asheville, NC) IN: International Conference on the Aviation Weather System, 3rd, Anaheim, CA, Jan. 30-Feb. 3, 1989, Preprints. Boston, MA, American Meteorological Society, 1989, p. 448-450. Copyright

The role of the Certifed Consulting Meteorologist in aviation litigation is discussed. It is is noted that, in this type of litigation, the courts seem to find no negligence if the pilot was properly briefed about a forecast which was wrong. However, negligence is found if the briefer deviated from the forecast, whether it was right or wrong. It is argued that such concepts as simplicity in Court, visual demonstration, and the use of a solid factual basis for all opinions pertain to all types of weather-related litigation.

A89-54908

CAD/CAM - MANAGERIAL CHALLENGES AND RESEARCH ISSUES

PAUL S. ADLER (Stanford University, CA) IEEE Transactions on Engineering Management (ISSN 0018-9391), vol. 36, Aug. 1989, p. 202-215. Research supported by McKinsey and Co. refs Copyright

Results are reported of an exploratory investigation into the managerial problems of integrating computer-aided design (broadly construed to include engineering design and drafting), and computer-aided manufacturing (encompassing machine control, materials handling, manufacturing scheduling, planning and administration, testing and quality assurance). The focus is on engineering, design, fabrication, assembly, and test of printed circuit boards used in the electronics industry and on design and fabrication of hydraulic tubing in the aircraft industry. Nine U.S. electronics businesses and four U.S. aircraft companies were visited with the aim of synthesizing the elements of 'best practice'. Managerial problems and research issues are identified at each of five key levels of organizational learning: skills, procedures, structure, strategy, and culture.

19

GENERAL

A89-52923

INVESTIGATIONS IN THE HISTORY AND THEORY OF THE DEVELOPMENT OF AVIATION AND ROCKET AND SPACE SCIENCE AND TECHNOLOGY, NO. 6 [ISSLEDOVANIIA PO ISTORII I TEORII RAZVITIIA AVIATSIONNOI I RAKETNO-KOSMICHESKOI NAUKI I TEKHNIKI, NO. 6]

B. V. RAUSHENBAKH, ED. Moscow, Izdatel'stvo Nauka, 1988, 224 p. In Russian. No individual items are abstracted in this volume.

Copyright

This collection of papers treats the main trends in the development of aviation and astronautics in the technical, biomedical, social and philosophical, and legal areas. This volume is distinguished by the fact that the authors are leading specialists and organizers in the areas of Soviet aviation and astronautics.

SUBJECT INDEX

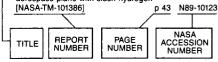
AERONAUTICAL ENGINEERING / A Continuing Bibliography (Supplement 247)

January 1990

Typical Subject Index Listing



Technology issues associated with fueling the national aerospace plane with slush hydrogen



The subject heading is a key to the subject content of the document. The title is used to provide a description of the subject matter. When the title is insufficiently descriptive of document content, a title extension is added, separated from the title by three hyphens. The (NASA or AIAA) accession number and the page number are included in each entry to assist the user in locating the abstract in the abstract section. If applicable, a report number is also included as an aid in identifying the document. Under any one subject heading, the accession numbers are arranged in sequence with the AIAA accession numbers appearing first.

A-10 AIRCRAFT

Operational test plan concept for evaluation of close air support alternative aircraft

[AD-A208185]	p 835	N89-28513
A-320 AIRCRAFT		

Lateral electric flight control laws of a civil aircraft based upon eigenstructure assignment technique p 851 A89-52718

ACCELEBATION (PHYSICS) Identification of an adequate model for collective response dynamics of a Sea King helicopter in hove (AD-A2080601 p 836 N89-29341 ACCELERATORS

Propulsion cycles for transatmospheric accelerators p 840 A89-54328

ACCIDENT	INVEST	IGATION
----------	--------	---------

Accident/incident data analysi	is database summaries,
volume 1	
[DOT/FAA/DS-89/17-1]	p 827 N89-29332
Accident/incident data analysi	
volume 2	
[DOT/FAA/DS-89/17-2]	p 828 N89-29333
ACOUSTIC EMISSION	· · · · · · · · · · · · · · · · · · ·
AE monitoring of airframe str	ructure during full scale

p 863 A89-53322 fatique test ACOUSTIC FATIGUE

Ultra high bypass aircraft sonic fatigue p 831 A89-51898

ACOUSTIC MEASUREMENT

Use of the Kirchhoff method	in acoustics	
	p 876	A89-53945
Acoustical tracking of fast r distributed sensors	maneuvering	aircraft by
[REPT-6-88]	p 877	N89-29156
The acoustic calibration of a part 1	rcraft fuselage	e structures,
LISVR-TR-169-PT-11	n 877	N89-29158

ACTIVE CONTROL

Active control of inlet distorted flow field in compressor inlet p 617 A89-52316 Modeling of aerodynamic forces in the Laplace domain with minimum number of augmented states for the design of active flutter suppression systems [AIAA PAPER 89-3466] p 844 A89-52561

Dynamic stability and active control of elastic vehicles acting with unsteady aerodynamic forces

p 848 A89-52643 [AIAA PAPER 89-3557] Optimal output feedback for linear time-periodic systems

[AIAA PAPER 89-3574] p 873 A89-52657 Robust control system design with multiple model approach and its application to active flutter control

[AIAA PAPER 89-3578] p 849 A89-52661 Active flutter suppression using invariant eros/eigensystem assignment

[AIAA PAPER 89-3610] p 350 A89-52688 Integration of active and passive sensors for obstacle p 330 A89-54083 voidance ACTUATORS

-- in flight An uncertainty model for saturated actuators p 833 A89-54066 control systems ADAPTIVE CONTROL

Adaptive control of high performance unstable aircraft p 851 A89-52989 A review ADHESIVES

High temperature adhesive systems [AD-A209166] p 860 N89-28643 ADSORPTION

Denormalized product of the adsorptive zeolite extraction of paraffins as a jet fuel component p 857 A89-52775

AEROACOUSTICS

Nozzle geometry effects on supersonic jet interaction p 876 A89-53932

Acoustical tracking of fast maneuvering aircraft by distributed sensors [REPT-6-88] p 877 N89-29156

AERODYNAMIC BRAKES

Some effects of aerodynamic spoilers on wing flutter [NASA-TM-101632] p 825 N89-29324 AERODYNAMIC CHARACTERISTICS

Theoretical study on the unsteady aerodynamic characteristics of an oscillating cascade with tip clearance - In the case of a nonloaded cascade

p 816 A89-51678 A three-dimensional boundary layer in finite-span thin

p 818 A89-52843 wings A second-order finite-difference scheme for calculating

three-dimensional supersonic flows of an ideal gas p 818 A89-52852 Calculation of the effect of the location of the jet-engine

air inlets on the air flow in front of the inlets p 820 A89-54486

Solution of the inverse boundary value problem of aerohydrodynamics with allowance for the boundary p 864 A89-54611 layer

Separated flow past a concave conical wing of large transverse curvature at small angles of attack p 820 A89-54619

The angles of the Kolibrie rotor tipvanes on the rods and on the blades

[IW-R515] p 822 N89-28499

Aerodynamic model tests of exhaust augmentors for F/A-18 engine run-up facility at RAAF Williamtown [AD-A208110] p 841 N89-28518

One-degree-of-freedom motion induced by modeled vortex shedding [NASA-TM-101038] p 866 N89-28870

Boundary-layer measurements on a transonic low-aspect ratio wing

[NASA-TM-88214] p 823 N89-29305 AERODYNAMIC COEFFICIENTS

Time domain numerical calculations of unsteady vortical flows about a flat plate airfoil

[NASA-TM-102318] p 866 N89-29726 **AERODYNAMIC CONFIGURATIONS**

Transonic flows with vorticity transport around slender p 820 A89-53949 bodies

Low-speed static and dynamic force tests of a generic supersonic cruise fighter configuration			
[NASA-TM-4138] p 821 N89-28486			
Chaotic response of aerosurfaces with structural nonlinearities			
[AD-A208433] p 824 N89-29316			
Revolutionary opportunities for materials and structures study, addendum			
[NASA-CR-179642-ADD] p 842 N89-29351			
AERODYNAMIC FORCES			
Nonlinear stabilizing control of high angle of attack flight dynamics			
[AIAA PAPER 89-3487] p 845 A89-52580			
Boundary-layer measurements on a transonic			
low-aspect ratio wing [NASA-TM-88214] p 823 N89-29305			
Some effects of aerodynamic spoilers on wing flutter			
[NASA-TM-101632] p 825 N89-29324			
AERODYNAMIC HEATING			
Thermo-viscoplastic analysis of hypersonic structures			
subjected to severe aerodynamic heating [NASA-CR-185915] p 825 N89-29328			
AERODYNAMIC LOADS			
Modeling of aerodynamic forces in the Laplace domain			
with minimum number of augmented states for the design of active flutter suppression systems			
[AIAA PAPER 89-3466] p 844 A89-52561			
Some aspects of aircraft dynamic loads due to flow			
separation p 832 A89-52959			
Correlation of Puma airloads: Evaluation of CFD prediction methods			
[NASA-TM-102226] p 822 N89-28498			
AERODYNAMIC NOISE			
The acoustic calibration of aircraft fuselage structures,			
part 1 [ISVR-TR-169-PT-1] p 877 N89-29158			
AERODYNAMIC STABILITY			
Flight control synthesis for an unstable fighter aircraft			
using the LOG/LTR methodology [AIAA PAPER 89-3452] p 844 A89-52551			
Sensitivity derivatives of flutter characteristics and			
stability margins for aeroservoelastic design			
[AIAA PAPER 89-3467] p 845 A89-52562			
Stability analysis of flexible body dynamics for a highly maneuverable fighter aircraft			
[AIAA PAPER 89-3471] p 845 A89-52565			
AERODYNAMIC STALLING			
Analysis of reattachment during ramp down tests			
helicopter blade upper surface flow in dynamic stall conditions p 816 A89-52043			
Three-dimensional airfoil performance measurements			
on a rotating wing			
[DE89-009443] p 821 N89-28487 AERODYNAMICS			
On the design of nonlinear controllers for flight control			
[AIAA PAPER 89-3489] p 845 A89-52582 Supercomputer requirements for selected disciplines			
important to aerospace p 874 A89-53152			
Scientific visualization in computational aerodynamics			
at NASA Ames Research Center p 875 A89-54907			
Small scale model tests in small wind and water tunnels at high incidence and pitch rates. Volume 1: Test program			
and discussion of results			
[AD-A208647] p 821 N89-28488			
Inviscid and viscous hypersonic aerodynamics: A review of the old and new p 823 N89-29308			
AEROELASTICITY			
A coupled rotor aeroelastic analysis utilizing nonlinear			
aerodynamics and refined wake modeling p 831 A89-52041			
Sensitivity derivatives of flutter characteristics and			
stability margins for aeroservoelastic design			
[AIAA PAPER 89-3467] p 845 A89-52562			
A multiloop, digital flutter suppression control law synthesis case study			

[AIAA PAPER 89-3556] p 848 A89-52642

Dynamic stability and active control of elastic vehicles acting with unsteady aerodynamic forces p 848 A89-52643 [AIAA PAPER 89-3557]

AERONAUTICAL ENGINEERING

SUBJECT INDEX

p 829 A89-52699

AIRCRAFT APPROACH SPACING

[AIAA PAPER 89-3624]

Controller evaluations of the descent advisor automation

Robust control system design with multiple model approach and its application to active flutter control [AIAA PAPER 89-3578] p 849 A89-52661

Phenomena and modelling of flow-induced vibrations of bluff bodies p 861 A89-52961

AERONAUTICAL ENGINEERING Technical communication in aeronautics - Results of an p 877 A89-53330 exploratory study

AERONAUTICS

Investigations in the history and theory of the development of aviation and rocket and space science and technology, No. 6 --- Russian book p 879 A89-52923

AEROSPACE ENGINEERING

- Supercomputer requirements for selected disciplines p 874 A89-53152 important to aerospace for advanced flight Facilities and support requirements vehicles p 854 A89-54368
- Results of a preliminary study of two high-speed civil p 834 A89-54372 transport design concepts Activities report in aerospace research in Germany,
- [ISSN-0070-3966] p 815 N89-28485 AEROSPACE INDUSTRY
- Aerospace investment casting in the U.S.A. 1988 p 857 A89-52022
- The importance of weight in a changing cost estimating
- [SAWE PAPER 1854] p 877 A89-52024 Aerospace Industry in India - Past, present and future p 815 A89-54472

AEROSPACE PLANES

Saenger aerospaceplane gains momentum p 855 A89-52973 Heat transfer in aerospace propulsion

p 862 A89-53282 A real-time guidance algorithm for aerospace plane optimal ascent to low earth orbit p 855 A89-54085 International Conference on Hypersonic Flight in the 21st Century, 1st, University of North Dakota, Grand Forks, p 855 A89-54326 Sept. 20-23, 1988, Proceedings

Saenger: An advanced space transport system for Europe - Program overview and key technology needs p 856 A89-54329 HOTOL - A European aerospaceplane for the 21st

- p 856 A89-54330 NAL's research for hypersonic flight
- p 856 A89-54331 Perspective on Japanese Space Plane research and evelopment p 856 A89-54332
- development Australian hypersonic facilities p 854 A89-54349 The U.S. supersonic transport - Three lessons for NASP p 878 A89-54354
- from history 'Spaceplanes' and the rise of 'Ultra Tech' p 856 A89-54355 Transnational legal problems for commercial hypersonic
- p 878 A89-54356 flight Hypersonic flight and the Warsaw Convention p 878 A89-54358
- The Trisonic aerospace motor Propulsion vehicle for p 856 A89-54359 the 21st century Interfacing hypersonic aircraft in the National Airspace
- p 831 A89-54366 System High temperature adhesive systems p 860 N89-28643 AD-A2091661
- AEROSPACE TECHNOLOGY TRANSFER The U.S. supersonic transport - Three lessons for NASP

from history AEROTHERMODYNAMICS p 878 A89-54354

- Supercomputer requirements for selected disciplines important to aerospace p 874 A89-53152 Thermal stress analysis of the NASA Dryden hypersonic p 856 A89-54340 wing test structure
- Hypersonic vehicle environment simulation, phase 1 p 864 N89-28754 [AD-A2090301 Special Course on Aerothermodynamics of Hypersonic
- /ehicles p 823 N89-29306 [AGARD-R-761] Aerothermodynamic instrumentation
- p 866 N89-29310 AIR BREATHING ENGINES
- An integrated configuration and control analysis p 833 A89-54006 technique for hypersonic vehicles Optimal trajectory generation and design trades for
- hypersonic vehicles p 855 A89-54009 AIR CARGO Proportional hazards modelling of aircraft cargo door
- complaints p 825 A89-52325 AIR DEFENSE
- Operational test plan concept for evaluation of close air support alternative aircraft [AD-A208185] p 835 N89-28513
- AIR FLOW
 - Flow similarity in ignition process of jet engine p 839 A89-52323

- Calculation of the effect of the location of the jet-engine air inlets on the air flow in front of the inlets A89-54486
- p 820 Time domain numerical calculations of unsteady vortical flows about a flat plate airfoil
- [NASA-TM-102318] n 866 N89-29726 AIR INTAKES
- Flight tests for air intake flowfield and engine operating p 839 A89-52317 stability AIR JETS
- Heat transfer characteristics of an aero-engine intake fitted with a hot air jet impingement anti-icing system p 833 A89-53255
- AIR LAW
- Hypersonic flight and the Warsaw Convention p 878 A89-54358
- AIR POLLUTION
- High altitude reconnaissance aircraft design [AIAA PAPER 89-2109] p 833 p 833 A89-54200 AIR TRAFFIC
- Competition and safety in air traffic [TUB-DISS-PAPER-128] p 827 N89-28508
- AIR TRAFFIC CONTROL Controller evaluations of the descent advisor automation
- aid p 829 A89-52699 [AIAA PAPER 89-3624]
- Piloted simulation of a ground-based time-control concept for air traffic control p 829 A89-52700 [AIAA PAPER 89-3625]
- A model of the National Airspace System [AIAA PAPER 89-3626] p 829 A89-52701
- Ground-holding strategies for ATC flow control [AIAA PAPER 89-3628] p 829 A89 p 829 A89-52702
- Aircraft trajectory prediction terminal automation [AIAA PAPER 89-3634] AIAA PAPER 89-3634] p 829 A89-52703 Operational experience with the Computer Oriented Metering Planning and Advisory System (COMPAS) at Frankfurt, Germany
- [AIAA PAPER 89-3627] p 829 A89-52721 Precision characteristics of a coordinate device for All transfer of the velocity of an object p 830 A89-52779 Air traffic control system - Can we close the control op? p 830 A89-537969 estimating the velocity of an object
- loop? Interfacing hypersonic aircraft in the National Airspace
- p 831 A89-54366 System JPL realtime weather processor system developed for
- p 875 A89-54858 FAA Collision avoidance operational concept
- [WP-88W00418] p 831 N89-28509 AIR TRAFFIC CONTROLLERS (PERSONNEL) Controller evaluations of the descent advisor automation
- aid [AIAA PAPER 89-3624] p 829 A89-52699
- AIR TRANSPORTATION
- A model of the National Airspace System
- [AIAA PAPER 89-3626] D 829 A89-52701 Ground-holding strategies for ATC flow control p 829 A89-52702 [AIAA PAPER 89-3628]
- A new hybrid airship ('Heliship') for commuter p 833 A89-53641 transport
- Hypersonic flight and world tourism p 878 A89-54352 Transnational legal problems for commercial hypersonic
- p 878 A89-54356 fliaht Hypersonic flight and the Warsaw Convention
- p 878 A89-54358 Accomplishments under the airport improvement orogram: Fiscal year 1988
- IAD-A2082001 p 855 N89-29352 AIRCRAFT ACCIDENT INVESTIGATION
- Dallas microburst storm environmental conditions determined from satellite soundings p 868 A89-54779 Numerical simulation of microbursts - Aircraft trajectory
- p 869 A89-54788 p 879 A89-54863 studies Weather testimony in litigation Aircraft accident/incident summary reports: Belleville,
- Illinois, August 22, 1987; Pensacola, Florida, December 27. 1987 [PB89-910405] p 827 N89-28507
- AIRCRAFT ACCIDENTS Accident/incident data analysis database summaries,
- [DOT/FAA/DS-89/17-1] o 827 N89-29332
- Accident/incident data analysis database summaries, volume 2 [DOT/FAA/DS-89/17-2] p 828 N89-29333
- Full-scale aircraft impact test for evaluation of impact forces. Part 1: Test plan, test method, and test results [DE89-009329] p 836 N89-29343 AIRCRAFT ANTENNAS
- Lightning protection testing of the E-6 wing tip antenna od/HF probe p 825 A89-53474 pod/HF probe Excitation of aircraft for hardness surveillance using the
- p 854 A89-53476 aircraft's own HE antenna Out-of-band response of VHF/UHF airborne antennae p 830 A89-53484

AIRCRAFT CONFIGURATIONS
An integrated configuration and control analysis
technique for hypersonic vehicles p 833 A89-54006
Water tunnel flow visualization on a hypersonic configuration p 820 A89-54373
Low-speed static and dynamic force tests of a generic
supersonic cruise fighter configuration
[NASA-TM-4138] p 821 N89-28486
Operational test plan concept for evaluation of close
air support alternative aircraft
[AD-A208185] p 835 N89-28513
Composite material repair and reliability
[AD-A209150] p 859 N89-28574
A study of an advanced variable cycle diesel as applied to an RPV: Evaluation of an RPV variable cycle diesel
engine
[AD-A207754] p 842 N89-29347
AIRCRAFT CONSTRUCTION MATERIALS
Aerospace investment casting in the U.S.A. 1988
p 857 A89-52022
High-performance fiber composite materials with
thermoplastic matrix
[MBB-Z-0257-89-PUB] p 857 A89-53310
History of the airframe. III p 833 A89-53631
Revolutionary opportunities for materials and structures
study, addendum [NASA-CR-179642-ADD] p 842 N89-29351
AIRCRAFT CONTROL
Parameter estimation for flight vehicles
p 831 A89-51701
Performance analysis of voting strategies for a fly-by-wire
system of a fighter aircraft p 842 A89-52168
AIAA Guidance, Navigation and Control Conference,
Boston, MA, Aug. 14-16, 1989, Technical Papers. Parts
1 & 2 p 842 A89-52526
A new technique for aircraft flight control
reconfiguration [AIAA PAPER 89-3425] p 843 A89-52527
Comparison of eigenstructure assignment and the
Salford singular perturbation methods in VSTOL aircraft
control law design
[AIAA PAPER 89-3451] p 844 A89-52550
Linear quadratic Gaussian design for robust
performance of a highly maneuverable aircraft [AIAA PAPER 89-3457] p 844 A89-52555
On-board automatic aid and advisory for pilots of
control-impaired aircraft
[AIAA PAPER 89-3460] p 844 A89-52558
Sensitivity derivatives of flutter characteristics and
stability margins for aeroservoelastic design
[AIAA PAPER 89-3467] p 845 A89-52562
An effective flutter control method using fast,
time-accurate CFD codes
[AIAA PAPER 89-3468] p 845 A89-52563 Nonlinear stabilizing control of high angle of attack flight
dynamics
[AIAA PAPER 89-3487] p 845 A89-52580
Design of adaptive digital model-following flight-mode
control systems for high-performance aircraft
[AIAA PAPER 89-3495] p 846 A89-52587
Evaluation methods for complex flight control systems
[AIAA PAPER 89-3502] p 846 A89-52595
Application of stochastic robustness to aircraft control
systems [AIAA PAPER 89-3505] p 846 A89-52598
Extended observability of linear time-invariant systems
under recurrent loss of output data
[AIAA PAPER 89-3510] p 873 A89-52603
An observer-based compensator for distributed delays
in integrated control systems
[AIAA PAPER 89-3541] p 847 A89-52628
Modal techniques for analyzing airplane dynamics
[AIAA PAPER 89-3609] p 850 A89-52687
A perfect explicit model following control solution to
imperfect model following control problems
[AIAA PAPER 89-3612] p 850 A89-52690
On optimal rigid body motions [AIAA PAPER 89-3616] D 850 A89-52694

p 850 A89-52694 [AIAA PAPER 89-3616] High performance linear-guadratic and H-infinity designs for a 'supermaneuverable' aircraft

- (AIAA PAPER 89-3456) p 832 A89-52712 On the control of elastic vehicles Model simplification
- and stability robustness [AIAA PAPER 89-3558] p 873 A89-52715 Lateral electric flight control laws of a civil aircraft based
- upon eigenstructure assignment technique [AIAA PAPER 89-3594] p 85 p 851 A89-52718
- Adaptive control of high performance unstable aircraft A review p 851 A89-52989 An improved pseudo state method for aircraft controller
- p 851 A89-53955 design

AIRCRAFT SPECIFICATIONS

SUBJECT INDEX

Nonlinear longitudinal control of a supermaneuverable p 851 A89-53957 aircraft A systematic approach to gain suppression using eigenstructure assignment p 875 A89-54024 An uncertainty model for saturated actuators --- in flight control systems p 833 A89-54066 Maximum principle solutions for time-optimal half-loop maneuvers of a high alpha fighter aircraft p 853 A89-54081 Integration of active and passive sensors for obstacle avoidance p 830 A89-54083 Study of a pursuit-evasion guidance law for high p 853 A89-54084 performance aircraft A method for calculation of matching point of inlet and enaine p 840 A89-54132 Hypersonic air vehicle stability and control p 834 A89-54344 Concepts for control of hypervelocity vehicles p 853 A89-54347 Low-speed static and dynamic force tests of a generic supersonic cruise fighter configuration [NASA-TM-4138] p 821 N89-28486 AIRCRAFT DESIGN aid A design procedure for the handling qualities optimization of the X-29A aircraft [AIAA PAPER 89-3428] p 843 A89-52529 High performance linear-quadratic and H-infinity designs for a 'supermaneuverable' aircraft [AIAA PAPER 89-3456] n 832 A89-52712 p 815 A89-52975 Closing the gap Aeronautical applications of high-temperature superconductors [AIAA PAPER 89-2142] p 840 A89-53304 History of the airframe. III p 833 A89-53631 Study on a design method for the lateral stability of the airplane by the conditions for the steady horizontal turn with control surfaces fixed p 851 A89-53640 Optimal trajectory generation and design trades for hypersonic vehicles p 855 A89-54009 High altitude reconnaissance aircraft design [AIAA PAPER 89-2109] p 833 A89-54200 Conceptual design tools for internal tankage of the p 834 hypersonic transport A89-54338 Hypersonic air vehicle stability and control p 834 A89-54344 The Advanced Aeronautic Design Program - Designing for the future p 834 A89-54370 Results of a preliminary study of two high-speed civi p 834 A89-54372 transport design concepts Overview of buckling in aircraft design p 834 A89-54462 Application of modern optimization tools for the design of aircraft structures p 834 A89-54471 Aerospace Industry in India - Past, present and future p 815 A89-54472 Design by functional feature for aircraft structure 2000 p 836 N89-29345 AIRCRAFT DETECTION Excitation of aircraft for hardness surveillance using the aircraft's own HF antenna p 854 A89-53476 Carnouflage cap allows aircraft to disappear p 838 A89-54482 Acoustical tracking of fast maneuvering aircraft by distributed sensors p 877 N89-29156 [REPT-6-881 AIRCRAFT ENGINES Ultra high bypass aircraft sonic fatigue р 831 A89-51898 Aerospace investment casting in the U.S.A. 1988 p 857 A89-52022 Flight tests for air intake flowfield and engine operating stability p 839 A89-52317 Probabilistic methods for estimating the remaining life of structural elements of operating aircraft gas turbine p 839 A89-52832 engines Heat transfer characteristics of an aero-engine intake fitted with a hot air jet impingement anti-icing system p 833 Á89-53255 Flight test of the F100-PW-220 engine in the F-16 p 840 A89-53366 Study on boundary layer of hypersonic inlets p 820 A89-54129 The Advanced Aeronautic Design Program - Designing p 834 A89-54370 for the future Development along different paths --- electronic control of aircraft engines p 820 A89-54484 Diagnostics and control of the fuel systems of aircraft engines --- Russian book p 841 A89-54881 Jet engines for high supersonic flight velocities (2nd

revised and enlarged edition) --- Russian book p 841 A89-54884 Microcomputer simulation of lubricant degradation in

turbine engines using laboratory data p 859 A89-54986

Statistics on aircraft gas turbine engine rotor failures that occurred in US commercial aviation during 1984 [NAPC-PE-185] p £41 N89-28516 Statistics on aircraft gas turbine engine rotor failures that occurred in US commercial aviation during 1985

[NAPC-PE-188] n 641 N89-28517 AIRCRAFT EQUIPMENT A 3-hour mesoscale assimilation system using ACARS

aircraft data combined with other observations aeronautical radio communications addressing and reporting system p 869 A89-54797 High temperature adhesive systems

AD-A2091661 p 860 N89-28643 AIRCRAFT FUEL SYSTEMS Diagnostics and control of the fuel systems of aircraft

--- Russian book p 841 A89-54881 AIRCRAFT GUIDANCE

Application of Artificial Intelligence (AI) programming techniques to tactical guidance for fighter aircraft

[AIAA PAPER 89-3525] p 815 A89-52614 Application of total energy control for high performance aircraft vertical transitions

[AIAA PAPER 89-3559] p 848 A89-52644 Controller evaluations of the descent advisor automation

- [AIAA PAPER 89-3624] p 329 A89-52699 Rotorcraft deceleration to hover using image-based guidance p 330 A89-54082 Study of a pursuit-evasion guidance law for high
- p 853 A89-54084 performance aircraft A real-time guidance algorithm for aerospace plane timal ascent to low earth orbit p 855 A89-54085

AIRCRAFT HAZARDS

- Pseudo-spectral and asymptotic sensitivity investigation of counter-rotating vortices p 861 A89-51755 Proportional hazards modelling of aircraft cargo door p 825 A89-52325 complaints Aircraft icing caused by large supercooled droplets p 826 A89-53793
- Aircraft icing hazards forecasting and synoptic classification p 827 A89-54821 The role of the Smith-Feddes model in improving the forecasting of aircraft icing p 827 A89-54823
- Severe aircraft icing events A Colorado case study p 827 A89-54838 An overview of the national program to improve aircraft
- icing forecasts p 872 A89-54862 AIRCRAFT INSTRUMENTS

Passive navigation using image irradiance tracking

- p 828 A89-52592 [AIAA PAPER 89-3500] Flight-test evaluation of civil helicopter terminal pproach operations using differential GPS
- p 828 A89-52594 [AIAA PAPER 89-3635] Update 89 - Additional results with the multifunction RLG
- TAIAA PAPER 89-35831
- Visual and sensory aids for helicopters in the year

n 837 A89-52716

- p 837 A89-53309 [MBB-UD-541-89-PUB] Airborne rain mapping radar c 837 A89-53313 Flight test method development for a quarter-scale aircraft with minimum instrumentation
- AD-A2078961 r 835 N89-29337 AIRCRAFT LANDING Integrated flight/propulsion control system design based
- on a centralized approach [AIAA PAPER 89-3520] p 847 A89-52611
- Thrust laws for microburst wind shear penetration [AIAA PAPER 89-3560] p 848 A89-5 p 848 A89-52645
- Integrated flight/propulsion control system design based on a decentralized, hierarchical approach D 851 A89-53301
- [AIAA PAPER 89-3519] Rotorcraft deceleration to hover using image-based quidance D 830 A89-54082
- AIRCRAFT MAINTENANCE
- An optimal material removal strategy for automated repair of aircraft canopies p 874 A89-53416 A proposed composite repair methodology for primary p 858 A89-54429 structure
- Diagnostics and control of the fuel systems of aircraft p 841 A89-54881 ngines --- Russian book AIRCRAFT MANEUVERS
- Nonlinear control of a supermaneuverable aircraft [AIAA PAPER 89-3486] p 845 A89-52579
- High gain flight controllers for nonlinear systems [AIAA PAPER 89-3488] p 845 A89-52581
- Optimal control for maximum energy extraction from wind shear
- [AIAA PAPER 89-3490] p 846 A89-52583 Thrust vectoring effect on time-optimal 90 degrees angle of attack pitch up maneuvers of a high alpha fighter aircraft
- [AIAA PAPER 89-3521] p 847 A89-52612 Singular trajectories for time-optimal half-loop

maneuvers of a high alpha fighter aircraft [AIAA PAPER 89-3614] p 850 A89-52692

On optimal rigid body motions [AIAA PAPER 89-3616] p 850 A89-52694

Identification of state-space parameters in the presence p 875 A89-54022 of uncertain nuisance parameters Maximum principle solutions for time-optimal half-loop

maneuvers of a high alpha fighter aircraft p 853 A89-54081 Acoustical tracking of fast maneuvering aircraft by

distributed sensors [REPT-6-88] n 877 N89-29156

A user's manual for the ARL mathematical model of the Sea King Mk-50 helicopter. Part 1: Basic use [AD-A208058] p 835 N8 p 835 N89-29339

AIRCRAFT MODELS

Analysis of absorbing characteristics of thin-type absorber for generalized conditions of incident wave p 861 A89-52105

Stability analysis of flexible body dynamics for a highly maneuverable fighter aircraft

- [AIAA PAPER 89-3471] p 845 A89-52565 Evaluation methods for complex flight control systems [AIAA PAPER 89-3502] p 846 A89-52595
- A systematic approach to gain suppression using eigenstructure assignment p 875 A89-54024

Physical mechanisms and disturbances related to the attachment of an electric arc to a conductive cylinder [ONERA-NT-1988-2] p 866 N89-29698 AIRCRAFT NOISE

- The Orient Express The emperor's new airplane p 878 A89-54357 Airport noise measuring data collction system
- p 855 N89-28526 [NLB-MP-87006-U] Noise produced by turbulent flow into a rotor: Users
- manual for noise calculation [NASA-CR-181790] p 876 N89-29152 Noise produced by turbulent flow into a rotor: Users
- manual for atmospheric turbulence prediction and mean flow and turbulence contraction prediction [NASA-CR-181791] p 876 N89-29154
- AIRCRAFT PARTS

CAD/CAM - Managerial challenges and research issue p 879 A89-54908 AIRCRAFT PERFORMANCE

Parameter estimation for flight vehicles

- p 831 A89-51701 AT3 demonstrates feasibility of cargo STOL with long p 832 A89-52201 range terminal automation
- Aircraft trajectory prediction for [AIAA PAPER 89-3634] p 829 A89-52703 Revolutionary opportunities for materials and structures
- study, addendum [NASA-CR-179642-ADD] p 842 N89-29351
- AIRCRAFT PILOTS Evaluation of a takeoff performance monitoring system p 837 A89-51704 display
- Towards a physiologically based HUD (Head-Up Display) symbology [AD-A207748]
- p 838 N89-28515 AIRCRAFT PRODUCTION
- The importance of weight in a changing cost estimating environment SAWE PAPER 18541 o 877 A89-52024
- Are the Soviets set to make the big time? p 825 A89-52513

AIRCRAFT RELIABILITY

Ultra high bypass aircraft sonic fatigue				
p 831 A89-51898				
Proportional hazards modelling of aircraft cargo door				
complaints p 825 A89-52325				
On-board automatic aid and advisory for pilots of control-impaired aircraft				
[AIAA PAPER 89-3460] p 844 A89-52558				
Workshop proceedings on Composite Aircraft				
Certification and Airworthiness				
[AD-A209321] p 835 N89-29336				
AIRCRAFT SAFETY				
Proportional hazards modelling of aircraft cargo door				
complaints p 825 A89-52325				
Competition and safety in air traffic				
[TUB-DISS-PAPER-128] p 827 N89-28508				
An experimental optical coupling device for an airborne digital redundant system				
[NAL-TR-1003] p 835 N89-28514				
Accident/incident data analysis database summaries,				
volume 1				
[DOT/FAA/DS-89/17-1] p 827 N89-29332				
Accident/incident data analysis database summaries, volume 2				
[DOT/FAA/DS-89/17-2] p 828 N89-29333				
Full-scale aircraft impact test for evaluation of impact				
force. Part 2: Analysis of results				
[DE89-009335] p 836 N89-29344				

AIRCRAFT SPECIFICATIONS Specifications and measurement procedures and aircraft

transparencies [AD-A209396]

p 834 N89-28511

p 829 A89-52699

Controller evaluations of the descent advisor automation

APPROACH CONTROL

[AIAA PAPER 89-3624]

AIRCRAFT STABILITY

AIRCRAFT STABILITY

- Design of a modalized observer with eigenvalue sensitivity reduction --- for lateral dynamics of L-1011 p 842 A89-51723 aircraft Integrated structure/control law design by multilevel optimization
- [AIAA PAPER 89-3470] p 873 A89-52564 Nonlinear control of a supermaneuverable aircraft
- [AIAA PAPER 89-3486] p 845 A89-52579 Modification of trim point and feedback gains for failed
- aircraft [AIAA PAPER 89-3507] p 846 A89-52600 Comparison of nonlinear controllers for twin-lift
- configurations [AIAA PAPER 89-3591] p 849 A89-52671 Adaptive control of high performance unstable aircraft p 851 A89-52989 A review
- Study on a design method for the lateral stability of the airplane by the conditions for the steady horizontal turn
- p 851 A89-53640 with control surfaces fixed Hypersonic air vehicle stability and control p 834 A89-54344

AIRCRAFT STRUCTURES

- Current research in composite structures at NASA's p 861 A89-51692 Langley Research Center Integrated structure/control law design by multilevel ptimization
- [AIAA PAPER 89-3470] p 873 A89-52564 Recovery of the fatigue strength of structural elements of aluminum alloys by surface hardening
- p 857 A89-52827 Sensitive skins p 837 A89-52974 A proposed composite repair methodology for primary p 858 A89-54429 structure Overview of buckling in aircraft design
- p 834 A89-54462 Application of modern optimization tools for the design of aircraft structures p 834 A89-54471
- Constant monitoring of the fatigue damage of aircraft p 863 A89-54488 lifting structures A study of the stress-strain state of connections in an thotropic material p 864 A89-54585
- orthotropic material Specifications and measurement procedures and aircraft transparencies
- [AD-A209396] p 834 N89-28511 Workshop proceedings on Certification and Airworthiness Composite Aircraft
- [AD-A209321] p 835 N89-29336 Design by functional feature for aircraft structure
- p 836 N89-29345 Revolutionary opportunities for materials and structures study, addendum [NASA-CR-179642-ADD]
- p 842 N89-29351 CSM research: Methods and application studies p 867 N89-29794

AIRCRAFT SURVIVABILITY

Surface failure detection and evaluation of control law for reconfiguration of flight control system [AIAA PAPER 89-3509] p 847 A89-52602

- AIRFOIL OSCILLATIONS Theoretical study on the unsteady aerodynamic characteristics of an oscillating cascade with tip clearance
- in the case of a nonloaded cascade p 816 A89-51678 Numerical simulation and hydrodynamic visualization of
- transient viscous flow around an oscillating aerofoil p 817 A89-52481 Transition and turbulence structure in the boundary
- layers of an oscillating airfoil p 824 N89-29317 [AD-A208968]

AIRFOIL PROFILES

- A regular perturbation method for subcritical flow over p 818 A89-53570 a two-dimensional airfoil Euler correction method for two- and three-dimensional
- p 819 A89-53934 transonic flows Profile-vortex interactions
- p 822 N89-28495 [ISL-R-125/87] The angles of the Kolibrie rotor tipvanes on the rods and on the blades
- p 822 N89-28499 [IW-R515] Wind tunnel tests of 16 percent thick airfoil with 30
- percent trailing edge flap at high angles of attack and with flap angles p 823 N89-28500 (FFA-TN-1985-58)
- AIRFOILS
- Analysis of reattachment during ramp down tests ---helicopter blade upper surface flow in dynamic stall p 816 A89-52043 conditions Finite element analysis of incompressible viscous flows
- around single and multi-element aerofoils in high Reynolds number region p 865 N89-28765 [NAL-TR-1010T]
- Transition and turbulence structure in the boundary layers of an oscillating airfoil
- [AD-A208968] p 824 N89-29317

Control of separated flow past a cylinder using tangential wall jet blowing [NASA-CR-185918] p 825 N89-29326

AIRFRAMES

- AE monitoring of airframe structure during full scale fatique test p 863 A89-53322 History of the airframe. III p 833 A89-53631
- Composite material repair and reliability p 859 N89-28574 [AD-A209150] STOL and STOVL hot gas ingestion and airframe heating
- tests in the NASA Lewis 9- by 15-foot low-speed wind tunnel
- p 824 N89-29323 [NASA-TM-102101] AIRLINE OPERATIONS
- MLS 1989 Status report from the perspective of the p 830 A89-53663 urline companies
- AIRPORT PLANNING
- Accomplishments under the airport improvement program: Fiscal year 1988 p 855 N89-29352 AD-A2082001
- AIRPORTS
- The detection of low level windshear with airport surveillance radar p 868 A89-54780 Evaluation of the 12-station enhanced Low Level Wind Shear Alert System (LLWAS) at Denver Stapleton
- International Airport p 868 A89-54784 Weather sensing with airport surveillance radars p 869 A89-54789
- Observations and forecasts for runway (pavement) p 826 A89-54802 surfaces
 - Verification of aerodrome forecasts p 870 A89-54824
- Very short-range aerodrome forecasts using regression p 870 A89-54831
- techniques Doppler weather radar service at the Chiang Kai-Shek p 871 A89-54840 International Airport
- A case study of local severe weather at Chang Kai Shek p 871 A89-54846 International Airport
- The development of numerically-based and expert system approaches for airfield nowcasting/very short range forecasting p 872 A89-54860
- Airport noise measuring data collction system [NLR-MP-87006-U] p 855 N89-28526
- Accomplishments under the airport improvement program: Fiscal year 1988 AD-A208200] p 855 N89-29352
- AIRSHIPS
- A new hybrid airship ('Heliship') for commuter ansport p 833 A89-53641 AIRSPEED
- Precision characteristics of a coordinate device for estimating the velocity of an object p 830 A89-52779 ALGORITHMS
- High speed corner and gap-seal computations using an 1U-SGS scheme
- [AIAA PAPER 89-2669] p 863 A89-54424 ALUMINUM ALLOYS
- Recovery of the fatigue strength of structural elements of aluminum alloys by surface hardening p 857 A89-52827
- AMMONIA
- Supersonic jet studies of fluorene clustered with water. ammonia and piperidine
- [AD-A209562] ANEMOMETERS
- Microburst detection from mesonet data p 868 A89-54783
- ANGLE OF ATTACK
- Nonlinear stabilizing control of high angle of attack flight dynamics
- [AIAA PAPER 89-3487] p 845 A89-52580 Thrust vectoring effect on time-optimal 90 degrees angle of attack pitch up maneuvers of a high alpha fighter aircraft
- p 847 A89-52612 [AIAA PAPER 89-3521] Application of variable-gain output feedback for high-alpha control
- p 848 A89-52659 [AIAA PAPER 89-3576] Maximum principle solutions for time-optimal half-loop
- maneuvers of a high alpha fighter aircraft p 853 A89-54081 Wind tunnel tests of 16 percent thick airfoil with 30
- percent trailing edge flap at high angles of attack and with flap angles [FFA-TN-1985-58] p 823 N89-28500
- ANNULI Stresses and strains in a cold-worked annulus
- [AR-005-548] p 866 N89-28871 ANTISUBMARINE WARFARE
- A user's manual for the ARL mathematical model of the Sea King Mk-50 helicopter. Part 1: Basic use p 835 N89-29339
- [AD-A208058] A user's manual for the ARL mathematical model of the Sea King Mk-50 helicopter. Part 2: Use with ARL flight
- [AD-A208059] p 836 N89-29340

[AIAA PAPER 89-3624] p 829	A89-52699
ARCHITECTURE (COMPUTERS)	
NASA Workshop on Computationa	I Structural
Mechanics 1987, part 2	
[NASA-CP-10012-PT-2] p 866	N89-29789
ARRAYS	
Piezoelectric foils as sensors in expe	rimental flow
mechanics	
[ILR-MITT-214] p 865	N89-28800
ARRIVALS	1400-20000
Controller evaluations of the descent advis	orautomation
aid	
[AIAA PAPER 89-3624] p 829	
Ground-holding strategies for ATC flow co	ontroi
[AIAA PAPER 89-3628] p 829	A89-52702
ARTIFICIAL INTELLIGENCE	
Application of Artificial Intelligence (AI)	programming
techniques to tactical guidance for fighter ai	
[AIAA PAPER 89-3525] p 815	
Intelligent flight management perform	nance using
discrete-event simulation	
[AIAA PAPER 89-3526] p 847	
Intelligent avionics p 838	A89-54345
ASPECT RATIO	
	eat transfer
coefficients and friction factors in passage	
aspect ratios roughened with 45 deg turbula	
p 862	A89-53274
ASTRONAUTICS	
Investigations in the history and the	eory of the
development of aviation and rocket and s	pace science
and technology, No. 6 Russian book	
p 879	A89-52923
ASYMPTOTIC METHODS	
ASYMPTOTIC METHODS	investigation
Pseudo-spectral and asymptotic sensitivity	
Pseudo-spectral and asymptotic sensitivity of counter-rotating vortices p 861	A89-51755
Pseudo-spectral and asymptotic sensitivity of counter-rotating vortices p 861 Asymptotic solution of a nonlinear bo	A89-51755
Pseudo-spectral and asymptotic sensitivity of counter-rotating vortices p 861 Asymptotic solution of a nonlinear bo problem with a partly unknown boundary	A89-51755 undary value
Pseudo-spectral and asymptotic sensitivity of counter-rotating vortices p 861 Asymptotic solution of a nonlinear bo problem with a partly unknown boundary p 874	A89-51755 undary value A89-52802
Pseudo-spectral and asymptotic sensitivity of counter-rotating vortices p 861 Asymptotic solution of a nonlinear bo problem with a partly unknown boundary	A89-51755 undary value A89-52802
Pseudo-spectral and asymptotic sensitivity of counter-rotating vortices p 861 Asymptotic solution of a nonlinear bo problem with a partly unknown boundary p 874	A89-51755 undary value A89-52802
Pseudo-spectral and asymptotic sensitivity of counter-rotating vortices p 661 Asymptotic solution of a nonlinear bo problem with a partly unknown boundary p 874 Asymptotically decoupled variable structu systems and large maneuver of aircraft	A89-51755 undary value A89-52802 ire control of
Pseudo-spectral and asymptotic sensitivity of counter-rotating vortices p 861 Asymptotic solution of a nonlinear bo problem with a partly unknown boundary p 874 Asymptotically decoupled variable structu systems and large maneuver of aircraft p 852	A89-51755 undary value A89-52802 ire control of
Pseudo-spectral and asymptotic sensitivity of counter-rotating vortices p 861 Asymptotic solution of a nonlinear bo problem with a partly unknown boundary p 874 Asymptotically decoupled variable structu systems and large maneuver of aircraft p 852 ATMOSPHERIC CHEMISTRY	A89-51755 undary value A89-52802 ire control of A89-53988
Pseudo-spectral and asymptotic sensitivity of counter-rotating vortices p 661 A symptotic solution of a nonlinear bo problem with a partly unknown boundary p 874 Asymptotically decoupled variable structu systems and large maneuver of aircraft p 852 ATMOSPHERIC CHEMISTRY A study of the sensitivity of stratosphe	A89-51755 undary value A89-52802 ire control of A89-53988 ric ozone to
Pseudo-spectral and asymptotic sensitivity of counter-rotating vortices p 661 A symptotic solution of a nonlinear bo problem with a partly unknown boundary p 874 Asymptotically decoupled variable structu systems and large maneuver of aircraft p 852 ATMOSPHERIC CHEMISTRY A study of the sensitivity of stratosphe hypersonic aircraft emissions p 867	A89-51755 undary value A89-52802 ire control of A89-53988 ric ozone to 2 A89-54363
Pseudo-spectral and asymptotic sensitivity of counter-rotating vortices p 661 A symptotic solution of a nonlinear bo problem with a partly unknown boundary p 874 Asymptotically decoupled variable structu systems and large maneuver of aircraft p 852 ATMOSPHERIC CHEMISTRY A study of the sensitivity of stratosphe	A89-51755 undary value A89-52802 ire control of A89-53988 ric ozone to 2 A89-54363
Pseudo-spectral and asymptotic sensitivity of counter-rotating vortices p 661 A symptotic solution of a nonlinear bo problem with a partly unknown boundary p 874 Asymptotically decoupled variable structu systems and large maneuver of aircraft p 852 ATMOSPHERIC CHEMISTRY A study of the sensitivity of stratosphe hypersonic aircraft emissions p 867	A89-51755 undary value A89-52802 ire control of A89-53988 ric ozone to 7 A89-54363 iion, phase 1
Pseudo-spectral and asymptotic sensitivity of counter-rotating vortices p 661 A symptotic solution of a nonlinear bo problem with a partly unknown boundary p 874 Asymptotically decoupled variable structu systems and large maneuver of aircraft p 852 ATMOSPHERIC CHEMISTRY A study of the sensitivity of stratosphe hypersonic aircraft emissions p 867 Hypersonic vehicle environment simulat [AD-A209030] p 864	A89-51755 undary value A89-52802 ire control of A89-53988 ric ozone to 7 A89-54363 iion, phase 1
Pseudo-spectral and asymptotic sensitivity of counter-rotating vortices p 661 A symptotic solution of a nonlinear bo problem with a partly unknown boundary p 874 Asymptotically decoupled variable structu systems and large maneuver of aircraft p 852 ATMOSPHERIC CHEMISTRY A study of the sensitivity of stratosphe hypersonic aircraft emissions p 867 Hypersonic vehicle environment simulat [AD-A209030] p 864 ATMOSPHERIC MOISTURE	A89-51755 undary value A89-52802 ire control of A89-53988 ric ozone to A89-54363 ion, phase 1 N89-28754
Pseudo-spectral and asymptotic sensitivity of counter-rotating vortices p 661 Asymptotic solution of a nonlinear bo problem with a partly unknown boundary p 874 Asymptotically decoupled variable structu systems and large maneuver of aircraft p 852 ATMOSPHERIC CHEMISTRY A study of the sensitivity of stratosphe hypersonic aircraft emissions p 867 Hypersonic vehicle environment simulat [AD-A209030] p 864 ATMOSPHERIC MOISTURE Aircraft icing conditions detected by com	A89-51755 undary value A89-52802 ire control of A89-53988 ric ozone to A89-54363 iion, phase 1 N89-28754 bined remote
Pseudo-spectral and asymptotic sensitivity of counter-rotating vortices p 861 Asymptotic solution of a nonlinear bo problem with a partly unknown boundary p 874 Asymptotically decoupled variable structu systems and large maneuver of aircraft p 852 ATMOSPHERIC CHEMISTRY A study of the sensitivity of stratosphe hypersonic aircraft emissions p 867 Hypersonic vehicle environment simulal [AD-A209030] p 864 ATMOSPHERIC MOISTURE Aircraft icing conditions detected by com sensors - A preliminary study p 827	A89-51755 undary value A89-52802 ire control of A89-53988 ric ozone to A89-54363 iion, phase 1 N89-28754 bined remote
Pseudo-spectral and asymptotic sensitivity of counter-rotating vortices p 661 A symptotic solution of a nonlinear bo problem with a partly unknown boundary p 874 Asymptotically decoupled variable struct systems and large maneuver of aircraft p 852 ATMOSPHERIC CHEMISTRY A study of the sensitivity of stratosphe hypersonic aircraft emissions p 867 Hypersonic vehicle environment simulaa [AD-A209030] p 864 ATMOSPHERIC MOISTURE Aircraft icing conditions detected by com sensors - A preliminary study p 827 ATMOSPHERIC TEMPERATURE	A89-51755 undary value A89-52802 ire control of A89-53988 ric ozone to A89-54363 iion, phase 1 N89-28754 bined remote A89-54807
Pseudo-spectral and asymptotic sensitivity of counter-rotating vortices p 661 A symptotic solution of a nonlinear bo problem with a partly unknown boundary p 874 Asymptotically decoupled variable structu systems and large maneuver of aircraft p 852 ATMOSPHERIC CHEMISTRY A study of the sensitivity of stratosphe hypersonic aircraft emissions p 867 Hypersonic vehicle environment simulal [AD-A209030] p 864 ATMOSPHERIC MOISTURE Aircraft icing conditions detected by com sensors - A preliminary study p 827 ATMOSPHERIC TEMPERATURE A relationship between peak temperati	A89-51755 undary value A89-52802 ure control of A89-53988 ric ozone to A89-54363 uion, phase 1 N89-28754 bined remote A89-54807 ure drop and
Pseudo-spectral and asymptotic sensitivity of counter-rotating vortices p 661 A symptotic solution of a nonlinear bo problem with a partly unknown boundary p 874 Asymptotically decoupled variable structu systems and large maneuver of aircraft p 852 ATMOSPHERIC CHEMISTRY A study of the sensitivity of stratosphe hypersonic aircraft emissions p 867 Hypersonic vehicle environment simulal [AD-A209030] p 864 ATMOSPHERIC MOISTURE Aircraft icing conditions detected by com sensors - A preliminary study p 827 ATMOSPHERIC TEMPERATURE A relationship between peak temperati	A89-51755 undary value A89-52802 ire control of A89-53988 ric ozone to A89-54363 iion, phase 1 N89-28754 bined remote A89-54807
Pseudo-spectral and asymptotic sensitivity of counter-rotating vortices p 661 A symptotic solution of a nonlinear bo problem with a partly unknown boundary p 874 Asymptotically decoupled variable structu systems and large maneuver of aircraft p 852 ATMOSPHERIC CHEMISTRY A study of the sensitivity of stratosphe hypersonic aircraft emissions p 867 Hypersonic vehicle environment simular [AD-A209030] p 864 ATMOSPHERIC MOISTURE Aircraft icing conditions detected by com sensors - A preliminary study p 827 ATMOSPHERIC TEMPERATURE A relationship between peak temperativelocity differential in a microburst p 867	A89-51755 undary value A89-52802 ure control of A89-53988 ric ozone to A89-54363 uion, phase 1 N89-28754 bined remote A89-54807 ure drop and
Pseudo-spectral and asymptotic sensitivity of counter-rotating vortices p 661 A symptotic solution of a nonlinear bo problem with a partly unknown boundary p 874 Asymptotically decoupled variable struct systems and large maneuver of aircraft p 852 ATMOSPHERIC CHEMISTRY A study of the sensitivity of stratosphe hypersonic aircraft emissions p 867 Hypersonic vehicle environment simulat [AD-A209030] p 864 ATMOSPHERIC MOISTURE Aircraft icing conditions detected by com sensors - A preliminary study p 827 ATMOSPHERIC TEMPERATURE A relationship between peak temperat velocity differential in a microburst p 867 ATMOSPHERIC TURBULENCE	A89-51755 undary value A89-52802 ire control of A89-53988 ric ozone to A89-54363 iion, phase 1 N89-28754 bined remote A89-54807 ure drop and A89-54777
Pseudo-spectral and asymptotic sensitivity of counter-rotating vortices p 661 A symptotic solution of a nonlinear bo problem with a partly unknown boundary p 874 Asymptotically decoupled variable struct systems and large maneuver of aircraft p 852 ATMOSPHERIC CHEMISTRY A study of the sensitivity of stratosphe hypersonic aircraft emissions p 867 Hypersonic vehicle environment simulat [AD-A209030] p 864 ATMOSPHERIC MOISTURE Aircraft icing conditions detected by com sensors - A preliminary study p 827 ATMOSPHERIC TEMPERATURE A relationship between peak temperat velocity differential in a microburst p 867 ATMOSPHERIC TURBULENCE Noise produced by turbulent flow into a	A89-51755 undary value A89-52802 ire control of A89-53988 ric ozone to A89-54363 ion, phase 1 N89-28754 bined remote A89-54807 ure drop and A89-54777 rotor: Users
Pseudo-spectral and asymptotic sensitivity of counter-rotating vortices p 661 A symptotic solution of a nonlinear bo problem with a partly unknown boundary p 874 Asymptotically decoupled variable structu systems and large maneuver of aircraft p 852 ATMOSPHERIC CHEMISTRY A study of the sensitivity of stratosphe hypersonic vehicle environment simulat [AD-A209030] p 864 ATMOSPHERIC MOISTURE Aircraft icing conditions detected by com sensors - A preliminary study p 827 ATMOSPHERIC TEMPERATURE A relationship between peak temperativelocity differential in a microburst p 867 ATMOSPHERIC TURBULENCE Noise produced by turbulent flow into a manual for atmospheric turbulence predicti	A89-51755 undary value A89-52802 ire control of A89-53988 ric ozone to A89-54363 ion, phase 1 N89-28754 bined remote A89-54807 ure drop and A89-54777 rotor: Users
Pseudo-spectral and asymptotic sensitivity of counter-rotating vortices p 661 A symptotic solution of a nonlinear bo problem with a partly unknown boundary p 874 Asymptotically decoupled variable structur systems and large maneuver of aircraft p 852 ATMOSPHERIC CHEMISTRY A study of the sensitivity of stratosphe hypersonic aircraft emissions p 867 Hypersonic vehicle environment simulat [AD-A209030] p 864 ATMOSPHERIC MOISTURE Aircraft icing conditions detected by com sensors - A preliminary study p 827 ATMOSPHERIC TEMPERATURE A relationship between peak temperativelocity differential in a microburst p 867 ATMOSPHERIC TURBULENCE Noise produced by turbulent flow into a manual for atmospheric turbulence predictii flow and turbulence contraction prediction	A89-51755 undary value A89-52802 ire control of A89-53988 ric ozone to A89-54363 iion, phase 1 N89-28754 bined remote A89-54807 ure drop and A89-54777 rotor: Users on and mean
Pseudo-spectral and asymptotic sensitivity of counter-rotating vortices p 661 A symptotic solution of a nonlinear bo problem with a partly unknown boundary p 874 Asymptotically decoupled variable struct systems and large maneuver of aircraft p 852 ATMOSPHERIC CHEMISTRY A study of the sensitivity of stratosphe hypersonic aircraft emissions p 867 Hypersonic vehicle environment simulat [AD-A209030] p 864 ATMOSPHERIC MOISTURE Aircraft icing conditions detected by com sensors - A preliminary study p 827 ATMOSPHERIC TEMPERATURE A relationship between peak temperat velocity differential in a microburst p 867 ATMOSPHERIC TEMPERATURE Noise produced by turbulent flow into a manual for atmospheric turbulence predicti flow and turbulence contraction prediction [NASA-CR-181791] p 876	A89-51755 undary value A89-52802 ire control of A89-53988 ric ozone to A89-54363 iion, phase 1 N89-28754 bined remote A89-54807 ure drop and A89-54777 rotor: Users on and mean
Pseudo-spectral and asymptotic sensitivity of counter-rotating vortices p 661 A symptotic solution of a nonlinear bo problem with a partly unknown boundary p 874 Asymptotically decoupled variable structur systems and large maneuver of aircraft p 852 ATMOSPHERIC CHEMISTRY A study of the sensitivity of stratosphe hypersonic aircraft emissions p 867 Hypersonic vehicle environment simulat [AD-A209030] p 864 ATMOSPHERIC MOISTURE Aircraft icing conditions detected by com sensors - A preliminary study p 827 ATMOSPHERIC TEMPERATURE A relationship between peak temperativelocity differential in a microburst p 867 ATMOSPHERIC TURBULENCE Noise produced by turbulent flow into a manual for atmospheric turbulence predictii flow and turbulence contraction prediction	A89-51755 undary value A89-52802 ire control of A89-53988 ric ozone to A89-54363 iion, phase 1 N89-28754 bined remote A89-54807 ure drop and A89-54777 rotor: Users on and mean
Pseudo-spectral and asymptotic sensitivity of counter-rotating vortices p 661 A symptotic solution of a nonlinear bo problem with a partly unknown boundary p 874 Asymptotically decoupled variable struct systems and large maneuver of aircraft p 852 ATMOSPHERIC CHEMISTRY A study of the sensitivity of stratosphe hypersonic aircraft emissions p 867 Hypersonic vehicle environment simulat [AD-A209030] p 864 ATMOSPHERIC MOISTURE Aircraft icing conditions detected by com sensors - A preliminary study p 827 ATMOSPHERIC TEMPERATURE A relationship between peak temperat velocity differential in a microburst p 867 ATMOSPHERIC TEMPERATURE Noise produced by turbulent flow into a manual for atmospheric turbulence predicti flow and turbulence contraction prediction [NASA-CR-181791] p 876	A89-51755 undary value A89-52802 ure control of A89-53988 ric ozone to A89-54363 tion, phase 1 N89-28754 bined remote A89-54807 ure drop and A89-54777 rotor: Users on and mean N89-29154
Pseudo-spectral and asymptotic sensitivity of counter-rotating vortices p 661 A symptotic solution of a nonlinear bo problem with a partly unknown boundary p 874 Asymptotically decoupled variable structu systems and large maneuver of aircraft p 852 ATMOSPHERIC CHEMISTRY A study of the sensitivity of stratosphe hypersonic vehicle environment simulat [AD-A209030] p 864 ATMOSPHERIC MOISTURE Aircraft icing conditions detected by com sensors - A preliminary study p 827 ATMOSPHERIC TEMPERATURE A relationship between peak temperativelocity differential in a microburst p 867 ATMOSPHERIC TURBULENCE Noise produced by turbulent flow into a manual for atmospheric turbulence predictifow and turbulence contraction prediction [NASA-CR-181791] p 876 ATTACK AIRCRAFT Intelligent flight management perform	A89-51755 undary value A89-52802 ure control of A89-53988 ric ozone to A89-54363 tion, phase 1 N89-28754 bined remote A89-54807 ure drop and A89-54777 rotor: Users on and mean N89-29154
Pseudo-spectral and asymptotic sensitivity of counter-rotating vortices p 661 A symptotic solution of a nonlinear bo problem with a partly unknown boundary p 874 Asymptotically decoupled variable struct systems and large maneuver of aircraft p 852 ATMOSPHERIC CHEMISTRY A study of the sensitivity of stratosphe hypersonic aircraft emissions p 867 Hypersonic vehicle environment simulat [AD-A209030] p 864 ATMOSPHERIC MOISTURE Aircraft icing conditions detected by com sensors - A preliminary study p 827 ATMOSPHERIC TEMPERATURE A relationship between peak temperat velocity differential in a microburst p 867 ATMOSPHERIC TURBULENCE Noise produced by turbulent flow into a manual for atmospheric turbulence predictio flow and turbulence contraction prediction [NASA-CR-181791] p 876 ATTACK AIRCRAFT Intelligent flight management perform discrete-event simulation	A89-51755 undary value A89-52802 ire control of A89-53988 ric ozone to A89-54363 ion, phase 1 N89-28754 bined remote A89-54807 ure drop and A89-54807 ure drop and A89-54777 rotor: Users on and mean N89-29154 hance using
Pseudo-spectral and asymptotic sensitivity of counter-rotating vortices p 661 A symptotic solution of a nonlinear bo problem with a partly unknown boundary p 874 Asymptotically decoupled variable struct systems and large maneuver of aircraft p 852 ATMOSPHERIC CHEMISTRY A study of the sensitivity of stratosphe hypersonic aircraft emissions p 867 Hypersonic vehicle environment simulat [AD-A209030] p 864 ATMOSPHERIC MOISTURE Aircraft icing conditions detected by com sensors - A preliminary study p 827 ATMOSPHERIC TEMPERATURE A relationship between peak temperat velocity differential in a microburst p 867 ATMOSPHERIC TURBULENCE Noise produced by turbulent flow into a manual for atmospheric turbulence predicti flow and turbulence contraction prediction [NASA-CR-181791] p 876 ATTACK AIRCRAFT Intelligent flight management perform discrete-event simulation [AIAA PAPER 89-3526] p 847	A89-51755 undary value A89-52802 ire control of A89-53988 ric ozone to A89-54363 ion, phase 1 N89-28754 bined remote A89-54807 ure drop and A89-54777 rotor: Users on and mean N89-29154 hance using
Pseudo-spectral and asymptotic sensitivity of counter-rotating vortices p 661 A symptotic solution of a nonlinear bo problem with a partly unknown boundary p 874 Asymptotically decoupled variable structu systems and large maneuver of aircraft p 852 ATMOSPHERIC CHEMISTRY A study of the sensitivity of stratosphe hypersonic aircraft emissions p 867 Hypersonic vehicle environment simulal [AD-A209030] p 864 ATMOSPHERIC MOISTURE Aircraft icing conditions detected by com sensors - A preliminary study p 827 ATMOSPHERIC TEMPERATURE A relationship between peak temperativelocity differential in a microburst p 867 ATMOSPHERIC TURBULENCE Noise produced by turbulent flow into a manual for atmospheric turbulence predictifow and turbulence contraction prediction [NASA-CR-181791] p 876 ATTACK AIRCRAFT Intelligent flight management perform discrete-event simulation [AIAA PAPER 89-3526] p 847 ATTENTION	A89-51755 undary value A89-52802 ire control of A89-53988 ric ozone to A89-54363 iion, phase 1 N89-28754 bined remote A89-54807 ure drop and A89-54777 rotor: Users on and mean N89-29154 hance using A89-52615
Pseudo-spectral and asymptotic sensitivity of counter-rotating vortices p 861 A symptotic solution of a nonlinear bo problem with a partly unknown boundary p 874 Asymptotically decoupled variable structur systems and large maneuver of aircraft p 852 ATMOSPHERIC CHEMISTRY A study of the sensitivity of stratosphe hypersonic aircraft emissions p 867 Hypersonic vehicle environment simulat [AD-A209030] p 864 ATMOSPHERIC MOISTURE Aircraft icing conditions detected by com sensors - A preliminary study p 827 ATMOSPHERIC TEMPERATURE A relationship between peak temperativelocity differential in a microburst p 867 ATMOSPHERIC TURBULENCE Noise produced by turbulent flow into a manual for atmospheric turbulence predictif flow and turbulence contraction prediction [NASA-CR-181791] p 876 ATTACK AIRCRAFT Intelligent flight management perform discrete-event simulation [AIAA PAPER 89-3526] p 847 ATTENTION	A89-51755 undary value A89-52802 ire control of A89-53988 ric ozone to A89-54363 iion, phase 1 N89-28754 bined remote A89-54807 ure drop and A89-54777 rotor: Users on and mean N89-29154 hance using A89-52615
Pseudo-spectral and asymptotic sensitivity of counter-rotating vortices p 661 A symptotic solution of a nonlinear bo problem with a partly unknown boundary p 874 Asymptotically decoupled variable struct systems and large maneuver of aircraft p 852 ATMOSPHERIC CHEMISTRY A study of the sensitivity of stratosphe hypersonic aircraft emissions p 867 Hypersonic vehicle environment simulat [AD-A209030] p 864 ATMOSPHERIC MOISTURE Aircraft icing conditions detected by com sensors - A preliminary study p 827 ATMOSPHERIC MOISTURE A relationship between peak temperat velocity differential in a microburst p 867 ATMOSPHERIC TEMPERATURE Noise produced by turbulent flow into a manual for atmospheric turbulence predictio flow and turbulence contraction prediction [NASA-CR-181791] p 876 ATTACK AIRCRAFT Intelligent flight management perform discrete-event simulation [AIAA PAPER 89-3526] p 847 ATTENTION Towards a physiologically based HUD (Hea symbology	A89-51755 undary value A89-52802 ire control of A89-53988 ric ozone to A89-54363 ion, phase 1 N89-28754 bined remote A89-54807 ure drop and A89-54807 rotor: Users on and mean N89-29154 nance using A89-52615 d-Up Display)
Pseudo-spectral and asymptotic sensitivity of counter-rotating vortices p 661 A symptotic solution of a nonlinear bo problem with a partly unknown boundary p 874 Asymptotically decoupled variable structur systems and large maneuver of aircraft p 852 ATMOSPHERIC CHEMISTRY A study of the sensitivity of stratosphe hypersonic aircraft emissions p 867 Hypersonic vehicle environment simulal [AD-A209030] p 864 ATMOSPHERIC MOISTURE Aircraft icing conditions detected by com sensors - A preliminary study p 827 ATMOSPHERIC TEMPERATURE A relationship between peak temperativelocity differential in a microburst p 867 ATMOSPHERIC TURBULENCE Noise produced by turbulent flow into a manual for atmospheric turbulence predictio flow and turbulence contraction prediction [NASA-CR-181791] p 876 ATTACK AIRCRAFT Intelligent flight management perform discrete-event simulation [AIAA PAPER 89-3526] p 847 ATTENTION Towards a physiologically based HUD (Hea symbology [AD-A207748] p 838	A89-51755 undary value A89-52802 ire control of A89-53988 ric ozone to A89-54363 ion, phase 1 N89-28754 bined remote A89-54807 ure drop and A89-54807 rotor: Users on and mean N89-29154 nance using A89-52615 d-Up Display)
Pseudo-spectral and asymptotic sensitivity of counter-rotating vortices p 661 A symptotic solution of a nonlinear bo problem with a partly unknown boundary p 874 Asymptotically decoupled variable struct systems and large maneuver of aircraft p 852 ATMOSPHERIC CHEMISTRY A study of the sensitivity of stratosphe hypersonic aircraft emissions p 867 Hypersonic vehicle environment simulat [AD-A209030] p 864 ATMOSPHERIC MOISTURE Aircraft icing conditions detected by com sensors - A preliminary study p 827 ATMOSPHERIC MOISTURE A relationship between peak temperat velocity differential in a microburst p 867 ATMOSPHERIC TEMPERATURE Noise produced by turbulent flow into a manual for atmospheric turbulence predictio flow and turbulence contraction prediction [NASA-CR-181791] p 876 ATTACK AIRCRAFT Intelligent flight management perform discrete-event simulation [AIAA PAPER 89-3526] p 847 ATTENTION Towards a physiologically based HUD (Hea symbology	A89-51755 undary value A89-52802 ire control of A89-53988 ric ozone to A89-54363 ion, phase 1 N89-28754 bined remote A89-54807 ure drop and A89-54807 rotor: Users on and mean N89-29154 nance using A89-52615 d-Up Display)

- Nonlinear control of a supermaneuverable aircraft p 845 A89-52579 [AIAA PAPER 89-3486] Towards a physiologically based HUD (Head-Up Display)
- symbology [AD-A207748] p 838 N89-28515
- ATTITUDE INDICATORS Towards a physiologically based HUD (Head-Up Display) symbology [AD-A207748] p 838 N89-28515 AUTOMATED PILOT ADVISORY SYSTEM On-board automatic aid and advisory for pilots of
- control-impaired aircraft [AIAA PAPER 89-3460] p 844 A89-52558
- AUTOMATIC CONTROL On-board automatic aid and advisory for pilots of
- control-impaired aircraft [AIAA PAPER 89-3460] p 844 A89-52558
- 1989 American Control Conference, 8th, Pittsburgh, PA, June 21-23, 1989, Proceedings. Volumes 1, 2, & 3
- p 874 A89-53951 AUTOMATIC FLIGHT CONTROL
- Self-tuning Generalized Predictive Control applied to terrain following flight
- [AIAA PAPER 89-3450] p 843 A89-52549

- p 860 N89-29497

Development of a flight control system for VTOL aircraft supported by ducted fans p 849 A89-52672 [AIAA PAPER 89-3592]

The flight control system for the Daedalus human powered aircraft

[AIAA PAPER 89-3593] p 849 A89-52673 AUTOMATIC LANDING CONTROL

Design of localizer capture and track using classical p 852 A89-53978 control techniques AUTOMATIC PILOTS

The flight control system for the Daedalus human powered aircraft p 849 A89-52673 [AIAA PAPER 89-3593]

- Design of integrated autopilot/autothrottle for NASA TSRV airplane using integral LQG methodology --transport systems research vehicle p 849 A89-52674
- [AIAA PAPER 89-3595] Lateral axis autopilot design for large transport aircraft - An explicit model-matching approach
- p 852 A89-53976 Design of localizer capture and track modes for a lateral autopilot using H(infinity) synthesis p 852 A89-53977
- Integral LQG model following controller p 852 A89-53979 A multivariable control design for the lateral axis autopilot
- of a transport aircraft p 852 AUTOMATIC TRAFFIC ADVISORY AND RESOLUTION Aircraft trajectory prediction for terminal automation [AIAA PAPER 89-3634] p 829 A89-52703
- Operational experience with the Computer Oriented Metering Planning and Advisory System (COMPAS) at Frankfurt, Germany p 829 A89-52721 [AIAA PAPER 89-3627]
- AUTOMATION
- An optimal material removal strategy for automated p 874 A89-53416 repair of aircraft canopies AVIATION METEOROLOGY
- Thrust laws for microburst wind shear penetration p 848 A89-52645 [AIAA PAPER 89-3560]
- Optimal paths through downbursts p 848 A89-52646 [AIAA PAPER 89-3561] International Conference on the Aviation Weather Systems, 3rd, Anaheim, CA, Jan. 30-Feb. 3, 1989
- Preprints p 867 A89-54776 The detection of low level windshear with airport p 868 A89-54780 surveillance radar
- Microburst detection from mesonet data p 868 A89-54783 Evaluation of the 12-station enhanced Low Level Wind Shear Alert System (LLWAS) at Denver Stapleton
- International Airport p 868 A89-54784 Microburst detection and display by TDWR - Shape, extent, and alarms --- Terminal Doppler Weather Radar
- p 868 A89-54785 Divergence estimation by a single Doppler radar
- p 868 A89-54786 Estimation of microburst asymmetry with a single p 868 A89-54787 Doppler radar
- Numerical simulation of microbursts Aircraft trajectory p 869 A89-54788 studies Weather sensing with airport surveillance radars
- p 869 A89-54789 Impact of automated weather observing systems on viation p 869 A89-54795 p 869 aviation
- A cursory study of F-factor applied to Doppler radar ---characterizing effect of wind shear on jet aircraft
- p 853 A89-54799 LDIS (Lightning Data and Information Systems) - A new p 869 A89-54801 resource for aviation meteorology
- Observations and forecasts for runway (pavement) p 826 A89-54802 surfaces The influence of ice accretion physics on the forecasting
- of aircraft icing conditions p 826 A89-54803 Measurements of hazardous icing conditions p 826 A89-54804
- A cooperative study on winter icing conditions in the Denver area D 869 A89-54806 Aircraft icing conditions detected by combined remote
- p 827 A89-54807 sensors - A preliminary study MET 90, a project for the development of the future p 870 A89-54817 Swedish aviation weather system
- Aircraft icing hazards forecasting and synoptic assification p 827 A89-54821 The role of the Smith-Feddes model in improving the classification
- forecasting of aircraft icing p 827 A89-54823 Verification of aerodrome forecasts
- p 870 A89-54824 Analysis of verification parameters for non-convective Sigmets --- significant meteorology to airmen
- p 870 A89-54825 The World Area Forecast System p 870 A89-54827 Very short-range aerodrome forecasts using regression p 870 A89-54831 techniques Severe aircraft icing events - A Colorado case study
 - p 827 A89 54838

Doppler weather radar service at the Chiang Kai-Shek A89-54840 International Airport p 871 An index for clear air turbulence based on horizontal deformation and vertical wind shear p 87* A89-54841 Improvement of the performance of sensors in the low-level wind shear alert system (LLWAS) p 871 A89-54844 A case study of local severe weather at Chang Kai Shek p 871 Å89-54846 International Airport Aircraft low level wind shear detection and warning p 838 A89-54848 Gust front detection algorithm for the Terminal Doppler Weather Radar. II - Performance assessment p 871 A89-54852 The Federal Aviation Administration's Low Level Windshear Alert System - A project management perspective p 871 A89-54854 The FAA Terminal Doppler Weather Radar (TDWR) p 871 A89-54855 program Ground based weather radar for aviation p 871 A89-54856 The status of the FAA Central Weather Processor (CWP) p 872 A89-54857 program JPL realtime weather processor system developed for FAA p 875 A89-54858 Data Link Processor (DLP), pilot access to weather data o 831 A89-54859 The development of numerically-based and expert system approaches for airfield nowcasting/very short range forecasting p 8?2 A89-54860 An overview of the national program to improve aircraft p 872 A89-54862 icing forecasts p 879 A89-54863 Weather testimony in litigation Federal plans to satisfy aviation weather information requirements in the 1990's p 872 A89-54865 Weather information systems for pilots - The Minnesota experience p 872 A89-54866 Techniques for the detection of microburst events using airport surveillance radars - Cross-spectral velocity estimation p 872 A89-54868 AVIONICS Integrated control and avionics for air superiority -Computational aspects of real-time flight management [AIAA PAPER 89-3463] p 637 A89-52559 A knowledge based tool for failure propagation p 874 A89-53970 analysis p 838 A89-54345 Intelligent avionics The Advanced Aeronautic Design Program - Designing p 834 A89-54370 for the future Flight systems design issues for a research-oriented p 853 A89-54371 hypersonic vehicle AXIAL FLOW Measurements of mean-flow and turbulence characteristics in a turbojet exhaust using a laser velocimeter p 341 N89-28519 [ISI -CO-226/88] **AXIAL FLOW TURBINES** A multi-objective optimum design method for a radial-axial flow turbine with the optimum criteria of blade twist at outlet of blades. p 838 A89-52306 **AXISYMMETRIC BODIES** Evolution of axisymmetric wakes from attached and separated flows p 818 A89-52945 Calculation of transonic flow past the tail section of a p 820 A89-54535 plane or axisymmetric body Laser velocimetry in the close wake of an axisymmetric

- rear body [ISL-R-114/87] p 865 N89-28774 AXISYMMETRIC FLOW mean-flow and turbulence Measurements of
- characteristics in a turbojet exhaust using a laser elocimeter [ISL-CO-226/88] p 841 N89-28519

В

BALL BEARINGS

- Turbomachinery rotor support with damping [NASA-CASE-MFS-28345-1] p 865 p 865 N89-28841 BEAMS (SUPPORTS)
- Fault-tolerant sensor and actuator selection for control of flexible structures p 874 A89-54007 BEARINGS
- Superconducting Meissner effect bearings for cryogenic turbomachines, phase 1 [AD-A209875] p 865 N89-28839
- **BLUFF BODIES**
- Phenomena and modelling of flow-induced vibrations of bluff bodies p 861 A89-52961 BODIES OF REVOLUTION
- Evolution of axisymmetric wakes from attached and separated flows p 818 A89-52945

BODY-WING CONFIGURATIONS

Experimental investigation of a three dimensional wake in the vicinity of a wing-body junction [CERT-0A-29/5025-AYD] p 825 N89-29325

- BOREHOLES
- Stresses and strains in a cold-worked annulus [AR-005-548] p 866 N89-28871 BOUNDARY ELEMENT METHOD

Boundary elements for structural analysis

p 867 N89-29800 BOUNDARY LAYER COMBUSTION Supersonic combustion at the DFVLR: Results and

xperiences

[DEVI R-88-044] n 859 N89-28610 BOUNDARY LAYER EQUATIONS

Solution of the inverse boundary value problem of aerohydrodynamics with allowance for the boundary p 864 A89-54611 laver

ayel poor A03-54011
BOUNDARY LAYER FLOW
The effects of longitudinal vortices on heat transfer of
laminar boundary layers p 860 A89-51680
Boundary-layer measurements on a transonic
low-aspect ratio wing
[NASA-TM-88214] p 823 N89-29305
BOUNDARY LAYER SEPARATION
Prediction of secondary separation in shock wave
boundary-layer interactions p 816 A89-51760
Evolution of axisymmetric wakes from attached and
separated flows p 818 A89-52945
Some aspects of aircraft dynamic loads due to flow
separation p 832 A89-52959
Theory for separated flow around the trailing edge of
a thin profile p 820 A89-54614
Transition and turbulence structure in the boundary
layers of an oscillating airfoil
[AD-A208968] p 824 N89-29317
BOUNDARY LAYER TRANSITION
Transition flight experiments on a swept wing with
suction p 819 A89-53830
Transition and turbulence structure in the boundary
layers of an oscillating airfoil
[AD-A208968] p 824 N89-29317
BOUNDARY LAYERS
Wake dissipation and total pressure loss in a
two-dimensional compressor cascade with crenulated
trailing edges
[AD-A209176] p 864 N89-28755
BOUNDARY VALUE PROBLEMS
Asymptotic solution of a nonlinear boundary value
problem with a partly unknown boundary
p 874 A89-52802
BUDGETING
Accomplishments under the airport improvement
program: Fiscal year 1988
[AD-A208200] p 855 N89-29352
BUFFETING
Some aspects of aircraft dynamic loads due to flow
separation p 832 A89-52959
BYPASS RATIO
Ultra high bypass aircraft sonic fatigue
p 831 A89-51898
h 021 W03-21030
-
C
-
CALIBRATING
VALIDNATING

The	acoustic	calibration of	aircraft	fuselage	structures,
nart 1					

[ISVR-TR-169-PT-1]	p 877	N89-29158
CAMOUELAGE		

Carnouflage cap allows aircraft to disappear

- p 838 A89-54482 CANOPIES
- Glazing into the future --- shielding coatings for military ockpit canopies p 832 A89-52525 An optimat material removal strategy for automated cockpit canopies
- pair of aircraft canopies p 874 A89-53416 CARGO AIRCRAFT AT3 demonstrates feasibility of cargo STOL with long

p 832 A89-52201 rance CASCADE CONTROL

A multiloop, digital flutter suppression control law synthesis case study

[AIAA PAPER 89-3556] p 848 A89-52642 CASCADE FLOW

- Theoretical study on the unsteady aerodynamic characteristics of an oscillating cascade with tip clearance - In the case of a nonloaded cascade
- p 816 A89-51678 Secondary flow control and loss reduction in a turbine cascade using endwall fences p 816 A89-51679 Computation of the detached shock shape in a p 816 A89-52307 supersonic or transonic cascade

Solution for two-dimensional inviscid transonic cascade p 817 A89-52308 flows with multiple-orid algorithm

CASCADE FLOW

CAST ALLOYS

Application of upwind factor method to transonic cascade calculation p 817 A89-52309 CAST ALLOYS

Aerospace investment casting in the U.S.A. 1988 p 857 A89-52022 CEMENTS

Joint sealants for airport pavements. Phase 1: Laboratory and field investigations

[DOT/FAA/DS-89/2-PHASE-1] p 854 N89-28523 CENTRIFUGAL COMPRESSORS

Superconducting Meissner effect bearings for cryogenic turbomachines, phase 1 [AD-A209875] p 865 N89-28839

CERAMIC MATRIX COMPOSITES Intermetallic and ceramic matrix composites for 815 to 1370 C (1500 to 2500 F) gas turbine engine applications

[NASA-TM-102326] p 860 N89-29490 CERAMICS Injection moulded ceramic rotors - Comparison of SiC

- and Si3N4 p 858 A89-53658 Tribological properties of alumina-boria-silicate fabric from 25 C to 850 C p 859 A89-54982 CERTIFICATION
- Workshop proceedings on Composite Aircraft Certification and Airworthiness
- [AD-A209321] p 835 N89-29336 CHANNELS (DATA TRANSMISSION)
- Linear token passing based bus interface unit for a fault tolerant multiprocessor testbed p 874 A89-53975 CHARTS

AHS National Specialists' Meeting on the Rotary Wing Aircraft Conceptual Design Process, Atlanta, GA, Apr. 3-5, 1989, Proceedings p 815 A89-52950 CHEMICAL REACTIONS

Hypersonic vehicle environment simulation, phase 1 [AD-A209030] p 864 N89-28754 CIRCULAR CYLINDERS

Control of separated flow past a cylinder using tangential wall iet blowing

- [NASA-CR-185918] p 825 N89-29326 CIVIL AVIATION
- MLS 1989 Status report from the perspective of the airline companies p 830 A89-53663 Results of a preliminary study of two high-speed civil transport design concepts p 834 A89-54372 International Conference on the Aviation Weather
- Systems, 3rd, Anaheim, CA, Jan. 30-Feb. 3, 1989, Preprints p 867 A89-54776
- Impact of automated weather observing systems on aviation p 869 A89-54795 MET 90, a project for the development of the future Swedish aviation weather system p 870 A89-54817
- Status and development potential of the fly by light technology in civil aircraft [ILR-MITT-212] p 854 N89-28522
- Workshop proceedings on Composite Aircraft Certification and Airworthiness [AD-A209321] p 835 N89-29336
- CLEAR AIR TURBULENCE
- An index for clear air turbulence based on horizontal deformation and vertical wind shear p 871 A89-54841 CLEARANCES

Controller evaluations of the descent advisor automation aid

- [AIAA PAPER 89-3624] p 829 A89-52699 CLIMATE
- Workshop proceedings on Composite Aircraft Certification and Airworthiness [AD-A209321] p 835 N89-29336

CLUMPS Supersonic jet studies of fluorene clustered with water,

ammonia and piperidine [AD-A209562] p 860 N89-29497

COCKPITS Glazing into the future --- shielding coatings for military cockpit canopies p 832 A89-52525

COEFFICIENT OF FRICTION Tribological properties of alumina-boria-silicate fabric from 25 C to 850 C p 859 A89-54982

COLD WORKING Stresses and strains in a cold-worked annulus

[AR-005-548] p 866 N89-28871

COLLISION AVOIDANCE Collision avoidance operational concept [WP-88W00418] p 831 N89-28509 COMBUSTIBLE FLOW

- Turbulent reactive flows p 857 A89-51860 Mixing augmentation technique for hypervelocity scramjets p 840 A89-53351 Combustion-related shear-flow dynamics in elliptic supersonic jets p 819 A89-53930
- COMBUSTION CHAMBERS

Fuel properties effect on the performance of a small high temperature rise combustor

[AIAA PAPER 89-2901] p 838 A89-52025

Unsteady heat transfer in turbine blade ducts - Focus on combustor sources p 862 A89-53286 COMBUSTION CONTROL

Engine combustion optimization by exhaust analysis [PB89-195788] p 859 N89-28588

- COMBUSTION EFFICIENCY
- Plasma torch igniter for scramjets p 858 A89-53355 Engine combustion optimization by exhaust analysis [PB89-195788] p 859 N89-28588 COMBUSTION TEMPERATURE
- Fuel properties effect on the performance of a small high temperature rise combustor
- [AIAA PAPER 89-2901] p 838 A89-52025 COMMERCIAL AIRCRAFT
 - Are the Soviets set to make the big time? p 825 A89-52513
- EUROFAR Project for a perpendicularly launched cruising aircraft [MBB-UD-538-88-PUB] p 833 A89-53308
- Hypersonic flight and world tourism p 878 A89-54352
- Hypersonic flight Future commercial potential p 878 A89-54353
- Transnational legal problems for commercial hypersonic flight p 878 A89-54356
- The Orient Express The emperor's new airplane p 878 A89-54357
- Statistics on aircraft gas turbine engine rotor failures that occurred in US commercial aviation during 1984 [NAPC-PE-185] p 841 N89-28516 Statistics on aircraft gas turbine engine rotor failures
- that occurred in US commercial aviation during 1985 [NAPC-PE-188] p 841 N89-28517 COMMUTER AIRCRAFT
- A new hybrid airship ('Heliship') for commuter transport p 833 A89-53641 COMPENSATORS
- An improved pseudo state method for aircraft controller design p 851 A89-53955 COMPETITION

Competition and safety in air traffic [TUB-DISS-PAPER-128] p 827 N89-28508

- COMPLEX SYSTEMS Evaluation methods for complex flight control systems
- [AIAA PAPER 89-3502] p 846 A89-52595 COMPOSITE MATERIALS
- Current research in composite structures at NASA's Langley Research Center p 861 A89-51692 Interlaminar fracture toughness and toughening of laminated composite materials - A review
- p 858 A89-54426
- Environmental effects on composite structures
- p 857 A89-52994 A proposed composite repair methodology for primary structure p 858 A89-54429
- Design, fabrication, and testing of a composite main landing gear retracting beam
- [SME PAPER EM88-551] p 834 A89-54901 Five year ground exposure of composite materials used on the Bell Model 206L flight service evaluation
- [NASA-TM-101645] p 859 N89-28579 Workshop proceedings on Composite Aircraft
- Certification and Airworthiness [AD-A209321] p 835 N89-29336
- COMPRESSIBLE BOUNDARY LAYER Special Course on Aerothermodynamics of Hypersonic Vehicles
- [AGARD-R-761] p 823 N89-29306 COMPRESSIBLE FLOW
- Application of compound compressible flow to nonuniformities in hypersonic propulsion systems
- p 818 A89-53367 Transonic flows with vorticity transport around slender bodies p 820 A89-53949
- COMPRESSION LOADS
- Overview of buckling in aircraft design
- p 834 A89-54462
- Computation of the detached shock shape in a supersonic or transonic cascade p 816 A89-52307 The development of advanced computational methods
- for turbomachinery blade design p 839 A89-52482 Wake dissipation and total pressure loss in a two-dimensional compressor cascade with crenulated trailing edges
- [AD-A209176] p 864 N89-28755 COMPRESSORS
- Wake dissipation and total pressure loss in a two-dimensional compressor cascade with crenulated trailing edges
- [AD-A209176] p 864 N89-28755 COMPUTATIONAL FLUID DYNAMICS
- Prediction of inplane damping from deterministic and stochastic models --- rotor blade stability in turbulent flow p 832 A89-52042

SUBJECT INDEX

Solution for two-dimensional inviscid transonic cascade p 817 A89-52308 flows with multiple-grid algorithm Application of upwind factor method to transonic cascade calculation p 817 A89-52309 The development of advanced computational methods for turbomachinery blade design p 839 A89-52482 Navier-Stokes computation of transonic vortices over a round leading edge delta wing p 817 A89-52483 Separated flow past three-dimensional bodies as a p 861 A89-52507 singular perturbation problem An effective flutter control method using fast, time-accurate CFD codes p 845 A89-52563 [AIAA PAPER 89-3468] Supercomputer requirements for selected disciplines A89-53152 important to aerospace p 874 A comparison of mixed and penalty finite element methods in analysis of heat exchangers p 862 A89-53254 CFD in the context of IHPTET - The Integrated High Performance Turbine Engine Technology Program [AIAA PAPER 89-2904] p 862 A89-53307 A regular perturbation method for subcritical flow over p 818 A89-53570 a two-dimensional airfoil Constructing a continuous parameter range of computational flows p 819 A89-53928 Forces for change and the future of hypersonic flight in the 21st century p 856 A89-54327 Representation and display of vector field topology in fluid flow data sets p 875 A89-54904 Scientific visualization in computational aerodynamics at NASA Ames Research Center p 875 A89-54907 Study of the wing-vortex interaction in three dimensional flows (incompressible inviscid flow) p 822 N89-28494 [ISL-R-123/87] Flow calculation over a delta-wing using the thin-layer Navier-Stokes equations [PD-CF-8924] p 822 N89-28497 Correlation of Puma airloads: Evaluation of CFD prediction methods. [NASA-TM-102226] p 822 N89-28498 Hypersonic vehicle environment simulation, phase 1 [AD-A209030] p 864 N89-28754 Special Course on Aerothermodynamics of Hypersonic Vehicles [AGARD-R-761] p 823 N89-29306 Inviscid and viscous hypersonic aerodynamics: A review of the old and new p 823 N89-29308 COMPUTER AIDED DESIGN Computerised design of blade elements in p 840 A89-52991 turbomachines Application of modern optimization tools for the design of aircraft structures p 834 A89-54471 CAD/CAM - Managerial challenges and research p 879 A89-54908 issues Design by functional feature for aircraft structure p 836 N89-29345 NASA Workshop on Computational Structural Mechanics 1987, part 2 [NASA-CP-10012-PT-2] n 866 N89-29789 COMPUTER AIDED MANUFACTURING CAD/CAM - Managerial challenges and research ieeuoe p 879 A89-54908 COMPUTER GRAPHICS Scientific visualization in computational aerodynamics at NASA Ames Research Center p 875 A89-54907 COMPUTER NETWORKS Extended observability of linear time-invariant systems under recurrent loss of output data [AIAA PAPER 89-3510] p 873 A89-52603 COMPUTER PROGRAMS Computerized life and reliability modeling for turboprop transmissions p 863 A89-53364 Analysis of leading edge separation using a low order anel method p 822 N89-28493 [NASA-CR-185892] Flow calculation over a delta-wing using the thin-layer Navier-Stokes equations [PD-CF-8924] p 822 N89-28497 Evaluation of LDA 3-component velocity data on a 65 deg delta wing at M = 0.85 and first results of an analysis [DFVLR-FB-89-19] p 823 N89-28505 Direct User Access Terminal (DUAT) operational concept [WP-88W00075] p 854 N89-28524 The 3-D inelastic analyses for computational structural p 867 N89-29804 COMPUTER SYSTEMS DESIGN Operational experience with the Computer Oriented Metering Planning and Advisory System (COMPAS) at Frankfurt, Germany

 [AIAA PAPER 89-3627]
 p 829
 A89-52721

 JPL realtime weather processor system developed for FAA
 p 875
 A89-54858

COMPUTER SYSTEMS PROGRAMS

Initial flight gualification and operational maintenance of X-29A flight software

[AIAA PAPER 89-3596]	p 850	A89-52675
NASA Workshop on	Computational	Structural
Mechanics 1987, part 2		
[NASA-CP-10012-PT-2]	p 866	N89-29789
COMPUTER TECHNIQUES		

Map, Operator, Maintenance Stations --- in mission planning

(AIAA PAPER 89-3523) p 854 A89-52613 COMPUTERIZED SIMULATION

Global positioning system accuracy improvement using Ridge regression [AIAA PAPER 89-3499] p 828 A89-52591

A model of the National Airspace System p 829 A89-52701 [AIAA PAPER 89-3626]

simulation Numerical of rollina uρ of leading/trailing-edge vortex sheets for slender wings p 819 A89-53926

Numerical simulation of microbursts - Aircraft trajectory p 869 A89-54788 studies

Scientific visualization in computational aerodynamics p 875 A89-54907 at NASA Ames Research Center Microcomputer simulation of lubricant degradation in

turbine engines using laboratory data p 859 A89-54986

Flow calculation over a delta-wing using the thin-layer Navier-Stokes equations [PD-CF-8924] p 822 N89-28497

A detailed survey of the flow passing through an asymmetric contraction and parallel duct

[BAE-WWT-RP-RES-AXR-000194-] p 823 N89-28501 A detailed survey of the flow passing through an asymmetric contraction and parallel duct

[BAE-WWT-RP-RES-AXR-000194-] p 823 N89-28502 Use of high-resolution upwind scheme for vortical flow simulations

- p 824 N89-29321 [NASA-CR-185910] NASA Workshop on Computational Structural
- Mechanics 1987, part 2 [NASA-CP-10012-PT-2] p 866 N89-29789 Computational structural mechanics engine structures p 866 N89-29792 computational simulator
- Interfacing modules for integrating discipline specific structural mechanics codes p 866 N89 CSM research: Methods and application studies p 866 N89-29793

p 867 N89-29794 CONCRETES

Joint sealants for airport pavements. Phase 1: aboratory and field investigations

[DOT/FAA/DS-89/2-PHASE-1] p 854 N89-28523 CONFERENCES

- AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Parts p 842 A89-52526 1&2 Turbulent shear flows 6; International Symposium, 6th, Universite de Toulouse III, France, Sept. 7-9, 1987, Selected Papers p 861 A89-52943
- AHS National Specialists' Meeting on the Rotary Wing Aircraft Conceptual Design Process, Atlanta, GA, Apr. 3-5,
- 1989, Proceedings p 815 A89-52950 1989 American Control Conference, 8th, Pittsburgh, PA,

June 21-23, 1989, Proceedings. Volumes 1, 2, & 3 p 874 A89-53951 International Conference on Hypersonic Flight in the 21st Century, 1st, University of North Dakota, Grand Forks, Sept. 20-23, 1988, Proceedings p 855 A89-54326 p 855 A89-54326

International Conference on the Aviation Weather Systems, 3rd, Anaheim, CA, Jan. 30-Feb. 3, 1989, Preprints p 867 A89-54776 Workshop proceedings on Composite Aircraft

Certification and Airworthiness [AD-A209321] p 835 N89-29336

NASA Workshop on Computational Structural Mechanics 1987, part 2 p 866 N89-29789 [NASA-CP-10012-PT-2]

CONFIGURATION MANAGEMENT An integrated configuration and control analysis

technique for hypersonic vehicles p 833 A89-54006 CONGRESSIONAL REPORTS

Accomplishments under the airport improvement program: Fiscal year 1988 [AD-A208200] p 855 N89-29352

CONICAL CAMBER Separated flow past a concave conical wing of large

transverse curvature at small angles of attack p 820 A89-54619

CONICAL FLOW

Construction of general-purpose supersonic nozzles of conical cross section p 821 A89-54624 CONSTRUCTION MATERIALS

Forces for change and the future of hypersonic flight in the 21st century p 856 A89-54327

Selecting high-temperature structural intermetallic compounds - The materials science approach p 858 A89-54671

- CONTROL CONFIGURED VEHICLES Application of perfect model following to a control
- configured vehicle p 844 A89-52552 [AIAA PAPER 89-3453] Surface failure detection and evaluation of control law
- for reconfiguration of flight control system [AIAA PAPER 89-35091 AIAA PAPER 89-3509 j p 347 A89-52602 An integrated configuration and control analysis
- technique for hypersonic vehicles p 833 A89-54006 CONTROL SIMULATION
- Experience with implementation of a lurbojet engine control program on a multiprocessor p 875 A89-54106
- CONTROL STABILITY
- Nonlinear stabilizing control of high angle of attack flight dynamics
- p 845 A89-52580 [AIAA PAPER 89-3487] Dynamic stability and active control of elastic vehicles acting with unsteady aerodynamic forces
- [AIAA PAPER 89-3557] p 848 A89-52643 On the control of elastic vehicles - Model simplification
- and stability robustness p 873 A89-52715 [AIAA PAPER 89-3558]
- CONTROL SURFACES Study on a design method for the lateral stability of the
- airplane by the conditions for the steady horizontal turn with control surfaces fixed p 851 A89-53640 Chaotic response of aerosurfaces with structural nonlinearities
- AD-A2084331 p 824 N89-29316 CONTROL SYSTEMS DESIGN
- AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Parts p 842 A89-52526 1&2
- new technique for aircraft flight control Ā reconfiguration
- [AIAA PAPER 89-3425] p 843 A89-52527 design procedure for the handling qualities
- optimization of the X-29A aircraft [AIAA PAPER 89-3428] p 843 A89-52529 Synthesis of a helicopter full authority controller
- [AIAA PAPER 89-3448] p 843 A89-52547 Comparison of eigenstructure assignment and the Salford singular perturbation methods in VSTOL aircraft
- control law design [AIAA PAPER 89-3451] p 844 A89-52550 Flight control synthesis for an unstable fighter aircraft using the LOG/LTR methodology
- [AIAA PAPER 89-3452] p 844 A89-52551
- Application of perfect model following to a control configured vehicle
- [AIAA PAPER 89-3453] p 844 A89-52552 Integrated control and avionics for air superiority -Computational aspects of real-time flight management
- p 837 A89-52559 [AIAA PAPER 89-3463] Modeling of aerodynamic forces in the Laplace domain with minimum number of augmented states for the design
- of active flutter suppression systems [AIAA PAPER 89-3466] p 844 A89-52561 Sensitivity derivatives of flutter characteristics and
- stability margins for aeroservoelastic des gn [AIAA PAPER 89-3467] p 645 A89-52562 An effective flutter control method using fast,
- time-accurate CFD codes [AIAA PAPER 89-3468] p 845 A89-52563 Integrated structure/control law design by multilevel
- optimization [AIAA PAPER 89-3470] p 873 A89-52564
- Nonlinear control of a supermaneuverable aircraft [AIAA PAPER 89-3486] p 845 A89-52579
- On the design of nonlinear controllers for flight control vstems [AIAA PAPER 89-3489] p 845 A89-52582
- Comparison of Characteristic Locus and h-infinity methods in VSTOL flight control system design [AIAA PAPER 89-3491] p 846 A89-52584
- A surrogate system approach to robust control design p 873 A89-52585 [AIAA PAPER 89-3492]
- Design of adaptive digital model-following flight-mode control systems for high-performance aircraft p 846 A89-52587 [AIAA PAPER 89-34951
- Modification of trim point and feedback gains for failed aircraft
- [AIAA PAPER 89-3507] n 846 A89-52600 Integrated flight/propulsion control system design based on a centralized approach
- [AIAA PAPER 89-3520] p 847 A89-52611 An observer-based compensator for cistributed delays in integrated control systems [AIAA PAPER 89-3541] p 347 A89-52628
- A multiloop, digital flutter suppression control law synthesis case study [AIAA PAPER 89-3556] p 348 A89-52642

Application of total energy control for high performance aircraft vertical transitions

CONTROL THEORY

[AIAA PAPER 89-3559] p 848 A89-52644 A variable-gain output feedback control design approach

[AIAA PAPER 89-3575] p 873 A89-52658 Application of variable-gain output feedback for high-alpha control

[AIAA PAPER 89-3576] p 848 A89-52659 Design of tunable digital set-point tracking PID

controllers for gas turbines with unmeasurable outputs [AIAA PAPER 89-3577] p 839 A89-52660 Robust control system design with multiple model

- approach and its application to active flutter control [AIAA PAPER 89-3578] p 849 A89-52661 Algebraic loop transfer recovery - An application to the
- design of a helicopter output feedback control law [AIAA PAPER 89-3579] p 849 A89-52662
- Development of a flight control system for VTOL aircraft supported by ducted fans
- [AIAA PAPER 89-3592] p 849 A89-52672 The flight control system for the Daedalus human powered aircraft
- [AIAA PAPER 89-3593] p 849 A89-52673 Design of integrated autopilot/autothrottle for NASA TSRV airplane using integral LQG methodology ---
- transport systems research vehicle [AIAA PAPER 89-3595] p 849 A89-52674
- Robust eigenstructure assignment for flight control using the Ctrl-C design package [AIAA PAPER 89-3607] p 850 A89-52685
- Modal techniques for analyzing airplane dynamics [AIAA PAPER 89-3609] p 850 A89-52687
- High performance linear-quadratic and H-infinity designs for a 'supermaneuverable' aircraft
- [AIAA PAPER 89-3456] p 832 A89-52712 Adaptive control of high performance unstable aircraft - A review p 851 A89-52989
- Integrated flight/propulsion control system design based on a decentralized, hierarchical approach [AIAA PAPER 89-3519] p 8
- p 851 A89-53301 An improved pseudo state method for aircraft controller p 851 A89-53955 design
- Turbofan engine control system design using the LQG/LTR methodology p 840 A89-53956 Nonlinear longitudinal control of a supermaneuverable
- aircraft p 851 A89-53957 Flight control reconfiguration using model reference
- adaptive control daptive control p 852 A89-53959 Air traffic control system - Can we close the control
- p 830 A89-53969 loop? An expert system for wind shear avoidance
- p 826 A89-53971 Linear token passing based bus interface unit for a fault
- tolerant multiprocessor testbed p 874 A89-53975 Lateral axis autopilot design for large transport aircraft
- An explicit model-matching approach p 852 A89-53976
- Design of localizer capture and track modes for a lateral autopilot using H(infinity) synthesis p 852 A89-53977
- Design of localizer capture and track using classical p 852 A89-53978 control techniques p 85 Integral LQG model following controller

of a transport aircraft

performance aircraft

optimal ascent to low earth orbit

Improved guidance law design

technique for

control systems

CONTROL THEORY

Α new

mixed-strategy concept

reconfiguration [AIAA PAPER 89-3425]

[AIAA PAPER 89-3451]

[AIAA PAPER 89-3470]

[AIAA PAPER 89-3574]

[AIAA PAPER 89-3576]

and stability robustness

[AIAA PAPER 89-3558]

high-alpha control

control law design

optimization

systems

A multivariable control design for the lateral axis autopilot

An uncertainty model for saturated actuators --- in flight

Study of a pursuit-evasion guidance law for high erformance aircraft p 853 A89-54084

A real-time guidance algorithm for aerospace plane

Comparison of eigenstructure assignment and the

Integrated structure/control law design by multilevel

Optimal output feedback for linear time-periodic

Application of variable-gain output feedback for

On the control of elastic vehicles - Model simplification

Salford singular perturbation methods in VSTOL aircraft

aircraft

Concepts for control of hypervelocity vehicles

p 852 A89-53979

p 852 A89-53980

p 833 A89-54066

p 855 A89-54085

p 853 A89-54347

based on the

flight control

p 828 A89-51716

p 843 A89-52527

p 844 A89-52550

p 873 A89-52564

p 873 A89-52657

p 848 A89-52659

p 873 A89-52715

A-7

CONTROLLABILITY

- Design of localizer capture and track using classical ontrol techniques p 852 A89-53978 control techniques An uncertainty model for saturated actuators --- in flight p 833 A89-54066 control systems QFT digital controller for an unmanned research vehicle
- p 853 A89-54080 (URV) Maximum principle solutions for time-optimal half-loop maneuvers of a high alpha fighter aircraft
- p 853 A89-54081 CONTROLLABILITY
- Flight investigation of helicopter low-speed response p 842 A89-51702 requirements A design procedure for the handling gualities optimization of the X-29A aircraft
- p 843 A89-52529 AIAA PAPER 89-34281 Fault-tolerant sensor and actuator selection for control of flexible structures p 874 A89-54007
- CONTROLLERS
- Synthesis of a helicopter full authority controller [AIAA PAPER 89-3448] p 843 A89-52547 Design of tunable digital set-point tracking PID controllers for gas turbines with unmeasurable outputs [AIAA PAPER 89-3577] p 839 A89-52660
- Integral LQG model following controller p 852 A89-53979 QFT digital controller for an unmanned research vehicle
- p 853 A89-54080 (URV) Development along different paths --- electronic control p 820 A89-54484 of aircraft engines
- CONVECTIVE HEAT TRANSFER A comparison of mixed and penalty finite element
- methods in analysis of heat exchangers
- p 862 A89-53254 CONVERGENT-DIVERGENT NOZZLES
- Optimum design for geometric axisymmetric converging-diverging nozzle p 839 A89-52319
- Effect of geometric parameters on internal performance p 839 A89-52320 of convergent-divergent nozzle Nozzle geometry effects on supersonic jet interaction
- p 876 A89-53932 Aerodynamic model tests of exhaust augmentors for F/A-18 engine run-up facility at RAAF Williamtown
- [AD-A208110] p 841 N89-28518 COOLING SYSTEMS
- An experimental investigation of heat transfer coefficients and friction factors in passages of different aspect ratios roughened with 45 deg turbulators p 862 A89-53274
- COST ANALYSIS p 878 A89-54351 Economics of hypersonic flight COST ESTIMATES
- The importance of weight in a changing cost estimating environment
- [SAWE PAPER 1854] p 877 A89-52024 p 878 A89-54351 Economics of hypersonic flight COUNTER ROTATION
- Pseudo-spectral and asymptotic sensitivity investigation of counter-rotating vortices p 861 A89-51755 CRUISING FLIGHT
- Study of aircraft cruise p 831 A89-51703 Application of total energy control for high performance aircraft vertical transitions
- [AIAA PAPER 89-3559] p 848 A89-52644 CRYOGENIC COOLING
- Superconducting Meissner effect bearings for cryogenic turbomachines, phase 1 p 865 N89-28839
- (AD-A2098751 CRYOGENIC EQUIPMENT Superconducting Meissner effect bearings for cryogenic
- turbomachines, phase 1 [AD-A209875] p 865 N89-28339 CUMULATIVE DAMAGE
- Probabilistic methods for estimating the remaining life of structural elements of operating aircraft gas turbine p 839 A89-52832 engines
- CURING Determining cure cycles for thermosetting epoxy resins
- [SME PAPER EM88-533] p 864 A89-54890
 - D

DAMAGE

A-8

- Full-scale aircraft impact test for evaluation of impact forces. Part 1: Test plan, test method, and test results [DE89-0093291 p 836 N89-29343
- DAMAGE ASSESSMENT Interlaminar fracture toughness and toughening of laminated composite materials - A review
- p 858 A89-54426 DAMPING
- Prediction of inplane damping from deterministic and stochastic models --- rotor blade stability in turbulent p 832 A89-52042 flow

- Turbomachinery rotor support with damping NASA-CASE-MFS-28345-1] p 865 N89-28841
- [NASA-CASE-MFS-28345-1] DATA ACQUISITION
- Airport noise measuring data collction system [NLR-MP-87006-U] p 855 N p 855 N89-28526 DATA BASES
- A survey of JP-8 and JP-5 properties
- [AD-A207721] p 860 N89-28661 Accident/incident data analysis database summaries, volume 1
- [DOT/FAA/DS-89/17-1] p 827 N89-29332 Accident/incident data analysis database summaries, volume 2
- [DOT/FAA/DS-89/17-2] p 828 N89-29333 DATA LINKS
- Data Link Processor (DLP), pilot access to weather p 831 A89-54859 data DATA PROCESSING
- JPL realtime weather processor system developed for FAA p 875 A89-54858 Accident/incident data analysis database summaries.
- volume 1 [DOT/FAA/DS-89/17-1] p 827 N89-29332
- DATA REDUCTION Analysis of verification parameters for non-convective
- Sigmets --- significant meteorology to airmen p 870 A89-54825 DEFENSE PROGRAM
- Hypersonic flight, domestic military policy, and ternational relations p 878 A89-54364 international relations DELTA WINGS
- Navier-Stokes computation of transonic vortices over p 817 A89-52483 a round leading edge delta wing Asymptotic solution of a nonlinear boundary value
- problem with a partly unknown boundary p 874 A89-52802
- Comparison of flow-visualised vortices with computed geometry over thin delta wings
- p 821 N89-28489 [AD-A209083] Flow calculation over a delta-wing using the thin-layer Navier-Stokes equations
- p 822 N89-28497 [PD-CF-8924] Evaluation of LDA 3-component velocity data on a 65 deg delta wing at M = 0.85 and first results of an
- [DFVLR-FB-89-19] p 823 N89-28505
- Use of high-resolution upwind scheme for vortical flow simulations [NASA-CR-185910] p 824 N89-29321
- DESCENT Controller evaluations of the descent advisor automation
- aid [AIAA PAPER 89-3624] p 829 A89-52699
- DESIGN ANALYSIS The development of advanced computational methods
- for turbomachinery blade design p 839 A89-52482 An integrated configuration and control analysis p 833 A89-54006 technique for hypersonic vehicles DIESEL ENGINES
- A study of an advanced variable cycle diesel as applied to an RPV; Evaluation of an RPV variable cycle diesel engine
- [AD-A207754] p 842 N89-29347 DIGITAL COMMAND SYSTEMS
- Design of adaptive digital model-following flight-mode control systems for high-performance aircraft [AIAA PAPER 89-3495] p 846 A89-52587
- Application of Artificial Intelligence (AI) programming techniques to tactical guidance for fighter aircraft [AIAA PAPER 89-3525] p 815 A89-52614
- DIGITAL ELECTRONICS A real time microcomputer implementation of sensor
- failure detection for turbofan engines p 876 N89-29032 [NASA-TM-102327]
- DIGITAL NAVIGATION
- Development and flight evaluation of an integrated GPS/INS navigation system [AIAA PAPER 89-3498] p 828 A89-52590
- Performance test results of a multi-function fault-tolerant RLG system
- p 837 A89-52717 [AIAA PAPER 89-3584] DIGITAL SIMULATION
- Modification of trim point and feedback gains for failed aircraft
- [AIAA PAPEB 89-3507] p 846 A89-52600 Scientific visualization in computational aerodynamics p 875 A89-54907 at NASA Ames Research Center DIGITAL SYSTEMS
- Design of tunable digital set-point tracking PID controllers for gas turbines with unmeasurable outputs [AIAA PAPER 89-3577] p 839 A89-52660 QFT digital controller for an unmanned research vehicle
- p 853 A89-54080 (URV) An experimental optical coupling device for an airborne
- digital redundant system [NAL-TR-1003] p 835 N89-28514

DIRECTIONAL CONTROL

Low-speed static and dynamic force tests of a generic supersonic cruise fighter configuration [NASA-TM-4138] p 821 N89-28486

SUBJECT INDEX

- DIRECTIONAL STABILITY Low-speed static and dynamic force tests of a generic
- supersonic cruise fighter configuration [NASA-TM-4138] p 821 N89-28486
- DISPLAY DEVICES Evaluation of a takeoff performance monitoring system display p 837 A89-51704
- example light-valve Display characteristics of projectors [AD-A209580] p 877 N89-29193
- DISSIPATION
 - Wake dissipation and total pressure loss in a two-dimensional compressor cascade with crenulated trailing edges [AD-A209176] p 864 N89-28755
- DISTRIBUTED PARAMETER SYSTEMS
 - Fixed-sign condition for integral quadratic forms and stability of systems with distributed parameters p 875 A89-54540
- DOORS Proportional hazards modelling of aircraft cargo door
- p 825 A89-52325 comp DOPPI FR RADAR
- Microburst detection and display by TDWR Shape, extent, and alarms --- Terminal Doppler Weather Rada p 868 A89-54785
- Divergence estimation by a single Doppler radar p 868 A89-54786
- Estimation of microburst asymmetry with a single p 868 A89-54787 Doppler radar
- A cursory study of F-factor applied to Doppler radar --characterizing effect of wind shear on jet aircraft
- p 853 A89-54799 Remote detection of aircraft icing hazards by Doppler p 826 A89-54805 radar
- Using features aloft to improve timeliness of TDWR hazard warnings --- Terminal Doppler Weather Radar
- p 870 A89-54809 Evaluation of microburst nowcasting during TDWR
- p 870 A89-54813 1987 Doppler weather radar service at the Chiang Kai-Shek
- International Airport p 871 A89-54840
- Gust front detection algorithm for the Terminal Doppler Weather Radar. II - Performance assessment p 871 A89-54852
- The FAA Terminal Doppler Weather Radar (TDWR) p 871 A89-54855

Aircraft icing caused by large supercooled droplets

Ultrasonic evaluation of matrix cracking in graphite

Development of a flight control system for VTOL aircraft supported by ducted fans

Unsteady heat transfer in turbine blade ducts - Focus

Comparison of Characteristic Locus and h-infinity

A coupled rotor aeroelastic analysis utilizing nonlinear

Design of adaptive digital model-following flight-mode

Parallel dynamic programming for on-line flight path

Identification of an adequate model for collective response dynamics of a Sea King helicopter in hover

Dynamic stability and active control of elastic vehicles acting with unsteady aerodynamic forces

Modal techniques for analyzing airplane dynamics

methods in VSTOL flight control system design

aerodynamics and refined wake modeling

control systems for high-performance aircraft

p 821 N89-28490

p 826 A89-53793

p 864 A89-54900

p 849 A89-52672

p 862 A89-53286

p 850 A89-52687

p 846 A89-52584

p 831 A89-52041

p 846 A89-52587

p 832 A89-52693

p 836 N89-29341

p 848 A89-52643

program DRAG REDUCTION Glider ground effect investigation

[AD-A209152]

DROPS (LIQUIDS)

DUCTED BODIES

DUCTED FANS

[SME PAPER EM88-549]

[AIAA PAPER 89-3592]

on combustor sources

[AIAA PAPER 89-3609]

[AIAA PAPER 89-3491]

[AIAA PAPER 89-3495]

DYNAMIC PROGRAMMING

[AIAA PAPER 89-3615]

[AIAA PAPER 89-3557]

DYNAMIC RESPONSE

[AD-A208060]

DYNAMIC STABILITY

DYNAMIC CONTROL

DYNAMIC MODELS

optimization

DYNAMIC CHARACTERISTICS

BMI

DUCTS

DYNAMIC STRUCTURAL ANALYSIS

- Finite element based modal analysis of helicopter rotor p 832 A89-52044 blades DYNAMIC TESTS
- Low-speed static and dynamic force tests of a generic supersonic cruise fighter configuration [NASA-TM-4138] p 821 N89-28486
- DYNAMICAL SYSTEMS
- Self-tuning Generalized Predictive Control applied to terrain following flight
- [AIAA PAPER 89-3450] p 843 A89-52549

Ε

ECONOMIC ANALYSIS

- Economics of hypersonic flight p 878 A89-54351 Hypersonic flight - Future commercial potential p 878 A89-54353
- The Orient Express The emperor's new airplane p 878 A89-54357

EIGENVALUES

- Design of a modalized observer with eigenvalue sensitivity reduction --- for lateral dynamics of L-1011 aircraft p 842 A89-51723 Symbolic eigenvalue analysis for adaptive stepsize p 816 A89-51756 control in PNS shock stabilization
- EIGENVECTORS Comparison of eigenstructure assignment and the Salford singular perturbation methods in VSTOL aircraft
- control law design p 844 A89-52550 [AIAA PAPER 89-3451]
- Lateral electric flight control laws of a civil aircraft based upon eigenstructure assignment technique p 851 A89-52718 [AIAA PAPER 89-3594]
- A systematic approach to gain suppression using structure assignment p 875 A89-54024 ELECTRIC ARCS
- Physical mechanisms and disturbances related to the attachment of an electric arc to a conductive cylinde p 866 N89-29698 [ONERA-NT-1988-2] ELECTRIC CONTROL
- Lateral electric flight control laws of a civil aircraft based upon eigenstructure assignment technique p 851 A89-52718 AIAA PAPER 89-35941
- ELECTRIC DISCHARGES
- Physical mechanisms and disturbances related to the attachment of an electric arc to a conductive cylinder [ONERA-NT-1988-2] p 866 N89-29698 p 866 N89-29698 **ELECTRICAL FAULTS**
- Lubricant evaluation and performance p 865 N89-28835 [AD-A2089251
- ELECTRICAL IMPEDANCE Excitation of aircraft for hardness surveillance using the
- p 854 A89-53476 aircraft's own HF antenna ELECTROMAGNETIC ABSORPTION
- Analysis of absorbing characteristics of thin-type absorber for generalized conditions of incident wave p 861 A89-52105
- ELECTROMAGNETIC FIELDS
- Excitation of aircraft for hardness surveillance using the aircraft's own HF antenna p 854 A89-53476 ELECTROMAGNETIC MEASUREMENT
- Excitation of aircraft for hardness surveillance using the aircraft's own HF antenna p 854 A89-53476 ELECTROMAGNETIC SHIELDING
- Excitation of aircraft for hardness surveillance using the aircraft's own HF antenna p 854 A89-53476 ELECTRONIC CONTROL
- Development along different paths --- electronic control p 820 A89-54484 of aircraft engines A real time microcomputer implementation of sensor
- failure detection for turbofan engines [NASA-TM-102327] p 876 N89-29032
- EMBEDDED COMPUTER SYSTEMS Initial flight qualification and operational maintenance
- of X-29A flight software [AIAA PAPER 89-3596] p 850 A89-52675 EMISSION SPECTRA
- Supersonic jet studies of fluorene clustered with water, ammonia and piperidine
- [AD-A209562] p 860 N89-29497 ENERGY DISTRIBUTION Optimal control for maximum energy extraction from
- wind shear [AIAA PAPER 89-3490] p 846 A89-52583
- ENERGY TECHNOLOGY Activities report in aerospace research in Germany, FR
- [ISSN-0070-3966] p 815 N89-28485 ENGINE CONTROL
- Integrated flight/propulsion control system design based on a decentralized, hierarchical approach
- p 851 A89-53301 [AIAA PAPER 89-3519] Flight test of the F100-PW-220 engine in the F-16 p 840 A89-53366

- Experience with implementation of a turbojet engine control program on a multiprocessor
- p 875 A89-54106 Development along different paths --- electronic control p 820 A89-54484 of aircraft engines ENGINE DESIGN
- CFD in the context of IHPTET "he Integrated High
- Performance Turbine Engine Technology Program p 862 A89-53307 [AIAA PAPER 89-2904] Propulsion cycles for transatmospheric accelerators p 840 A89-54328
- The Trisonic aerospace motor Propulsion vehicle for the 21st century p 856 A89-54359 Gas turbine research and development in India
 - p 841 A89-54473 p 841 A89-54483 History of low-power let engines
- Jet engines for high supersonic flight velocities (2nd revised and enlarged edition) --- Russian book
 - p 841 A89-54884
- Computational structural mechanics engine structures computational simulator p £66 N89-29792 Boundary elements for structural analysis p £67 N89-29800
- ENGINE FAILURE
- Research on surge monitoring system of turbojet engine on active service p 840 A89-54131 ENGINE INLETS
- Heat transfer characteristics of an aero-engine intake fitted with a hot air jet impingement anti-icing system
- p 833 A89-53255 Study on boundary layer of hypersonic inlets
- p 820 A89-54129 A method for calculation of matching point of inlet and p 840 A89-54132 engine
- Calculation of the effect of the location of the jet-engine air inlets on the air flow in front of the inlets
- p 820 A89-54486 ENGINE MONITORING INSTRUMENTS
- A modified least squares estimator for gas turbine identification
- [AD-A207911] p 8-42 N89-29348 ENGINE PARTS
- Fatigue life of ZhS6U alloy with protective coatings under thermal cycling loading p 857 A89-52830 Computational structural mechanics engine structures computational simulator p 866 N89-29792 The 3-D inelastic analyses for computational structural
- p 667 N89-29804 mechanics ENGINE TESTS Noise produced by a jet aircraft during the engine test
- n 876 A89-54487 run ubricant evaluation and performance [AD-A208925] p 865 N89-28835
- A real time microcomputer implementation of sensor failure detection for turbofan engines
- [NASA-TM-102327] p 876 N89-29032 Flight test method development for a quarter-scale aircraft with minimum instrumentation
- [AD-A207896] p 835 N89-29337 A modified least squares estimator for gas turbine identification
- p 842 N89-29348 (AD-A207911) ENTHALPY
- Species composition measurements in nonequilibrium high-speed flows p 824 N89-29312 ENVIRONMENT SIMULATION
- Hypersonic vehicle environment simulation, phase 1
- p 864 N89-28754 [AD.A2090301 ENVIRONMENTAL TESTS
- Environmental effects on composite structures p 857 A89-52994 **FPOXY RESINS**
- Determining cure cycles for thermosetting epoxy
- ISME PAPER EM88-5331 p 864 A89-54890 EQUATIONS OF MOTION
- On optimal rigid body motions TAIAA PAPER 89-3616] p 850 A89-52694
- EQUIPMENT SPECIFICATIONS
- Airport noise measuring data collction system [NLR-MP-87006-U] p 855 N89-28526 ERROR ANALYSIS
- An investigation on stagnation pressure errors due to rotation state behind a rotor p 339 A89-52315 Surface failure detection and evaluation of control law for reconfiguration of flight control system
- p 847 A89-52602 [AIAA PAPER 89-3509] Observability studies of inertial navigation systems
- [AIAA PAPER 89-3580] p 329 A89-52663 A perfect explicit model following control solution to
- imperfect model following control problems p 950 A89-52690 (AIAA PAPER 89-3612) EULER BUCKLING
- Overview of buckling in aircraft design p 834 A89-54462

F-4 AIRCRAFT

- EULER EQUATIONS OF MOTION On TVD difference schemes for the three-dimensional Euler equations in general co-ordinates p 817 A89-52484 Euler correction method for two- and three-dimensional transonic flows p 819 A89-53934 High speed corner and gap-seal computations using an LU-SGS scheme [AIAA PAPER 89-2669] p 863 A89-54424 EUROPEAN SPACE PROGRAMS Saenger aerospaceplane gains momentum p 855 A89-52973 Saenger: An advanced space transport system for Europe - Program overview and key technology needs p 856 A89-54329 HOTOL - A European aerospaceplane for the 21st century p 856 A89-54330 EVALUATION Evaluation of LDA 3-component velocity data on a 65 deg delta wing at M = 0.85 and first results of an [DFVLR-FB-89-19] p 823 N89-28505 A survey of JP-8 and JP-5 properties [AD-A207721] p p 860 N89-28661 EVASIVE ACTIONS Study of a pursuit-evasion guidance law for high p 853 A89-54084 nerformance aircraft EXHAUST EMISSION Fuel properties effect on the performance of a small high temperature rise combustor [AIAA PAPER 89-2901] p 838 A89-52025 A study of the sensitivity of stratospheric ozone to hypersonic aircraft emissions p 867 A89-54363 EXHAUST GASES Engine combustion optimization by exhaust analysis [PB89-195788] p 859 N89-28588 EXHAUST NOZZLES Optimum design for geometric parameters of axisymmetric converging-diverging nozzle p 839 A89-52319 Effect of geometric parameters on internal performance of convergent-divergent nozzle p 839 A89-52320 Combustion-related shear-flow dynamics in elliptic upersonic iete p 819 A89-53930 EXPERIMENT DESIGN Physical mechanisms and disturbances related to the attachment of an electric arc to a conductive cylinder p 866 N89-29698 [ONFRA-NT-1988-2] EXPERT SYSTEMS A real-time expert system for self-repairing flight control [AIAA PAPER 89-3427] p 843 A89-52528 On-board automatic aid and advisory for pilots of control-impaired aircraft [AIAA PAPER 89-3460] p 844 A89-52558 Air traffic control system - Can we close the control
 - loop? p 830 A89-53969 An expert system for wind shear avoidance p 826 A89-53971
 - Intelligent avionics p 838 A89-54345 The development of numerically-based and expert
- system approaches for airfield nowcasting/very short range forecasting p 872 A89-54860 Computational structural mechanics engine structures computational simulator p 866 N89-29792
- EXPOSURE Five year ground exposure of composite materials used
- on the Bell Model 206L flight service evaluation [NASA-TM-101645] p 859 N89-28579

F

- F-104 AIRCRAFT
- Application of perfect model following to a control onfigured vehicle
- [AIAA PAPER 89-3453] p 844 A89-52552 F-16 AIRCRAFT
 - Design of adaptive digital model-following flight-mode control systems for high-performance aircraft
 - [AIAA PAPER 89-3495] p 846 A89-52587 Flight test of the F100-PW-220 engine in the F-16
- p 840 A89-53366 Operational test plan concept for evaluation of close air support alternative aircraft
- [AD-A208185] p 835 N89-28513 F-18 AIRCRAFT
 - High performance linear-quadratic and H-infinity designs for a 'supermaneuverable' aircraft
- [AIAA PAPER 89-3456] p 832 A89-52712 Aerodynamic model tests of exhaust augmentors for F/A-18 engine run-up facility at RAAF Williamtown
- [AD-A208110] p 841 N89-28518 **F-4 AIRCRAFT**
- Study of aircraft cruise p 831 A89-51703

FABRICS

FABRICS

Tribological properties of alumina-boria-silicate fabric from 25 C to 850 C p 859 A89-54982 FAILURE

- Statistics on aircraft gas turbine engine rotor failures that occurred in US commercial aviation during 1984 p 841 N89-28516 [NAPC-PE-185] Statistics on aircraft gas turbine engine rotor failures that occurred in US commercial aviation during 1985
- p 841 N89-28517 [NAPC-PE-188] Composite material repair and reliability p 859 N89-28574 [AD-A209150]
- FAILURE ANALYSIS Surface failure detection and evaluation of control law
- for reconfiguration of flight control system p 847 A89-52602 [AIAA PAPER 89-3509] A knowledge based tool for failure propagation
- p 874 A89-53970 analysis A real time microcomputer implementation of sensor failure detection for turbofan engines p 876 N89-29032
- [NASA-TM-102327] FAR FIELDS Use of the Kirchhoff method in acoustics
- p 876 A89-53945 FASTENERS
- Stresses and strains in a cold-worked annulus [AR-005-548] p 866 N8
- p 866 N89-28871 FATIGUE LIFE
- Recovery of the fatigue strength of structural elements of aluminum alloys by surface hardening
- p 857 A89-52827 Computerized life and reliability modeling for turboprop p 863 A89-53364 transmissions
- Fatigue life of dovetail joints Verification of a simple p 863 A89-54119 biaxial model Constant monitoring of the fatigue damage of aircraft
- lifting structures p 863 A89-54488 FATIGUE TESTING MACHINES
- Constant monitoring of the fatigue damage of aircraft lifting structures p 863 A89-54488 FATIGUE TESTS
- AE monitoring of airframe structure during full scale tigue test p 863 A89-53322 fatique test Fatigue life of dovetail joints - Verification of a simple p 863 A89-54119 biaxial model
- FAULT TOLERANCE
- Performance test results of a multi-function fault-tolerant RLG system
- p 837 A89-52717 [AIAA PAPER 89-3584] Linear token passing based bus interface unit for a fault tolerant multiprocessor testbed p 874 A89-53975
- Fault-tolerant sensor and actuator selection for control p 874 A89-54007 of flexible structures FEASIBILITY ANALYSIS
- AT3 demonstrates feasibility of cargo STOL with long p 832 A89-52201 range FEDERAL BUDGETS
- Accomplishments under the airport improvement program: Fiscal year 1988 AD-A2082001 p 855 N89-29352
- FEEDBACK CONTROL Linear quadratic Gaussian design for robust
- erformance of a highly maneuverable aircraft p 844 A89-52555 AIAA PAPER 89-34571 Nonlinear stabilizing control of high angle of attack flight
- dvnamics p 845 A89-52580 [AIAA PAPER 89-3487] Modification of trim point and feedback gains for failed aircraft
- [AIAA PAPER 89-3507] p 846 A89-52600 Optimal output feedback for linear time-periodic systems
- [AIAA PAPER 89-3574] p 873 A89-52657 A variable-gain output feedback control design approach
- [AIAA PAPER 89-3575] p 873 A89-52658 Application of variable-gain output feedback for
- high-alpha control [AIAA PAPER 89-3576] p 848 A89-52659
- Algebraic loop transfer recovery An application to the design of a helicopter output feedback control law [AIAA PAPER 89-3579] p 849 A89-52662
- Comparison of nonlinear controllers for twin-lift configurations [AIAA PAPER 89-3591] p 849 A89-52671
- Robust eigenstructure assignment for flight control using the Ctrl-C design package
- p 850 A89-52685 [AIAA PAPER 89-3607] Active flutter suppression using invariant zeros/eigensystem assignment
- [AIAA PAPER 89-3610] p 850 A89-52688 Singular trajectories for time-optimal half-loop maneuvers of a high alpha fighter aircraft p 850 A89-52692 [AIAA PAPER 89-3614]
- Turbofan engine control system design using the p 840 A89-53956 LQG/LTR methodology

Nonlinear longitudinal control of a supermaneuverable p 851 A89-53957 aircraft Design of localizer capture and track modes for a lateral

- autopilot using H(infinity) synthesis p 852 A89-53977 Design of localizer capture and track using classical p 852 A89-53978 control techniques Asymptotically decoupled variable structure control of
- systems and large maneuver of aircraft p 852 A89-53988 A systematic approach to gain suppression using
- p 875 A89-54024 eigenstructure assignment QFT digital controller for an unmanned research vehicle (URV) p 853 A89-54080
- FENCES (BARRIERS)
- Secondary flow control and loss reduction in a turbine p 816 A89-51679 cascade using endwall fences FIBER COMPOSITES
- High-performance fiber composite materials with thermoplastic matrix [MBB-Z-0257-89-PUB]
- p 857 A89-53310 A study of the stress-strain state of connections in an p 864 A89-54585
- orthotropic material Determining cure cycles for thermosetting epoxy resins [SME PAPER EM88-533] p 864 A89-54890
- Intermetallic and ceramic matrix composites for 815 to 1370 C (1500 to 2500 F) gas turbine engine applications [NASA-TM-102326] p 860 N89-29490 FIBER OPTICS
- Status and development potential of the fly by light technology in civil aircraft [ILR-MITT-212]
- p 854 N89-28522 FIGHTER AIRCRAFT
- Performance analysis of voting strategies for a fly-by-wire ystem of a fighter aircraft p 842 A89-52168 system of a fighter aircraft Flight tests for air intake flowfield and engine operating p 839 A89-52317 stability
- Flight control synthesis for an unstable fighter aircraft using the LOG/LTR methodology [AIAA PAPER 89-3452]
- p 844 A89-52551 Integrated control and avionics for air superiority -Computational aspects of real-time flight management [AIAA PAPER 89-3463] p 837 A89-52559
- Stability analysis of flexible body dynamics for a highly maneuverable fighter aircraft [AIAA PAPER 89-3471] p 845 A89-52565
- Thrust vectoring effect on time-optimal 90 degrees angle of attack pitch up maneuvers of a high alpha fighter aircraft
- [AIAA PAPER 89-3521] p 847 A89-52612 Application of Artificial Intelligence (AI) programming
- techniques to tactical guidance for fighter aircraft [AIAA PAPER 89-3525] p 815 A85 Singular trajectories for time-optimal h p815 A89-52614 half-loop
- maneuvers of a high alpha fighter aircraft [AIAA PAPER 89-3614] p 85 p 850 A89-52692 High performance linear-quadratic and H-infinity designs for a 'supermaneuverable' aircraft
- [AIAA PAPER 89-3456] p 832 A89-52712
- Integrated flight/propulsion control system design based on a decentralized, hierarchical approach [AIAA PAPER 89-3519] p 851 A89-53301
- Study of a pursuit-evasion guidance law for high performance aircraft p 853 A89-54084 Research on surge monitoring system of turbojet engine
- p 840 A89-54131 on active service Gas turbine research and development in India
- p 841 A89-54473 Composite material repair and reliability
- p 859 N89-28574 [AD-A209150] FINITE DIFFERENCE THEORY
- A second-order finite-difference scheme for calculating three-dimensional supersonic flows of an ideal gas
- p 818 A89-52852 Calculation of transonic flow past the tail section of a
- p 820 A89-54535 plane or axisymmetric body FINITE ELEMENT METHOD
- Finite element based modal analysis of helicopter rotor p 832 A89-52044 blades A comparison of mixed and penalty finite element
- methods in analysis of heat exchangers p 862 A89-53254
- Finite element analysis of gyroscopic effects p 863 A89-53499
- Application of modern optimization tools for the design p 834 A89-54471 of aircraft structures Composite material repair and reliability
- p 859 N89-28574 [AD-A209150] Finite element analysis of incompressible viscous flows around single and multi-element aerofoils in high Reynolds number region
- [NAL-TR-1010T] p 865 N89-28765 NASA Workshop on Computational Structural Mechanics 1987, part 2 [NASA-CP-10012-PT-2] p 866 N89-29789

approach

[AIAA PAPER 89-3575]

p 873 A89-52658

The 3-D inelastic analyses for computational structural mechanics p 867 N89-29804
FIXED WINGS Composite material repair and reliability
[AD-A209150] p 859 N89-28574 FLAME STABILITY
Supersonic combustion at the DFVLR: Results and
experiences [DFVLR-88-044] p 859 N89-28610
FLAPPING HINGES Thin aerofoil with multiple slotted flap p 816 A89-51625
FLASH LAMPS
Flash lamp planar imaging p 863 A89-54348 FLAT PLATES
Time domain numerical calculations of unsteady vortical flows about a flat plate airfoil
[NASA-TM-102318] p 866 N89-29726 FLEXIBLE BODIES
Stability analysis of flexible body dynamics for a highly maneuverable fighter aircraft
[AIAA PAPER 89-3471] p 845 A89-52565 On the control of elastic vehicles - Model simplification
and stability robustness [AIAA PAPER 89-3558] p 873 A89-52715
Fault-tolerant sensor and actuator selection for control of flexible structures p 874 A89-54007
FLEXIBLE WINGS Active flutter suppression using invariant
zeros/eigensystem assignment
[AIAA PAPER 89-3610] p 850 A89-52688 FLIGHT ALTITUDE
Glider ground effect investigation [AD-A209152] p 821 N89-28490
FLIGHT CONTROL AIAA Guidance, Navigation and Control Conference,
Boston, MA, Aug. 14-16, 1989, Technical Papers. Parts 1 & 2 p 842 A89-52526
A new technique for aircraft flight control reconfiguration
[AIAA PAPER 89-3425] p 843 A89-52527 A real-time expert system for self-repairing flight
control [AIAA PAPER 89-3427] p 843 A89-52528
Synthesis of a helicopter full authority controller [AIAA PAPER 89-3448] p 843 A89-52547
Self-tuning Generalized Predictive Control applied to terrain following flight
[AIAA PAPER 89-3450] p 843 A89-52549
Flight control synthesis for an unstable fighter aircraft using the LOG/LTR methodology
[AIAA PAPER 89-3452] p 844 A89-52551 Application of perfect model following to a control
configured vehicle [AIAA PAPER 89-3453] p 844 A89-52552
Nonlinear control of a supermaneuverable aircraft [AIAA PAPER 89-3486] p 845 A89-52579
Nonlinear stabilizing control of high angle of attack flight dynamics
[ÁIAA PAPER 89-3487] p 845 A89-52580 High gain flight controllers for nonlinear systems
[AIAA PAPER 89-3488] p 845 A89-52581 On the design of nonlinear controllers for flight control
systems
Comparison of Characteristic Locus and h-infinity
methods in VSTOL flight control system design [AIAA PAPER 89-3491] p 846 A89-52584
A surrogate system approach to robust control design [AIAA PAPER 89-3492] p 873 A89-52585
Design of adaptive digital model-following flight-mode control systems for high-performance aircraft
[AIAA PAPER 89-3495] p 846 A89-52587 Evaluation methods for complex flight control systems
[AIAA PAPER 89-3502] p 846 A89-52595
Modification of trim point and feedback gains for failed aircraft
[AIAA PAPER 89-3507] p 846 A89-52600 Surface failure detection and evaluation of control law
for reconfiguration of flight control system [AIAA PAPER 89-3509] p 847 A89-52602
Evaluation of a technique for predicting longitudinal
pilot-induced-oscillations [AIAA PAPER 89-3517] p 847 A89-52609
Integrated flight/propulsion control system design based on a centralized approach
[AIAA PAPER 89-3520] p 847 A89-52611 Application of total energy control for high performance
aircraft vertical transitions [AIAA PAPER 89-3559] p 848 A89-52644
Optimal paths through downbursts
[AIAA PAPER 89-3561] p 848 A89-52646 A variable-gain output feedback control design

SUBJECT INDEX

- Application of variable-gain output feedback for high-alpha control [AIAA PAPER 89-3576] p 848 A89-52659 Initial flight gualification and operational maintenance of X-29A flight software p 850 A89-52675 [AIAA PAPER 89-3596] Robust eigenstructure assignment for flight control using the Ctrl-C design package p 850 A89-52685 [AIAA PAPER 89-3607] Adaptive control of high performance unstable aircraft p 851 A89-52989 A review Integrated flight/propulsion control system design based on a decentralized, hierarchical approach p 851 A89-53301 [AIAA PAPER 89-3519]
- Flight control reconfiguration using model reference p 852 A89-53959 adaptive control An expert system for wind shear avoidance
- p 826 A89-53971 Linear token passing based bus interface unit for a fault p 874 A89-53975 tolerant multiprocessor testbed Asymptotically decoupled variable structure control of
- systems and large maneuver of aircraft p 852 A89-53988 Fault-tolerant sensor and actuator selection for control
- of flexible structures p 874 A89-54007 Optimal trajectory generation and design trades for hypersonic vehicles p 855 A89-54009
- An uncertainty model for saturated actuators --- in flight p 833 A89-54066 control systems QFT digital controller for an unmanned research vehicle
- (URV) p 853 A89-54080 Flight systems design issues for a research-oriented
- p 853 A89-54371 hypersonic vehicle An experimental optical coupling device for an airborne digital redundant system
- [NAL-TR-1003] p 835 N89-28514 Towards a physiologically based HUD (Head-Up Display) symbology
- [AD-A207748] p 838 N89-28515 Status and development potential of the fly by light technology in civil aircraft
- ILR-MITT-2121 p 854 N89-28522 FLIGHT HAZABOS
- International Conference on the Aviation Weather Systems, 3rd, Anaheim, CA, Jan. 30-Feb. 3, 1989, Preprints p 867 A89-54776 A relationship between peak temperature drop and
- p 867 A89-54777 velocity differential in a microburst Dallas microburst storm environmental conditions determined from satellite soundings p 868 A89-54779
- Microburst detection from mesonet data p 868 A89-54783 Evaluation of the 12-station enhanced Low Level Wind
- Shear Alert System (LLWAS) at Denver Stapleton International Airport p 868 A89-54784 Microburst detection and display by TDWR - Shape,
- extent, and alarms --- Terminal Doppler Weather Radar p 868 A89-54785 Divergence estimation by a single Doppler radar
- p 868 A89-54786 Estimation of microburst asymmetry with a single p 868 A89-54787 Doppler radar
- A cursory study of F-factor applied to Doppler radar --characterizing effect of wind shear on jet aircraft p 853 A89-54799
- LDIS (Lightning Data and Information Systems) A new resource for aviation meteorology p 869 A89-54801 The influence of ice accretion physics on the forecasting
- p 826 A89-54803 of aircraft icing conditions Measurements of hazardous icing conditions
- p 826 A89-54804 Remote detection of aircraft icing hazards by Doppler A89-54805 p 826 radar
- A cooperative study on winter icing conditions in the n 869 A89-54806 Denver area Using features aloft to improve timeliness of TDWR
- hazard warnings --- Terminal Doppler Weather Radar p 870 A89-54809 Analysis of verification parameters for non-convective
- Signets --- significant meteorology to airmen p 870 A89-54825
- Severe aircraft icing events A Colorado case study A89-54838 D 827
- Ground based weather radar for aviation p 871 489-54856 A89-54863 Weather testimony in litigation D 879
- FLIGHT MANAGEMENT SYSTEMS
- Evaluation of a takeoff performance monitoring system p 837 A89-51704 display Integrated control and avionics for air superiority -Computational aspects of real-time flight management [AIAA PAPER 89-3463] p 837 A89-52559 Map, Operator, Maintenance Stations --- in mission nlanning [AIAA PAPER 89-3523] p 854 A89-52613

- Intelligent flight management performance using discrete-event simulation [AIAA PAPER 89-3526] p 847 A89-52615 FLIGHT OPTIMIZATION Study of aircraft cruise p 831 A89-51703
- Optimal control for maximum energy extraction from vind shear [AIAA PAPER 89-3490] n 846 A89-52583
- Glider ground effect investigation [AD-A209152] p 821 N89-28490
- Aircraft trajectory generation: A literature review AR-005-609] p 835 N89-29335 FLIGHT PATHS
- Parallel dynamic programming for on-line flight path ptimization
- [AIAA PAPER 89-3615] p 832 A89-52693 Controller evaluations of the descent advisor automation hie
- [AIAA PAPER 89-3624] p 829 A89-52699
- Optimal trajectory generation and design trades for hypersonic vehicles p 855 A89-54009 Numerical simulation of microbursts - Aircraft trajectory
- studies p 869 A89-54788 Glider ground effect investigation (AD-A209152)
- p 821 N89-28490 Aircraft trajectory generation: A literature review
- p 835 N89-29335 AB-005-6091 FLIGHT PLANS
- Direct User Access Terminal (DUAT) operational concept WP-88W00075]
- p 854 N89-28524 FLIGHT SAFFTY
- Evaluation methods for complex flight control systems [AIAA PAPER 89-3502] p 846 A89-52595 Aircraft low level wind shear detection and warning
- system p 838 A89-54848 The Federal Aviation Administration's Low Level Windshear Alert System - A project management p 871 A89-54854
- perspective The FAA Terminal Doppler Weather Radar (TDWR) p 871 A89-54855 program
- Weather information systems for pilots The Minnesota p 872 A89-54866 experience
- Competition and safety in air traffic [TUB-DISS-PAPER-128] p 827 N89-28508
- Collision avoidance operational concept [WP-88W00418] p 831 N89-28509 FLIGHT SIMULATION
- Flight investigation of helicopter low-speed response p 842 A89-51702 requirements
- Piloted simulation of a ground based time-control concept for air traffic control [AIAA PAPER 89-3625] p 829 A89-52700

F

F

- Glider ground effect investigation
- [AD-A209152] p 821 N89-28490 Species composition measurements in nonequilibrium p 824 N89-29312 high-speed flows
- A user's manual for the ARL mathematical model of the Sea King Mk-50 helicopter. Part 1 Basic use
- p 835 N89-29339 [AD-A208058] A user's manual for the ARL mathematical model of the Sea King Mk-50 helicopter. Part 2: Use with ARL flight
- data [AD-A208059] c 836 N89-29340
- FLIGHT TEST INSTRUMENTS Flight test method development for a quarter-scale
- aircraft with minimum instrumentation p 835 N89-29337 [AD-A207896]
- FLIGHT TESTS
- Flight tests for air intake flowfield and engine operating p 839 A89-52317 stability Flight-test evaluation of civil helicopter terminal
- approach operations using differential GPS p 828 A89-52594 (AIAA PAPER 89-36351 Evaluation of a technique for predicting longitudinal
- ilot-induced-oscillations [AIAA PAPER 89-3517] p 847 A89-52609
- Flight test of the F100-PW-220 engine in the F-16 p 840 A89-53366
- Transition flight experiments on a swept wing with p 819 A89-53830 suction
- Glider ground effect investigation [AD-A209152] p 821 N89-28490 Flight test method development for a quarter-scale
- aircraft with minimum instrumentation [AD-A207896] p 835 N89-29337
- A user's manual for the ARL mathematical model of the Sea King Mk-50 helicopter, Part 2: Use with ARL flight data [AD-A208059] p 836 N89-29340
- FLIGHT VEHICLES
- Facilities and support requirements for advanced flight p 854 A89-54368 vehicles

Prediction of inplane damping from deterministic and stochastic models rotor blade stability in turbulent flow p 832 A89-52042
FLOW CHARACTERISTICS
Turbulent reactive flows p 857 A89-51860
Numerical simulation and hydrodynamic visualization of
transient viscous flow around an oscillating aerofoil
p 817 A89-52481
FLOW DEFLECTION
Euler correction method for two- and three-dimensional
transonic flows p 819 A89-53934
Theory for separated flow around the trailing edge of
a thin profile p 820 A89-54614
FLOW DISTORTION
Active control of inlet distorted flow field in compressor
inlet p 817 A89-52316
Calculations of inlet distortion induced compressor flow
field instability p 818 A89-52498
Unsteady vortical disturbances around a thin airfoil in
the presence of a wall p 819 A89-53944
FLOW DISTRIBUTION
Constructing a continuous parameter range of
computational flows p 819 A89-53928
Three-dimensional airfoil performance measurements
on a rotating wing
[DE89-009443] p 821 N89-28487
Comparison of flow-visualised vortices with computed
geometry over thin delta wings
[AD-A209083] p 821 N89-28489
Some computations of unsteady Navier-Stokes flow
around oscillating airfoil/wing
[NAL-TR-1004T] p 822 N89-28492
Flow calculation over a delta-wing using the thin-layer
Navier-Stokes equations
[PD-CF-8924] p 822 N89-28497
Correlation of Puma airloads: Evaluation of CFD
prediction methods
[NASA-TM-102226] p 822 N89-28498
Measurements of mean-flow and turbulence
characteristics in a turbojet exhaust using a laser
velocimeter
[ISL-CO-226/88] p 841 N89-28519
Hypersonic vehicle environment simulation, phase 1
[AD-A209030] p 864 N89-28754
Inviscid and viscous hypersonic aerodynamics: A review
of the old and new p 823 N89-29308
Control of separated flow past a cylinder using tangential
wall jet blowing
[NASA-CR-185918] p 825 N89-29326
LOW GEOMETRY
Noncircular jet dynamics in supersonic combustion
p 863 A89-53353
LOW MEASUREMENT
Measurements of mean-flow and turbulence
characteristics in a turbojet exhaust using a laser
velocimeter
[ISL-CO-226/88] p 841 N89-28519
Piezoelectric foils as sensors in experimental flow
mechanics
[ILR-MITT-214] p 865 N89-28800
LOW STABILITY
Symbolic eigenvalue analysis for adaptive stepsize
Calculations of inlet distortion induced compressor flow
field instability p 818 A89-52498
LOW VELOCITY
Measurements of mean-flow and turbulence

FLOQUET THEOREM

- Measurements of mean-flow and turbulence characteristics in a turbojet exhaust using a laser velocimeter
- [ISL-CO-226/88] p 841 N89-28519 FLOW VISUALIZATION p 863 A89-54348
- Flash lamp planar imaging Water tunnel flow visualization on a hypersonic p 820 configuration A89-54373
- Representation and display of vector field topology in p 875 A89-54904 fluid flow data sets Comparison of flow-visualised vortices with computed
- geometry over thin delta wings [AD-A209083] p 821 N89-28489
- FLUID DYNAMICS Finite element analysis of incompressible viscous flows
- around single and multi-element aerofoils in high Reynolds number region [NAL-TR-1010T]
- p 865 N89-28765 Use of high-resolution upwind scheme for vortical flow
- simulations [NASA-CR-185910] p 824 N89-29321
- Control of separated flow past a cylinder using tangential wall jet blowing
- [NASA-CR-185918] p 825 N89-29326 FLUID FLOW
 - Representation and display of vector field topology in p 875 A89-54904 fluid flow data sets

FLUORINE

FLUORINE

- Supersonic jet studies of fluorene clustered with water, ammonia and piperidine
- [AD-A209562] p 860 N89-29497
- Modeling of aerodynamic forces in the Laplace domain with minimum number of augmented states for the design of active flutter suppression systems
- [AIAA PAPER 89-3466] p 844 A89-52561 FLUTTER ANALYSIS
- Sensitivity derivatives of flutter characteristics and stability margins for aeroservoelastic design [AIAA PAPER 89-3467] p 845 A89-52562 An effective flutter control method using fast,
- An effective flutter control method using fast, time-accurate CFD codes [AIAA PAPER 89-3468] p 845 A89-52563
- Robust control system design with multiple model approach and its application to active flutter control [AIAA PAPER 89-3578] p 849 A89-52661
- Active flutter suppression using invariant zeros/eigenstem assignment
- [AIAA PAPER 89-3610] p 850 A89-52688 Phenomena and modelling of flow-induced vibrations of bluff bodies p 861 A89-52961
- Flutter calculations for a model wing using the MSC NASTRAN structural analysis program
- [AD-A209244] p 824 N89-29318 FLY BY WIRE CONTROL
- Performance analysis of voting strategies for a fly-by-wire system of a fighter aircraft p 842 A89-52168 Lateral electric flight control laws of a civil aircraft based upon eigenstructure assignment technique
- [AIAA PAPER 89-3594] p 851 A89-52718 FOILS (MATERIALS)
- Piezoelectric foils as sensors in experimental flow mechanics
- [ILR-MITT-214] p 865 N89-28800 FRACTURE MECHANICS
- High temperature adhesive systems [AD-A209166] p 860 N89-28643
- FRACTURE STRENGTH Interlaminar fracture toughness and toughening of laminated composite materials - A review
- p 858 A89-54426
- An experimental investigation of heat transfer coefficients and friction factors in passages of different aspect ratios roughened with 45 deg turbulators p 862 A89-53274
- FUEL COMBUSTION
- Supersonic combustion at the DFVLR: Results and experiences
- [DFVLR-88-044] p 859 N89-28610 FUEL CONTROL
- Diagnostics and control of the fuel systems of aircraft engines --- Russian book p 841 A89-54881 Engine combustion optimization by exhaust analysis
- [PB89-195788] p 859 N89-28588 FUEL FLOW
- Flow similarity in ignition process of jet engine p 839 A89-52323
- FUEL INJECTION Fuel properties effect on the performance of a small
- high temperature rise combustor [AIAA PAPER 89-2901] p 838 A89-52025
- FUEL TANKS Conceptual design tools for internal tankage of the hypersonic transport p 834 A89-54338

FUEL-AIR RATIO

- Engine combustion optimization by exhaust analysis [PB89-195788] p 859 N89-28588 FULL SCALE TESTS
- Full-scale aircraft impact test for evaluation of impact forces. Part 1: Test plan, test method, and test results [DE89-009329] p 836 N89-29343 Full-scale aircraft impact test for evaluation of impact
- force. Part 2: Analysis of results [DE89-009335] p 836 N89-29344 FUNCTIONAL DESIGN SPECIFICATIONS
- MDX A helicopter designed by its users p 833 A89-53630
- Design by functional feature for aircraft structure p 836 N89-29345
- FUSELAGES The acoustic calibration of aircraft fuselage structures,
- part 1 [ISVR-TR-169-PT-1] p 877 N89-29158
 - G
- GALERKIN METHOD
- Finite element analysis of incompressible viscous flows around single and multi-element aerofoils in high Reynolds number region INAL-TR-1010T1 p 865 N89-28765

- GAME THEORY
- Improved guidance law design based on the mixed-strategy concept p 828 A89-51716 GAS DYNAMICS
- Calculation of transonic flow past the tail section of a plane or axisymmetric body p 820 A89-54535 GAS JETS
- Flash lamp planar imaging p 863 A89-54348 GAS MIXTURES
- Hypersonic vehicle environment simulation, phase 1 [AD-A209030] p 864 N89-28754
- GAS TURBINE ENGINES
- Fuel properties effect on the performance of a small high temperature rise combustor [AIAA PAPER 89-2901] p 838 A89-52025
- Design of tunable digital set-point tracking PID controllers for gas turbines with unmeasurable outputs [AIAA PAPER 89-3577] p 839 A89-52660
- Fatigue life of ZhS6U alloy with protective coatings under thermal cycling loading p 857 A89-52830 Probabilistic methods for estimating the remaining life
- of structural elements of operating aircraft gas turbine engines p 839 A89-52832
- High-resolution liquid-crystal heat-transfer measurements on the endwall of a turbine passage with variations in Reynolds number p 862 A89-53289
- Comparative durability of six coating systems on first-stage gas turbine blades in the engines of a long-range
- maritime patrol aircraft p 858 A89-54255 Statistics on aircraft gas turbine engine rotor failures
- that occurred in US commercial aviation during 1984 [NAPC-PE-185] p 841 N89-28516 Statistics on aircraft gas turbine engine rotor failures
- that occurred in US commercial aviation during 1985 [NAPC-PE-188] p 841 N89-28517
- A modified least squares estimator for gas turbine identification
- [AD-A207911] p 842 N89-29348 Intermetallic and ceramic matrix composites for 815 to
- 1370 C (1500 to 2500 F) gas turbine engine applications [NASA-TM-102326] p 860 N89-29490 Boundary elements for structural analysis
- p 867 N89-29800
- Gas turbine research and development in India p 841 A89-54473
- GAUSS EQUATION High speed corner and gap-seal computations using an
- LU-SGS scheme [AIAA PAPER 89-2669] p 863 A89-54424
- GEOMETRIC DILUTION OF PRECISION
- Global positioning system accuracy improvement using Ridge regression [AIAA PAPER 89-3499] p 828 A89-52591
- GLASS FIBER REINFORCED PLASTICS Environmental effects on composite structures
- p 857 A89-52994
- Glazing into the future --- shielding coatings for military cockpit canopies p 832 A89-52525 GLIDERS
- Glider ground effect investigation
- [AD-A209152] p 821 N89-28490 GLOBAL POSITIONING SYSTEM
- Development and flight evaluation of an integrated GPS/INS navigation system
- [AIAA PAPER 89-3498] p 828 A89-52590 Global positioning system accuracy improvement using
- Ridge regression [AIAA PAPER 89-3499] p 828 A89-52591
- Flight-test evaluation of civil helicopter terminal approach operations using differential GPS [AIAA PAPER 89-3635] p 828 A89-52594
- GRANTS Accomplishments under the airport improvement
- program: Fiscal year 1988 [AD-A208200] p 855 N89-29352
- GRAPHITE-EPOXY COMPOSITES Interlaminar fracture toughness and toughening of
- laminated composite materials A review p 858 A89-54426
- GRAPHITE-POLYIMIDE COMPOSITES
- Ultrasonic evaluation of matrix cracking in graphite BMI (SME PAPER EM88-549) p 864 A89-54900
- [SME PAPER EM88-549] p 864 A89-54900 GRINDING (MATERIAL REMOVAL) An optimal material removal strategy for automated
- repair of aircraft canopies p 874 A89-53416 GROUND BASED CONTROL
- Piloted simulation of a ground-based time-control concept for air traffic control [AIAA PAPER 89-3625] p 829 A89-52700
- GROUND EFFECT (AERODYNAMICS) Glider ground effect investigation
- [AD-A209152] p 821 N89-28490

GUIDANCE (MOTION)

AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Parts 1 & 2 p 842 A89-52526 GUST LOADS

SUBJECT INDEX

- Gust front detection algorithm for the Terminal Doppler Weather Radar. II - Performance assessment
- p 871 A89-54852
- Finite element analysis of gyroscopic effects p 863 A89-53499
- GYROSCOPIC STABILITY
- Wideband linear quadratic Gaussian control of strapdown dry tuned gyro/accelerometers [AIAA PAPER 89-3441] p 837 A89-52540

н

HEAD-UP DISPLAYS

- Towards a physiologically based HUD (Head-Up Display) symbology [AD-A207748] p 838 N89-28515
- HEAT EXCHANGERS A comparison of mixed and penalty finite element
- methods in analysis of heat exchangers p 862 A89-53254

Unsteady heat transfer in turbine blade ducts - Focus

on combustor sources p 862 A89-53286 High-resolution liquid-crystal heat-transfer

measurements on the endwall of a turbine passage with

The effects of longitudinal vortices on heat transfer of

Heat transfer characteristics of an aero-engine intake fitted with a hot air jet impingement anti-icing system p 833 A89-53255

An experimental investigation of heat transfer

coefficients and friction factors in passages of different

HEAVY LIFT HELICOPTERS Comparison of nonlinear controllers for twin-lift

Flight investigation of helicopter low-speed response

Algebraic loop transfer recovery - An application to the

Comparison of nonlinear controllers for twin-lift

Parallel dynamic programming for on-line flight path

AHS National Specialists' Meeting on the Rotary Wing

Visual and sensory aids for helicopters in the year

Rotorcraft research and technology advances at MBB

Flight investigation of helicopter low-speed response

Correlation of Puma airloads: Evaluation of CFD

A coupled rotor aeroelastic analysis utilizing nonlinear

Incorporation of vortex line and vortex ring hover wake

models into a comprehensive rotorcraft analysis code

MDX - A helicopter designed by its users

Flight-test evaluation of civil helicop approach operations using differential GPS

aerodynamics and refined wake modeling

Aircraft Conceptual Design Process, Atlanta, GA, Apr. 3-5

Synthesis of a helicopter full authority controller

Time periodic control of a multi-blade helicopter

design of a helicopter output feedback control law

aspect ratios roughened with 45 deg turbulators

p 862 A89-53289

p 866 N89-29310

p 860 A89-51680

p 862 A89-53274

p 849 A89-52671

p 842 A89-51702

p 843 A89-52547

p 843 A89-52548

p 849 A89-52662

p 849 A89-52671

p 832 A89-52693

p 815 A89-52950

p 837 A89-53309

p 815 A89-53334

p 833 A89-53630

p 842 A89-51702

helicopter terminal

p 828 A89-52594

p 822 N89-28498

p 831 A89-52041

p 835 N89-29338

HEAT TRANSFER

variations in Reynolds number

HEAT TRANSFER COEFFICIENTS

laminar boundary layers

configurations [AIAA PAPER 89-3591]

requirements

configurations

optimization

2000

HELICOPTER CONTROL

[AIAA PAPER 89-3448]

[AIAA PAPER 89-3449]

[AIAA PAPER 89-3579]

[AIAA PAPER 89-3591]

[AIAA PAPER 89-3615]

HELICOPTER DESIGN

1989, Proceedings

[MBB-UD-541-89-PUB]

[MBB-UD-0537-88-PUB]

HELICOPTER PERFORMANCE

[AIAA PAPER 89-3635]

prediction methods

HELICOPTER WAKES

[AD-A2080361

[NASA-TM-102226]

requirements

Aerothermodynamic instrumentation

Heat transfer in aerospace propulsion p 862 A89-53282

HELICOPTERS

- Five year ground exposure of composite materials used on the Bell Model 206L flight service evaluation
- [NASA-TM-101645] p 859 N89-28579 Noise produced by turbulent flow into a rotor: Users manual for atmospheric turbulence prediction and mean flow and turbulence contraction prediction
- [NASA-CR-181791] p 876 N89-29154 Identification of an adequate model for collective response dynamics of a Sea King helicopter in hove AD-A2080601 p 836 N89-29341 HIGH ALTITUDE
- High altitude reconnaissance aircraft design
- [AIAA PAPER 89-2109] p 833 A89-54200 HIGH TEMPERATURE High temperature adhesive systems
- 1881002A-0A1 p 860 N89-28643 HIGH TEMPERATURE SUPERCONDUCTORS Aeronautical applications of high-temperature
- superconductors [AIAA PAPER 89-2142] p 840 A89-53304 Superconducting Meissner effect bearings for cryogenic
- turbomachines, phase 1 [AD-A209875] p 865 N89-28839 HIGH TEMPERATURE TESTS
- Fatigue life of dovetail joints Verification of a simple biaxial model p 863 A89-54119 Selecting high-temperature structural intermetallic compounds - The materials science approach
- p 858 A89-54671 HIGHLY MANEUVERABLE AIRCRAFT
- Linear quadratic Gaussian design for robust performance of a highly maneuverable aircraft p 844 A89-52555 AIAA PAPER 89-34571
- Stability analysis of flexible body dynamics for a highly maneuverable fighter aircraft [AIAA PAPER 89-3471] p 845 A89-52565
- Nonlinear longitudinal control of a supermaneuverable p 851 A89-53957 aircraft Asymptotically decoupled variable structure control of
- systems and large maneuver of aircraft n 852 A89-53988 HOTOL LAUNCH VEHICLE
- HOTOL A European aerospaceplane for the 21st centurv p 856 A89-54330 HOVERING
- Rotorcraft deceleration to hover using image-based uidance p 830 A89-54082 quidance Incorporation of vortex line and vortex ring hover wake
- models into a comprehensive rotorcraft analysis code p 835 N89-29338 [AD-A2080361 Identification of an adequate model for collective response dynamics of a Sea King helicopter in hover
- AD-A208060] p 836 N89-29341 HUMAN FACTORS ENGINEERING Towards a physiologically based HUD (Head-Up Display)
- symbology [AD-A207748] p 838 N89-28515 Accident/incident data analysis database summaries.
- olume 1 [DOT/FAA/DS-89/17-1] p 827 N89-29332
- HYDRAULIC ANALOGIES Water tunnel flow visualization
- on a hypersonic configuration p 820 A89-54373 HYDRAULIC TEST TUNNELS
- Small scale model tests in small wind and water tunnels at high incidence and pitch rates. Volume 1: Test program and discussion of results [AD-A208647]
- p 821 N89-28488 HYDROCARBON COMBUSTION
- Supersonic combustion at the DFVLR: Results and experiences [DEVI B-88-044] p 859 N89-28610
- HYDRODYNAMIC EQUATIONS Solution of the inverse boundary value problem of aerohydrodynamics with allowance for the boundary
- p 864 A89-54611 laver HYDROGEN OXYGEN FUEL CELLS Supersonic combustion at the DFVLR: Results and
- experiences [DEVI B-88-044] p 859 N89-28610
- HYPERSONIC AIRCRAFT

NAL's research for hypersonic flight p 856 A89-54331 Thermal stress analysis of the NASA Dryden hypersonic wing test structure p 856 A89-54340 A study of the sensitivity of stratospheric ozone to p 867 A89-54363 hypersonic aircraft emissions Interfacing hypersonic aircraft in the National Airspace p 831 A89-54366 System The Advanced Aeronautic Design Program - Designing p 834 A89-54370 for the future Flight systems design issues for a research-oriented p 853 hypersonic vehicle A89-54371 Water tunnel flow visualization on a hypersonic configuration p 820 A89-54373

HYPERSONIC BOUNDARY LAYER

Study on boundary layer of hypersonic inlets p 820 A89-54129 HYPERSONIC FLIGHT Application of compound compressible flow to nonuniformities in hypersonic propulsion systems p 318 A89-53367 International Conference on Hypersonic Flight in the 21st Century, 1st, University of North Dakota, Grand Forks, p 355 A89-54326 Sept. 20-23, 1988, Proceedings Forces for change and the future of hypersonic flight

- p 356 A89-54327 in the 21st century NAL's research for hypersonic flight p 856 A89-54331 Perspective on Japanese Space Plane research and A89-54332 p 856 development Flash lamp planar imaging p 863 A89-54348 Economics of hypersonic flight p 878 A89-54351 Hypersonic flight and world tourism
- p 878 A89-54352 Hypersonic flight - Future commercial potentia
- p 878 A89-54353 'Spaceplanes' and the rise of 'Ultra Tech' p 856 A89-54355
- Transnational legal problems for commercial hypersonic p 878 A89-54356
- flight The Trisonic aerospace motor - Propulsion vehicle for the 21st century point flight, domestic military policy, NRTR A89-5 p 856 A89-54359
- p 878 A89-54364 HYPERSONIC FLOW
- Asymptotic solution of a nonlinear boundary value problem with a partly unknown boundary
 - p 874 A89-52802 Turbulence modeling in a hypersonic inlet
- p 819 A89-53931 High speed corner and gap-seal computations using an
- LU-SGS scheme [AIAA PAPER 89-2669] p 863 A89-54424
- Hypersonic vehicle environment simulation, phase 1 [AD-A2090301 p 864 N89-28754 Special Course on Aerothermodynamics of Hypersonic
- Vehicles [AGARD-R-761] p 823 N89-29306 Inviscid and viscous hypersonic aerodynamics: A review
- p 823 N89-29308 of the old and new HYPERSONIC INLETS
- Turbulence modeling in a hypersonic inlet p 819 A89-53931
- HYPERSONIC VEHICLES An integrated configuration and control analysis technique for hypersonic vehicles p 833 A89-54006
- Optimal trajectory generation and design trades for p 855 A89-54009 hypersonic vehicles SST/Concorde - Lessons for hypersonic programs
- p 877 A89-54337
- Conceptual design tools for internal tankage of the p 834 A89-54338 hypersonic transport Hypersonic air vehicle stability and control
- p 834 489-54344 Concepts for control of hypervelocity vehicles F 853 A89-54347
- c 854 A89-54349 Australian hypersonic facilities
- Hypersonic vehicle environment simulation, phase 1
- IAD-A2090301 r 864 N89-28754 Thermo-viscoplastic analysis of hypersonic structures
- subjected to severe aerodynamic heating [NASA-CR-185915] p 8: p 825 N89-29328
- HYPERVELOCITY Concepts for control of hypervelocity vehicles
- p 853 A89-54347 HYPERVELOCITY FLOW
- Mixing augmentation technique for hypervelocity scramjets p 840 A89-53351 Species composition measurements in nonequilibrium p 824 N89-29312 high-speed flows

ICE FORMATION

Aircraft icing caused by large supercooled droplets

- D 826 A89-53793 The influence of ice accretion physics on the forecasting of aircraft icing conditions p 826 A89-54803
- Measurements of hazardous icing conditions p 826 A89-54804
- Remote detection of aircraft icing hazards by Doppler p 826 A89-54805 radar A cooperative study on winter cing conditions in the
- Denver area p 869 A89-54806 Aircraft icing conditions detected by combined remote sensors - A preliminary study p 827 A89-54807
- Aircraft icing hazards forecasting and synoptic assification p 827 A89-54821 classification

The role of the Smith-Feddes model in improving the forecasting of aircraft icing p 827 A89-54823 Severe aircraft icing events - A Colorado case study

INFORMATION SYSTEMS

p 827 A89-54838 An overview of the national program to improve aircraft icing forecasts p 872 A89-54862

- ICE PREVENTION Heat transfer characteristics of an aero-engine intake
- fitted with a hot air jet impingement anti-icing system p 833 A89-53255 Observations and forecasts for runway (pavement)
- p 826 A89-54802 surfaces IDEAL GAS
- A second-order finite-difference scheme for calculating three-dimensional supersonic flows of an ideal gas
- p 818 A89-52852 IGNITERS
- Plasma torch igniter for scramiets p 858 A89-53355 IGNITION
- Flow similarity in ignition process of jet engine p 839 A89-52323 IL YUSHIN AIRCRAFT
- Are the Soviets set to make the big time?
- p 825 A89-52513

IMAGE PROCESSING

Passive navigation using image	e irradiance	tracking
[AIAA PAPER 89-3500]	p 828	A89-52592
IMAGING TECHNIQUES		

- Flash lamp planar imaging p 863 A89-54348 IMPACT DAMAGE
- Workshop proceedings on Certification and Airworthiness Composite Aircraft n 835 N89-29336
- [AD-A209321] IMPACT LOADS
- Full-scale aircraft impact test for evaluation of impact force. Part 2: Analysis of results
- [DE89-0093351 n 836 N89-29344 IMPACT STRENGTH
- Full-scale aircraft impact test for evaluation of impact forces. Part 1: Test plan, test method, and test results [DE89-009329] p 836 N89-29343

IMPACT TESTS

Full-scale aircraft impact test for evaluation of impact forces. Part 1: Test plan, test method, and test results [DE89-009329] p 836 N89-29343 Full-scale aircraft impact test for evaluation of impact

- force. Part 2: Analysis of results p 836 N89-29344 [DE89-0093351
- IN-FLIGHT MONITORING

18

system

[AIAA PAPER 89-3583]

[AIAA PAPER 89-3498]

GPS/INS navigation system

INFORMATION MANAGEMENT

INFORMATION RETRIEVAL

DOT/FAA/DS-89/17-11

[DOT/FAA/DS-89/17-2]

INFORMATION SYSTEMS

INFORMATION DISSEMINATION

INERTIAL PLATFORMS

exploratory study

volume 1

volume 2

- Research on surge monitoring system of turbojet engine on active service p 840 A89-54131
- Constant monitoring of the fatigue damage of aircraft p 863 A89-54488 lifting structures
- Analysis of verification parameters for non-convective Sigmets --- significant meteorology to airmen
- p 870 A89-54825 INCOMPRESSIBLE FLOW

Analysis of incompressible massively separated viscous

flow using unsteady Navier-Stokes equations p818 A89-52485 Finite element analysis of incompressible viscous flows

around single and multi-element aerofoils in high Reynolds number region [NAL-TR-1010T] D 865 N80-28765

NDIAN SPACE PROGRAM	h 999	1409-20703
Aerospace Industry in India - Past,		
	p 815	A89-54472
NERTIAL NAVIGATION		

Development and flight evalu	ation of an	integrated
GPS/INS navigation system		
[AIAA PAPER 89-3498]	p 828	A89-52590
Observability studies of inertial	navigation s	ystems
[AIAA PAPER 89-3580]	p 829	A89-52663

Update 89 - Additional results with the multifunction RLG

Development and flight evaluation of an integrated

Technical communication in aeronautics - Results of an

Interfacing modules for integrating discipline specific structural mechanics codes p 866 N89-29793

Accident/incident data analysis database summaries,

Accident/incident data analysis database summaries,

p 837 A89-52716

p 828 A89-52590

p 877 A89-53330

p 827 N89-29332

p 828 N89-29333

A-13

INGESTION (ENGINES)

INGESTION (ENGINES)

STOL and STOVL hot gas ingestion and airframe heating tests in the NASA Lewis 9- by 15-foot low-speed wind tunnel

[NASA-TM-102101]		p 824	N89-29323
INJECTION MOLDING			
Injection moulded	ceramic rotors -	Compar	ison of SiC
and Si3N4		p 858	A89-53658

- INLET FLOW
- Active control of inlet distorted flow field in compressor p 817 A89-52316 inlot Calculations of inlet distortion induced compressor flow
- field instability p 818 A89-52498 A method for calculation of matching point of inlet and p 840 A89-54132 enaine
- Calculation of the effect of the location of the jet-engine air inlets on the air flow in front of the inlets
- p 820 A89-54486 INSPECTION
- A survey of JP-8 and JP-5 properties AD-A207721 p p 860 N89-28661

INSTRUMENT APPROACH Aircraft accident/incident summary reports: Belleville,

- Illinois, August 22, 1987; Pensacola, Florida, December 27.1987 [PB89-910405]
- p 827 N89-28507 INTERACTIONAL AERODYNAMICS
- Prediction of secondary separation in shock wave p 816 A89-51760 boundary-layer interactions rolling Numerical simulation of up of leading/trailing-edge vortex sheets for slender wings

p 819 A89-53926 Study of the wing-vortex interaction in three dimensional flows (incompressible inviscid flow)

- p 822 N89-28494 [ISL-R-123/87] Profile-vortex interactions [ISL-R-125/87] p 822 N89-28495
- INTERFACES Interfacing modules for integrating discipline specific

structural mechanics codes p 866 N89-29793 INTERMETALLICS

Selecting high-temperature structural intermetallic compounds - The materials science approach p 858 A89-54671

Intermetallic and ceramic matrix composites for 815 to 1370 C (1500 to 2500 F) gas turbine engine applications [NASA-TM-102326] p 860 N89-29490 p 860 N89-29490

INTERNAL COMBUSTION ENGINES Engine combustion optimization by exhaust analysis [PB89-195788] p 859 N89-28588

p 859 N89-28588 INTERNATIONAL LAW

- Transnational legal problems for commercial hypersonic flight p 878 A89-54356 INTERNATIONAL RELATIONS
- Hypersonic flight and the Warsaw Convention p 878 A89-54358
- INVESTMENT CASTING

Aerospace investment casting in the U.S.A. 1988 p 857 A89-52022 INVISCID FLOW

- Inviscid and viscous hypersonic aerodynamics: A review
- p 823 N89-29308 of the old and new

J

JACOBI MATRIX METHOD

Constructing a continuous parameter computational flows p 819 range of p 819 A89-53928 JAPANESE SPACE PROGRAM

- Perspective on Japanese Space Plane research and p 856 A89-54332 development
- JET AIRCRAFT p 841 A89-54483 History of low-power jet engines JET AIRCRAFT NOISE
- Nozzle geometry effects on supersonic jet interaction p 876 A89-53932
- Noise produced by a jet aircraft during the engine test D 876 A89-54487 run

JET ENGINE FUELS

Denormalized product of the adsorptive zeolite extraction of paraffins as a jet fuel component p 857 A89-52775

JET ENGINES

Flow similarity in ignition process of jet engine

- p 839 A89-52323 p 841 A89-54483 History of low-power jet engines Jet engines for high supersonic flight velocities (2nd revised and enlarged edition) --- Russian book
- p 841 A89-54884 Computational structural mechanics engine structures computational simulator p 866 N89-29792 Interfacing modules for integrating discipline specific p 866 N89-29793
- structural mechanics codes A-14

- JET EXHAUST
 - Measurements of mean-flow and turbulence characteristics in a turbojet exhaust using a laser velocimeter [ISL-CO-226/881 p 841 N89-28519
 - JET FLOW Measurements of mean-flow and turbulence
 - characteristics in a turbojet exhaust using a laser velocimeter p 841 N89-28519 [ISL-CO-226/88]
 - Laser velocimetry in the close wake of an axisymmetric rear body [ISL-B-114/87] n 865 N89-28774
 - JET IMPINGEMENT
 - Heat transfer characteristics of an aero-engine intake fitted with a hot air jet impingement anti-icing system p 833 A89-53255
 - JET MIXING FLOW
 - Noncircular jet dynamics in supersonic combusti p 863 A89-53353 Combustion-related shear-flow dynamics in elliptic p 819 A89-53930
 - supersonic jets JOINTS (JUNCTIONS)
 - Fatigue life of dovetail joints Verification of a simple p 863 A89-54119 biaxial model JP-5 JET FUEL

 - A survey of JP-8 and JP-5 properties [AD-A207721] p p 860 N89-28661 JP-8 JET FUEL
 - A survey of JP-8 and JP-5 properties [AD-A207721] p p 860 N89-28661

Κ

- KALMAN FILTERS
- Development and flight evaluation of an integrated GPS/INS navigation system p 828 A89-52590
- [AIAA PAPER 89-3498] Global positioning system accuracy improvement using Ridge regression [AIAA PAPER 89-3499]
- p 828 A89-52591 Identification of state-space parameters in the presence p 875 A89-54022 of uncertain nuisance parameters KINEMATICS
- A survey of JP-8 and JP-5 properties [AD-A207721] p
- p 860 N89-28661 KIRCHHOFF LAW OF RADIATION Use of the Kirchhoff method in acoustics
- p 876 A89-53945 KNOWLEDGE BASES (ARTIFICIAL INTELLIGENCE)
- A knowledge based tool for failure propagation nalysis p 874 A89-53970 analysis p 874

L

- I-1011 AIRCRAFT
- Design of a modalized observer with eigenvalue sensitivity reduction --- for lateral dynamics of L-1011 p 842 A89-51723 aircraft A systematic approach to gain suppression using
- eigenstructure assignment p 875 A89-54024 LAMB WAVES Ultrasonic evaluation of matrix cracking in graphite
- BMI [SME PAPER EM88-549] p 864 A89-54900
- LAMINAR BOUNDARY LAYER The effects of longitudinal vortices on heat transfer of
- p 860 A89-51680 laminar boundary lavers LAMINAR FLOW
- Finite element analysis of incompressible viscous flows around single and multi-element aerofoils in high Reynolds number region [NAL-TR-1010T] p 865 N89-28765
- LÀMINATES
- Interlaminar fracture toughness and toughening of laminated composite materials - A review p 858 A89-54426
- Design, fabrication, and testing of a composite main landing gear retracting beam
- [SME PAPER EM88-551] p 834 A89-54901 Composite material repair and reliability
- p 859 N89-28574 [AD-A209150] LANDING GEAR
- Design, fabrication, and testing of a composite main landing gear retracting beam
- p 834 A89-54901 [SME PAPER EM88-551] Aircraft accident/incident summary reports: Belleville, Illinois, August 22, 1987; Pensacola, Florida, December 27, 1987
- [PB89-910405] p 827 N89-28507 LARGE SPACE STRUCTURES
- Integrated structure/control law design by multilevel optimization [AIAA PAPER 89-3470] p 873 A89-52564

LASER ANEMOMETERS Laser velocimetry in the close wake of an axisymmetric rear body [ISL-R-114/87] p 865 N89-28774 LASER APPLICATIONS Species composition measurements in nonequilibrium high-speed flow p 824 N89-29312 LASER DOPPLER VELOCIMETERS

SUBJECT INDEX

- mean-flow turbulence Measurements of and characteristics in a turbojet exhaust using a laser velocimeter [ISL-CO-226/88] p 841 N89-28519
- Laser velocimetry in the close wake of an axisymmetric rear body
- [ISL-B-114/87] p 865 N89-28774 LASER GYROSCOPES
 - Update 89 Additional results with the multifunction RLG vstem
 - [AIAA PAPER 89-3583] p 837 A89-52716 Performance test results of a multi-function fault-tolerant
- RLG system [AIAA PAPER 89-3584] p 837 A89-52717
- LATERAL CONTROL Stability analysis of flexible body dynamics for a highly
- maneuverable fighter aircraft [AIAA PAPER 89-3471] p 845 A89-52565
- Lateral electric flight control laws of a civil aircraft based upon eigenstructure assignment technique
- [AIAA PAPER 89-3594] p 851 A89-52718 Lateral axis autopilot design for large transport aircraft An explicit model-matching approach
- p 852 A89-53976 Design of localizer capture and track modes for a lateral
- autopilot using H(infinity) synthesis p 852 A89-53977
- A multivariable control design for the lateral axis autopilot p 852 A89-53980
- of a transport aircraft LATERAL STABILITY

a round leading edge delta wing

Euler equations in general co-ordinates

simulation

LEADING EDGES

suction

Numerical

panel method

[AD-A2089681

identification

[AD-A207911]

LEGAL LIABILITY

LIFE (DURABILITY)

[ISL-R-125/87]

LIFT DRAG RATIO

LIGHT AIRCRAFT

LIGHT MODULATION

wind shear

projectors

LIGHTNING

[AD-A209580]

pod/HF probe

LIFT

maritime patrol aircraft

[AIAA PAPER 89-3490]

Display characteristics of

resource for aviation meteorology

LIGHTNING SUPPRESSION

Profile-vortex interactions

[NASA-CR-185892]

layers of an oscillating airfoil

LEAST SQUARES METHOD

- Study on a design method for the lateral stability of the airplane by the conditions for the steady horizontal turn with control surfaces fixed p 851 A89-53640 LAUNCH VEHICLES
- Saenger: An advanced space transport system for Europe - Program overview and key technology needs p 856 A89-54329
- LAW (JURISPRUDENCE) Weather testimony in litigation p 879 A89-54863 Navier-Stokes computation of transonic vortices over

On TVD difference schemes for the three-dimensional

Transition flight experiments on a swept wing with

Analysis of leading edge separation using a low order

Transition and turbulence structure in the boundary

A modified least squares estimator for gas turbine

Comparative durability of six coating systems on

Optimal control for maximum energy extraction from

LDIS (Lightning Data and Information Systems) - A new

Lightning protection testing of the E-6 wing tip antenna

Gas turbine research and development in India

first-stage gas turbine blades in the engines of a long-range

Hypersonic flight and the Warsaw Convention

leading/trailing-edge vortex sheets for slender wings

of

p 817 A89-52483

p 817 A89-52484

p 819 A89-53830

p 819 A89-53926

p 822 N89-28493

p 824 N89-29317

p 842 N89-29348

p 878 A89-54358

p 858 A89-54255

p 822 N89-28495

p 846 A89-52583

p 841 A89-54473

p 877 N89-29193

p 869 A89-54801

p 825 A89-53474

light-valve

example

up

of

rolling

LINEAR QUADRATIC GAUSSIAN CONTROL

- Wideband linear quadratic Gaussian control of strapdown dry tuned gyro/accelerometers [AIAA PAPER 89-3441] p 837 A89-52540
- Flight control synthesis for an unstable fighter aircraft using the LOG/LTR methodology p 844 A89-52551 [AIAA PAPER 89-3452]
- Linear quadratic Gaussian design for robust performance of a highly maneuverable aircraft
- [AIAA PAPER 89-3457] p 844 A89-52555 A surrogate system approach to robust control design [AIAA PAPER 89-3492] p 873 A89-52585
- Application of stochastic robustness to aircraft control systems
- [AIAA PAPER 89-3505] p 846 A89-52598 Integrated flight/propulsion control system design based on a centralized approach
- [AIAA PAPER 89-3520] p 847 A89-52611 Design of integrated autopilot/autothrottle for NASA TSRV airplane using integral LQG methodology transport systems research vehicle
- [AIAA PAPER 89-3595] p 849 A89-52674 Turbofan engine control system design using the
- LQG/LTR methodology p 840 A89-53956 Integral LQG model following controller p 852 A89-53979
- LINEAR QUADRATIC REGULATOR
- Self-tuning Generalized Predictive Control applied to terrain following flight
- [AIAA PAPER 89-3450] p 843 A89-52549 Dynamic stability and active control of elastic vehicles
- acting with unsteady aerodynamic forces [AIAA PAPER 89-3557] p 8 p 848 A89-52643 LINEAR SYSTEMS
- Extended observability of linear time-invariant systems
- under recurrent loss of output data [AIAA PAPER 89-3510] p 873 A89-52603
- Optimal output feedback for linear time-periodic systems [AIAA PAPER 89-3574] p 873 A89-52657
- LININGS
- Fuel properties effect on the performance of a small high temperature rise combustor [AIAA PAPER 89-2901]
- p 838 A89-52025 LIQUID BEARINGS
- Turbomachinery rotor support with damping [NASA-CASE-MFS-28345-1] p 865 N89-28841 LIQUID CRYSTALS
- High-resolution liquid-crystal heat-transfer measurements on the endwall of a turbine passage with variations in Reynolds number p 862 A89-53289 LONG TERM EFFECTS
- Five year ground exposure of composite materials used on the Bell Model 206L flight service evaluation [NASA-TM-101645] p 859 N89-28579
- LONGITUDINAL CONTROL
- Thrust vectoring effect on time-optimal 90 degrees angle of attack pitch up maneuvers of a high alpha fighter aircraft
- [AIAA PAPER 89-3521] p 847 A89-52612 Nonlinear longitudinal control of a supermaneuverable p 851 A89-53957 LOW ASPECT RATIO WINGS
- Boundary-layer measurements а transonic low-aspect ratio wing
- [NASA-TM-88214] p 823 N89-29305 Some effects of aerodynamic spoile rs on wing flutte [NASA-TM-101632] p 825 N89-29324
- LOW SPEED Flight investigation of helicopter low-speed response
- p 842 A89-51702 requirements LOW SPEED STABILITY
- Low-speed static and dynamic force tests of a generic supersonic cruise fighter configuration NASA-TM-41381
- p 821 N89-28486 LOW SPEED WIND TUNNELS Small scale model tests in small wind and water tunnels
- at high incidence and pitch rates. Volume 1: Test program and discussion of results [AD-A208647] p 821 N89-28488
- STOL and STOVL hot gas ingestion and airframe heating tests in the NASA Lewis 9- by 15-foot low-speed wind tunnel
- p 824 N89-29323 [NASA-TM-102101] LUBRICANT TESTS
- Lubricant evaluation and performance p 865 N89-28835 [AD-A208925] LUBRICANTS
- Tribological properties of alumina-boria-silicate fabric from 25 C to 850 C p 859 A89-54982 p 859 A89-54982 LUBRICATING OILS
- Microcomputer simulation of lubricant degradation in turbine engines using laboratory data
 - p 859 A89-54986

LUMINANCE

- Specifications and measurement procedures and aircraft transparencies
- TAD-A2093961 p 834 N89-28511 М

- MAINTENANCE
- Initial flight qualification and operational maintenance of X-29A flight software [AIAA PAPER 89-3596] p 850 A89-52675
- Composite material repair and reliability p 859 N89-28574 [AD-A209150]
- MAN MACHINE SYSTEMS
- Towards a physiologically based HUD (Head-Up Display) symbology AD-42077481 p 838 N89-28515
- MAN POWERED AIRCRAFT
- The flight control system for the Daedalus human powered aircraft
- [AIAA PAPER 89-3593] p 849 A89-52673 MAN-COMPUTER INTERFACE
- Operational experience with the Computer Oriented Metering Planning and Advisory System (COMPAS) at Frankfurt, Germany [AIAA PAPER 89-3627] o 829 A89-52721
- MANAGEMENT SYSTEMS
- CAD/CAM Managerial challenges and research issues p 879 A89-54908 MANDRELS
- Stresses and strains in a cold-worked annulus [AR-005-548] p 866 N89-28871
- MANEUVERABILITY High performance linear-quadratic and H-infinity designs
- for a 'supermaneuverable' aircraft [AIAA PAPER 89-3456] o 832 A89-52712
- MAPS Map, Operator, Maintenance Stations --- in mission
- planning [AIAA PAPER 89-3523] p 854 A89-52613
- MARKET RESEARCH
- Competition and safety in air traffic [TUB-DISS-PAPER-128] p 827 N89-28508 MARKETING
- Hypersonic flight Future commercial potential 0 878 A89-54353
- Competition and safety in air traffic p 827 N89-28508 [TUB-DISS-PAPER-128]
- MASS FLOW Study on boundary layer of hypersonic inlets
- 5 820 A89-54129 MATERIALS SCIENCE
- Current research in composite structures at NASA's angley Research Center 2 861 A89-51692 Langley Research Center Selecting high-temperature structural intermetallic
- compounds The materials science approach o 858 A89-54671 MATHEMATICAL MODELS
- A perfect explicit model following control solution to
- imperfect model following control problems [AIAA PAPER 89-3612] p 850 A89-52690 The role of the Smith-Feddes model in improving the recasting of aircraft icing p 827 A89-54823 forecasting of aircraft icing One-degree-of-freedom motion induced by modeled
- dding ortex she [NASA-TM-101038] p 866 N89-28870
- Aerothermodynamic instrumentation p 866 N89-29310 A user's manual for the ARL mathematical model of
- the Sea King Mk-50 helicopter. Part 1: Basic use [AD-A208058] p 835 N89-29339 A user's manual for the ARL mathematical model of
- the Sea King Mk-50 helicopter. Part 2: Jse with ARL flight data [AD-A208059] p 836 N89-29340
- Identification of an adequate model for collective response dynamics of a Sea King helicopter in hove [AD-A2080601 p 836 N89-29341
- MATRIX MATERIALS Ultrasonic evaluation of matrix cracking in graphite
- вмі p 864 A89-54900 (SME PAPER EM88-549)
- MAXIMUM LIKELIHOOD ESTIMATES Identification of state-space parameters in the presence
- p 875 A89-54022 of uncertain nuisance parameters MAXIMUM PRINCIPLE
- Maximum principle solutions for time-optimal half-loop maneuvers of a high alpha fighter aircraft
- p 853 A89-54081 MCDONNELL DOUGLAS AIRCRAFT
- MDX A helicopter designed by its users
- p 833 A89-53630 MEASURING INSTRUMENTS

Aerothermodynamic instrumentation

p 866 N89-29310

MICROBURSTS (METEOROLOGY)

MELTING POINTS

Selecting high-temperature structural intermetallic compounds - The materials science approach p 858 A89-54671

MESOMETEOROLOGY

A 3-hour mesoscale assimilation system using ACARS aircraft data combined with other observations aeronautical radio communications addressing and p 869 A89-54797 reporting system

METAL COATINGS

program

Preprints

International Airport

Doppler radar

reporting system

International Airport

range forecasting

experience

requirements in the 1990's

[AIAA PAPER 89-3560]

[AIAA PAPER 89-3561]

surveillance radar

Doppler radar

MICROBURSTS (METEOROLOGY)

Optimal paths through downbursts

Microburst detection from mesonet data

velocity differential in a microburst

Swedish aviation weather system

aviation

FAA

data

Comparative durability of six coating systems on first-stage gas turbine blades in the engines of a long-range maritime patrol aircraft p 858 A89-54255 METAL FATIGUE

- Ultra high bypass aircraft sonic fatigue
- p 831 A89-51898 METEOROLOGICAL PARAMETERS
 - Measurements of hazardous icing conditions p 826 A89-54804

p 871 A89-54855

p 871 A89-54856

p 867 A89-54776

p 868 A89-54785

p 868 A89-54786

p 868 A89-54787

p 869 A89-54789

p 869 A89-54795

p 869 A89-54797

p 870 A89-54817

p 875 A89-54858

p 831 A89-54859

p 872 A89-54860

p 872 A89-54865

p 872 A89-54866

p 848 A89-52645

p 848 A89-52646

p 867 A89-54777

p 868 A89-54780

p 868 A89-54785

n 868 A89-54786

p 868 A89-54787

A89-54783

Δ-15

p 868

A89-54783

A89-54784

p 868

p 868

METEOROLOGICAL RADAR

- Airborne rain mapping rada p 837 A89-53313 The detection of low level windshear with airport p 868 A89-54780 surveillance radar Using features aloft to improve timeliness of TDWR
- hazard warnings --- Terminal Doppler Weather Radar p 870 A89-54809
- Evaluation of microburst nowcasting during TDWR p 870 A89-54813 1987 Gust front detection algorithm for the Terminal Doppler
- Weather Radar. II Performance assessment p 871 A89-54852 The FAA Terminal Doppler Weather Radar (TDWR)

International Conference on the Aviation Weather

Evaluation of the 12-station enhanced Low Level Wind

Shear Alert System (LLWAS) at Denver Stapleton

Microburst detection and display by TDWR - Shape, extent, and alarms --- Terminal Doppler Weather Radar

Estimation of microburst asymmetry with a single

Impact of automated weather observing systems on

A 3-hour mesoscale assimilation system using ACARS

aircraft data combined with other observations -

aeronautical radio communications addressing and

resource for aviation meteorology p 869 A89-54801 MET 90, a project for the development of the future

LDIS (Lightning Data and Information Systems) - A new

Doppler weather radar service at the Chiang Kai-Shek ternational Airport p 871 A89-54840

JPL realtime weather processor system developed for

Data Link Processor (DLP), pilot access to weather

The development of numerically-based and expert

ederal plans to satisfy aviation weather information

Weather information systems for pilots - The Minnesota

A relationship between peak temperature drop and

Dallas microburst storm environmental conditions

The detection of low level windshear with airport

Microburst detection and display by TDWR - Shape,

Estimation of microburst asymmetry with a single

extent, and alarms --- Terminal Doppler Weather Radar

Divergence estimation by a single Doppler radar

determined from satellite soundings p 868 A89-54779

Thrust laws for microburst wind shear penetration

system approaches for airfield nowcasting/very short

Divergence estimation by a single Doppler radar

Weather sensing with airport surveillance radars

Systems, 3rd, Anaheim, CA, Jan. 30-Feb. 3, 1989,

Ground based weather radar for aviation

Microburst detection from mesonet data

METEOROLOGICAL SERVICES

MICROCOMPUTERS

Numerical simulation of microbursts - Aircraft trajectory p 869 A89-54788 studies Using features aloft to improve timeliness of TDWR hazard warnings --- Terminal Doppler Weather Radar p 870 A89-54809 Evaluation of microburst nowcasting during TDWR p 870 A89-54813

Aircraft low level wind shear detection and warning p 838 A89-54848 system Techniques for the detection of microburst events using

airport surveillance radars - Cross-spectral velocity p 872 A89-54868 timation MICROCOMPUTERS

A real time microcomputer implementation of sensor failure detection for turbofan engines

p 876 N89-29032 [NASA-TM-102327] MICROCRACKS

Ultrasonic evaluation of matrix cracking in graphite BMI [SME PAPER EM88-549] p 864 A89-54900

MICROWAVE LANDING SYSTEMS MLS 1989 - Status report from the perspective of the

p 830 A89-53663 airline companies MICROWAVE RADIOMETERS

Aircraft icing conditions detected by combined remote p 827 A89-54807 sensors - A preliminary study MIL AIRCRAFT

Mi-28 Havoc is still tomorrow's tank-buster

p 832 A89-52514 MILITARY AIRCRAFT

- AT3 demonstrates feasibility of cargo STOL with long p 832 A89-52201 ranae Glazing into the future --- shielding coatings for military cockpit canopies p 832 A89-52525
- Map, Operator, Maintenance Stations --- in mission planning

AIAA PAPER 89-3523	p 854	A89-52613
Closing the gap	p 815	A89-52975
Camouflage cap allows aircraft to	disappea	ar

p 838 A89-54482 MILITARY HELICOPTERS

- Flight investigation of helicopter low-speed response requirements p 842 A89-51702 Mi-28 Havoc is still tomorrow's tank-buster
- p 832 A89-52514 Visual and sensory aids for helicopters in the year 2000
- [MBB-UD-541-89-PUB] p 837 A89-53309 **MILITARY OPERATIONS**
- Hypersonic flight, domestic military policy, and p 878 A89-54364 international relations MILITARY SPACECRAFT
- Hypersonic flight, domestic military policy, and ternational relations p 878 A89-54364 international relations MISSILE CONTROL
- Improved guidance law design n based on the p828 A89-51716 mixed-strategy concept Wideband linear quadratic Gaussian control of strapdown dry tuned gyro/accelerometers [AIAA PAPER 89-3441] p 83
- p 837 A89-52540 MISSILE TRACKING based on the
- Improved guidance law design p 828 A89-51716 mixed-strategy concept MISSION PLANNING

Map, Operator, Maintenance Stations --- in mission planning p 854 A89-52613 [AIAA PAPER 89-3523]

Special Course on Aerothermodynamics of Hypersonic Vehicles

p 823 N89-29306 (AGARD-R-761) MODAL RESPONSE Finite element based modal analysis of helicopter roto

- blades p 832 A89-52044 Time periodic control of a multi-blade helicopter
- [AIAA PAPER 89-3449] p 843 A89-52548 MODEL REFERENCE ADAPTIVE CONTROL
- Application of perfect model following to a control configured vehicle p 844 A89-52552 [AIAA PAPER 89-3453]
- Design of adaptive digital model-following flight-mode control systems for high-performance aircraft p 846 A89-52587 [AIAA PAPER 89-3495]
- A perfect explicit model following control solution to imperfect model following control problems p 850 A89-52690
- [AIAA PAPER 89-3612] Flight control reconfiguration using model reference adaptive control p 852 A89-53959
- Lateral axis autopilot design for large transport aircraft An explicit model-matching approach
- p 852 A89-53976 Integral LQG model following controller
- p 852 A89-53979 MODELS
- Computerized life and reliability modeling for turboprop transmissions p 863 A89-53364

A-16

MODULATION TRANSFER FUNCTION Display characteristics of example light-valve

projectors AD-A2095801 p 877 N89-29193

- MONITORS Evaluation of a takeoff performance monitoring system
- p 837 A89-51704 display MONTE CARLO METHOD
- Global positioning system accuracy improvement using Ridge regression
- [AIAA PAPER 89-3499] p 828 A89-52591 MOTION STABILITY
- High gain flight controllers for nonlinear systems [AIAA PAPER 89-3488] p 845 A89-52581
- MULTIPROCESSING (COMPUTERS)
- Linear token passing based bus interface unit for a fault tolerant multiprocessor testbed p 874 A89-53975 Experience with implementation of a turbojet engine control program on a multiprocessor p 875 A89-54106

MULTISENSOR APPLICATIONS		
Sensitive skins	p 837	A89-52974

Ν

- NAP-OF-THE-EARTH NAVIGATION
- Integration of active and passive sensors for obstacle avoidance p 830 A89-54083 NASA PROGRAMS
- Current research in composite structures at NASA's Langley Research Center p 861 A89-51692 NASTRAN
- Flutter calculations for a model wing using the MSC NASTRAN structural analysis program
- AD-A2092441 p 824 N89-29318 NATIONAL AEROSPACE PLANE PROGRAM
- Hypersonic flight, domestic military policy, and international relations p 878 A89-54364 NATIONAL AIRSPACE SYSTEM
- A model of the National Airspace System [AIAA PAPER 89-3626] p 829 A89-52701
- Interfacing hypersonic aircraft in the National Airspace System p 831 A89-54366 The status of the FAA Central Weather Processor (CWP)
- p 872 A89-54857 program Data Link Processor (DLP), pilot access to weather
- A89-54859 p 831 Collision avoidance operational concept
- [WP-88W00418] p 831 N89-28509 Direct User Access Terminal (DUAT) operational concept
- [WP-88W00075] p 854 N89-28524 NAVIER-STOKES EQUATION
- Symbolic eigenvalue analysis for adaptive stepsize control in PNS shock stabilization p 816 A89-51756 Navier-Stokes computation of transonic vortices over
- p 817 A89-52483 a round leading edge delta wing Analysis of incompressible massively separated viscous flow using unsteady Navier-Stokes equations
- p 818 A89-52485 High speed corner and gap-seal computations using an
- LU-SGS scheme [AIAA PAPER 89-2669] p 863 A89-54424
- Some computations of unsteady Navier-Stokes flow around oscillating airfoil/wing p 822 N89-28492 [NAL-TR-1004T]
- Flow calculation over a delta-wing using the thin-layer Navier-Stokes equations p 822 N89-28497 (PD-CF-8924)
- NAVIGATION
- AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Parts p 842 A89-52526 1 & 2 NAVIGATION AIDS
 - Passive navigation using image irradiance tracking [AIAA PAPER 89-3500] p 828 A89-52 p 828 A89-52592
- NAVIGATION SATELLITES The Locstar radiodetermination satellite system
- p 830 A89-53660 NAVSTAR SATELLITES
- Flight-test evaluation of civil helicopter terminal approach operations using differential GPS [AIAA PAPER 89-3635] p 828 A89-52594
- NEAR WAKES Separated flow past three-dimensional bodies as a singular perturbation problem p 861 A89-52507 Laser velocimetry in the close wake of an axisymmetric
- rear body [ISL-R-114/87] p 865 N89-28774 NOISE MEASUREMENT
- Use of the Kirchhoff method in acoustics
- p 876 A89-53945 Noise produced by a jet aircraft during the engine test run p 876 A89-54487

Airport noise measuring data collction system (NLR-MP-87006-U) p 855 N89-28526

- NOISE PREDICTION (AIRCRAFT) Noise produced by turbulent flow into a rotor: Users
- manual for noise calculation [NASA-CR-181790] p 876 N89-29152 Noise produced by turbulent flow into a rotor: Users manual for atmospheric turbulence prediction and mean
- flow and turbulence contraction prediction [NASA-CB-181791] p 876 N89-29154 NONLINEAR EQUATIONS
- A coupled rotor aeroelastic analysis utilizing nonlinear
- aerodynamics and refined wake modeling p 831 A89-52041 Comparison of nonlinear controllers for twin-lift
- configurations AIAA PAPER 89-35911 p 849 A89-52671
- NONLINEAR SYSTEMS
- High gain flight controllers for nonlinear systems [AIAA PAPER 89-3488] p 845 A89p 845 A89-52581 On the design of nonlinear controllers for flight control systems
- [AIAA PAPER 89-34891 p 845 A89-52582 Asymptotically decoupled variable structure control of
- systems and large maneuver of aircraft p 852 A89-53988 One-degree-of-freedom motion induced by modeled
- vortex shedding [NASA TM-101038] p 866 N89-28870
- Chaotic response of aerosurfaces with structural nonlinearities [AD-A208433] p 824 N89-29316
- NONLINEARITY
- The 3-D inelastic analyses for computational structural mechanics p 867 N89-29804 NOWCASTING
- Evaluation of microburst nowcasting during TDWR p 870 A89-54813 1987
- Very short-range aerodrome forecasts using regression techniques p 870 A89-54831
- The development of numerically-based and expert system approaches for airfield nowcasting/very short range forecasting NOZZLE DESIGN p 872 A89-54860

Optimum design for geometric

axisymmetric converging-diverging nozzle

of convergent-divergent nozzle

NUMERICAL DIFFERENTIATION

estimating the velocity of an object

NUMERICAL FLOW VISUALIZATION

at NASA Ames Research Center

NUMERICAL WEATHER FORECASTING

supersonic jets

fluid flow data sets

range forecasting

NYQUIST DIAGRAM

aircraft

(AIAA PAPER 89-3491)

OBSERVABILITY (SYSTEMS)

[AIAA PAPER 89-3510]

under recurrent loss of output data

- parameters of axisymmetric converging-diverging nozzle p 839 A89-52319
- Effect of geometric parameters on internal performance p 839 A89-52320 of convergent-divergent nozzle NOZZLE FLOW
- Construction of general-purpose supersonic nozzles of p 821 A89-54624 conical cross section
- NOZZLE GEOMETRY Optimum design for geometric parameters of

Effect of geometric parameters on internal performance

Combustion-related shear-flow dynamics in elliptic

Nozzle geometry effects on supersonic jet interaction

Precision characteristics of a coordinate device for

Numerical simulation and hydrodynamic visualization of

Representation and display of vector field topology in

Scientific visualization in computational aerodynamics

The World Area Forecast System p 870 A89-54827

The development of numerically-based and expert

system approaches for airfield nowcasting/very short

Comparison of Characteristic Locus and h-infinity methods in VSTOL flight control system design

Ο

Design of a modalized observer with eigenvalue

Extended observability of linear time-invariant systems

sensitivity reduction --- for lateral dynamics of L-1011

transient viscous flow around an oscillating aerofoil

Noncircular jet dynamics in supersonic combustion

p 839 A89-52319

p 839 A89-52320

p 863 A89-53353

p 819 A89-53930

p 876 A89-53932

p 830 A89-52779

p 817 A89-52481

p 875 A89-54904

p 875 A89-54907

p 872 A89-54860

p 846 A89-52584

p 842 A89-51723

p 873 A89-52603

- An observer-based compensator for distributed delays in integrated control systems [AIAA PAPER 89-3541] p 847 A89-52628
- Observability studies of inertial navigation systems [AIAA PAPER 89-3580] p 829 A89-52663
- Fault-tolerant sensor and actuator selection for control p 874 A89-54007 of flexible structures OBSTACLE AVOIDANCE

An expert system for wind shear avoidance

- p 826 A89-53971 Integration of active and passive sensors for obstacle p 830 A89-54083 avoidance
- UNBOARD DATA PROCESSING
- On-board automatic aid and advisory for pilots of control-impaired aircraft
- [AIAA PAPER 89-3460] p 844 A89-52558 Integrated control and avionics for air superiority -Computational aspects of real-time flight management p 837 A89-52559 AIAA PAPER 89.34631
- Map, Operator, Maintenance Stations --- in mission planning [AIAA PAPER 89-3523] p 854 A89-52613
- ONBOARD EQUIPMENT MLS 1989 - Status report from the perspective of the
- p 830 A89-53663 airline companies Flight test method development for a quarter-scale aircraft with minimum instrumentation
- p 835 N89-29337 [AD-A2078961 OPTICAL COMMUNICATION
- Status and development potential of the fly by light technology in civil aircraft [ILR-MITT-212] p 854 N89-28522
- OPTICAL COUPLING
- An experimental optical coupling device for an airborne digital redundant system
- [NAL-TR-1003] p 835 N89-28514 OPTICAL GYROSCOPES
- Update 89 Additional results with the multifunction RLG system [AIAA PAPER 89-3583] p 837 A89-52716
- Performance test results of a multi-function fault-tolerant RLG system
- [AIAA PAPER 89-3584] p 837 A89-52717 OPTICAL TRANSFER FUNCTION
- Display characteristics example light-valve of projectors (AD-A209580) n 877 N89-29193
- OPTIMAL CONTROL Improved guidance law design based on the
- p 828 A89-51716 mixed-strategy concept Modeling of aerodynamic forces in the Laplace domain with minimum number of augmented states for the design of active flutter suppression systems
- [AIAA PAPER 89-3466] p 844 A89-52561 High gain flight controllers for nonlinear systems p 845 A89-52581 [AIAA PAPER 89-3488]
- Optimal control for maximum energy extraction from l shea [AIAA PAPER 89-3490] p 846 A89-52583
- Evaluation of a technique for predicting longitudinal pilot-induced-oscillations [AIAA PAPER 89-3517]
- p 847 A89-52609 Optimal paths through downbursts [AIAA PAPER 89-3561] p 848 A89-52646
- Optimal output feedback for linear time-periodic systems
- [AIAA PAPER 89-3574] p 873 A89-52657 A variable-gain output feedback control design approach
- [AIAA PAPER 89-3575] p 873 A89-52658 A real-time guidance algorithm for aerospace plane p 855 A89-54085
- optimal ascent to low earth orbit OPTIMIZATION
- A multi-objective optimum design method for a radial-axial flow turbine with the optimum criteria of blade twist at outlet of blades p 838 A89-52306
- Optimum design for geometric parameters of axisymmetric converging-diverging nozzle p 839 A89-52319
- A design procedure for the handling qualities optimization of the X-29A aircraft p 843 A89-52529
- [AIAA PAPER 89-3428] Integrated structure/control law design by multilevel optimization
- (AIAA PAPER 89-3470) p 873 A89-52564 Application of modern optimization tools for the design of aircraft structures p 834 A89-54471
- ORTHOTROPISM A study of the stress-strain state of connections in an rthotropic material p 864 A89-54585 OSCILLATING FLOW
- Transition and turbulence structure in the boundary layers of an oscillating airfoil
- [AD-A208968] p 824 N89-29317

- OZONE DEPLETION
- A study of the sensitivity of stratospheric ozone to p 867 A89-54363 hypersonic aircraft emissions

P

PANEL METHOD (FLUID DYNAMICS)

- Analysis of leading edge separation using a low order anel method
- 0.822 N89-28/03 [NASA-CB-185892] PARAFFINS
- Denormalized product of the adsorptive zeolite extraction of paraffins as a jet fuel component p 857 A89-52775
- PARALLEL FLOW
- Nozzle geometry effects on supersonic let interaction p 876 A89-53932
- PARALLEL PROCESSING (COMPUTERS) Computational structural mechanics engine structures p 866 N89-29792 computational simulator CSM research: Methods and application studies
- p 867 N89-29794 PARALLEL PROGRAMMING
- Parallel dynamic programming for on-line flight path optimization AIAA PAPER 89-36151
- o 832 A89-52693 PARAMETER IDENTIFICATION
 - Parameter estimation for flight vehicles
- a 831 A89-51701 Modification of trim point and feedback gains for failed
- [AIAA PAPER 89-3507] o 846 A89-52600 Identification of state-space parameters in the presence uncertain nuisance parameters p 875 A89-54022 Identification of an adequate model for collective response dynamics of a Sea King helicopter in hover [AD-A2080601 p 836 N89-29341
- A modified least squares estimator for gas turbine identification (AD-A2079111 p 842 N89-29348
- PARAMETERIZATION
- A surrogate system approach to robust control design [AIAA PAPER 89-3492] p 873 A89-52585 PASCAL (PROGRAMMING LANGUAGE)
- Airport noise measuring data collection system [NLR-MP-87006-U] p 855 N p 855 N89-28526
- PASSENGER AIRCRAFT Hypersonic flight and world tourism
- n 878 A89-54352 PAVEMENTS
- Observations and forecasts for runway (pavement) surfaces p 826 A89-54802 Joint sealants for airport pavements. Phase 1:
- Laboratory and field investigations [DOT/FAA/DS-89/2-PHASE-1] p 854 N89-28523
- PENALTY FUNCTION A comparison of mixed and penalty finite element
- methods in analysis of heat exchangers p 862 A89-53254
- PERFORMANCE PREDICTION Microcomputer simulation of lubricant degradation in turbine engines using laboratory data
- p 859 A89-54986 Analysis of leading edge separation using a low order
- panel method NASA-CR-1858921 p 822 N89-28493 Correlation of Puma airloads: Evaluation of CED
- prediction methods p 822 N89-28498 . NASA-TM-1022261
- PERFORMANCE TESTS
- Performance test results of a multi-function fault-tolerant **RLG** system [AIAA PAPER 89-3584] p 837 A89-52717
- Five year ground exposure of composite materials used on the Bell Model 206L flight service evaluation
- [NASA-TM-101645] p 859 N89-28579 PERMEABILITY
- Optimal permeability of wind tunnel walls at low supersonic velocities p 821 A89-54625 PERMITTIVITY
- Lubricant evaluation and performance [AD-A2089251 p 865 N89-28835
- PERSONAL COMPUTERS Direct User Access Terminal (DUAT) operational
- concept [WP-88W00075] p 854 N89-28524
- PERTURBATION THEORY
- Separated flow past three-dimensional bodies as a singular perturbation problem p 861 A89-52507 Comparison of eigenstructure assignment and the Salford singular perturbation methods in VSTOL aircraft control law design
- [AIAA PAPER 89-3451] p 844 A89-52550 A regular perturbation method for subcritical flow over p 818 A89-53570 a two-dimensional airfoil

PROBABILITY THEORY

PHYSIOLOGY

- Towards a physiologically based HUD (Head-Up Display) symbology [AD-A207748] n 838 N89-28515
- PIEZOELECTRIC GAGES
- Piezoelectric foils as sensors in experimental flow mechanics [ILB-MITT-214]
- p 865 N89-28800 PIGGYBACK SYSTEMS
- Saenger aerospaceplane gains momentum
- p 855 A89-52973 Saenger: An advanced space transport system for
- Europe Program overview and key technology needs p 856 A89-54329
- PILOT INDUCED OSCILLATION Evaluation of a technique for predicting longitudinal
- ilot-induced-oscillations p 847 A89-52609 AIAA PAPER 89-35171
- PILOT TRAINING Piloted simulation of a ground-based time-control
 - concept for air traffic control TAIAA PAPER 89-36251 p 829 A89-52700
 - PILOTI ESS AIRCRAFT
 - Flight test method development for a quarter-scale aircraft with minimum instrumentation [AD-A2078961 p 835 N89-29337
 - PIPERIDINE Supersonic jet studies of fluorene clustered with water,
 - ammonia and piperidine [AD-A209562] n 860 N89-29497
 - PITCH (INCLINATION)
 - Analysis of reattachment during ramp down tests --helicopter blade upper surface flow in dynamic stall conditions p 816 A89-52043

at high incidence and pitch rates. Volume 1: Test program

Plasma torch igniter for scramjets p 858 A89-53355 PLASTIC AIRCRAFT STRUCTURES

High-performance fiber composite materials with

An optimal material removal strategy for automated

Determining cure cycles for thermosetting epoxy

Recovery of the fatigue strength of structural elements

Optimal permeability of wind tunnel walls at low

The Locstar radiodetermination satellite system

Observability studies of inertial navigation systems [AIAA PAPER 89-3580] p 829 A89-5;

Comparison of flow-visualised vortices with computed

Analysis of leading edge separation using a low order

Evaluation of a technique for predicting longitudinal

Control of separated flow past a cylinder using tangential

CAD/CAM - Managerial challenges and research

Probabilistic methods for estimating the remaining life

of structural elements of operating aircraft gas turbine

Stresses and strains in a cold-worked annulus

Environmental effects on composite structures

p 821 N89-28488

p 857 A89-52994

p 857 A89-53310

p 874 A89-53416

p 864 A89-54890

p 857 A89-52827

p 866 N89-28871

p 860 N89-28643

p 821 A89-54625

p 830 A89-53660

p 829 A89-52663

p 821 N89-28489

p 822 N89-28493

p 847 A89-52609

p 857 A89-51860

p 825 N89-29326

p 879 A89-54908

p 839 A89-52832

A-17

PLANFORMS Small scale model tests in small wind and water tunnels

[AD-A208647]

PLASMA TORCHES

thermoplastic matrix

[MBB-7-0257-89-PUB]

repair of aircraft canopies

[SME PAPER EM88-533]

of aluminum alloys by surface hardening

High temperature adhesive systems

PLASTIC DEFORMATION

PLASTIC FLOW

[AR-005-548]

[AD-A209166]

POROUS WALLS

POLYMER CHEMISTRY

supersonic velocities

POSITION (LOCATION)

POSITION ERRORS

POTENTIAL FLOW

[AD-A209083]

panel method

[NASA-CR-185892]

pilot-induced-oscillations

[AIAA PAPER 89-3517]

PRESSURE GRADIENTS

wall jet blowing [NASA-CR-185918]

PROBABILITY THEORY

PRINTED CIRCUITS

issues

engines

Turbulent reactive flows

PREMIXED FLAMES

geometry over thin delta wings

PREDICTION ANALYSIS TECHNIQUES

and discussion of results

PROGRAM VERIFICATION (COMPUTERS)

Composite material repair and reliability p 859 N89-28574 [AD-A209150] PROGRAM VERIFICATION (COMPUTERS)

Verification of aerodrome forecasts p 870 A89-54824 Analysis of verification parameters for non-convective Sigmets --- significant meteorology to airmen p 870 A89-54825

PROJECT MANAGEMENT

SST/Concorde - Lessons for hypersonic programs p 877 A89-54337 The Federal Aviation Administration's Low Level Windshear Alert System - A project managem p 871 A89-54854 perspective PROJECT PLANNING

SST/Concorde - Lessons for hypersonic programs p 877 A89-54337

PROJECTORS

Display characteristics of example light-valve projectors p 877 N89-29193 AD-A209580

PROLATE SPHEROIDS Evolution of axisymmetric wakes from attached and

p 818 A89-52945 separated flows PROPELLANT COMBUSTION

Supersonic combustion at the DFVLR: Results and experiences p 859 N89-28610 [DFVLR-88-044]

PROPELLER NOISE

Aircraft propeller induced structure-borne noise p 876 N89-29155 [NASA-CR-4255] PROPULSION SYSTEM CONFIGURATIONS

Heat transfer in aerospace propulsion p 862 A89-53282 Aeronautical applications of high-temperature superconductors

[AIAA PAPER 89-2142] p 840 A89-53304 Propulsion cycles for transatmospheric accelerators p 840 A89-54328

The Trisonic aerospace motor - Propulsion vehicle for e 21st century p 856 A89-54359 p 856 the 21st century Revolutionary opportunities for materials and structures

study, addendum [NASA-CR-179642-ADD] p 842 N89-29351 PROPULSION SYSTEM PERFORMANCE

Integrated flight/propulsion control system design based on a centralized approach

[AIAA PAPER 89-3520] p 847 A89-52611 Diagnostic techniques for propulsion systems

p 839 A89-52960 Flight test of the F100-PW-220 engine in the F-16 p 840 A89-53366

High altitude reconnaissance aircraft design p 833 A89-54200 [AIAA PAPER 89-2109]

PROTECTIVE COATINGS Glazing into the future --- shielding coatings for military

p 832 A89-52525 cockpit canopies Fatigue life of ZhS6U alloy with protective coatings under thermal cycling loading p 857 A89-52830

Comparative durability of six coating systems on first-stage gas turbine blades in the engines of a long-range maritime patrol aircraft p 858 A89-54255 PUBLIC LAW

Accomplishments under the airport improvement program: Fiscal year 1988 p 855 N89-29352 AD-A2082001

PUBLIC RELATIONS The Orient Express - The emperor's new airplane

p 878 A89-54357 PULSE DOPPLER BADAR

Weather sensing with airport surveillance radars

p 869 A89-54789 PURSUIT TRACKING

Study of a pursuit-evasion guidance law for high p 853 A89-54084 performance aircraft

R

RADAR DETECTION Camouflage cap allows aircraft to disappear p 838 A89-54482 Remote detection of aircraft icing hazards by Doppler p 826 A89-54805 radar RADAR MAPS

p 837 A89-53313 Airborne rain mapping radar RADAR MEASUREMENT

Ground based weather radar for aviation p 871 A89-54856 RADAR SIGNATURES

Camouflage cap allows aircraft to disappe p 838 A89-54482

Techniques for the detection of microburst events using airport surveillance radars - Cross-spectral velocity p 872 A89-54868 estimation

A-18

RADIAL FLOW

A multi-objective optimum design method for radial-axial flow turbine with the optimum criteria of blade twist at outlet of blades p 838 A89-52306 RADIATION SHIELDING

Glazing into the future --- shielding coatings for military p 832 A89-52525 cockpit canopies RADIO ANTENNAS

Out-of-band response of VHF/UHF airborne antennae p 830 A89-53484 RADIO CONTROL

Flight test method development for a quarter-scale aircraft with minimum instrumentation p 835 N89-29337 (AD-A2078961

RADIO FREQUENCY INTERFERENCE Out-of-band response of VHF/UHF airborne antennae

p 830 A89-53484 **RADIO NAVIGATION**

- The Locstar radiodetermination satellite system
- p 830 A89-53660 RADIO TRANSMITTERS
- Out-of-band response of VHF/UHF airborne antennae p 830 A89-53484 RAIN
- Airborne rain mapping radar p 837 A89-53313 RAMJET ENGINES
- Plasma torch igniter for scramjets p 858 A89-53355 REACTION KINETICS
- Hypersonic vehicle environment simulation, phase 1 p 864 N89-28754 [AD-A209030]

REAL TIME OPERATION A real-time expert system for self-repairing flight

control [AIAA PAPER 89-3427] p 843 A89-52528

Piloted simulation of a ground-based time-control concept for air traffic control p 829 A89-52700 [AIAA PAPER 89-3625]

A real-time guidance algorithm for aerospace plane p 855 A89-54085 optimal ascent to low earth orbit A real time microcomputer implementation of sensor failure detection for turbofan engines

[NASA-TM-102327] p 876 N89-29032 REATTACHED FLOW

Analysis of reattachment during ramp down tests --helicopter blade upper surface flow in dynamic stall p 816 A89-52043 conditions RECONNAISSANCE AIRCRAFT

High altitude reconnaissance aircraft design NAA PAPER 89-2109] p 833 A89-54200 [AIAA PAPER 89-2109] RECTANGULAR PLANFORMS

Some effects of aerodynamic spoilers on wing flutter [NASA-TM-101632] p 825 N89-29324

REDUCED ORDER FILTERS

Synthesis of a helicopter full authority controller [AIAA PAPER 89-3448] p 843 A89-52547 Algebraic loop transfer recovery - An application to the design of a helicopter output feedback control law

[AIAA PAPER 89-3579] p 849 A89-52662 REDUNDANT COMPONENTS

An experimental optical coupling device for an airborne digital redundant system p 835 N89-28514

[NAL-TR-1003] REGRESSION ANALYSIS

Very short-range aerodrome forecasts using regression chniques p 870 A89-54831 techniques

RELIABILITY Composite material repair and reliability

p 859 N89-28574 [AD-A209150] RELIABILITY ANALYSIS

Computerized life and reliability modeling for turboprop p 863 A89-53364 transmissions RELIABILITY ENGINEERING

- An experimental optical coupling device for an airborne
- digital redundant system [NAL-TR-1003] p 835 N89-28514
- REMOTE SENSING Remote detection of aircraft icing hazards by Dopple p 826 A89-54805 radar
- Aircraft icing conditions detected by combined remote p 827 A89-54807 sensors - A preliminary study REMOTELY PILOTED VEHICLES

QFT digital controller for an unmanned research vehicle (URV) p 853 A89-54080 The Advanced Aeronautic Design Program - Designing p 834 A89-54370 for the future

Flight test method development for a guarter-scale ircraft with minimum instrumentation p 835 N89-29337

[AD-A207896] A study of an advanced variable cycle diesel as applied to an RPV: Evaluation of an RPV variable cycle diesel

[AD-A207754] p 842 N89-29347 RESEARCH AIRCRAFT Design of integrated autopilot/autothrottle for NASA TSRV airplane using integral LQG methodology --transport systems research vehicle [AIAA PAPER 89-3595]

p 849 A89-52674 NAL's research for hypersonic flight

p 856 A89-54331 Flight systems design issues for a research-oriented

hypersonic vehicle p 853 A89-54371

An overview of the national program to improve aircraft p 872 A89-54862 icing forecasts

RESEARCH AND DEVELOPMENT Rotorcraft research and technology advances at MBB

- [MBB-UD-0537-88-PUB] p 815 A89-53334 Forces for change and the future of hypersonic flight in the 21st century p 856 A89-54327
- Perspective on Japanese Space Plane research and development p 856 A89-54332
- Activities report in aerospace research in Germany, FR [ISSN-0070-39661 p 815 N89-28485

RESEARCH FACILITIES

CSM research: Methods and application studies p 867 N89-29794

RESIN BONDING

High temperature adhesive systems [AD-A209166] p 860 N89-28643 RETRACTABLE EQUIPMENT

Design, fabrication, and testing of a composite main landing gear retracting beam [SME PAPER EM88-551] p 834 A89-54901

REYNOLDS NUMBER

High-resolution liquid-crystal heat-transfer measurements on the endwall of a turbine passage with p 862 A89-53289

variations in Reynolds number RHEOLOGY

repair of aircraft canopies

[AIAA PAPER 89-3457]

[AIAA PAPER 89-3492]

[AIAA PAPER 89-3505]

the Ctrl-C design package [AIAA PAPER 89-3607]

and stability robustness

[AIAA PAPEB 89-3558]

ROCKET FLIGHT

and on the blades [IW-R515]

ROLLING CONTACT LOADS

ROTARY WING AIRCRAFT

[AIAA PAPER 89-3500]

layers of an oscillating airfoil

1989, Proceedings

[AD-A208968]

RODS

contact

flow

systems

ROBUSTNESS (MATHEMATICS)

Determining cure cycles for thermosetting epoxy

[SME PAPER EM88-533] p 864 A89-54890 RIGIC STRUCTURES

On optimal rigid body motions [AIAA PAPER 89-3616] p 850 A89-52694 RING LASERS

Update 89 - Additional results with the multifunction RLG

[AIAA PAPER 89-3583] p 837 A89-52716 Performance test results of a multi-function fault-tolerant RLG system

[AIAA PAPER 89-3584] p 837 A89-52717 ROBOTS An optimal material removal strategy for automated

A surrogate system approach to robust control design

Application of stochastic robustness to aircraft control

Robust control system design with multiple model

Robust eigenstructure assignment for flight control using

On the control of elastic vehicles - Model simplification

Investigations in the history and theory of the

The angles of the Kolibrie rotor tipvanes on the rods

Estimate of surface temperatures during rolling

Prediction of inplane damping from deterministic and

AHS National Specialists' Meeting on the Rotary Wing

Transition and turbulence structure in the boundary

Aircraft Conceptual Design Process, Atlanta, GA, Apr. 3-5,

stochastic models --- rotor blade stability in turbulent

Passive navigation using image irradiance tracking

development of aviation and rocket and space science

and technology, No. 6 --- Russian book

approach and its application to active flutter control [AIAA PAPER 89-3578] p 849 A89-52661

Linear quadratic Gaussian design fo performance of a highly maneuverable aircraft

p 874 A89-53416

p 844 A89-52555

p 873 A89-52585

p 846 A89-52598

p 850 A89-52685

p 873 A89-52715

p 879 A89-52923

p 822 N89-28499

p 864 A89-54981

p 832 A89-52042

p 828 A89-52592

p 815 A89-52950

p 824 N89-29317

design for robust

Incorporation of vortex line and vortex ring hover wake models into a comprehensive rotorcraft analysis code [AD-A208036] p 835 N89-29338 ROTARY WINGS

A coupled rotor aeroelastic analysis utilizing nonlinear aerodynamics and refined wake modeling p 831 A89-52041

Finite element based modal analysis of helicopter rotor blades p 832 A89-52044 Correlation of Puma airloads: Evaluation of CFD prediction methods

[NASA-TM-102226] p 822 N89-28498 Noise produced by turbulent flow into a rotor: Users manual for noise calculation

 [NASA-CR-181790]
 p 876
 N89-29152

 Incorporation of vortex line and vortex ring hover wake
 models into a comprehensive rotorcraft analysis code

 [AD-A208036]
 p 835
 N89-29338

ROTOR AERODYNAMICS

A coupled rotor aeroelastic analysis utilizing nonlinear aerodynamics and refined wake modeling p 831 A89-52041

An investigation on stagnation pressure errors due to rotation state behind a rotor p 839 A89-52315

Time periodic control of a multi-blade helicopter [AIAA PAPER 89-3449] p 843 A89-52548 The angles of the Kolibrie rotor tipvanes on the rods and on the blades

[IW-R515] p 822 N89-28499 Incorporation of vortex line and vortex ring hover wake models into a comprehensive rotorcraft analysis code

[AD-A208036] p 835 N89-29338 Identification of an adequate model for collective response dynamics of a Sea King helicopter in hover (AD-A208060] p 836 N89-29341

ROTOR BLADES

- Prediction of inplane damping from deterministic and stochastic models --- rotor blade stability in turbulent flow p 832 A89-52042 Computation of the detached shock shape in a
- Computation of the detached shock shape in a supersonic or transonic cascade p 816 A89-52307 An investigation on stagnation pressure errors due to
- rotation state behind a rotor p 839 A89-52315 Computerised design of blade elements in
- turbomachines p 840 A89-52991 The angles of the Kolibrie rotor tipvanes on the rods and on the blades

[IW-R515] p 822 N89-28499 Statistics on aircraft gas turbine engine rotor failures that occurred in US commercial aviation during 1984

[NAPC-PE-185] p 841 N89-28516 Statistics on aircraft gas turbine engine rotor failures that occurred in US commercial aviation during 1985 [NAPC-PE-188] p 841 N89-28517

[NAPC-PE-188]

Injection moulded ceramic rotors - Comparison of SiC and Si3N4 p 858 A89-53658

EUROFAR - Project for a perpendicularly launched cruising aircraft

[MBB-UD-538-88-PUB] p 833 A89-53308 Rotorcraft research and technology advances at MBB [MBB-UD-0537-88-PUB] p 815 A89-53334

Rotorcraft deceleration to hover using image-based guidance p 830 A89-54082 ROTORS

Statistics on aircraft gas turbine engine rotor failures that occurred in US commercial aviation during 1984 [NAPC-PE-185] p 841 N89-28516 Statistics on aircraft gas turbine engine rotor failures

that occurred in US commercial aviation during 1985 [NAPC-PE-188] p 841 N89-28517

Turbomachinery rotor support with damping [NASA-CASE-MFS-28345-1] p 865 N89-28841 Noise produced by turbulent flow into a rotor: Users manual for atmospheric turbulence prediction and mean

flow and turbulence contraction prediction [NASA-CR-181791] p 876 N89-29154 RUNWAY CONDITIONS

Observations and forecasts for runway (pavement) surfaces p 826 A89-54802 Verification of aerodrome forecasts

p 870 A89-54824 Very short-range aerodrome forecasts using regression techniques p 870 A89-54831 RUNWAYS

Joint sealants for airport pavements. Phase 1: Laboratory and field investigations [DOT/FAA/DS-89/2-PHASE-1] p 854 N89-28523 S

SAFETY DEVICES

Evaluation of a takeoff performance monitoring system display p 837 A89-51704

SATELLITE GROUND SUPPORT The Locstar radiodetermination satellile system p 830 A89-53660

SATELLITE NETWORKS

The Locstar radiodetermination satellite system p 830 A89-53660 SATELLITE SOUNDING

Dallas microburst storm environmental conditions determined from satellite soundings p 868 A89-54779 SCALE MODELS

Small scale model tests in small wind and water tunnels at high incidence and pitch rates. Volume 1: Test program and discussion of results

[AD-A208647] p 521 N89-28488 SEALERS

Joint sealants for airport pavements. Phase 1: Laboratory and field investigations

[DOT/FAA/DS-89/2-PHASE-1] p 854 N89-28523 SEALS (STOPPERS)

- Tribological properties of alumina-boria-silicate fabric from 25 C to 850 C p 859 A89-54982
- Turbomachinery rotor support with damping [NASA-CASE-MFS-28345-1] p 865 N89-28841
- SEAMS (JOINTS) Joint sealants for airport pavements. Phase 1:
- Laboratory and field investigations [DOT/FAA/DS-89/2-PHASE-1] p 854 N89-28523

SECONDARY FLOW

Secondary flow control and loss reduction in a turbine cascade using endwall fences p 816 A89-51679 SELF REPAIRING DEVICES

A real-time expert system for self-repairing flight control

[AIAA PAPER 89-3427] p 843 A89-52528

SEMISPAN MODELS

Flutter calculations for a model wing using the MSC NASTRAN structural analysis program [AD-A209244] p 824 N89-29318

SENSORS Integration of active and passive sensors for obstacle avoidance p 830 A89-54083

SEPARATED FLOW Analysis of incompressible massively separated viscous

- flow using unsteady Navier-Stokes equations p 818 A89-52485
- Separated flow past three-dimensional bodies as a singular perturbation problem p 861 A89-52507 Evolution of axisymmetric wakes from attached and
- separated flows p 818 A89-52945 Separated flow past a concave conical wing of large transverse curvature at small angles of attack
- p 820 A89-54619 Analysis of leading edge separation using a low order panel method
- [NASA-CR-185892] p 822 N89-28493 Transition and turbulence structure in the boundary
- layers of an oscillating airfoil [AD-A208968] 0.824 N89-29317

Use of high-resolution upwind scheme for vortical flow simulations

- [NASA-CR-185910] p 824 N89-29321 Control of separated flow past a cylinder using tangential
- wall jet blowing [NASA-CR-185918] p 825 N89-29326 SERVICE LIFE
- Probabilistic methods for estimating the remaining life of structural elements of operating aircraft gas turbine engines p 839 A89-52832 Intermetallic and ceramic matrix composites for 815 to
- 1370 C (1500 to 2500 F) gas turbine engine applications [NASA-TM-102326] F 860 N89-29490
- SERVOCONTROL
- Sensitivity derivatives of flutter characteristics and stability margins for aeroservoelastic design [AIAA PAPER 89-3467] p 845 A89-52562

[AIAA PAPER 89-3467] p 845 A69-52562 SH-3 HELICOPTER

- A user's manual for the ARL mathematical model of the Sea King Mk-50 helicopter. Part 1: Basic use [AD-A208058] p 835 N89-29339
- A user's manual for the ARL mathematical model of the Sea King Mk-50 helicopter. Parl 2: Use with ARL flight data

[AD-A208059] p 836 N89-29340 Identification of an adequate model for collective response dynamics of a Sea King helicopter in hover [AD-A208060] p 836 N89-29341 SHFAE FLOW

Turbulent shear flows 6; International Symposium, 6th, Universite de Toulouse III, France, Sept. 7-9, 1987, Selected Papers p 861 A89-52943

SPACECRAFT CONSTRUCTION MATERIALS

Combustion-related shear-flow dynamics in elliptic supersonic jets p 819 A89-53930 SHOCK TUNNELS

- Australian hypersonic facilities p 854 A89-54349 SHOCK WAVE INTERACTION
- Symbolic eigenvalue analysis for adaptive stepsize control in PNS shock stabilization p 816 A89-51756 Prediction of secondary separation in shock wave
- boundary-layer interactions p 816 A89-51760 SHOCK WAVES
- On TVD difference schemes for the three-dimensional Euler equations in general co-ordinates
 - p 817 A89-52484 Study on boundary layer of hypersonic inlets
- p 820 A89-54129 SHORT TAKEOFF AIRCRAFT
- AT3 demonstrates feasibility of cargo STOL with long range p 832 A89-52201
- SILICATES
- Denormalized product of the adsorptive zeolite extraction of paraffins as a jet fuel component p 857 A89-52775
- SILICON CARBIDES Injection moulded ceramic rotors - Comparison of SiC
- and Si3N4 p 858 A89-53658 SILICON NITRIDES
- Injection moulded ceramic rotors Comparison of SiC and Si3N4 p 858 A89-53658 SIMULATION
- Nonlinear control of a supermaneuverable aircraft [AIAA PAPER 89-3486] p 845 A89-52579
- Aircraft propeller induced structure-borne noise [NASA-CR-4255] p 876 N89-29155 SIMULATORS
- Computational structural mechanics engine structures computational simulator p 866 N89-29792 Interfacing modules for integrating discipline specific
- structural mechanics codes p 866 N89-29793 SINGLE STAGE TO ORBIT VEHICLES Propulsion cycles for transitioner boris coolectors

Propulsion cycles for transatmospheric accelerators p 840 A89-54328 SISO (CONTROL SYSTEMS)

- On the design of nonlinear controllers for flight control systems [AIAA PAPER 89-3489] p 845 A89-52582
- SKIN (STRUCTURAL MEMBER) Sensitive skins p 837 A89-52974
- SLENDER BODIES Transonic flows with vorticity transport around slender

bodies p 820 A89-53949
SLENDER WINGS

Numerical simulation of rolling

SOFTWARE TOOLS

SOLID LUBRICANTS

from 25 C to 850 C

SOUND TRANSMISSION

[NASA-CR-4255]

SPACE LAW

SPACE PROGRAMS

SPACE STATIONS

flight

SPACE BASED RADAR

SOLID PROPELLANT COMBUSTION

Airborne rain mapping radar

Sept. 20-23, 1988, Proceedings

SPACE TRANSPORTATION

and technology, No. 6 --- Russian book

SPACE INDUSTRIALIZATION

leading/trailing-edge vortex sheets for slender wings p 819 A89-53926 SNOW

up of

p 836 N89-29345

p 859 A89-54982

p 839 A89-52960

p 876 N89-29155

p 837 A89-53313

p 879 A89-52923

p 878 A89-54356

p 855 A89-54326

p 867 N89-29794

p 855 A89-52973

p 857 A89-52022

A-19

Observations and forecasts for runway (pavement) surfaces p 826 A89-54802

SOFTWARE ENGINEERING Design by functional feature for aircraft structure

Scientific visualization in computational aerodynamics at NASA Ames Research Center p 875 A89-54907

Diagnostic techniques for propulsion systems

Aircraft propeller induced structure-borne noise

Tribological properties of alumina-boria-silicate fabric

Investigations in the history and theory of the

Transnational legal problems for commercial hypersonic

International Conference on Hypersonic Flight in the 21st

Century, 1st, University of North Dakota, Grand Forks,

CSM research: Methods and application studies

Aerospace investment casting in the U.S.A. 1988

Saenger aerospaceplane gains momentum

SPACECRAFT CONSTRUCTION MATERIALS

development of aviation and rocket and space science

SPACECRAFT CONTROL

Aeronautical applications	of	high	-temperature
superconductors		•	
[AIAA PAPER 89-2142]		p 840	A89-53304
SPACECRAFT CONTROL			
AIAA Guidance, Navigation a	nd C	ontrol	Conference,
Boston, MA, Aug. 14-16, 1989,	Tech	nnical P	apers. Parts
1&2		p 842	A89-52526
SPACECRAFT DESIGN			
Aeronautical applications	of	high	temperature
superconductors			
[AIAA PAPER 89-2142]		p 840	A89-53304
SPACECRAFT PROPULSION			
Heat transfer in aerospace pro	pulsi		
			A89-53282
The Trisonic aerospace motor	- Pr		
the 21st century		p 856	A89-54359
SPACECRAFT STABILITY			
Integrated structure/control in	aw d	lesign l	by multilevel
optimization			
[AIAA PAPER 89-3470]		p 873	A89-52564
SPECTRA			
Supersonic jet studies of fluore	ne c	lustered	d with water,
ammonia and piperidine			
[AD-A209562]		p 860	N89-29497
SPECTRAL METHODS			
Pseudo-spectral and asymptotic			
of counter-rotating vortices		p 861	A89-51755
SPECTROSCOPY			
Supersonic jet studies of fluore	ne ci	ustered	i with water,
ammonia and piperidine		- 000	NO0 00 407
[AD-A209562]		p 860	N89-29497
SPEED INDICATORS			device for
Precision characteristics of a			
estimating the velocity of an object SPOILERS		h 930	A09-32779
Some effects of aerodynamic			wing fluttor
[NASA-TM-101632]		p 825	
[NASA-IN-101032]		h 050	1109-29324

STAGNATION PRESSURE An investigation on stagnation pressure errors due to tation state behind a rotor p 839 A89-52315

rotation state behind a rotor STATIC AERODYNAMIC CHARACTERISTICS Transition and turbulence structure in the boundary

layers of an oscillating airfoil [AD-A208968] p 824 N89-29317

STATIC TESTS Low-speed static and dynamic force tests of a generic supersonic cruise fighter configuration

- p 821 N89-28486 [NASA-TM-4138] STATISTICAL ANALYSIS
- Statistics on aircraft gas turbine engine rotor failures that occurred in US commercial aviation during 1984 p 841 N89-28516 [NAPC-PE-185] Statistics on aircraft gas turbine engine rotor failures that occurred in US commercial aviation during 1985 p 841 N89-28517 [NAPC-PE-188] STATISTICAL TESTS
- A proposed composite repair methodology for primar structure p 858 A89-54429 STATISTICAL WEATHER FORECASTING
- Aircraft icing hazards forecasting and synoptic p 827 A89-54821 classification Verification of aerodrome forecasts
- p 870 A89-54824 Very short-range aerodrome forecasts using regression p 870 techniques A89-54831 STATOR BLADES

Computerised design of blade elements in p 840 A89-52991 turbomachines STATORS

Turbomachinery rotor support with damping [NASA-CASE-MFS-28345-1] p 865 p 865 N89-28841

- STOCHASTIC PROCESSES Prediction of inplane damping from deterministic and stochastic models --- rotor blade stability in turbulent flow p 832 A89-52042 Application of stochastic robustness to aircraft control
- systems [AIAA PAPER 89-3505] p 846 A89-52598
- STORAGE TANKS
- Conceptual design tools for internal tankage of the p 834 A89-54338 hypersonic transport STORMS (METEOROLOGY)
- Dallas microburst storm environmental conditions determined from satellite soundings p 868 A89-54779 STRAKES
- Use of high-resolution upwind scheme for vortical flow simulations p 824 N89-29321 [NASA-CR-185910]
- STRAPDOWN INERTIAL GUIDANCE
- Wideband linear quadratic Gaussian strapdown dry tuned gyro/accelerometers control of [AIAA PAPER 89-3441] p 837 A89-52540
- Development and flight evaluation of an integrated GPS/INS navigation system p 828 A89-52590
- [AIAA PAPER 89-3498]

- STRESS ANALYSIS
 - Thermal stress analysis of the NASA Dryden hypersonic wing test structure p 856 A89-54340 STRESS CONCENTRATION
 - Stresses and strains in a cold-worked annulus
 - [AR-005-548] p 866 N89-28871 STRESS-STRAIN RELATIONSHIPS
 - A study of the stress-strain state of connections in an orthotropic material p 864 A89-54585 STRESSES
 - Stresses and strains in a cold-worked annulus p 866 N89-28871 [AR-005-548]
 - STRUCTURAL ANALYSIS Current research in composite structures at NASA's
 - Langley Research Center p 861 A89-51692 Flutter calculations for a model wing using the MSC NASTRAN structural analysis program
 - p 824 N89-29318 [AD-A209244] Thermo-viscoplastic analysis of hypersonic structures
 - subjected to severe aerodynamic heating p 825 N89-29328 [NASA-CR-185915] NASA Workshop on Computational Structural
 - Mechanics 1987, part 2 [NASA-CP-10012-PT-2] p 866 N89-29789
 - CSM research: Methods and application studies p 867 N89-29794 Boundary elements for structural analysis
 - p 867 N89-29800 The 3-D inelastic analyses for computational structural N89-29804 p 867
 - STRUCTURAL DESIGN
 - Ultra high bypass aircraft sonic fatigue
 - p 831 A89-51898 Integrated structure/control law design by multilevel optimization
 - p 873 A89-52564 [AIAA PAPER 89-3470] Overview of buckling in aircraft design
 - p 834 A89-54462 Application of modern optimization tools for the design aircraft structures p 834 A89-54471 of aircraft structures
 - STRUCTURAL ENGINEERING NASA Workshop on Computational Structural
 - Mechanics 1987, part 2 [NASA-CP-10012-PT-2] p 866 N89-29789
 - Computational structural mechanics engine structures p 866 N89-29792 computational simulator Interfacing modules for integrating discipline specific structural mechanics codes p 866 N89-29793
 - CSM research: Methods and application studies p 867 N89-29794
 - STRUCTURAL FAILURE
 - A proposed composite repair methodology for primary tructure p 858 A89-54429 structure STRUCTURAL RELIABILITY
 - AE monitoring of airframe structure during full scale tigue test p 863 A89-53322 fatique test STRUCTURAL VIBRATION
 - Phenomena and modelling of flow-induced vibrations of bluff bodies p 861 A89-52961
 - Aircraft propeller induced structure-borne noise [NASA-CR-4255] p 876 N85 p 876 N89-29155 STRUCTURAL WEIGHT
 - The importance of weight in a changing cost estimating environment
 - [SAWE PAPER 1854] p 877 A89-52024 SUBCRITICAL FLOW
 - A regular perturbation method for subcritical flow over two-dimensional airfoil p 818 A89-53570 SUBSONIC FLOW
 - Solution of the inverse boundary value problem of aerohydrodynamics with allowance for the boundary Measurements of mean-flow and turbulence layer
 - characteristics in a turbojet exhaust using a laser velocimeter [ISL-CO-226/88] p 841 N89-28519
 - SUCTION Transition flight experiments on a swept wing with p 819 A89-53830 suction
- SUPERCOMPUTERS
- Supercomputer requirements for selected disciplines important to aerospace p 874 A89-53152 SUPERCONDUCTIVITY
- Superconducting Meissner effect bearings for cryogenic turbomachines, phase 1 p 865 N89-28839 [AD-A209875]
- SUPERCOOLING
- Aircraft icing caused by large supercooled droplets p 826 A89-53793 SUPERSONIC AIRCRAFT
- Flight tests for air intake flowfield and engine operating tability p 839 A89-52317 stability
- Supersonic jet studies of fluorene clustered with water, ammonia and piperidine
- [AD A209562] p 860 N89-29497

p 819 A89-53928

p 839 A89-52960

p 863 A89-53353

of

(DFVLR-88-044) p 859 N89-28610 SUPERSONIC COMBUSTION RAMJET ENGINES Mixing augmentation technique for hypervelocity p 840 A89-53351 scramiets Application of compound compressible flow to nonuniformities in hypersonic propulsion systems p 818 A89-53367 Supersonic combustion at the DFVLR: Results and experiences [DFVLR-88-044] p 859 N89-28610 SUPERSONIC CRUISE AIRCRAFT RESEARCH Low-speed static and dynamic force tests of a generic supersonic cruise fighter configuration [NASA-TM-4138] p 821 N89-28486 SUPERSONIC FLIGHT Jet engines for high supersonic flight velocities (2nd revised and enlarged edition) --- Russian book p 841 A89-54884 SUPERSONIC FLOW Symbolic eigenvalue analysis for adaptive stepsize control in PNS shock stabilization p 816 A89-51756 A second-order finite-difference scheme for calculating

Constructing a continuous parameter range

Noncircular jet dynamics in supersonic combustion

Plasma torch igniter for scramjets p 858 A89-53355

Supersonic combustion at the DFVLR: Results and

Diagnostic techniques for propulsion systems

- three-dimensional supersonic flows of an ideal gas p 818 A89-52852 Optimal permeability of wind tunnel walls at low upersonic velocities p 821 A89-54625
- supersonic velocities Use of high-resolution upwind scheme for vortical flow simulations [NASA-CR-185910]
- p 824 N89-29321 SUPERSONIC JET FLOW
- Combustion-related shear-flow dynamics in elliptic p 819 A89-53930 supersonic jets Nozzle geometry effects on supersonic jet interaction
 - p 876 A89-53932
- SUPERSONIC NOZZLES

SUPERSONIC AIRFOILS

computational flows

experiences

SUPERSONIC COMBUSTION

- Construction of general-purpose supersonic nozzles of conical cross section p 821 A89-54624 SUPERSONIC TRANSPORTS
- SST/Concorde Lessons for hypersonic programs p 877 A89-54337
 - The U.S. supersonic transport Three lessons for NASP
- p 878 A89-54354 from history The Orient Express - The emperor's new airplane
- p 878 A89-54357 Results of a preliminary study of two high-speed civil
- p 834 A89-54372 transport design concepts Revolutionary opportunities for materials and structures study, addendum
- [NASA-CR-179642-ADD] p 842 N89-29351
- SUPPORT SYSTEMS Facilities and support requirements for advanced flight p 854 A89-54368 vehicles
- SUPPORTS
- Turbomachinery rotor support with damping VASA-CASE-MFS-28345-1] p 865 N89-28841 [NASA-CASE-MFS-28345-1] SURFACE ROUGHNESS
- An experimental investigation of heat transfer coefficients and friction factors in passages of different aspect ratios roughened with 45 deg turbulators p 862 A89-53274

SURFACE STABILITY

- Recovery of the fatigue strength of structural elements of aluminum alloys by surface hardening
- p 857 A89-52827 SURFACE TEMPERATURE Estimate of surface temperatures during rolling
- p 864 A89-54981 contact SURGES
- on active service p 840 A89-54131
- The detection of low level windshear with airport urveillance radar p 868 A89-54780 surveillance radar
- Weather sensing with airport surveillance radars p 869 A89-54789
- SWEPT FORWARD WINGS
 - Application of stochastic robustness to aircraft control systems
- [AIAA PAPER 89-3505] p 846 A89-52598 SWEPT WINGS
- Transition flight experiments on a swept wing with suction p 819 A89-53830
- Differing development of the velocity profiles of three-dimensional turbulent boundary layers p 819 A89-53947

A-20

- - Research on surge monitoring system of turbojet engine
 - SURVEILLANCE RADAR

Experimental investigation of a three dimensional wake in the vicinity of a wing-body junction p 825 N89-29325 (CERT-0A-29/5025-AYD)

SYMBOLS

- Towards a physiologically based HUD (Head-Up Display) symbology [AD-A207748] p 838 N89-28515
- SYNOPTIC MEASUREMENT
- Aircraft icing hazards forecasting and synoptic classification p 827 A89-54821 SYSTEM EFFECTIVENESS

Operational test plan concept for evaluation of close air support alternative aircraft

p 835 N89-28513 [AD-A208185] SYSTEM FAILURES

Extended observability of linear time-invariant systems under recurrent loss of output data

- [AIAA PAPER 89-3510] p 873 A89-52603 Flight control reconfiguration using model reference adaptive control p 852 A89-53959
- A knowledge based tool for failure propagation p 874 A89-53970 analysis

SYSTEMS INTEGRATION

- Integrated control and avionics for air superiority -Computational aspects of real-time flight management p 837 A89-52559 [AIAA PAPER 89-3463] Integrated flight/propulsion control system design based
- on a centralized approach p 847 A89-52611 [AIAA PAPER 89-3520]

An observer-based compensator for distributed delays in integrated control systems

[AIAA PAPER 89-3541] p 847 A89-52628 Integrated flight/propulsion control system design based

on a decentralized, hierarchical approach [AIAA PAPER 89-3519] p 851 A89-53301 SYSTEMS STABILITY

Application of stochastic robustness to aircraft control systems

p 846 A89-52598 [AIAA PAPER 89-3505] Fixed-sign condition for integral quadratic forms and

stability of systems with distributed parameters p 875 A89-54540

TAKEOFF

Evaluation of a takeoff performance monitoring system p 837 A89-51704 display

Т

- TANDEM ROTOR HELICOPTERS Design, fabrication, and testing of a composite main
- landing gear retracting beam SME PAPER EM88-5511 D 834 A89-54901
- TANDEM WING AIRCRAFT AT3 demonstrates feasibility of cargo STOL with long
- p 832 A89-52201 TECHNOLOGICAL FORECASTING

Visual and sensory aids for helicopters in the year 2000

- p 837 A89-53309 [MBB-UD-541-89-PUB] Forces for change and the future of hypersonic flight
- in the 21st century p 856 A89-5432 HOTOL A European aerospaceplane for the 21s p 856 A89-54327 century p 856 A89-54330
- 'Spaceplanes' and the rise of 'Ultra Tech p 856 A89-54355 The Trisonic aerospace motor - Propulsion vehicle for

p 856 A89-54359 the 21st century TECHNOLOGY ASSESSMENT

Investigations in the history and theory of the development of aviation and rocket and space science and technology, No. 6 --- Russian book p 879 A89-52023

MLS 1989 - Status report from the perspective of the p 830 A89-53663 airline companies Status and development potential of the fly by light

technology in civil aircraft 212] **FILR-MITT** p 854 N89-28522

TEMPERATURE DISTRIBUTION High-resolution liquid-crystal heat-transfer measurements on the endwall of a turbine passage with

p 862 A89-53289 variations in Reynolds number TEMPERATURE MEASUREMENT Diagnostic techniques for propulsion systems

p 839 A89-52960 High-resolution liquid-crystal heat-transfer measurements on the endwall of a turbine passage with variations in Reynolds number p 862 A89-53289 Aerothermodynamic instrumentation

p 866 N89-29310 TERMINAL FACILITIES

Microburst detection from mesonet data p 868 A89-54783

Weather sensing with airport surveillance radars p 869 A89-54789 TERRAIN

- Towards a physiologically based HUD (Head-Up Display) symbology [AD-A207748]
- p 838 N89-28515 TERRAIN ANALYSIS

Rotorcraft deceleration to hover using image-based quidance p 830 A89-54082 TERRAIN FOLLOWING AIRCRAFT

- Self-tuning Generalized Predictive Control applied to terrain following flight
- [AIAA PAPER 89-3450] p 843 A89-52549 Passive navigation using image irradiance tracking p 828 A89-52592 [AIAA PAPER 89-3500]
- TEST FACILITIES
- p 8-54 A89-54349 Australian hypersonic facilities THERMAL ANALYSIS Thermo-viscoplastic analysis of hypersonic structures
- subjected to severe aerodynamic heating p £25 N89-29328 INASA-CR-1859151
- THERMAL CYCLING TESTS Fatigue life of ZhS6U alloy with protective coatings under thermal cycling loading p 857 A89-52830
- THERMAL EMISSION Unsteady heat transfer in turbine blade ducts - Focus
- p 862 A89-53286 on combustor sources THERMAL STABILITY
- Fatigue life of ZhS6U alloy with protective coatings under n 857 A89-52830 thermal cycling loading THERMAL STRESSES
- Thermal stress analysis of the NASA Dryden hype wing test structure p 856 A89-54340 THERMODYNAMIC PROPERTIES
- Jet engines for high supersonic flight velocities (2nd revised and enlarged edition) --- Russian book
- p 841 A89-54884 THERMODYNAMICS
- Computational structural mechanics engine structures p 866 N89-29792 computational simulator
- THERMOGRAPHY Aerothermodynamic instrumentation p 866 N89-29310
- THERMOPLASTIC RESINS
- High-performance fiber composite materials with thermoplastic matrix
- [MBB-Z-0257-89-PUB] p 357 A89-53310 Interlaminar fracture toughness and toughening of
- laminated composite materials A review p 358 A89-54426
- THERMOSETTING RESINS Determining cure cycles for thermosetting epoxy
- resins [SME PAPER EM88-533] p 864 A89-54890
- THIN AIRFOILS
 - Thin aerofoil with multiple slotted flap
- p 816 A89-51625 Unsteady vortical disturbances around a thin airfoil in
- the presence of a wall p 819 A89-53944 Theory for separated flow around the trailing edge of p 820 A89-54614 a thin profile
- THIN WINGS
- A three-dimensional boundary layer in finite-span thin p 818 A89-52843 wings
- Comparison of flow-visualised vortices with computed cometry over thin delta wings [AD-A209083] p 821 N89-28489
- THREE DIMENSIONAL BODIES
- Separated flow past three-dimensional bodies as a p 861 A89-52507 singular perturbation problem
- THREE DIMENSIONAL BOUNDARY LAYER A three-dimensional boundary layer in finite-span thin
- p 818 A89-52843 wings Differing development of the velocity profiles of three-dimensional turbulent boundary layers
- p 819 A89-53947 THREE DIMENSIONAL FLOW
- On TVD difference schemes for the three-dimensional Euler equations in general co-ordinates p 817 A89-52484
- A second-order finite-difference scheme for calculating three-dimensional supersonic flows of an ideal gas
- p 818 A89-52852 Noncircular jet dynamics in supersonic combustion
- p 863 A89-53353 Euler correction method for two- and three-dimensional
- p 819 A89-53934 transonic flows Study of the wing-vortex interaction in three dimensional
- flows (incompressible inviscid flow) [ISL-R-123/87] p 822 N89-28494 THROTTLING
- Design of integrated autopilot/autothrottle for NASA TSRV airplane using integral LQG methodology ---transport systems research vehicle
 - [AIAA PAPER 89-3595] p 849 A89-52674

TRAJECTORY OPTIMIZATION

THRUST AUGMENTATION

- Aerodynamic model tests of exhaust augmentors for F/A-18 engine run-up facility at RAAF Williamtown [AD-A208110] p 841 N89-28518
- THRUST VECTOR CONTROL Comparison of Characteristic Locus and h-infinity
- methods in VSTOL flight control system design p 846 A89-52584 [AIAA PAPER 89-3491]
- Thrust vectoring effect on time-optimal 90 degrees angle of attack pitch up maneuvers of a high alpha fighter aircraft
- [AIAA PAPER 89-3521] p 847 A89-52612 THUNDERSTORMS
 - LDIS (Lightning Data and Information Systems) A new resource for aviation meteorology p 869 A89-54801 A case study of local severe weather at Chang Kai Shek
- p 871 Å89-54846 International Airport TILT BOTOR AIRCRAFT
- Evaluation methods for complex flight control systems [AIAA PAPER 89-3502] p 846 A89-52595 EUROFAR - Project for a perpendicularly launched
- cruising aircraft [MBB-UD-538-88-PUB] p 833 A89-53308
- TIME OPTIMAL CONTROL
 - Time periodic control of a multi-blade helicopter
 - p 843 A89-52548 [AIAA PAPER 89-3449] Thrust vectoring effect on time-optimal 90 degrees angle of attack pitch up maneuvers of a high alpha fighter aircraft
 - (AIAA PAPER 89-3521) p 847 A89-52612 Thrust laws for microburst wind shear penetration p 848 A89-52645 [AIAA PAPER 89-3560] p 848 A89-52645 Singular trajectories for time-optimal half-loop

Maximum principle solutions for time-optimal half-loop

The angles of the Kolibrie rotor tipvanes on the rods

Fatigue life of dovetail joints - Verification of a simple

Fixed-sign condition for integral quadratic forms and

Design of tunable digital set-point tracking PID

Acoustical tracking of fast maneuvering aircraft by

Surface failure detection and evaluation of control law

Wind tunnel tests of 16 percent thick airfoil with 30

of

Theory for separated flow around the trailing edge of thin profile p 820 A89-54614

Wake dissipation and total pressure loss in

two-dimensional compressor cascade with crenulated

Aircraft trajectory prediction for terminal automation

Numerical simulation of microbursts - Aircraft trajectory

Self-tuning Generalized Predictive Control applied to

Thrust laws for microburst wind shear penetration

for

euvers of a high alpha fighter aircraft

Aircraft trajectory generation: A literature review

percent trailing edge flap at high angles of attack and

rs for gas turbines with unmeasurable outputs

stability of systems with distributed parameters

for reconfiguration of flight control system

simulation

leading/trailing-edge vortex sheets for slender wings

p 850 A89-52692

p 853 A89-54081

p 822 N89-28499

p 863 A89-54119

p 875 A89-54540

p 839 A89-52660

p 877 N89-29156

p 847 A89-52602

p 823 N89-28500

p 819 A89-53926

p 864 N89-28755

p 829 A89-52703

p 869 A89-54788

p 835 N89-29335

p 843 A89-52549

p 831 A89-51703

p 848 A89-52645

p 848 A89-52646

p 850 A89-52692

half-loop

A-21

time-optimal

rolling

maneuvers of a high alpha fighter aircraft

maneuvers of a high alpha fighter aircraft

[AIAA PAPER 89-3614]

and on the blades

TORSIONAL VIBRATION

TRACKING (POSITION)

distributed sensors

TRACKING PROBLEM

(REPT-6-88)

[AIAA PAPER 89-3577]

[AIAA PAPER 89-3509]

TRAILING EDGE FLAPS

with flap angles

TRAILING EDGES

Numerical

a thin profile

trailing edges

studies

AD-A2091761

[AR-005-609]

TRAJECTORY ANALYSIS

[AIAA PAPER 89-3634]

TRAJECTORY CONTROL

terrain following flight

AIAA PAPER 89-34501

[AIAA PAPER 89-3560]

[AIAA PAPER 89-3561]

[AIAA PAPER 89-3614]

Singular trajectories

TRAJECTORY OPTIMIZATION

Study of aircraft cruise

Optimal paths through downbursts

[FFA-TN-1985-58]

TITANIUM ALLOYS

biaxial model

TIP VANES

[IW-R515]

TRANSATMOSPHERIC VEHICLES

Parallel dynamic programming for on-line flight path optimization [AIAA PAPER 89-3615] p 832 A89-52693

- On optimal rigid body motions [AIAA PAPER 89-3616] p 850 A89-52694
- Optimal trajectory generation and design trades for hypersonic vehicles p 855 A89-54009 A real-time guidance algorithm for aerospace plane
- optimal ascent to low earth orbit p 855 A89-54085 Aircraft trajectory generation: A literature review

[AR-005-609] p 835 N89-29335 TRANSATMOSPHERIC VEHICLES

International Conference on Hypersonic Flight in the 21st Century, 1st, University of North Dakota, Grand Forks, Sept. 20-23, 1988, Proceedings p 855 A89-54326 Propulsion cycles for transatmospheric accelerators

p 840 A89-54328 Hypersonic flight - Future commercial potential p 878 A89-54353

TRANSFER FUNCTIONS

Design of localizer capture and track modes for a lateral autopilot using H(infinity) synthesis p 852 A89-53977 TRANSIENT RESPONSE

A modified least squares estimator for gas turbine identification

[AD-A207911] p 842 N89-29348 TRANSITION FLOW

Forces for change and the future of hypersonic flight in the 21st century p 856 A89-54327 TRANSMISSIONS (MACHINE ELEMENTS)

Computerized life and reliability modeling for turboprop transmissions p 863 A89-53364 TRANSOCEANIC FLIGHT

Hypersonic flight and world tourism

- p 878 A89-54352 TRANSONIC COMPRESSORS
- Computation of the detached shock shape in a supersonic or transonic cascade p 816 A89-52307 TRANSONIC FLOW
- Application of upwind factor method to transonic cascade calculation p 817 A89-52309 Euler correction method for two- and three-dimensional
- Euler correction method for two- and three-dimensional transonic flows p 819 A89-53934 Transonic flows with vorticity transport around slender
- bodies p 820 A89-53949 Calculation of transport flow past the tail section of a
- Calculation of transonic flow past the tail section of a plane or axisymmetric body p 820 A89-54535 A detailed survey of the flow passing through an asymmetric contraction and parallel duct
- [BAE-WWT-RP-RES-AXR-000194-] p 823 N89-28501 A detailed survey of the flow passing through an
- asymmetric contraction and parallel duct [BAE-WWT-RP-RES-AXR-000194-] p 823 N89-28502 TRANSONIC FLUTTER
- A multiloop, digital flutter suppression control law synthesis case study
- [AIAA PAPER 89-3556] p 848 A89-52642 Some computations of unsteady Navier-Stokes flow around oscillating airfoil/wing
- [NAL-TR-1004T] p 822 N89-28492 TRANSONIC SPEED
- Boundary-layer measurements on a transonic low-aspect ratio wing [NASA-TM-88214] p 823 N89-29305
- TRANSONIC WIND TUNNELS
- A detailed survey of the flow passing through an asymmetric contraction and parallel duct [BAE-WWT-RP-RES-AXR-000194-] p 823 N89-28501

A detailed survey of the flow passing through an asymmetric contraction and parallel duct [BAE-WWT-RP-RES-AXR-000194-] p 823 N89-28502

- [BAE-WWT-RP-RES-AXR-000194-] p 823 N89-28502 TRANSPARENCE
- Specifications and measurement procedures and aircraft transparencies [AD-A209396] p 834 N89-28511

[AD-A209396] TRANSPORT AIRCRAF

A-22

RANSPORT AIRCRAFT		
Study of aircraft cruise	p 831	A89-51703

Ultra high bypass	aircraft	sonic	fatigue	
			p 831	A89-51898

Are the Soviets set to make the big time? p 825 A89-52513

Design of integrated autopilot/autothrottle for NASA TSRV airplane using integral LQG methodology --transport systems research vehicle

- [AIAA PAPER 89-3595]
 p 849
 A89-52674

 EUROFAR Project for a perpendicularly launched cruising aircraft
 [MBB-UD-538-88-PUB]
 p 833
 A89-53308
- Lateral axis autopilot design for large transport aircraft - An explicit model-matching approach
- p 852 A89-53976 A multivariable control design for the lateral axis autopilot of a transport aircraft p 852 A89-53980 Conceptual design tools for internal tankage of the
- hypersonic transport p 834 A89-54338

TRANSPORT PROPERTIES

Hypersonic vehicle environment simulation, phase 1 [AD-A209030] p 864 N89-28754 TRANSPORT THEORY

- Transonic flows with vorticity transport around slender bodies p 820 A89-53949 TRIBOLOGY
- Estimate of surface temperatures during rolling contact p 864 A89-54981 Tribological properties of alumina-boria-silicate fabric
- from 25 C to 850 C p 859 A89-54982 TROPOSPHERE
- A 3-hour mesoscale assimilation system using ACARS aircraft data combined with other observations --aeronautical radio communications addressing and reporting system p 869 A89-54797 **TRUSSES**
- Integrated structure/control law design by multilevel optimization
- [AIAA PAPER 89-3470] p 873 A89-52564 TUPOLEV AIRCRAFT
- Are the Soviets set to make the big time? p 825 A89-52513
- TURBINE BLADES Secondary flow control and loss reduction in a turbine
- cascade using endwall fences p 816 A89-51679 A multi-objective optimum design method for a radial-axial flow turbine with the optimum criteria of blade
- twist at outlet of blades p 838 A89-52306 The development of advanced computational methods for turbomachinery blade design p 839 A89-52482
- Computerised design of blade elements in turbomachines p 840 A89-52991
- Unsteady heat transfer in turbine blade ducts Focus on combustor sources p 862 A89-53286 Fatigue life of dovetail joints - Verification of a simple
- biaxial model p 863 A89-54119 Comparative durability of six coating systems on first-stage gas turbine blades in the engines of a long-range
- maritime patrol aircraft p 858 A89-54255 Three-dimensional airfoil performance measurements on a rotating wing
- (DE89-009443) p 821 N89-28487 Interfacing modules for integrating discipline specific structural mechanics codes p 866 N89-29793
- TURBINE ENGINES Microcomputer simulation of lubricant degradation in
- turbine engines using laboratory data p 859 A89-54986
- TURBINES Superconducting Meissner effect bearings for cryogenic
- turbomachines, phase 1 [AD-A209875] p 865 N89-28839
- TURBOCOMPRESSORS
- Active control of inlet distorted flow field in compressor inlet p 817 A89-52316 Calculations of inlet distortion induced compressor flow field instability p 818 A89-52498
- TURBOFAN ENGINES CFD in the context of IHPTET - The Integrated High
- Performance Turbine Engine Technology Program [AIAA PAPER 89-2904] p 862 A89-53307 Turbofan engine control system design using the
- LQG/LTR methodology p 840 A89-53956 Aerodynamic model tests of exhaust augmentors for
- F/A-18 engine run-up facility at RAAF Williamtown [AD-A208110] p 841 N89-28518 A real time microcomputer implementation of sensor
- failure detection for turbofan engines [NASA-TM-102327] p 876 N89-29032
- TURBOJET ENGINE CONTROL
- Turbofan engine control system design using the LQG/LTR methodology p 840 A89-53956 A real time microcomputer implementation of sensor failure detection for turbofan engines
- [NASA-TM-102327] p 876 N89-29032 TURBOJET ENGINES
- Experience with implementation of a turbojet engine control program on a multiprocessor
- p 875 A89-54106 Research on surge monitoring system of turbojet engine on active service p 840 A89-54131
- The 3-D inelastic analyses for computational structural mechanics p 867 N89-29804 TURBOMACHINE BLADES
- The development of advanced computational methods for turbomachinery blade design p 839 A89-52482 TURBOMACHINERY
- Computerised design of blade elements in turbomachines p 840 A89-52991 Superconducting Meissner effect bearings for cryogenic
- turbomachines, phase 1 [AD-A209875] p 865 N89-28839 TURBOPROP ENGINES
- Computerized life and reliability modeling for turboprop transmissions p 863 A89-53364

TURBULENCE

Measurements of mean-flow and turbulence characteristics in a turbojet exhaust using a laser velocimeter [ISL-CO-226/88] p 841 N89-28519

SUBJECT INDEX

- TURBULENCE EFFECTS
- Prediction of inplane damping from deterministic and stochastic models --- rotor blade stability in turbulent flow p 832 A89-52042
- TURBULENCE MODELS

Turbulence modeling in a hypersonic inlet

- Noise produced by turbulent flow into a rotor: Users manual for noise calculation
- [NASA-CR-181790] p 876 N89-29152 TURBULENT BOUNDARY LAYER
- Prediction of secondary separation in shock wave boundary-layer interactions p 816 A89-51760 Differing development of the velocity profiles of
- three-dimensional turbulent boundary layers p 819 A89-53947 Transition and turbulence structure in the boundary
- layers of an oscillating airfoil [AD-A208968] p 824 N89-29317
- TURBULENT FLOW
- Turbulent reactive flows
 p
 857
 A89-51860

 Turbulent shear flows 6; International Symposium, 6th,
 Universite de Toulouse III, France, Sept. 7-9, 1987,
 Selected Papers
 p
 861
 A89-52943

 Turbulence modeling in a hypersonic inlet
 Selected
 Selected
- p 819 A89-53931 Representation and display of vector field topology in
- fluid flow data sets p 875 A89-54904 Noise produced by turbulent flow into a rotor: Users manual for noise calculation
- [NASA-CR-181790] p 876 N89-29152 Noise produced by turbulent flow into a rotor: Users
- manual for atmospheric turbulence prediction and mean flow and turbulence contraction prediction [NASA-CR-181791] p 876 N89-29154
- TURBULENT HEAT TRANSFER An experimental investigation of heat transfer
- coefficients and friction factors in passages of different aspect ratios roughened with 45 deg turbulators p 862 A89-53274
- TURBULENT MIXING

separated flows

of bluff bodies

Mixing augmentation technique for hypervelocity scramjets p 840 A89-53351 **TURBULENT WAKES** Evolution of axisymmetric wakes from attached and

Phenomena and modelling of flow-induced vibrations

Experimental investigation of a three dimensional wake

Solution for two-dimensional inviscid transonic cascade

A regular perturbation method for subcritical flow over

Euler correction method for two- and three-dimensional

Wake dissipation and total pressure loss in a

Finite element analysis of incompressible viscous flows

A study of the sensitivity of stratospheric ozone to

U

Out-of-band response of VHE/UHE airborne antennae

Ultrasonic evaluation of matrix cracking in graphite

Theoretical study on the unsteady aerodynamic characteristics of an oscillating cascade with tip clearance

Numerical simulation and hydrodynamic visualization of transient viscous flow around an oscillating aerofoil p 817 A89-52481

around single and multi-element aerofoils in high Reynolds

two-dimensional compressor cascade with crenulated

in the vicinity of a wing-body junction

flows with multiple-grid algorithm

[CERT-0A-29/5025-AYD]

TWO DIMENSIONAL FLOW

a two-dimensional airfoil

Profile-vortex interactions

transonic flows

[ISL-R-125/87]

trailing edges

[AD-A209176]

number region

BMI

[NAL-TR-1010T]

TWO DIMENSIONAL MODELS

hypersonic aircraft emissions

ULTRAHIGH FREQUENCIES

[SME PAPER EM88-549]

UNSTEADY AERODYNAMICS

In the case of a nonloaded cascade

ULTRASONIC FLAW DETECTION

p 818 A89-52945

p 861 A89-52961

p 825 N89-29325

p 817 A89-52308

p 818 A89-53570

p 819 A89-53934

p 822 N89-28495

p 864 N89-28755

p 865 N89-28765

p 867 A89-54363

p 830 A89-53484

p 864 A89-54900

p 816 A89-51678

					method	using	fast,
tir	ne-a	ccurate CF	D codes	6			
[A	AIAA	PAPER 89	-3468]		p 845	A89-5	52563
	D	الطعلم ملساء	. است. م		and the state		

- stability and active control of elastic vehicles acting with unsteady aerodynamic forces [AIAA PAPER 89-3557] p 848 A89-52643
- Some aspects of aircraft dynamic loads due to flow p 832 A89-52959 separation
- Unsteady vortical disturbances around a thin airfoil in the presence of a wall p 819 A89-53944 UNSTEADY FLOW

Analysis of incompressible massively separated viscous flow using unsteady Navier-Stokes equations

p 818 A89-52485 Unsteady heat transfer in turbine blade ducts - Focus p 862 A89-53286 on combustor sources Some computations of unsteady Navier-Stokes flow

around oscillating airfoil/wing [NAL-TR-1004T] p 822 N89-28492

- Transition and turbulence structure in the boundary layers of an oscillating airfoil
- [AD-A208968] p 824 N89-29317 Time domain numerical calculations of unsteady vortical flows about a flat plate airfoil

[NASA-TM-102318] p 866 N89-29726 UPPER ATMOSPHERE

Hypersonic vehicle environment simulation, phase 1 [AD-A209030] p 864 N89-28754

USER MANUALS (COMPUTER PROGRAMS) Noise produced by turbulent flow into a rotor: Users manual for noise calculation

p 876 N89-29152 [NASA-CR-181790] Noise produced by turbulent flow into a rotor: Users

manual for atmospheric turbulence prediction and mean flow and turbulence contraction prediction p 876 N89-29154 [NASA-CR-181791]

A user's manual for the ARL mathematical model of the Sea King Mk-50 helicopter. Part 1: Basic use [AD-A208058] p 835 N89 p 835 N89-29339

A user's manual for the ARL mathematical model of the Sea King Mk-50 helicopter. Part 2: Use with ARL flight data

[AD-A208059] p 836 N89-29340 USER REQUIREMENTS

MDX - A helicopter designed by its users p 833 A89-53630 Direct User Access Terminal (DUAT) operational concept [WP-88W000751 p 854 N89-28524

ν

V/STOL AIRCRAFT

Comparison of eigenstructure assignment and the Salford singular perturbation methods in VSTOL aircraft control law design

p 844 A89-52550 [AIAA PAPER 89-3451] AHS National Specialists' Meeting on the Rotary Wing Aircraft Conceptual Design Process, Atlanta, GA, Apr. 3-5, 1989, Proceedings p 815 A89-52950 STOL and STOVL hot gas ingestion and airframe heating tests in the NASA Lewis 9- by 15-foot low-speed wind

tunnel [NASA-TM-102101] p 824 N89-29323

VARIABLE CYCLE ENGINES A study of an advanced variable cycle diesel as applied

to an RPV: Evaluation of an RPV variable cycle diesel enaine AD-A2077541

p 842 N89-29347 **VECTOR PROCESSING (COMPUTERS)**

Representation and display of vector field topology in fluid flow data sets p 875 A89-54904 VELOCITY DISTRIBUTION

Differing development of the velocity profiles of three-dimensional turbulent boundary layers

p 819 A89-53947 Time domain numerical calculations of unsteady vortical flows about a flat plate airfoil

[NASA-TM-102318] p 866 N89-29726 VELOCITY ERRORS

Precision characteristics of a coordinate device for estimating the velocity of an object p 830 A89-52779 VELOCITY MEASUREMENT

Diagnostic techniques for propulsion systems

p 839 A89-52960 Evaluation of LDA 3-component velocity data on a 65 deg delta wing at M = 0.85 and first results of an analysis

[DFVLR-FB-89-19] p 823 N89-28505 Species composition measurements in nonequilibrium high-speed flows p 824 N89-29312 VERTICAL AIR CURRENTS

An index for clear air turbulence based on horizonta deformation and vertical wind shear p 871 A89-54841

VERTICAL FLIGHT

Identification of an adequate model for collective response dynamics of a Sea King helicopter in hover [AD-A208060] p 836 N89-29341 VERTICAL TAKEOFF AIRCRAFT

On the design of nonlinear controllers for flight control systems

- [AIAA PAPER 89-3489] p 845 A89-52582 Comparison of Characteristic Local and methods in VSTOL flight control system design p 846 A89-52584
- Development of a flight control system for VTOL aircraft supported by ducted fans
- [AIAA PAPER 89-3592] p 849 A89-52672 EUROFAR · Project for a perpendicularly launched cruising aircraft
- [MBB-UD-538-88-PUB] c 833 A89-53308 VERY HIGH FREQUENCIES
- Out-of-band response of VHF/UHF airborne antennae p 830 A89-53484 VIBRATION DAMPING
- Time periodic control of a multi-blade helicopte [AIAA PAPER 89-3449] p 843 A89 p 843 A89-52548 Modeling of aerodynamic forces in the Laplace domain with minimum number of augmented states for the design of active flutter suppression systems
- p 844 A89-52561 [AIAA PAPER 89-3466]
- An effective flutter control method using fast, time-accurate CFD codes [AIAA PAPER 89-3468] c 845 A89-52563
- A multiloop, digital flutter suppression control law synthesis case study [AIAA PAPER 89-3556] c 843 A89-52642
- Robust control system design with multiple model approach and its application to active futter control
- [AIAA PAPER 89-3578] p 849 A89-52661 VIBRATION MODE
- Finite element based modal analysis of helicopter rotor p 832 A89-52044 blades VISCOPLASTICITY
- Thermo-viscoplastic analysis of hypersonic structures subjected to severe aerodynamic heating
- p 825 N89-29328 [NASA-CR-185915] VISCOSITY
- Lubricant evaluation and performance [AD-A208925] p 865 N89-28835
- VISCOUS FLOW Numerical simulation and hydrodynamic visualization of
- transient viscous flow around an oscillating aerofoil p 817 A89-52481
- Analysis of incompressible massively separated viscous flow using unsteady Navier-Stokes equations p 818 A89-52485
- Hypersonic vehicle environment simulation phase 1 [AD-A209030] p 864 N89-28754
- Finite element analysis of incompressible viscous flows around single and multi-element aerofor's in high Reynolds number region [NAL-TR-1010T]
- p 865 N89-28765 Inviscid and viscous hypersonic aerodynamics: A review of the old and new p 823 N89-29308
- VISUAL AIDS Visual and sensory aids for helicopters in the year 2000
- [MBB-UD-541-89-PUB] p 837 A89-53309 VISUAL PERCEPTION
- Towards a physiologically based HUD (Head-Up Display)
- symbology [AD-A207748] p 838 N89-28515 VISUAL SIGNALS
- Towards a physiologically based HUD (Head-Up Display) symbology [AD-A207748]
- p 838 N89-28515 VORTEX RINGS
- Incorporation of vortex line and vortex ring hover wake models into a comprehensive rotorcraft analysis code [AD-A208036] p 835 N89-29338 VORTEX SHEDDING
- One-degree-of-freedom motion induced by modeled vortex shedding [NASA-TM-101038]
- p 866 N89-28870 VORTEX SHEETS simulation Numerical of
- rolling up of leading/trailing-edge vortex sheets for slender wings p 819 A89-53926
- VORTICES The effects of longitudinal vortices on heat transfer of laminar boundary layers p 860 A89-51680 Pseudo-spectral and asymptotic sensitivity investigation
- of counter-rotating vortices p 861 A89-51755 Navier-Stokes computation of transpolic vortices over
- a round leading edge delta wing p 817 A89-52483 Comparison of flow-visualised vortices with computed geometry over thin delta wings
- [AD-A2090831 p 821 N89-28489

Study of the wing-vortex interaction in three dimensional flows (incompressible inviscid flow) [ISL-R-123/87] p 822 N89-28494

WEAR TESTS

- Profile-vortex interactions [ISL-R-125/87] p 822 N89-28495
- A detailed survey of the flow passing through an
 - asymmetric contraction and parallel duct [BAE-WWT-RP-RES-AXR-000194-] p 823 N89-28501 A detailed survey of the flow passing through an
- asymmetric contraction and parallel duct [BAE-WWT-RP-RES-AXR-000194-] p 823 N89-28502 Wake dissipation and total pressure loss in a
- two-dimensional compressor cascade with crenulated trailing edges [AD-A209176]
- p 864 N89-28755 Aircraft propeller induced structure-borne noise
- [NASA-CR-4255] p 876 N89-29155 Use of high-resolution upwind scheme for vortical flow simulations
- [NASA-CR-185910] p 824 N89-29321 Incorporation of vortex line and vortex ring hover wake
- models into a comprehensive rotorcraft analysis code [AD-A2080361 p 835 N89-29338
- Time domain numerical calculations of unsteady vortical flows about a flat plate airfoil
- [NASA-TM-102318] p 866 N89-29726 VORTICITY
- Unsteady vortical disturbances around a thin airfoil in the presence of a wall p 819 A89-53944 the presence of a wall Transonic flows with vorticity transport around slender hodies p 820 A89-53949

VULNERABILITY

Operational test plan concept for evaluation of close air support alternative aircraft [AD-A208185] p 835 N89-28513

p 868 A89-54784

p 868 A89-54785

p 868 A89-54786

p 868 A89-54787

p 870 A89-54809

p 838 A89-54848

p 871 A89-54854

p 871 A89-54855

p 831 N89-28509

p 820 A89-54373

p 821 N89-28488

p 862 A89-53286

p 863 A89-54488

p 865 N89-28835

A-23

W

International Airport

Doppler radar

system

perspective

[WP-88W00418]

configuration

[AD-A208647]

lifting structures WEAR TESTS

[AD-A208925]

WEAR

WAVE PROPAGATION

on combustor sources

WATER TUNNEL TESTS

and discussion of results

program

WAKES Wake dissipation and total pressure loss in a two-dimensional compressor cascade with crenulated trailing edges [AD-A209176] p 864 N89-28755

- Transition and turbulence structure in the boundary layers of an oscillating airfoil [AD-A208968]
- p 824 N89-29317 WALL FLOW
- Unsteady vortical disturbances around a thin airfoil in the presence of a wall p 819 A89-53944 WALL JETS
- Control of separated flow past a cylinder using tangential wall jet blowing [NASA-CR-185918]

Evaluation of the 12-station enhanced Low Level Wind

Microburst detection and display by TDWR - Shape,

Estimation of microburst asymmetry with a single

Using features aloft to improve timeliness of TDWR

Aircraft low level wind shear detection and warning

The Federal Aviation Administration's Low Level

The FAA Terminal Doppler Weather Radar (TDWR)

Water tunnel flow visualization on a hypersonic

Small scale model tests in small wind and water tunnels

Unsteady heat transfer in turbine blade ducts - Focus

Constant monitoring of the fatigue damage of aircraft

at high incidence and pitch rates. Volume 1: Test program

Collision avoidance operational concept

Lubricant evaluation and performance

Windshear Alert System - A project management

extent, and alarms --- Terminal Doppler Weather Radar

Divergence estimation by a single Doppler radar

hazard warnings --- Terminal Doppler Weather Radar

Shear Alert System (LLWAS) at Denver Stapleton

p 825 N89-29326 WARNING SYSTEMS

WEATHER FORECASTING

WEATHER FORECASTING

- International Conference on the Aviation Weather Systems, 3rd, Anaheim, CA, Jan. 30-Feb. 3, 1989, Preprints p867 A89-54776 A 3-hour mesoscale assimilation system using ACARS aircraft data combined with other observations ---aeronautical radio communications addressing and recording system
- reporting system p 869 A89-54797 The influence of ice accretion physics on the forecasting of aircraft icing conditions p 826 A89-54803 MET 90, a project for the development of the future Swodieb existence
- Swedish aviation weather system p 870 A89-54817 Doppler weather radar service at the Chiang Kai-Shek International Airport p 871 A89-54840
- A case study of local severe weather at Chang Kai Shek International Airport p 871 A89-54846 The status of the FAA Central Weather Processor (CWP) program p 872 A89-54857

WEATHERING

Five year ground exposure of composite materials used on the Bell Model 206L flight service evaluation [NASA-TM-101645] p 859 N89-28579

- WEST GERMANY Activities report in aerospace research in Germany,
- F.R. [ISSN-0070-3966] p 815 N89-28485 WHEEL BRAKES
- Aircraft accident/incident summary reports: Belleville, Illinois, August 22, 1987; Pensacola, Florida, December 27, 1987

[PB89-910405] p 827 N89-28507 WIND MEASUREMENT

- Improvement of the performance of sensors in the low-level wind shear alert system (LLWAS) p 871 A89-54844
- Aircraft low level wind shear detection and warning system p 838 A89-54848 Gust front detection algorithm for the Terminal Doppler
- Weather Radar. II Performance assessment p 871 A89-54852 Techniques for the detection of microburst events using
- airport surveillance radars Cross-spectral velocity estimation p 872 A89-54868 WIND PRESSURE
- Three-dimensional airfoil performance measurements on a rotating wing

{DE89-009443} p 821 N89-28487 WIND PROFILES

An index for clear air turbulence based on horizontal deformation and vertical wind shear p 871 A89-54841 Gust front detection algorithm for the Terminal Doppler

- Weather Radar. II Performance assessment p 871 A89-54852
- WIND SHEAR
- Optimal control for maximum energy extraction from wind shear [AIAA PAPER 89-3490] p 846 A89-52583
- Thrust laws for microburst wind shear penetration [AIAA PAPER 89-3560] p 848 A89-52645
- An expert system for wind shear avoidance p 826 A89-53971 The detection of low level windshear with airport
- The detection of low level windshear with airport surveillance radar p 868 A89-54780 Evaluation of the 12-station enhanced Low Level Wind Shear Alert System (LLWAS) at Denver Stapleton International Airport p 868 A89-54784
- International Airport p 868 A89-54784 A cursory study of F-factor applied to Doppler radar ---
- characterizing effect of wind shear on jet aircraft p 853 A89-54799
- An index for clear air turbulence based on horizontal deformation and vertical wind shear p 871 A89-54841 Improvement of the performance of sensors in the low-level wind shear alert system (LLWAS)
- p 871 A89-54844 Aircraft low level wind shear detection and warning
- system p 838 A89-54848 The Federal Aviation Administration's Low Level
- Windshear Alert System A project management perspective p 871 A89-54854 The FAA Terminal Doppler Weather Radar (TDWR)
- program p 871 A89-54855 Techniques for the detection of microburst events using
- airport surveillance radars Cross-spectral velocity estimation p 872 A89-54868 WIND TUNNEL MODELS
- Small scale model tests in small wind and water tunnels at high incidence and pitch rates. Volume 1: Test program and discussion of results
- [AD-A208647] p 821 N89-28488 Experimental investigation of a three dimensional wake in the vicinity of a wing-body junction
- [CERT-0A-29/5025-AYD] p 825 N89-29325 WIND TUNNEL TESTS
- Analysis of reattachment during ramp down tests ---helicopter blade upper surface flow in dynamic stall conditions p 816 A89-52043

Active flutter suppression using invariant zeros/eigensystem assignment [AIAA PAPER 89-3610] p 850 A89-52688

- Some aspects of aircraft dynamic loads due to flow separation p 832 A89-52000
- A method for calculation of matching point of inlet and engine p 840 A89-54132
- Small scale model tests in small wind and water tunnels at high incidence and pitch rates. Volume 1: Test program and discussion of results [AD-A208647] p 821 N89-28488
- Wind turnel tests of 16 percent thick airfoil with 30 percent trailing edge flap at high angles of attack and with flap angles
- [FFA-TN-1985-56] p 823 N89-28500 A detailed survey of the flow passing through an asymmetric contraction and parallel duct [BAE-WWT-RP-RES-AXR-000194-] p 823 N89-28501
- [BAE-WWT-RP-RES-AXR-000194-] p 823 N89-28501 A detailed survey of the flow passing through an asymmetric contraction and parallel duct
- [BAE-WWT-RP-RES-AXR-000194-] p 823 N89-28502 Boundary-layer measurements on a transonic low-aspect ratio wing
- [NASA-TM-88214] p 823 N89-29305 Species composition measurements in nonequilibrium
- high-speed flows p 824 N89-29312 STOL and STOVL hot gas ingestion and airframe heating tests in the NASA Lewis 9- by 15-foot low-speed wind tunnel
- [NASA-TM-102101] p 824 N89-29323 WIND TUNNEL WALLS
- Optimal permeability of wind tunnel walls at low supersonic velocities p 821 A89-54625 WIND TUNNELS
- Small scale model tests in small wind and water tunnels at high incidence and pitch rates. Volume 1: Test program and discussion of results
- [AD-A208647] p 821 N89-28488 WIND TURBINES
- Three-dimensional airfoil performance measurements on a rotating wing [DE89-009443] p 821 N89-28487
- WIND VELOCITY
- A relationship between peak temperature drop and velocity differential in a microburst p 867 A89-54777 WINDPOWER UTILIZATION
- Three-dimensional airfoil performance measurements on a rotating wing
- [DE89-009443] p 821 N89-28487 WINDSHIELDS
- Specifications and measurement procedures and aircraft transparencies
- [AD-A209396] p 834 N89-28511 WING FLAPS
- Thin aerofoil with multiple slotted flap p 816 A89-51625 WING LOADING
- Thermal stress analysis of the NASA Dryden hypersonic wing test structure p 856 A89-54340
- WING OSCILLATIONS Fixed-sign condition for integral quadratic forms and stability of systems with distributed parameters
- p 875 A89-54540 Some computations of unsteady Navier-Stokes flow
- around oscillating airfoil/wing [NAL-TR-1004T] p 822 N89-28492
- Some effects of aerodynamic spoilers on wing flutter [NASA-TM-101632] p 825 N89-29324
- WING PROFILES Thin aerofoil with multiple slotted flap
 - b 816 A89-51625 High altitude reconnaissance aircraft design
- [AIAA PAPER 89-2109] p 833 A89-54200 Separated flow past a concave conical wing of large
- transverse curvature at small angles of attack p 820 A89-54619

Study of the wing-vortex interaction in three dimensional flows (incompressible inviscid flow) [ISL-R-123/87] p 822 N89-28494

- WING TIPS Lightning protection testing of the E-6 wing tip antenna
- pod/HF probe p 825 A89-53474 WINGS
- Flutter calculations for a model wing using the MSC NASTRAN structural analysis program
- [AD-A209244] p 824 N89-29318 WINTER
- A cooperative study on winter icing conditions in the Denver area p 869 A89-54806 WORK HARDENING
- Recovery of the fatigue strength of structural elements of aluminum alloys by surface hardening
- p 857 A89-52827 WORLD DATA CENTERS
 - The World Area Forecast System p 870 A89-54827

- X-22 AIRCRAFT
- Identification of state-space parameters in the presence of uncertain nuisance parameters p 875 A89-54022 X-29 AIRCRAFT

Х

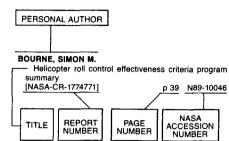
- A design procedure for the handling qualities optimization of the X-29A aircraft
- (AIAA PAPER 89-3428) p 843 A89-52529 Initial flight qualification and operational maintenance of X-29A flight software
 - [AIAA PAPER 89-3596] p 850 A89-52675

PERSONAL AUTHOR INDEX

AERONAUTICAL ENGINEERING / A Continuing Bibliography (Supplement 247)

January 1990

Typical Personal Author Index Listing



Listings in this index are arranged alphabetically by personal author. The title of the document provides the user with a brief description of the subject matter. The report number helps to indicate the type of document listed (e.g., NASA report, translation, NASA contractor report). The page and accession numbers are located beneath and to the right of the title. Under any one author's name the accession numbers are arranged in sequence with the AIAA accession numbers appearing first.

Δ

ABDEL-FATTAH, A. M.

- Aerodynamic model tests of exhaust augmentors for F/A-18 engine run-up facility at RAAF Williamtown p 841 N89-28518 [AD-A2081101
- ABED, EYAD H. Nonlinear stabilizing control of high angle of attack flight dynamics
- [AIAA PAPER 89-3487] p 845 A89-52580 ACOSTA, WALDO A.
- Fuel properties effect on the performance of a small high temperature rise combustor
- [AIAA PAPER 89-2901] p 838 A89-52025 ADACHI, TSUTOMU
- Secondary flow control and loss reduction in a turbine cascade using endwall fences p 816 A89-51679 ADAMS, NEIL J.
- An integrated configuration and control analysis technique for hypersonic vehicles p 833 A89-54006
- ADAMS, W. M., JR. flutter Active suppression using invariant
- zeros/eigensystem assignment [AIAA PAPER 89-3610] p 850 A89-52688 ADLER, PAUL S.
- CAD/CAM · Managerial challenges and research p 879 A89-54908 issues AGARWAL, A. K.
- A real-time expert system for self-repairing flight control
- [AIAA PAPER 89-3427] p 843 A89-52528 AJMANI, K.
- Turbulence modeling in a hypersonic inlet p 819 A89-53931
- AMBERG, T.
- Differing development of the velocity profiles of three-dimensional turbulent boundary layers p 819 A89-53947

AMIET. R. K.

- Noise produced by turbulent flow into a rotor: Users anual for noise calculation [NASA-CR-181790] p 876 N89-29152
- ANDERSON, JOHN D., JR.
- Inviscid and viscous hypersonic aerodynamics: A review of the old and new p 823 N89-29308

ANDERSON, JOHN R.

- Techniques for the detection of microburst events using airport surveillance radars - Cross-spectral velocity p 872 A89-54868 estimation ANDERSON, MARK R.
- Evaluation methods for complex flight control systems [AIAA PAPER 89-3502] p 846 A89-52595
- An uncertainty model for saturated actuators p 833 A89-54066 ANDO, SHIGENORI
- A new hybrid airship ('Heliship') transport pt for commuter p 833 A89-53641 ANDRE, JEAN-CLAUDE
- Turbulent shear flows 6; International Symposium, 6th, Universite de Toulouse III, France, Sept. 7-9, 1987, Selected Papers p 861 A89-52943
- ANDREWS, JOHN W. Aircraft trajectory prediction for terminal automation [AIAA PAPER 89-3634] p 829 A89-52703 p 829 A89-52703 ANGSTEN. G.
- High temperature adhesive systems p 860 N89-28643 [AD-A209166]
- ANTONIEWICZ, ROBERT F.
- Study of a pursuit-evasion guidance law for high p 853 A89-54084 performance aircraft ANTONOVA, A. M.
- Asymptotic solution of a nonlinear boundary value problem with a partly unknown boundary p 874 A89-52802
- APKARIAN, P. Algebraic loop transfer recovery - An application to the design of a helicopter output feedback control law [AIAA PAPER 89-3579] p 849 A89-52662
- ARBUCKLE, P. DOUGLAS Modal techniques for analyzing airplane dynamics
- [AIAA PAPER 89-3609] p 850 A89-52687 ARNEY, A. M.
- A user's manual for the ARL mathematical model of the Sea King Mk-50 helicopter. Part 1: Basic use [AD-A2080581 p 835 N89-29339
- A user's manual for the ARL mathematical model of the Sea King Mk-50 helicopter. Part 2: Use with ARL flight data
- [AD-A2080591 p 836 N89-29340 ATASSI, H. M.

Unsteady vortical disturbances around a thin airfoil in p 819 A89-53944 the presence of a wall ATLAS. DAVID

- The detection of low level windshear with airport irveillance radar p 868 A89-54780 AUKIN. M. K.
- A second-order finite-difference scheme for calculating three-dimensional supersonic flows of an ideal gas p 818 A89-52852

В

BABCOCK, MICHAEL R.

- Numerical simulation of microbursts Aircraft trajectory studies p 869 A89-54788
- Supercomputer requirements for selected disciplines important to aerospace p 874 A89-53152
- stability of systems with distributed parameters p 875 A89-54540

- Five year ground exposure of composite materials used on the Bell Model 206L flight service evaluation NASA-TM-101645] p 859 N89-28579
- BAMICHAS, NICOLAOS D. Flight test method development for a quarter-scale
- ircraft with minimum instrumentation AD-A2078961 p 835 N89-29337
- BANCROFT, GORDON V. Scientific visualization in computational aerodynamics
- at NASA Ames Research Center p 875 A89-54907 BANDA, SIVA S. Design of a modalized observer with eigenvalue
- p 842 A89-51723 sensitivity reduction

A surrogate system approach to robust control design [AIAA PAPER 89-3492] p 873 A89-52585 p 873 A89-52585 BAR-ITZHACK, I. Y.

Observability studies of inertial navigation systems [AIAA PAPER 89-3580] p 829 A89-52 p 829 A89-52663 BARBER, S. A.

- Estimate of surface temperatures during rolling p 864 A89-54981 contact BARCLAY, REBECCA O.
- Technical communication in aeronautics Results of an p 877 A89-53330 exploratory study
- BARILO, V. G. Fatigue life of ZhS6U alloy with protective coatings under thermal cycling loading p 857 A89-52830
- BASSANINÍ, P. Separated flow past three-dimensional bodies as a
- singular perturbation problem p 861 A89-52507 BAUCHAU. O. A.
- Finite element based modal analysis of helicopter rotor hlades p 832 A89-52044 BAUER, K. G.
- LDIS (Lightning Data and Information Systems) A new resource for aviation meteorology BAUMEISTER, K. J. p 869 A89-54801
- Unsteady heat transfer in turbine blade ducts Focus on combustor sources p 862 A89-53286 BAYLESS, R. A.
- Engine combustion optimization by exhaust analysis [PB89-195788] p 859 N89-28588 BECKEL, STEPHEN A.
- Fuel properties effect on the performance of a small high temperature rise combustor
- [AIAA PAPER 89-2901] p 838 A89-52025 BEGEEV, T. K.
- A study of the stress-strain state of connections in an orthotropic material p 864 A89-54585 BENJAMIN, STANLEY G.
- A 3-hour mesoscale assimilation system using ACARS aircraft data combined with other observations p 869 A89-54797
- BENSON, RUSSELL A.
- Design of integrated autopilot/autothrottle for NASA TSRV airplane using integral LQG methodology [AIAA PAPER 89-3595] p 849 A89-52674
- BEREKET, D. A knowledge based tool for failure propagation
- analysi p 874 A89-53970 BERNER, C.
- Laser velocimetry in the close wake of an axisymmetric rear body [ISL-R-114/87] p 865 N89-28774
- BERNHARDT, DAVID
- Severe aircraft icing events A Colorado case study p 827 A89-54838
- BERNHARDT, DAVID W. Aircraft icing hazards forecasting and synoptic p 827 A89-54821 classification
- BERNSTEIN, E. R. Supersonic jet studies of fluorene clustered with water,
- ammonia and piperidine [AD-A209562] p 860 N89-29497
- BERREEN, T. F. Aircraft trajectory generation: A literature review
- [AR-005-609] p 835 N89-29335 BESELER, JAN
 - Lateral axis autopilot design for large transport aircraft An explicit model-matching approach
- p 852 A89-53976 BICKEL. D. C.
 - Full-scale aircraft impact test for evaluation of impact forces. Part 1: Test plan, test method, and test results p 836 N89-29343 [DE89-009329] Full-scale aircraft impact test for evaluation of impact force. Part 2: Analysis of results
- [DE89-009335] p 836 N89-29344 **BILLIG, FREDERICK S.**
- Propulsion cycles for transatmospheric accelerators p 840 A89-54328

BLACKMAN, D. R.

Aircraft trajectory generation: A literature review [AR-005-609] p 835 N89-29335

BAILEY, F. RON BAIRAMOV. F. D.

- Fixed-sign condition for integral quadratic forms and
- BAKER, DONALD J.

BLEDSOE, ROBERT L.

BLEDSOE, ROBERT L.

- SST/Concorde Lessons for hypersonic programs p 877 A89-54337
- BOEHM, H.-D. V. Visual and sensory aids for helicopters in the year 2000
- p 837 A89-53309 [MBB-UD-541-89-PUB] BOHNE, ALAN R.
- The development of numerically-based and expert system approaches for airfield nowcasting/very short p 872 A89-54860 range forecasting BORGHI, R.
- Turbulent reactive flows n 857 A89-51860 BORSHCH, V. L.
- Separated flow past a concave conical wing of large transverse curvature at small angles of attack p 820 A89-54619
- BORZACCHIELLO, G.
- AE monitoring of airframe structure during full scale p 863 A89-53322 fatigue test BOSWORTH, JOHN T.
- A design procedure for the handling qualities optimization of the X-29A aircraft p 843 A89-52529 [AIAA PAPER 89-3428]
- BOWDEN, J. N.
- A survey of JP-8 and JP-5 properties [AD-A207721] n p 860 N89-28661 BOYER, DONALD W.
- Species composition measurements in nonequilibrium p 824 N89-29312 high-speed flows BOZZETTI, D.
- AE monitoring of airframe structure during full scale p 863 A89-53322 fatique test BRADSHAW. A.
- Comparison of eigenstructure assignment and the Salford singular perturbation methods in VSTOL aircraft control law design [AIAA PAPER 89-3451] p 844 A89-52550
- BRAHNEY, JAMES H.
- MDX A helicopter designed by its users p 833 A89-53630
- BREWSTER, KEITH A. A 3-hour mesoscale assimilation system using ACARS aircraft data combined with other observations p 869 A89-54797
- BRIDENBAUGH, JOHN C.
- Specifications and measurement procedures and aircraft transparencies
- p 834 N89-28511 [AD-A209396] BRISLAWN, KRISTI
- Microburst detection and display by TDWR Shape p 868 A89-54785 extent, and alarms Divergence estimation by a single Doppler radar
- p 868 A89-54786 BRUINING, A.
- The angles of the Kolibrie rotor tipvanes on the rods and on the blades
- p 822 N89-28499 BRUMMER RENATE
- A 3-hour mesoscale assimilation system using ACARS aircraft data combined with other observations p 869 A89-54797
- BRYAN, D. A. LDIS (Lightning Data and Information Systems) - A new p 869 A89-54801 resource for aviation meteorology BRYSON, A. E.
- Optimal paths through downbursts [AIAA PAPER 89-3561] p 848 A89-52646
- BUETEFISCH, KARL-ALOYS Evaluation of LDA 3-component velocity data on a 65 deg delta wing at M = 0.85 and first results of an
- analysis p 823 N89-28505 [DFVLR-FB-89-19]
- BUISKIKH, K. P. Fatigue life of ZhS6U alloy with protective coatings under thermal cycling loading p 857 A89-52830 BULLARD, RANDY
- Integrated flight/propulsion control system design based on a decentralized, hierarchical approach
- p 851 A89-53301 AIAA PAPER 89-3519] BULLARD, BANDY E. Integrated flight/propulsion control system design based
- on a centralized approach p 847 A89-52611 AIAA PAPER 89-35201
- BURNS, B. R. A. HOTOL - A European aerospaceplane for the 21st
- p 856 A89-54330 century BURROWS, S. P.
- Robust eigenstructure assignment for flight control using the Ctrl-C design package p 850 A89-52685 AIAA PAPER 89-36071
- BUSHLOW, TODD Small scale model tests in small wind and water tunnels
- at high incidence and pitch rates. Volume 1: Test program and discussion of results p 821 N89-28488 [AD-A208647]
- **B-2**

- BUSHNELL, D. M.
- Mixing augmentation technique for hypervelocity p 840 A89-53351 scramiets BUSHUEVA, E. M.
- Denormalized product of the adsorptive zeolite extraction of paraffins as a jet fuel component p 857 A89-52775
- BUTTERFIELD, C. P.
- Three-dimensional airfoil performance measurements on a rotating wing p 821 N89-28487 [DE89-009443]

С

- CALICO, ROBERT A.
- Time periodic control of a multi-blade helicopter [AIAA PAPER 89-3449] p 843 A89p 843 A89-52548 CÀLISE, A. J.
- A real-time guidance algorithm for aerospace plane p 855 A89-54085 optimal ascent to low earth orbit
- CALISE, ANTHONY J. Optimal output feedback for linear time-periodic
- systems AIAA PAPER 89-35741 p 873 A89-52657 CAMPBELL, STEVEN D.
- Using features aloft to improve timeliness of TDWR hazard warnings p 870 A89-54809
- CAPIZZI, VINCENT Australian hypersonic facilities
- p 854 A89-54349 CAPLIN. B.
- Noise produced by turbulent flow into a rotor: Users manual for atmospheric turbulence prediction and mean flow and turbulence contraction prediction
- [NASA-CR-181791] p 876 N89-29154 CARD. MICHAEL F.
- Current research in composite structures at NASA's p 861 A89-51692 Langley Research Center CAREY, GRAHAM F.
- Symbolic eigenvalue analysis for adaptive stepsize p 816 A89-51756 control in PNS shock stabilization CARRICO, MATTHEW J.
- Development and flight evaluation of an integrated GPS/INS navigation system
- p 828 A89-52590 LAIAA PAPER 89-34981 CATSIFF. E. H.
- High temperature adhesive systems p 860 N89-28643 [AD-A209166]
- CENTERS, PHILLIP W. Microcomputer simulation of lubricant degradation in
- turbine engines using laboratory data p 859 A89-54986
- CERBUS, C. A. The role of the Smith-Feddes model in improving the D 827 A89-54823 forecasting of aircraft icing
- CHAKRAVARTY, A. A knowledge based tool for failure propagation
- p 874 A89-53970 analysis CHAMIS, C. C.
- Computational structural mechanics engine structures computational simulator p 866 N89-29792 The 3-D inelastic analyses for computational structural p 867 N89-29804 mechanics
- CHAMPETIER, C. Algebraic loop transfer recovery - An application to the design of a helicopter output feedback control law
- [AIAA PAPER 89-3579] p 849 A89-52662 CHANDRA, RAMESH
- Environmental effects on composite structures p 857 A89-52994

CHANDRASEKHAR, J.

- Adaptive control of high performance unstable aircraft p 851 A89-52989 A review CHAPMAN, G. T.
 - One-degree-of-freedom motion induced by modeled vortex shedding
- [NASA-TM-101038] p 866 N89-28870 CHEN. H. C.
- Evolution of axisymmetric wakes from attached and p 818 A89-52945 separated flows CHEN, LEE-TZONG
- Euler correction method for two- and three-dimensional transonic flows p 819 A89-53934
- CHEN, LINGEN
- A multi-objective optimum design method for a radial-axial flow turbine with the optimum criteria of blade p 838 A89-52306 twist at outlet of blades CHEN. PHILIP C.
- JPL realtime weather processor system developed for p 875 A89-54858 FAA CHEN. SHILU
- Dynamic stability and active control of elastic vehicles acting with unsteady aerodynamic forces
- p 848 A89-52643 [AIAA PAPER 89-3557]

PERSONAL AUTHOR INDEX

CHENG VICTOR H. L.

- Integration of active and passive sensors for obstacle p 830 A89-54083 avoidance CHILDRE MARK T.
- Flight test of the F100-PW-220 engine in the F-16 p 840 A89-53366 CHIRKOV, L.V.
- Construction of general-purpose supersonic nozzles of conical cross section p 821 A89-54624
- CHISHOLM. DONALD A. The development of numerically-based and expert system approaches for airfield nowcasting/very short p 872 A89-54860 range forecasting
- CHOPRA, I. M. Aerospace Industry in India - Past, present and future
- p 815 A89-54472 CHOPRA, INDERJIT
- A coupled rotor aeroelastic analysis utilizing nonlinear aerodynamics and refined wake modeling
- D 831 A89-52041 CHOW, J. H. A multivariable control design for the lateral axis autopilot
- p 852 A89-53980 of a transport aircraft CHOW, JOE H.
- Lateral axis autopilot design for large transport aircraft - An explicit model-matching approach
- p 852 A89-53976 CHOWDHRY, RAJIV S.
- On optimal rigid body motions p 850 A89-52694 [AIAA PAPER 89-3616] CHU. HUNG-PENG
- Doppler weather radar service at the Chiang Kai-Shek p 871 A89-54840 International Airport
- CHUE, R. Calculations of inlet distortion induced compressor flow
- p 818 A89-52498 field instability CLIFF, EUGENE M.

Symbolic eigenvalue analysis for adaptive stepsize

Comparative durability of six coating systems on

High speed corner and gap-seal computations using an

Design of localizer capture and track using classical

Transition flight experiments on a swept wing with

Wideband linear quadratic Gaussian control of

Supercomputer requirements for selected disciplines

A real-time guidance algorithm for aerospace plane optimal ascent to low earth orbit p 855 A89-54085

Turbulent shear flows 6; International Symposium, 6th,

Numerical simulation and hydrodynamic visualization of

A design procedure for the handling qualities optimization of the X-29A aircraft

Computerized life and reliability modeling for turboprop

Engine combustion optimization by exhaust analysis

Small scale model tests in small wind and water tunnels at high incidence and pitch rates. Volume 1: Test program

transient viscous flow around an oscillating aerofoil

Universite de Toulouse III, France, Sept. 7-9, 1987,

Integral LQG model following controller

History of low-power jet engines

strapdown dry tuned gyro/accelerometers [AIAA PAPER 89-3441] p 83

Microburst detection from mesonet data

first-stage gas turbine blades in the engines of a long-range

p 850 A89-52694

p 816 A89-51756

p 858 A89-54255

p 863 A89-54424

p 852 A89-53978

p 852 A89-53979

p 819 A89-53830

p 841 A89-54483

p 837 A89-52540

p 874 A89-53152

p 868 A89-54783

p 861 A89-52943

p 817 A89-52481

p 843 A89-52529

p 863 A89-53364

p 859 N89-28588

p 821 N89-28488

On optimal rigid body motions [AIAA PAPER 89-3616]

control in PNS shock stabilization

CLINE, DOUGLAS D.

maritime patrol aircraft

[AIAA PAPER 89-2669]

COLEMAN, EDWARD E.

control techniques

COLLIER, F. S., JR.

COLLIN, KARL-HEINZ

CONSTANCIS, PIERRE

COOPER. DAVID M.

CORNMAN, LARRY B.

COUSTEIX. JEAN

Selected Papers

COUTANCEAU, M.

COX. TIMOTHY H.

transmissions

CREMEAN, S. P.

[PB89-1957881

[AD-A2086471

COY. J. J.

[AIAA PAPER 89-3428]

CUNNINGHAM, ATLEE M., JR.

and discussion of results

CORBAN, J. E.

important to aerospace

suction

COIRIER, WILLIAM J.

LU-SGS scheme

COCKING, J. L.

PERSONAL AUTHOR INDEX

D

DAGAN, A.

Pseudo-spectral and asymptotic sensitivity investigation of counter-rotating vortices p 861 A89-51755 DAMODARAN, K. A.

- Computerised design of blade elements in turbomachines p 840 A89-52991 DANG, THONG Q
- Euler correction method for two- and three-dimensional transonic flows p 819 A89-53934 DAUBE, O.
- Numerical simulation and hydrodynamic visualization of transient viscous flow around an oscillating aerofoil p 817 A89-52481
- DAVIS, THOMAS J.
- Piloted simulation of a ground-based time-control concept for air traffic control [AIAA PAPER 89-3625] p 829 A89-52700
- [AIAA PAPER 09-3020] p 829 A89-52700 DEBSKI, MAREK
- Constant monitoring of the fatigue damage of aircraft lifting structures p 863 A89-54488 DEIWERT, GEORGE S.
- Supercomputer requirements for selected disciplines important to aerospace p 874 A89-53152 **DEJONG, F. J.**
- Hypersonic vehicle environment simulation, phase 1 [AD-A209030] p 864 N89-28754 DELAAT, JOHN C.
- A real time microcomputer implementation of sensor failure detection for turbofan engines
- [NASA-TM-102327] p 876 N89-29032 DELLACORTE, CHRISTOPHER
- Tribological properties of alumina-boria-silicate fabric from 25 C to 850 C p 859 A89-54982 DELUCIA, R. A.
- Statistics on aircraft gas turbine engine rotor failures that occurred in US commercial aviation during 1984 [NAPC-PE-185] p 841 N89-28516 Statistics on aircraft gas turbine engine rotor failures that occurred in US commercial aviation during 1985
- [NAPC-PE-188] p 841 N89-28517 DENG, GUO-HUA Numerical simulation of rolling up of
- Numerical simulation of rolling up of leading/trailing-edge vortex sheets for slender wings p 819 A89-53926
- DERBASI, T. A.
- Thin aerofoil with multiple slotted flap p 816 A89-51625 DERUYCK, J.
- Transition and turbulence structure in the boundary layers of an oscillating airfoil [AD-A208968] p 824 N89-29317
- [AD-A208968] p 824 N89-29317 DESOPPER, ANDRE Correlation of Purna airloads: Evaluation of CFD
- prediction methods [NASA-TM-102226] p 822 N89-28498
- DEUTSCH, OWEN L. Ground-holding strategies for ATC flow control [AIAA PAPER 89-3628] p 829 A89-52702
- DINGEMAN, D. Stability analysis of flexible body dynamics for a highly maneuverable fighter aircraft (AIAA FAPER 88-3471) p 845 A89-52565
- [AIAA PAPER 89-3471] p 845 A89-52565 DOGGETT, ROBERT V., JR.
- Some effects of aerodynamic spoilers on wing flutter [NASA-TM-101632] p 825 N89-29324 DOMMERMUTH, F.
- Acoustical tracking of fast maneuvering aircraft by distributed sensors [REPT-6-88] p 877 N89-29156
- DOUGHERTY, T. K. High temperature adhesive systems
- [AD-A209166] p 860 N89-28643 DOWELL, EARL H.
- Robust control system design with multiple model approach and its application to active flutter control [AIAA PAPER 89-3578] p 849 A89-52661
- DOWNS, S. J. Heat transfer characteristics of an aero-engine intake
- fitted with a hot air jet impingement anti-icing system p 833 A89-53255
- DROEGEMEIER, KELVIN K. Numerical simulation of microbursts - Aircraft trajectory studies p 869 A89-54788
- studies p 869 A89-54788 DUKE, E. L. A real-time expert system for self-repairing flight
- control [AIAA PAPER 89-3427] p 843 A89-52528 DUKE, EUGENE L.
- Study of a pursuit-evasion guidance law for high performance aircraft p 853 A89-54084 DULIEU. A.
- Numerical simulation and hydrodynamic visualization of transient viscous flow around an oscillating aerofoil p 817 A89-52481

- DUPEROUX, J. P.
- Laser velocimetry in the close wake of an axisymmetric rear body
- [ISL-R-114/87] p 865 N89-28774 DURHAM, WAYNE C.
- Application of perfect model following to a control configured vehicle
- [AIAA PAPER 89-3453] p 844 A89-52552 A perfect explicit model following control solution to imperfect model following control problems
- [AIAA PAPER 89-3612] p 650 A89-52690 DURLAK, SUSAN K.
- The Advanced Aeronautic Design Program Designing for the future p 834 A89-54370
- DURST, FRANZ Turbulent shear flows 6; International Symposium, 6th, Universite de Toulouse III, France, Sept. 7-9, 1987, Selected Papers p 161 A89-52943
- DYER, ROSEMARY M.
- The development of numerically-based and expert system approaches for airfield nowcasting/very short range forecasting p 872 A89-54860 DZYONIK, L. I.
- Asymptotic solution of a nonlinear boundary value problem with a partly unknown boundary p 874 A89-52802

Ε

- EARLS, MICHAEL R.
- Initial flight qualification and operational maintenance of X-29A flight software [AIAA PAPER 89-3596] p 350 A89-52675
- [AIAA PAPER 89-3596] p 350 A89-52675 EBRAHIMI, YAGHOOB S.
- Design of localizer capture and track using classical control techniques p 352 A89-53978 EDWARDS, F. G.
- Flight-test evaluation of civil hel copter terminal approach operations using differential GPS
- [AIAA PAPER 89-3635] p 828 A89-52594 EGGERS, JAMES M.
- Plasma torch igniter for scramjets p 858 A89-53355 EGOLF, C. G.
- Noise produced by turbulent flow into a rotor: Users manual for noise calculation [NASA-CR-181790] p 876 N89-29152
- EILTS. MICHAEL D.
- Estimation of microburst asymmetry with a single Doppler radar p 868 A89-54787 FLCRAT. A. R
- Separated flow past three-dimensional bodies as a
- singular perturbation problem p 861 A89-52507 ELIAS, W. E. High temperature adhesive systems
- [AD-A209166] p 860 N89-28643 ELISEEV. A. A.
- Precision characteristics of a coordinate device for estimating the velocity of an object p 830 A89-52779 ELLROD. GARY
- Dallas microburst storm environmental conditions determined from satellite soundings p 868 A89-54779 ELLROD, GARY P.
- An index for clear air turbulence based on horizontal deformation and vertical wind shear p 871 A89-54841
- ELMORE, KIMBERLY L. A cursory study of F-factor applied to Doppler radar p 853 A89-54799
- EMSLIE, BETTY Flutter calculations for a model wing using the MSC
- NASTRAN structural analysis program [AD-A209244] r 824 N89-29318
- ENDRES, NED M.
- Interfacing modules for integrating discipline specific structural mechanics codes p 866 N89-29793 ENGLIN, B. A.
- Denormalized product of the adsorptive zeolite extraction of paraffins as a jet fuel component p 857 A89-52775
- ENNS, DALE F.
- Nonlinear control of a supermaneuverable aircraft [AIAA PAPER 89-3486] p 845 A89-52579 Nonlinear longitudinal control of a supermaneuverable
- aircraft p 851 A89-53957 ENOCHSON, G. L.
- Lightning protection testing of the E-6 wing tip antenna pod/HF probe 2 825 A89-53474 ERZBERGER. HEINZ
- Controller evaluations of the descent advisor automation aid
- [AIAA PAPER 89-3624] p 829 A89-52699 EVSTRATOVA, S. P.
- Recovery of the fatigue strength of structural elements of aluminum alloys by surface hardening p 857 A89-52827

GARRARD, WILLIAM L.

F

- FAHY, F. J.
- The acoustic calibration of aircraft fuselage structures, part 1
- [ISVR-TR-169-PT-1] p 877 N89-29158 FARAFONOV, V. G.
- Precision characteristics of a coordinate device for estimating the velocity of an object p 830 A89-52779 FARINEAU. J.
- Lateral electric flight control laws of a civil aircraft based upon eigenstructure assignment technique [AIAA PAPER 89-3594] p 851 A89-52718
- FEIG, P. D.
- Revolutionary opportunities for materials and structures study, addendum [NASA-CR-179642-ADD] p 842 N89-29351
- FEIK, R. A. Identification of an adequate model for collective
- response dynamics of a Sea King helicopter in hover [AD-A208060] p 836 N89-29341 FENTON, B. C.
- Statistics on aircraft gas turbine engine rotor failures that occurred in US commercial aviation during 1984 [NAPC-PE-185] p 841 N89-28516
- Statistics on aircraft gas turbine engine rotor failures that occurred in US commercial aviation during 1985 [NAPC-PE-188] p 841 N89-28517
- FINBERG, STEPHEN L. The flight control system for the Daedalus human
- powered aircraft [AIAA PAPER 89-3593] p 849 A89-52673
- FISHER, S. A. Aerodynamic model tests of exhaust augmentors for
- F/A-18 engine run-up facility at RAAF Williamtown [AD-A208110] p 841 N89-28518 FLANDRO. G. A.
- A real-time guidance algorithm for aerospace plane optimal ascent to low earth orbit p 855 A89-54085 FLEISCHER, ROBERT L.
- Selecting high-temperature structural intermetallic compounds - The materials science approach p 858 A89-54671
- FORTE, I. Improved guidance law design based on the mixed-strategy concept p 828 A89-51716

Linear quadratic Gaussian design for robust

Use of high-resolution upwind scheme for vortical flow

Analysis of absorbing characteristics of thin-type

Ultrasonic evaluation of matrix cracking in graphite

absorber for generalized conditions of incident wave

Saenger aerospaceplane gains momentum

G

Analysis of reattachment during ramp down tests

Prediction of inplane damping from deterministic and stochastic models p 832 A89-52042

Integrated flight/propulsion control system design based

Integrated flight/propulsion control system design based

Turbofan engine control system design using the

Identification of state-space parameters in the presence

Nonlinear control of a supermaneuverable aircraft

on a decentralized, hierarchical approach

A real-time expert system for self-repairing flight

p 844 A89-52555

p 841 A89-54483

p 824 N89-29321

p 861 A89-52105

p 864 A89-54900

p 855 A89-52973

p 843 A89-52528

p 816 A89-52043

p 847 A89-52611

p 851 A89-53301

p 840 A89-53956

p 875 A89-54022

p 845 A89-52579

B-3

performance of a highly maneuverable aircraft

History of low-power jet engines

FREUDENBERG, JAMES S.

AIAA PAPER 89-3457]

FRICKE, HANS

simulations

FUKAI, ICHIRO

FURNISS, TIM

GAITHER, S. A.

control

[NASA-CR-185910]

FULLER, MICHAEL D.

[SME PAPER EM88-549]

[AIAA PAPER 89-3427]

on a centralized approach

[AIAA PAPER 89-3520]

[AIAA PAPER 89-3519]

LQG/LTR methodology

GARRARD, WILLIAM L.

[AIAA PAPER 89-3486]

of uncertain nuisance parameters

GARNER, JOHN P.

GAONKAR, GOPAL H.

GARG. SANJAY

GALBRAITH, RODERICK A. MCD.

FUJII. KOZO

GEBERT, G. A.

Nonlinear longitudinal control of a supermaneuverable p 851 A89-53957 aircraft GEBERT, G. A.

- Unsteady vortical disturbances around a thin airfoil in the presence of a wall p 819 A89-53944 GEORGALLIS, MICHAEL
- p 863 A89-54348 Flash lamp planar imaging GEORGE, A. R.
- Use of the Kirchhoff method in acoustics p 876 A89-53945

GETMANENKO, G. G. Precision characteristics of a coordinate device for

estimating the velocity of an object p 830 A89-52779 GHIA, K. N. Analysis of incompressible massively separated viscous

flow using unsteady Navier-Stokes equations p 818 A89-52485

GHIA, U.

Analysis of incompressible massively separated viscous flow using unsteady Navier-Stokes equations p 818 A89-52485

GIFFORD, ROBERT N.

- Techniques for the detection of microburst events using airport surveillance radars - Cross-spectral velocity p 872 A89-54868 estimation GILBERT, MICHAEL G.
- Integrated structure/control law design by multilevel optimization

[AIAA PAPER 89-3470] p 873 A89-52564 GILBERT, N. E.

- Incorporation of vortex line and vortex ring hover wake models into a comprehensive rotorcraft analysis code [AD-A208036] p 835 N89-29338
- A user's manual for the ARL mathematical model of the Sea King Mk-50 helicopter. Part 1: Basic use [AD-A208058] p 835 N89-29339
- A user's manual for the ARL mathematical model of the Sea King Mk-50 helicopter. Part 2: Use with ARL flight data [AD-A208059] p 836 N89-29340
- GLADDEN, H. J. Heat transfer in aerospace propulsion
- p 862 A89-53282 GLASSMAN, MYRON
- Technical communication in aeronautics Results of an p 877 A89-53330 exploratory study GOFF. CRAIG R
- The Federal Aviation Administration's Low Level Windshear Alert System - A project management perspective p 871 A89-54854 GOLDBURG, ARNOLD
- The U.S. supersonic transport Three lessons for NASP from history p 878 A89-54354 GOLDMAN, NATHAN C.
- Transnational legal problems for commercial hypersonic p 878 A89-54356 fliaht GOODRICH, KENNETH H.
- Application of Artificial Intelligence (AI) programming techniques to tactical guidance for fighter aircraft [AIAA PAPER 89-3525] p815 A89-52614
- GOODRICH, KENT Microburst detection and display by TDWR - Shape, extent, and alarms p 868 A89-54785 **GOODRICH, R. KENT**
- Divergence estimation by a single Doppler rada p 868 A89-54786 GOPALAN, R.

Environmental effects on composite structures p 857 A89-52994

- GORDON, LOU
- The importance of weight in a changing cost estimating environment [SAWE PAPER 1854] p 877 A89-52024
- GORDON, NEIL D.
- Verification of aerodrome forecasts p 870 A89-54824
- GOSHEN-MESKIN, D.

B-4

- Observability studies of inertial navigation systems [AIAA PAPER 89-3580] p 829 A89-52663 GRAMZOW, RICHARD H.
- The Federal Aviation Administration's Low Level Windshear Alert System A project management p 871 A89-54854 perspective GRASSIAN, V. H.
- Supersonic jet studies of fluorene clustered with water, ammonia and piperidine
- [AD-A209562] p 860 N89-29497 GREEN, STEVEN M.
- Piloted simulation of a ground-based time-control concept for air traffic control [AIAA PAPER 89-3625] p 829 A89-52700
- GREIM, J.
- Injection moulded ceramic rotors Comparison of SiC and Si3N4 p 858 A89-53658

- GREITZER. E. M.
- Calculations of inlet distortion induced compressor flow field instability p 818 A89-52498 GRISHIN, V. I.
- A study of the stress-strain state of connections in an p 864 A89-54585 orthotropic material GUAN, QIANLIE
- Study on boundary layer of hypersonic inlets p 820 A89-54129
- **GUTHRIE, JOHN** 'Spaceplanes' and the rise of 'Ultra Tech'
- p 856 A89-54355 GUTMARK, E.
- Noncircular jet dynamics in supersonic combustion p 863 A89-53353 Combustion-related shear-flow dynamics in elliptic p 819 A89-53930 supersonic jets

н

HADFIELD, MICHAEL J.

- Update 89 Additional results with the multifunction RLG system
- p 837 A89-52716 [AIAA PAPER 89-3583] HAERTIG, J. Profile-vortex interactions [ISL-R-125/87] p 822 N89-28495 HAGGARD, WILLIAM H. p 879 A89-54863 Weather testimony in litigation HAGMANN, U. EUROFAR - Project for a perpendicularly launched cruising aircraft p 833 A89-53308 [MBB-UD-538-88-PUB] HAHNE, DAVID E.
- Low-speed static and dynamic force tests of a generic supersonic cruise fighter configuration p 821 N89-28486 [NASA-TM-4138]
- HAINES, P. A. The role of the Smith-Feddes model in improving the
- forecasting of aircraft icing p 827 A89-54823 HAKIMI, M.
- A knowledge based tool for failure propagation p 874 A89-53970 analysis HALEVI, YORAM
- Extended observability of linear time-invariant systems under recurrent loss of output data
- p 873 A89-52603 [AIAA PAPER 89-3510] HALL, S. R.
- A proposed composite repair methodology for primary structure p 858 A89-54429 HAMILTON, S.
- QFT digital controller for an unmanned research vehicle (URV) p 853 A89-54080
- HAMMOND, R. A.
 - A multivariable control design for the lateral axis autopilot p 852 A89-53980 of a transport aircraft HAMORY, PHILIP J.
 - Flight systems design issues for a research-oriented hypersonic vehicle p 853 A89-54371 HANSEN, ARTHUR L.
 - Ground based weather radar for aviation p 871 A89-54856
 - HANSMAN, R. JOHN, JR. The influence of ice accretion physics on the forecasting
 - of aircraft icing conditions p 826 A89-54803 HARIHARAN, S. I.
 - Time domain numerical calculations of unsteady vortical flows about a flat plate airfoil
 - INASA-TM-1023181 p 866 N89-29726 HARINARAYANA, KOTA
- Adaptive control of high performance unstable aircraft p 851 A89-52989 - A review
- HARPER, THEODORE R. The Orient Express - The emperor's new airplane p 878 A89-54357
- HASSANEN, A. N. Thin aerofoil with multiple slotted flap
- p 816 A89-51625 HASTINGS, DANIEL E.
- Application of compound compressible flow to nonuniformities in hypersonic propulsion systems p 818 A89-53367
- HATTIS, PHILIP D. Optimal trajectory generation and design trades for hypersonic vehicles p 855 A89-54009
- HATTIS, PHILLIP D. An integrated configuration and control analysis technique for hypersonic vehicles p 833 A89-54006 HAUENSTEIN, ANTHONY J.
- Chaotic response of aerosurfaces with structural nonlinearities
- [AD-A208433] p 824 N89-29316

HAUSER, JOHN

- On the design of nonlinear controllers for flight control systems AIAA PAPER 89-3489 p 845 A89-52582 HAYLO, NESIM A variable-gain output feedback control design approach AIAA PAPER 89-35751 p 873 A89-52658 HAZARIKA, B. Transition and turbulence structure in the boundary layers of an oscillating airfoil p 824 N89-29317 [AD-A208968] HÈ, M. J.
- Fatigue life of dovetail joints Verification of a simple p 863 A89-54119 biaxial model HEFFELFINGER, S. R.
- Full-scale aircraft impact test for evaluation of impact forces. Part 1: Test plan, test method, and test results p 836 N89-29343 [DE89-009329] HEGARTY, D. M.
- Flight-test evaluation of civil helicopter terminal approach operations using differential GPS [AIAA PAPER 89-3635] p 828 p 828 A89-52594
- HEIGES. M. W. Synthesis of a helicopter full authority controller [AIAA PAPER 89-3448] p 843 A89
- p 843 A89-52547 HEISE, SHARON A.
- A surrogate system approach to robust control design [AIAA PAPER 89-3492] p 873 A89-52585 p 873 A89-52585 HÈLLROTH, BJORN
- MET 90, a project for the development of the future Swedish aviation weather system p 870 A89-54817 HELMAN, JAMES
- Representation and display of vector field topology in p 875 A89-54904 fluid flow data sets
- HENDRICH, LOUIS J.
- Results of a preliminary study of two high-speed civil transport design concepts p 834 A89-54372 p 834 A89-54372 HENDRICKS, R. C. Heat transfer in aerospace propulsion
- p 862 A89-53282 HENNING, H. J.
- Development along different paths
- p 820 A89-54484 HERRING, DAVID G. F.
- Analysis of reattachment during ramp down tests p 816 A89-52043 HESS, R. A.
- Self-tuning Generalized Predictive Control applied to terrain following flight
- [AIAA PAPER 89-3450] p 843 A89-52549
- Evaluation of a technique for predicting longitudinal pilot-induced-oscillations
- AIAA PAPER 89-3517 p 847 A89-52609 HESSELINK, LAMBERTUS
- Representation and display of vector field topology in fluid flow data sets p 875 A89-54904 HETSKO, JEAN
- Accomplishments under the airport improvement program: Fiscal year 1988
- p 855 N89-29352 [AD-A2082001 HIGBEA, MARY E.
- International Conference on Hypersonic Flight in the 21st Century, 1st, University of North Dakota, Grand Forks, Sept. 20-23, 1988, Proceedings p 855 A89-54326 HIGHT, TIMOTHY K.

hypersonic transport

HINKELMAN, JOHN W., JR.

HINKLEMAN, JOHN W., JR.

variations in Reynolds number

Laboratory and field investigations [DOT/FAA/DS-89/2-PHASE-1]

layers of an oscillating airfoil

HIPPENSTEELE, S. A.

High-resolution

HIRONAKA, M. C.

[AD-A2089681

HOAG. PAUL W.

HJELMFELT, MARK R.

international relations

HIRSCH, CH.

1987

[AD-A208036]

icing forecasts

HILL S.

Conceptual design tools for internal tankage of the

Incorporation of vortex line and vortex ring hover wake

An overview of the national program to improve aircraft

Aircraft icing conditions detected by combined remote sensors - A preliminary study p 827 A89-54807

measurements on the endwall of a turbine passage with

Joint sealants for airport pavements. Phase 1:

Transition and turbulence structure in the boundary

Evaluation of microburst nowcasting during TDWR

Hypersonic flight, domestic military policy, and ternational relations p 878 A89-54364

liquid-crystal

models into a comprehensive rotorcraft analysis code

p 834 A89-54338

p 835 N89-29338

p 872 A89-54862

p 862 A89-53289

p 854 N89-28523

p 824 N89-29317

p 870 A89-54813

heat-transfer

PERSONAL AUTHOR INDEX

HOEFT, L. O.

Excitation of aircraft for hardness surveillance using the aircraft's own HF antenna p 854 A89-53476 HOFFMAN, ERIC

- Thrust vectoring effect on time-optimal 90 degrees angle of attack pitch up maneuvers of a high alpha fighter aircraft
- [AIAA PAPER 89-3521]
 p 847
 A89-52612

 Singular trajectories for time-optimal maneuvers of a high alpha fighter aircraft
 half-loop

 [AIAA PAPER 89-3614]
 p 850
 A89-52692
- Maximum principle solutions for time-optimal half-loop maneuvers of a high alpha fighter aircraft p 853 A89-54081
- HOFSTRA, J. S. Excitation of aircraft for hardness surveillance using the
- aircraft's own HF antenna p 854 A89-53476 HOH, ROGER H.
- Flight investigation of helicopter low-speed response requirements p 842 A89-51702 HOLST. TERRY L.
- Supercomputer requirements for selected disciplines important to aerospace p 874 A89-53152 HOPKINS, D. A.
- The 3-D inelastic analyses for computational structural mechanics p 867 N89-29804 HOPPER. D.
- Comparison of eigenstructure assignment and the Salford singular perturbation methods in VSTOL aircraft control law design
- [AIAA PAPER 89-3451] p 844 A89-52550 HOROWITZ, I. M.
- QFT digital controller for an unmanned research vehicle (URV) p 853 A89-54080 HORSTMAN, C. C.
- Prediction of secondary separation in shock wave boundary-layer interactions p 816 A89-51760 HOUPIS. C. H.
- QFT digital controller for an unmanned research vehicle (URV) p 853 A89-54080 HOWARD, CELESTE M.
- Display characteristics of example light-valve projectors (AD-A209580) p 877 N89-29193
- HOWARD, R. J. Airborne rain mapping radar p 837 A89-53313
- HU, K. Parallel dynamic programming for on-line flight path optimization [AIAA PAPER 89-3615] p 832 A89-52693
- [ÅIAA PAPER 89-3615] p 832 A89-52693 HUA, YAONAN
- Computation of the detached shock shape in a supersonic or transonic cascade p 816 A89-52307 HUBER. H.
- EUROFAR Project for a perpendicularly launched cruising aircraft
- [MBB-UD-538-88-PUB] p 833 A89-53308 HUBER, HELMUT B.
- Rotorcraft research and technology advances at MBB [MBB-UD-0537-88-PUB] p 815 A89-53334 HUDSON. DALE A.
- CFD in the context of IHPTET The Integrated High Performance Turbine Engine Technology Program [AIAA PAPER 89-2904] p 862 A89-53307
- HUFF, R. Unsteady heat transfer in turbine blade ducts - Focus on combustor sources p 862 A89-53286
- HULL, JOHN Aeronautical applications of high-temperature superconductors
- (AIAA PAPER 89-2142) p 840 A89-53304 HUNOLD. K.
- Injection moulded ceramic rotors Comparison of SiC and Si3N4 p 858 A89-53658 HUNT, OLGA
- Observations and forecasts for runway (pavement) surfaces p 826 A89-54802
- HUO, XIUFANG Dynamic stability and active control of elastic vehicles acting with unsteady aerodynamic forces
- [AIAĀ PAPER 89-3557] p 848 A89-52643 HUSSAINI, M. Y. Mixing augmentation technique for hypervelocity
- scramjets p 840 A89-53351 HYNES, T. P.
- Calculations of inlet distortion induced compressor flow field instability p 818 A89-52498

- IANNELLO, VICTOR
- Superconducting Meissner effect bearings for cryogenic turbomachines, phase 1 [AD-A209875] p 865 N89-28839

- IDE, H.
- An effective flutter control method using fast, time-accurate CFD codes
- [AIAA PAPER 89-3468] p 845 A89-52563 IL'INSKII, A. N.
- Solution of the inverse boundary value problem of aerohydrodynamics with allowance for the boundary layer p 864 A89-54611
- ILIFF, KENNETH W.
- Parameter estimation for flight vehicles ρ 831 A89-51701 IM. H. S.
 - Supersonic jet studies of fluorene clustered with water, ammonia and piperidine
 - [AD-A209562] p 860 N89-29497 IM, K. E. Airborne rain mapping radar p 837 A89-53313
 - INABA, C. M. Joint sealants for airport pavements. Phase 1:
 - Laboratory and field investigations [DOT/FAA/DS-89/2-PHASE-1] p 854 N89-28523
 - INNOCENTI, MARIO High gain flight controllers for nonlinear systems
 - [AIAA PAPER 89-3488] p 845 A89-52581 IOANNOU, PETROS
 - Surface failure detection and evaluation of control law for reconfiguration of flight control system [AIAA PAPER 89-3509] p 847 A89-52602
 - [AIRA FAFER 09-3009] [0 847 A09-32002 ISAMINGER, MARK A. Using features aloft to improve timeliness of TDWR
 - hazard warnings p 870 A89-54809 ISHAI. O.
 - Interlaminar fracture toughness and toughening of laminated composite materials - A review
 - p 858 A89-54426
 - On TVD difference schemes for the three-dimensional Euler equations in general co-ordinates p 817 A89-52484

J

- JAFFE, KENNETH D.
- Improvement of the performance of sensors in the low-level wind shear alert system (LLWA:S) p 871 A89-54844
- JAHN, R. K. Engine combustion optimization by exhaust analysis
- [PB89-195788] p 859 N89-28588 JAIN, VINOD K. Lubricant evaluation and performance
- [AD-A208925] p £65 N89-28835 JAMES, E. H.
- Heat transfer characteristics of an aero-engine intake fitted with a hot air jet impingement anti-icing system p 833 A89-53255
- JANEKE, C. E. The Trisonic aerospace motor - Propulsion vehicle for the 21st century p 856 A89-54359
- JANUSIAK, KAZÍMIERZ Noise produced by a jet aircraft during the engine test
- run p 876 A89-54487 JAVID, S. H. A multivariable control design for the lateral axis autopilot
- of a transport aircraft p 852 A89-53980 JAYARAMAN, V.
- Experimental investigation of a three dimensional wake in the vicinity of a wing-body junction
- [CERT-0A-29/5025-AYD] p 825 N89-29325 JEERAGE. MAHESH K.
- Performance test results of a multi-function fault-tolerant RLG system
- [AIAA PAPER 89-3584] p 837 A89-52717 JEWETT, BRIAN F.
- A 3-hour mesoscale assimilation system using ACARS aircraft data combined with other observations p 869 A89-54797
- JOFFE, ELYA B. Out-of-band response of VHF/UHF airborne antennae
- _____
- JOHE, CH. Profile-vortex interactions [ISL-R-125/87] p 822 N89-28495 JOHNS. ALBERT L.
- STOUL and STOUL hot gas ingestion and airframe heating tests in the NASA Lewis 9- by 15-foot low-speed wind
- tunnel [NASA-TM-102101] p 824 N89-29323
- JOHNSON-FREESE, JOAN SST/Concorde - Lessons for hypersonic programs p 877 A89-54337
- JOHNSTON, G. R.

Comparative durability of six coating systems on first-stage gas turbine blades in the engines of a long-range maritime patrol aircraft p 858 A89-54255

p 830 A89-53484

JOHNSTON, HAROLD S.

A study of the sensitivity of stratospheric ozone to hypersonic aircraft emissions p 867 A89-54363 JOHNSTON, RICHARD P.

KHOKHLACHEVA, M. V.

- A study of an advanced variable cycle diesel as applied to an RPV: Evaluation of an RPV variable cycle diesel
- engine [AD-A207754] p 842 N89-29347
- JONES, ALAN Correlation of Puma airloads: Evaluation of CFD prediction methods
- [NASA-TM-102226] p 822 N89-28498 JONES. NATHAN H.
 - Glider ground effect investigation [AD-A209152] p 821 N89-28490
 - JOST, G. S.
 - Stresses and strains in a cold-worked annulus [AR-005-548] p 866 N89-28871
- JUNG, Y. C. Self-tuning Generalized Predictive Control applied to
- terrain following flight [AIAA PAPER 89-3450] p 843 A89-52549

K

KAJI, SHOJIRO

KANAI, KIMIO

KANNEL, J. W.

[AIAA PAPER 89-3507]

[AIAA PAPER 89-3467]

KAUFFMAN, ROBERT E.

aircraft

contact

KARPEL. M.

KÅTTI, D. Y.

KAWAI, TATSUO

KEENER, EARL R.

low-aspect ratio wing

[NASA-TM-88214]

KELLER, MICHAEL A.

[AD-A208925]

KELLY, JAMES W.

Ridge regression

[AIAA PAPER 89-3499]

KHARGONEKAR, PRAMOD P.

KHOKHLACHEVA, M. V.

KELLEY, J. R.

surfaces

KELLY, R. J.

KERN, LURA

configuration

- Theoretical study on the unsteady aerodynamic characteristics of an oscillating cascade with tip clearance - In the case of a nonloaded cascade
- p 816 A89-51678
- Analysis of absorbing characteristics of thin-type absorber for generalized conditions of incident wave p 861 A89-52105
- KALE, M. A. A multivariable control design for the lateral axis autopilot
- of a transport aircraft p 852 A89-53980 KALTEIS, R. M.

Evaluation of a technique for predicting longitudinal pilot-induced-oscillations [AIAA PAPER 89-3517] p 847 A89-52609

- (AMA PAPER 89-3517) p 847 A89-52609 KAMINER, ISAAC
- Design of integrated autopilot/autothrottle for NASA TSRV airplane using integral LQG methodology [AIAA PAPER 89-3595] p 849 A89-52674 Design of localizer capture and track modes for a lateral

autopilot using H(infinity) synthesis p 852 A89-53977

Modification of trim point and feedback gains for failed

Estimate of surface temperatures during rolling

Sensitivity derivatives of flutter characteristics and

Secondary flow control and loss reduction in a turbine

Boundary-layer measurements on a transonic

Observations and forecasts for runway (pavement)

Global positioning system accuracy improvement using

Water tunnel flow visualization on a hypersonic

Design of localizer capture and track modes for a lateral

Denormalized product of the adsorptive zeolite extraction of paraffins as a jet fuel component

autopilot using H(infinity) synthesis p 852 A89-53977

stability margins for aeroservoelastic design

Overview of buckling in aircraft design

Lubricant evaluation and performance [AD-A208925] p

Lubricant evaluation and performance

Hypersonic air vehicle stability and control

cascade using endwall fences

p 846 A89-52600

p 864 A89-54981

p 845 A89-52562

p 834 A89-54462

p 865 N89-28835

p 816 A89-51679

p 823 N89-29305

p 865 N89-28835

p 826 A89-54802

p 834 A89-54344

p 828 A89-52591

p 820 A89-54373

p 857 A89-52775

B-5

KHON'KIN, A. D.

KHON'KIN, A. D.

- A three-dimensional boundary layer in finite-span thin p 818 A89-52843 winas KIM, JOHN
- Supercomputer requirements for selected disciplines important to aerospace p 874 A89-53152 KINNISON, DOUGLAS E.
- A study of the sensitivity of stratospheric ozone to p 867 A89-54363 hypersonic aircraft emissions
- KLEIN, PAVEL Data Link Processor (DLP), pilot access to weather data p 831 A89-54859

KLINGE-WILSON, DIANA

- Gust front detection algorithm for the Terminal Doppler Weather Radar. II Performance assessment p 871 A89-54852
- KLOPFER, GOETZ H.
- Transonic flows with vorticity transport around slender p 820 A89-53949 bodies KNAUSS, W. G.

High temperature adhesive systems

- p 860 N89-28643 [AD-A209166] KNIGHT, NORMAN F., JR.
- CSM research: Methods and application studies p 867 N89-29794
- KNOLL, ALEXANDER
- Optimal control for maximum energy extraction from wind shea
- [AIAA PAPER 89-3490] p 846 A89-52583 KOBAYASHI, SHIGEO
- Perspective on Japanese Space Plane research and development p 856 A89-54332 KOCH. JENS-UWE
- MLS 1989 Status report from the perspective of the airline companies p 830 A89-53663 KONDO, J.
- Development of a flight control system for VTOL aircraft supported by ducted fans
- [AIAA PAPER 89-3592] p 849 A89-52672 KOREN, U.
- Flash lamp planar imaging p 863 A89-54348 KORMANYOS, S. W.
- Lightning protection testing of the E-6 wing tip antenna p 825 A89-53474 nod/HE probe KORNECKI, ANDREW J.
- Air traffic control system Can we close the control loop? p 830 A89-53969
- KOROLEV, G. L. Theory for separated flow around the trailing edge of p 820 A89-54614 a thin profile
- KOSHIGOE. S. Combustion-related shear-flow dynamics in elliptic supersonic jets p 819 A89-53930
- KOSHIKA, N. Full-scale aircraft impact test for evaluation of impact
- forces. Part 1: Test plan, test method, and test results p 836 N89-29343 [DE89-009329] Full-scale aircraft impact test for evaluation of impact force. Part 2: Analysis of results
- p 836 N89-29344 [DE89-0093351 KRAUS, KENNETH
- Impact of automated weather observing systems on aviation p 869 A89-54795 KRAVETS, V. V.
- Separated flow past a concave conical wing of large transverse curvature at small angles of attack p 820 A89-54619

KUCHER, A. G.

Probabilistic methods for estimating the remaining life of structural elements of operating aircraft gas turbine enaines p 839 A89-52832 KUCZERA, HERIBERT

Saenger: An advanced space transport system for Europe - Program overview and key technology needs p 856 A89-54329

KUHN, PETER M.

B-6

- Aircraft low level wind shear detection and warning system p 838 A89-54848 KUMAR. A.
- Mixing augmentation technique for hypervelocity scramjets p 840 A89-53351 KUMAR, ANAND
- Flow calculation over a delta-wing using the thin-layer Navier-Stokes equations
- p 822 N89-28497 (PD-CE-8924) KURSHAKOV, M. IU.
- Construction of general-purpose supersonic nozzles of conical cross section p 821 A89-54624 KURZINER, RUVIM I.
- Jet engines for high supersonic flight velocities (2nd p 841 A89-54884 revised and enlarged edition) KWOK. YUE-KUEN
- A regular perturbation method for subcritical flow over p 818 A89-53570 a two-dimensional airfoil

- LACALLI, ROBERT P. Economics of hypersonic flight p 878 A89-54351 LAEL TIMOTHY J.
- Interfacing hypersonic aircraft in the National Airspace System p 831 A89-54366
- LAMBERT, MARK Mi-28 Havoc is still tomorrow's tank-buster
- p 832 A89-52514 LAPUMA, PETER T. Specifications and measurement procedures and aircraft
- transparencies [AD-A209396] p 834 N89-28511
- LARSON, DEAN C.
- Weather information systems for pilots The Minnesota xperience p 872 A89-54866 LAUNDER, BRIAN E.
- Turbulent shear flows 6: International Symposium, 6th. Universite de Toulouse III, France, Sept. 7-9, 1987, p 861 A89-52943 Selected Papers
- LAURENSON, ROBERT M. Chaotic response of aerosurfaces with structural nonlinearities
- [AD-A2084331 p 824 N89-29316 LEE. D. J.
- Engine combustion optimization by exhaust analysis [PB89-195788] p 859 N89-28588 LEE. S. P.
- Stability analysis of flexible body dynamics for a highly maneuverable fighter aircraft [AIAA PAPER 89-3471] p 845 A89-52565
- LEITAO, A. L. F.
- Proportional hazards modelling of aircraft cargo door complaints p 825 A89-52325 LEPERA. M. E.
- A survey of JP-8 and JP-5 properties [AD-A207721] p 860 N89-28661 LESCH. KLAUS
- Optimal control for maximum energy extraction from wind shear [AIAA PAPER 89-3490] p 846 A89-52583
- LEVENDOSKI, R. J.
- Accident/incident data analysis database summaries. olume 1
- p 827 N89-29332 [DOT/FAA/DS-89/17-1] Accident/incident data analysis database summaries,
- volume 2 [DOT/FAA/DS-89/17-2] p 828 N89-29333
- LEVESQUE. PATRICK
- Physical mechanisms and disturbances related to the attachment of an electric arc to a conductive cylinder [ONERA-NT-1988-2] p 866 N89-29698
- LEWICKI, D. G. Computerized life and reliability modeling for turboprop
- transmissions p 863 A89-53364 LEWIS, MARK J. Application of compound compressible flow to
- nonuniformities in hypersonic propulsion systems p 818 A89-53367
- LI, F. K.
- Airborne rain mapping radar p 837 A89-53313 LIECHTI, K. M.
- High temperature adhesive systems [AD-A209166] p 860 N89-28643 LIN, CHIN E.
- An improved pseudo state method for aircraft controlle p 851 A89-53955 desian
- LIPP. A. Injection moulded ceramic rotors - Comparison of SiC and Si3N4 p 858 A89-53658
- LITVINOV, V. B.

LONGLEY, J. P.

- A study of the stress-strain state of connections in an orthotropic material p 864 A89-54585 LIU, KOUNG-YING
- A case study of local severe weather at Chang Kai Shek International Airport p 871 A89-54846 LIU. S. P.
- Finite element based modal analysis of helicopter rotor p 832 A89-52044 blades LIU. WANXUE
- Research on surge monitoring system of turbojet engine p 840 A89-54131 on active service LOGINOV, VASILII E.
- Diagnostics and control of the fuel systems of aircraft engines p 841 A89-54881 LOGVINENKO, V. V.
- Recovery of the fatigue strength of structural elements of aluminum alloys by surface hardening
 - p 857 A89-52827
- Calculations of inlet distortion induced compressor flow field instability p 818 A89-52498

LOOZE, DOUGLAS P.

Linear quadratic Gaussian design for robust performance of a highly maneuverable aircraft [AIAA PAPER 89-3457] p 844 A89-52555

PERSONAL AUTHOR INDEX

- LORCH, DANIEL R. Ultra high bypass aircraft sonic fatigue
- p 831 A89-51898 LOTZE. A.

Application of modern optimization tools for the design of aircraft structures p 834 A89-54471

- LU. XIAOLING Application of upwind factor method to transonic cascade calculation
- p 817 A89-52309 LUCK, ROGELIO Extended observability of linear time-invariant systems
- under recurrent loss of output data
- [AIAA PAPER 89-3510] p 873 A89-52603 An observer-based compensator for distributed delays in integrated control systems
- [AIAA PAPER 89-3541] p 847 A89-52628 LUDWIG, HAL
- The status of the FAA Central Weather Processor (CWP) program p 872 A89-54857
- LUERS, J. K.
- The role of the Smith-Feddes model in improving the forecasting of aircraft icing p 827 A89-54823 LUIDENS, ROGER W.
- Aeronautical applications of high-temperature uperconductors
- [AIAA PAPER 89-2142] p 840 A89-53304 LUN, YIYUN
- Flight tests for air intake flowfield and engine operating p 839 A89-52317 stability LUTZE, FREDERICK H.

LDIS (Lightning Data and Information Systems) - A new

Μ

Some aspects of aircraft dynamic loads due to flow

Comparison of flow-visualised vortices with computed

Transition flight experiments on a swept wing with

Calculation of the effect of the location of the jet-engine

Algebraic loop transfer recovery - An application to the

Microburst detection and display by TDWR - Shape,

Gust front detection algorithm for the Terminal Doppler

Perspective on Japanese Space Plane research and

The status of the FAA Central Weather Processor (CWP)

Superconducting Meissner effect bearings for cryogenic

The acoustic calibration of aircraft fuselage structures,

Design by functional feature for aircraft structure

design of a helicopter output feedback control la

Weather Radar. II - Performance assessment

Composite material repair and reliability

air inlets on the air flow in front of the inlets

p 850 A89-52690

p 850 A89-52694

p 837 A89-52974

p 869 A89-54801

p 876 A89-53945

p 832 A89-52959

p 821 N89-28489

p 819 A89-53830

p 820 A89-54486

p 836 N89-29345

p 849 A89-52662

p 868 A89-54785

p 871 A89-54852

p 856 A89-54332

p 859 N89-28574

p 872 A89-54857

p 865 N89-28839

p 877 N89-29158

A perfect explicit model following control solution to

On optimal rigid body motions

resource for aviation meteorology

geometry over thin delta wings

[AIAA PAPER 89-3612]

[AIAA PAPER 89-3616]

LYNN, NORMAN

LYRINTZIS, A. S.

MABEY. D. G.

separation

MACLAREN, L. D.

AD-A2090831

MADDALON, D. V.

MADEJ, LUCJAN

MAGLEBY, SPENCER P.

[AIAA PAPER 89-3579]

MAHONEY, WILLIAM P., III

MAHONEY, WILLIAM

extent, and alarms

MAITA, MASATAKA

development

MAMAN, SHMUEL

[AD-A209150]

MARSHALL, JEFFREY S.

turbomachines, phase 1 [AD-A209875]

[ISVR-TR-169-PT-1]

MANDEL, ERIC

program

MASON, J. M.

part 1

suction

MAGNI, J. F.

I YONS, W. A

Sensitive skins

imperfect model following control problems

Use of the Kirchhoff method in acoustics

PERSONAL AUTHOR INDEX

MATTERN, DUANE

- Integrated flight/propulsion control system design based on a decentralized, hierarchical approach
- [AIAA PAPER 89-3519] p 851 A89-53301 MATTERN, DUANE L. Integrated flight/propulsion control system design based
- on a centralized approach [AIAA PAPER 89-3520] p 847 A89-52611 MAYOU, LARRY
- Impact of automated weather observing systems on viation p 869 A89-54795 aviation
- MCAFEE, KEVIN A. Design, fabrication, and testing of a composite main
- [SME PAPER EM88-551] p 834 A89-54901
- MCCARTHY, JOHN The FAA Terminal Doppler Weather Radar (TDWR) p 871 A89-54855 program
- MCCASLAND, WILLIAM N.
- Fault-tolerant sensor and actuator selection for control of flexible structures p 874 A89-54007 MCCOY, KEVIN D.
- Flight test of the F100-PW-220 engine in the F-16 p 840 A89-53366 MCDONALD, H.
- Hypersonic vehicle environment simulation, phase 1 AD-A209030] p 864 N89-28754 [AD-A209030]
- MCFALLS, DAVID S. An optimal material removal strategy for automated repair of aircraft canopies p 874 A89-53416
- MCGINLEY, JOHN A cooperative study on winter icing conditions in the
- Denver area p 869 A89-54806 MCKAY, ESTHER L.
- The World Area Forecast System p 870 A89-54827 MCMANUS, JOHN W.
- Application of Artificial Intelligence (AI) programming techniques to tactical guidance for fighter aircraft [AIAA PAPER 89-3525] p 815 A89-52614
- MĚNON, P. K. Synthesis of a helicopter full authority controller
- p 843 A89-52547 [AIAA PAPER 89-3448] MENON, P. K. A.
- p 831 A89-51703 Study of aircraft cruise Passive navigation using image irradiance tracking
- [AIAA PAPER 89-3500] p 828 A89-52592 Study of a pursuit-evasion guidance law for high p 853 A89-54084 performance aircraft
- MENSON, HEINRICH
- Status and development potential of the fly by light technology in civil aircraft [ILR-MITT-212]
- p 854 N89-28522 MERCER JOHN R
- Small scale model tests in small wind and water tunnels at high incidence and pitch rates. Volume 1: Test program and discussion of results [AD-A208647] p 821 N89-28488
- MERRIGNTON, G. L.
- A modified least squares estimator for gas turbine identification
- p 842 N89-29348 [AD-A207911]
- MERRILL, WALTER C. A real time microcomputer implementation of sensor failure detection for turbofan engines
- [NASA-TM-102327] p 876 N89-29032 MERRITT, FERGUS
- Scientific visualization in computational aerodynamics p 875 A89-54907 at NASA Ames Research Center
- MEYER, GEORGE On the design of nonlinear controllers for flight control
- systems [AIAA PAPER 89-3489] p 845 A89-52582
- MICKELSON, WILMER A. Development and flight evaluation of an integrated
- GPS/INS navigation system [AIAA PAPER 89-3498] p 828 A89-52590
- MIDDLETON, DAVID B. Evaluation of a takeoff performance monitoring system display p 837 A89-51704
- MILLER, JUDITH Correlation of Puma airloads: Evaluation of CFD prediction methods
- [NASA-TM-102226] p 822 N89-28498 MINTO, K. DEAN
- Lateral axis autopilot design for large transport aircraft An explicit model-matching approach
- p 852 A89-53976
- MITCHELL, DAVID G. Flight investigation of helicopter low-speed response requirements p 842 A89-51702 MITTAL, MANOJ
- Comparison of nonlinear controllers for twin-lift configurations
- [AIAA PAPER 89-3591] p 849 A89-52671

- MIYAZAWA, YOSHIKAZU
 - Robust control system design with multiple model approach and its application to active flutter control [AIAA PAPER 89-3578] p 849 A89-52661
 - MONTOYA, L. C. Transition flight experiments on a swept wing with action p 819 A89-53830 suction MOON. D. A.
 - LDIS (Lightning Data and Information Systems) A new p 869 A89-54801 resource for aviation meteorology MORGAN, J. MURRAY
 - Flight investigation of helicopter low-speed response requirements p 842 A89-51702
 - MORRIS, GLENN Thermal stress analysis of the NASA Dryden hypersonic p 856 A89-54340 wing test structure
 - MORSE, WILLIAM
 - Flight control reconfiguration using model reference adaptive control p 852 A89-53959 MOSELEY, WARREN
 - Intelligent avionics p 838 A89-54345 MOZALEV, V. V.
 - Recovery of the fatigue strength of structural elements of aluminum alloys by surface hardening
 - p 857 A89-52827 MUELLER, BERNHARD
 - Navier-Stokes computation of transonic vortices over a round leading edge delta wing p 817 A89-52483 p 817 A89-52483 MUKHOPADHYAY, VIVEK
 - A multiloop, digital flutter suppression control law synthesis case study [AIAA PAPER 89-3556] p 848 A89-52642
- MURAKAMI, M.
- Development of a flight control system for VTOL aircraft supported by ducted fans [AIAA PAPER 89-3592] p 849 A89-52672
- MURPHY, T. P. Accident/incident data analysis database summaries,
- volume 1 [DOT/FAA/DS-89/17-1] o 827 N89-29332
- Accident/incident data analysis database summaries, volume 2
- [DOT/FAA/DS-89/17-2] p 828 N89-29333 MURTHY, S. N. B. Turbulent reactive flows p 857 A89-51860
- MURTY, V. D.
- A comparison of mixed and penalty finite element methods in analysis of heat exchangers p 862 A89-53254
- MUTO, K.
- Full-scale aircraft impact test for evaluation of impact forces. Part 1: Test plan, test method, and test results [DE89-0093291 p 836 N89-29343
- Full-scale aircraft impact test for evaluation of impact force. Part 2: Analysis of results [DE89-009335] p 836 N89-29344
 - Ν
- NAGABHUSHANAM, J. Prediction of inplane damping from deterministic and stochastic models p 832 A89-52042 NAGARAJ, C. S.
- Prediction of inplane damping from deterministic and stochastic models p 832 A89-52042 NAGASHIMA, MASAYOSHI
- Study on a design method for the lateral stability of the airplane by the conditions for the steady horizontal turn p 851 A89-53640 with control surfaces fixed NAKAMICHI, JIRO
- Some computations of unsteady Navier-Stokes flow
- around oscillating airfoil/wing [NAL-TR-1004T] p 822 N89-28492 NAPOLITANO, MARCELLO R. A new technique for
- aircraft flight control reconfiguration
- [AIAA PAPER 89-3425] p 843 A89-52527 NEILAND, V. M.
- Optimal permeability of wind tunnel walls at low supersonic velocities p 821 A89-54625 NESS, P. S.
- A knowledge based tool for failure propagation nalysis p 874 A89-53970 analysis NEUMÁNN, RICHARD D.
- Aerothermodynamic instrumentation
- p 866 N89-29310 NEWMAN, BRETT
- On the control of elastic vehicles Model simplification and stability robustness
- [AIAA PAPER 89-3558] p 873 A89-52715 NEWTON, D. W.
- Proportional hazards modelling of aircraft cargo door p 825 A89-52325 complaints

Turbulence modeling in a hypersor	nic inlet	
•	p 819	A89-53931
IISSIM, E.	'	
Modeling of aerodynamic forces in	the Lap	lace domain
with minimum number of augmented	states fo	or the design
of active flutter suppression systems		-
[AIAA PAPER 89-3466]	p 844	A89-52561
ITSCHE, WOLFGANG		
Piezoelectric foils as sensors in	experir	nental flow
mechanics	•	
[ILR-MITT-214]	p 865	N89-28800
IVEN, ANDREW J.	•	
Analysis of reattachment during rai	mp dowi	n tests
	p 816	A89-52043
IWA, S.	•	
Development of a flight control syst	em for V	TOL aircraft
supported by ducted fans		
[AIAA PAPER 89-3592]	p 849	A89-52672
IXON, DAVID	•	
Transonic flows with vorticity trans	port aro	und slender
bodies		A89-53949
OFFZ, GREGORY	F · · · ·	
Water tunnel flow visualization	on a	hypersonic
configuration		A89-54373
OLL, THOMAS E.	•	
A multiloop, digital flutter suppl	ression	control law
synthesis case study		
[AIAA PAPER 89-3556]	p 848	A89-52642
ORTHAM, G. BURTON	•	-
Plasma torch igniter for scramjets	p 858	A89-53355
OVINGON T		

OMINSKY, D.

- NOVINSON, T. Joint sealants for airport pavements. Phase 1: aboratory and field investigations
- [DOT/FAA/DS-89/2-PHASE-1] p 854 N89-28523

О

O'BRIEN, WALTER F.

M

NG, W. F.

- Plasma torch igniter for scramjets p 858 A89-53355 OBAYASHI, SHIGERU
- Use of high-resolution upwind scheme for vortical flow simulations
- [NASA-CR-185910] p 824 N89-29321 OCHI, YOSHIMASA
- Modification of trim point and feedback gains for failed aircraft
- [AIAA PAPER 89-3507] p 846 A89-52600 ODEN, J. TINSLEY
 - Thermo-viscoplastic analysis of hypersonic structures subjected to severe aerodynamic heating [NASA-CR-185915] p 825 N89-29328
- ODONI, AMEDEO R.
- Ground-holding strategies for ATC flow control [AIAA PAPER 89-3628] p 829 A8 p 829 A89-52702 OGAWA, SATORU
- On TVD difference schemes for the three-dimensional Euler equations in general co-ordinates
 - p 817 A89-52484

Perspective on Japanese Space Plane research and

Numerical simulation and hydrodynamic visualization of transient viscous flow around an oscillating aerofoil

Full-scale aircraft impact test for evaluation of impact

prces. Part 1: Test plan, test method, and test results

Full-scale aircraft impact test for evaluation of impact force. Part 2: Analysis of results

Technical communication in aeronautics - Results of an kploratory study p 877 A89-53330

Gust front detection algorithm for the Terminal Doppler

MET 90, a project for the development of the future

An effective flutter control method using fast, time-accurate CFD codes

Weather Radar. II - Performance assessment

Swedish aviation weather system

Economics of hypersonic flight

[AIAA PAPER 89-3468]

p 825 N89-29326

p 856 A89-54332

p 817 A89-52481

p 836 N89-29343

p 836 N89-29344

p 871 A89-54852

p 870 A89-54817

p 878 A89-54351

p 845 A89-52563

B-7

OH, SEJONG Control of separated flow past a cylinder using tangential

OHMI, K.

OHRUI, S.

wall jet blowing [NASA-CR-185918]

OHKAMI. YOSHIAKI

development

[DE89-009329]

[DE89-009335]

exploratory study

OLSON, STEPHEN H.

OLSSON, ESBJORN

OMAN. HENRY

OMINSKY, D.

OLIU, WALTER E.

OSBORNE, LEON

OSBORNE, LEON

- A cooperative study on winter icing conditions in the Denver area p 869 A89-54806 OSBORNE, LEON F., JR.
- Remote detection of aircraft icing hazards by Doppler p 826 A89-54805 radar Severe aircraft icing events - A Colorado case study p 827 A89-54838

OSSMAN, KATHLEEN

- Flight control reconfiguration using model reference ive control p 852 A89-53959 OSSWALD, G. A.
- Analysis of incompressible massively separated viscous flow using unsteady Navier-Stokes equations p 818 A89-52485
- OSTROFF, AARON J. Application of variable-gain output feedback for high-alpha control
- p 848 A89-52659 AIAA PAPER 89-3576]
- OTHMAN, M. Z. Design of adaptive digital model-following flight-mode control systems for high-performance aircraft [AIAA PAPER 89-3495] p 846 p 846 A89-52587
- OTMAN, ZAKHARII S. Diagnostics and control of the fuel systems of aircraft
- p 841 A89-54881 engines

P

- PAILHAS. G.
- Experimental investigation of a three dimensional wake in the vicinity of a wing-body junction [CERT-0A-29/5025-AYD] p 825 N89-29325
- PAJAK, M. E. A comparison of mixed and penalty finite element methods in analysis of heat exchangers
- p 862 A89-53254 PANZER, DAVID
- The status of the FAA Central Weather Processor (CWP) p 872 A89-54857 program
- PARK, KIHONG Thrust laws for microburst wind shear penetration [AIAA PAPER 89-3560] p 848 A89-52645
- PARKINSON, GEOFFREY Phenomena and modelling of flow-induced vibrations
- of bluff bodies p 861 A89-52961 PARKS, G. S.
- Airborne rain mapping radar p 837 A89-53313 PARRISH, R. L.
- Full-scale aircraft impact test for evaluation of impact forces. Part 1: Test plan, test method, and test results p 836 N89-29343 [DE89-0093291 Full-scale aircraft impact test for evaluation of impact
- force. Part 2: Analysis of results p 836 N89-29344 [DE89-0093351 PATEL. T. S.
- Thin aerofoil with multiple slotted flap
- p 816 A89-51625 PATEL, V. C.
- Evolution of axisymmetric wakes from attached and eparated flows p 818 A89-52945 PATTON B .I
- Robust eigenstructure assignment for flight control using the Ctrl-C design package
- p 850 A89-52685 [AIAA PAPER 89-36071 PAUL. D. B.
- A comparison of mixed and penalty finite element methods in analysis of heat exchangers p 862 A89-53254
- PAYNE, JACQUELINE B.
- Determining cure cycles for thermosetting epoxy resins
- (SME PAPER EM88-533) p 864 A89-54890 PEREZHIGINA, M. V.
- Denormalized product of the adsorptive zeolite extraction of paraffins as a jet fuel component p 857 A89-52775
- PERRIN, R. H.
- Identification of an adequate model for collective esponse dynamics of a Sea King helicopter in hove p 836 N89-29341 [AD-A208060] PERRY, BOYD, III
- A multiloop, digital flutter suppression control law synthesis case study
- [AIAA PAPER 89-3556] p 848 A89-52642 PETERSON, VICTOR L.
- Supercomputer requirements for selected disciplines p 874 A89-53152 important to aerospace PETIT. N. J.
- LDIS (Lightning Data and Information Systems) A new esource for aviation meteorology p 869 A89-54801 PETITDAMAGE, V.
- Laser velocimetry in the close wake of an axisymmetric rear body
- p 865 N89-28774 [ISL-R-114/87]

PFEIL, H.

- Differing development of the velocity profiles of three-dimensional turbulent boundary layer p 819 A89-53947
- PHATAK, ANIL V.
- Rotorcraft deceleration to hover using image-based p 830 A89-54082 quidance PINELLI, THOMAS E.
- Technical communication in aeronautics Results of an exploratory study p 877 A89-53330 PLESSEL TODD
- Scientific visualization in computational aerodynamics NASA Ames Research Center p 875 A89-54907 POKROVSKII, A. V.
- Precision characteristics of a coordinate device for estimating the velocity of an object p 830 A89-52779 POLADIAN, D.
- High altitude reconnaissance aircraft design p 833 A89-54200 [AIAA PAPER 89-2109] POLITOVICH, MARCIA K.
- Aircraft icing caused by large supercooled droplets p 826 A89-53793
- Measurements of hazardous icing conditions p 826 A89-54804 A cooperative study on winter icing conditions in the
- p 869 A89-54806 Denver area Aircraft icing conditions detected by combined remote
- p 827 A89-54807 ensors - A preliminary study POPA FOTINO, INGRID A.
- Aircraft icing conditions detected by combined remote insors - A preliminary study p 827 A89-54807 POPE, RICK
- Map, Operator, Maintenance Stations
- p 854 A89-52613 [AIAA PAPER 89-3523] PORTER, B.
- Design of adaptive digital model-following flight-mode control systems for high-performance aircraft [AIAA PAPER 89-3495] p 846
- p 846 A89-52587 Design of tunable digital set-point tracking PID controllers for gas turbines with unmeasurable outputs [AIAA PAPER 89-3577] p 839 A89-52660 POTASHEV. A. V.
- Solution of the inverse boundary value problem of aerohydrodynamics with allowance for the boundary p 864 A89-54611 iave
- PRASAD, ARUN Gas turbine research and development in India p 841 A89-54473
- PRASAD, J. V. R. Comparison of nonlinear controllers for twin-lift
- configurations [AIAA PAPER 89-3591] p 849 A89-52671
- PRATHER. W. D. Excitation of aircraft for hardness surveillance using the
- aircraft's own HF antenna p 854 A89-53476 PREVIC, FRED H.
- Towards a physiologically based HUD (Head-Up Display) symbology
- p 838 N89-28515 AD-42077481 PRICE, F. DEAN
- Microcomputer simulation of lubricant degradation in turbine engines using laboratory data p 859 A89-54986
- PROCTOR, FRED H.
- A relationship between peak temperature drop and p 867 A89-54777 velocity differential in a microburst PSIAKI MARK I.
- Thrust laws for microburst wind shear penetration [AIAA PAPER 89-3560] p 848 A89-52645 PUTNAM, R. J.
- Transition flight experiments on a swept wing with p 819 A89-53830 suction

R

- RABIN, URI H.
- Evaluation methods for complex flight control systems [AIAA PAPER 89-3502] p 846 A89-52595 RÀDIL, K. C.
- Computerized life and reliability modeling for turboprop transmissions p 863 A89-53364 RAIZENNE, M. D.
- A proposed composite repair methodology for primary tructure p 858 A89-54429 structure
- RAUSHENBAKH, B. V. Investigations in the history and theory of the development of aviation and rocket and space science and technology, No. 6 p 879 A89-52923 RAY. ASOK
- Extended observability of linear time-invariant systems under recurrent loss of output data
- p 873 A89-52603 [AIAA PAPER 89-3510] An observer-based compensator for distributed delays in integrated control systems
- [AIAA PAPER 89-3541] p 847 A89-52628

PERSONAL AUTHOR INDEX

REDDY, B. S.

- Adaptive control of high performance unstable aircraft - A review p 851 A89-52989 REDDY, K. R.
- Incorporation of vortex line and vortex ring hover wake models into a comprehensive rotorcraft analysis code p 835 N89-29338 [AD-A2080361 REGIS, RENAUD
- The Locstar radiodetermination satellite system p 830 A89-53660

REINHARD, D. J.

BOBERTS, BITA D.

ROTHSTEIN, STEVEN W.

[AIAA PAPER 89-3463]

variations in Reynolds number

Flash lamp planar imaging

[AIAA PAPER 89-3505]

SABA, COSTANDY S.

AD-A208925]

SABATINO. C.

fatique test

SABER, A. J.

SABNIS, J. S.

AD-A2090301

wind shear

SACHS, GOTTFRIED

[AIAA PAPER 89-3490]

SADOWSKI, DENNIS R.

AD-A209321 }

[NAPC-PE-1851

[NAPC-PE-188]

fatique test

SALVINO, J. T.

SALA. A.

1987

RÙIZ. C.

biaxial model

RYAN, LAURA E.

evetom

High-resolution

RUSSELL, L. M.

ROONEY, R.

- High altitude reconnaissance aircraft design
- [AIAA PAPER 89-2109] p 833 A89-54200 RENWICK, JIM Very short-range aerodrome forecasts using regression
- p 870 A89-54831 techniques RHODES, TOM
- History of the airframe. III p 833 A89-53631
- **BICHARDS, P. G.** Comparative durability of six coating systems on first-stage gas turbine blades in the engines of a long-ra p 858 A89-54255 maritime patrol aircraft
- RICHTER, H. High-performance fiber composite materials with
- thermoplastic matrix MBB-Z-0257-89-PUB1 p 857 A89-53310 **RIDDER, SVEN-OLOF**
- Wind tunnel tests of 16 percent thick airfoil with 30 percent trailing edge flap at high angles of attack and with flap angles
- FFA-TN-19 85-581 p 823 N89-28500 **BIZZI, ABTHUR**
- Navier-Stokes computation of transonic vortices over round leading edge delta wing p 817 A89-52483 ROBEL GREG
- Design of localizer capture and track modes for a lateral autopilot using H(infinity) synthesis p 852 A89-53977 ROBERTS, LEONARD
- Control of the wall jet blowing Control of separated flow past a cylinder using tangential

Evaluation of microburst nowcasting during TDWR

Surface failure detection and evaluation of control law

Integrated control and avionics for air superiority -

Fatigue life of dovetail joints - Verification of a simple

liquid-crystal

measurements on the endwall of a turbine passage with

Application of stochastic robustness to aircraft control

AE monitoring of airframe structure during full scale

Hypersonic vehicle environment simulation, phase 1

Optimal control for maximum energy extraction from

Workshop proceedings on Composite Aircraft Certification and Airworthiness

AE monitoring of airframe structure during full scale

Statistics on aircraft gas turbine engine rotor failures

Statistics on aircraft gas turbine engine rotor failures

that occurred in US commercial aviation during 1985

that occurred in US commercial aviation during 1984

S

Lubricant evaluation and performance

Computational aspects of real-time flight managem

for reconfiguration of flight control system

ER 89-35091

p 825 N89-29326

p 870 A89-54813

p 847 A89-52602

p 837 A89-52559

p 863 A89-54119

p 862 A89-53289

p 846 A89-52598

p 865 N89-28835

p 863 A89-53322

p 863 A89-54348

p 864 N89-28754

p 846 A89-52583

p 835 N89-29336

p 863 A89-53322

p 841 N89-28516

p 841 N89-28517

heat-transfer

PERSONAL AUTHOR INDEX

SAND, WAYNE R.

- A cursory study of F-factor applied to Doppler radar p 853 A89-54799 A cooperative study on winter icing conditions in the
- p 869 A89-54806 SANDLIN, DORAL B. Analysis of leading edge separation using a low order
- nanal mathod [NASA-CR-185892] p 822 N89-28493
- SASTRY, SHANKAR On the design of nonlinear controllers for flight control
- systems AIAA PAPER 89-3489] p 845 A89-52582
- SAUER. GERHARD Finite element analysis of gyroscopic effects p 863 A89-53499
- SAVAGE. M. Computerized life and reliability modeling for turboprop p 863 A89-53364 transmissions
- SCHADOW, K. C. Noncircular jet dynamics in supersonic combustion p 863 A89-53353 Combustion-related shear-flow dynamics in elliptic
- p 819 A89-53930 SCHAFFER H. J.
- Measurements of mean-flow and turbulence characteristics in a turbojet exhaust using a laser velocimeter
- [ISL-CO-226/88] p 841 N89-28519 SCHAFFAR. M. Study of the wing-vortex interaction in three dimensional
- flows (incompressible inviscid flow) [ISL-R-123/87] p 822 N89-28494
- Profile-vortex interactions [ISL-R-125/87] p 822 N89-28495
- SCHENK, HANS-DIETER Operational experience with the Computer Oriented Metering Planning and Advisory System (COMPAS) at Frankfurt, Germany
- [AIAA PAPER 89-3627] p 829 A89-52721 SCHENKE, MICHAEL
- Flash lamp planar imaging p 863 A89-54348 SCHLATTER, THOMAS W.
- A 3-hour mesoscale assimilation system using ACARS aircraft data combined with other observations
- p 869 A89-54797 SCHMIDT, DAVID K.
- Flight control synthesis for an unstable fighter aircraft using the LOG/LTR methodology
- [AIAA PAPER 89-3452] p 844 A89-52551 Integrated structure/control law design by multilevel optimization
- [AIAA PAPER 89-3470] p 873 A89-52564 On the control of elastic vehicles - Model simplification
- and stability robustness p 873 A89-52715 [AIAA PAPER 89-3558]
- An uncertainty model for saturated actuators p 833 A89-54066
- SCHMIDT, FRANK W.
- Turbulent shear flows 6; International Symposium, 6th, Universite de Toulouse III, France, Sept. 7-9, 1987, Selected Papers p 861 A89-52943 SCHRAGE, D. P.
- Synthesis of a helicopter full authority controller [AIAA PAPER 89-3448] p 843 A89-52547 Comparison of nonlinear controllers for twin-lift configurations
- [AIAA PAPER 89-3591] p 849 A89-52671 SCHRAGE, DANIEL P.
- Optimal output feedback for linear time-periodic systems
- [AIAA PAPER 89-3574] p 873 A89-52657 SCHUETTE, RALPH
- Status and development potential of the fly by light technology in civil aircraft [ILR-MITT-212] p 854 N89-28522
- SCHWEIGER, J.
- Application of modern optimization tools for the design aircraft structures p 834 A89-54471 of aircraft structures SCHWOERKE, STEVE N.
- Small scale model tests in small wind and water tunnels at high incidence and pitch rates. Volume 1: Test program and discussion of results
- p 821 N89-28488 [AD-A208647] SCOTT, J. R.
- Time domain numerical calculations of unsteady vortical flows about a flat plate airfoil
- [NASA-TM-102318] p 866 N89-29726 SCOTT, WILLIAM B. AT3 demonstrates feasibility of cargo STOL with long
- p 832 A89-52201 range SEIBOLD, R. W.
- High temperature adhesive systems
- p 860 N89-28643 [AD-A209166]

- SELA. N.
- Interlaminar fracture toughness and toughening of laminated composite materials - A review p 858 A89-54426
- SESHADRI, S. N. Evaluation of LDA 3-component velocity data on a 65 deg delta wing at M = 0.85 and first results of an
- analysis [DFVLR-FB-89-19] p 823 N89-28505
- SEVERSON, V. L. Lightning protection testing of the E-6 wing tip antenna pod/HF probe p 825 A89-53474
- SHAFFER, PHILLIP L. Experience with implementation of a turbojet engine control program on a multiprocessor
- p 875 A89-54106 SHAH. S. C.
- A real-time expert system for self-repairing flight control
- [AIAA PAPER 89-3427] p 843 A89-52528 SHALAEV, V. I.
- A three-dimensional boundary layer in finite-span thin winas p 818 A89-52843 SHAPIRO, E. Y.
- A systematic approach to gain suppression using p 875 A89-54024 eigenstructure assignment SHARMA, MEERA
- Collision avoidance operational concept WP-88W004181 p 831 N89-28509
- SHARP, H. THOMAS
- Constructing a continuous parameter range of computational flows p 819 A89-53928 SHCHERBAKOV, S. A.
- Calculation of transonic flow past the tail section of a plane or axisymmetric body p 820 A89-54535 SHENG. CHUNHUA
- Solution for two-dimensional inviscid transonic cascade p 817 A89-52308 flows with multiple-grid algorithm SHIGEMI. MASASHI
- Finite element analysis of incompressible viscous flows around single and multi-element aerofoils in high Reynolds number region
- NAL-TR-1010T1 p 865 N89-28765 SHIMABUKURO, S.
- High temperature adhesive systems [AD-A209166] p 860 N89-28643 SHINAR, J.
- Improved guidance law design based on the mixed-strategy concept SHINOKI, SHUJI p 828 A89-51716
- Secondary flow control and loss reduction in a turbine cascade using endwall fences SHYU, TIAN-YOW p 816 A89-51679
- A case study of local severe weather at Chang Kai Shek p 871 A89-54846 International Airport SIMONEAU, R. J.
- Heat transfer in aerospace propulsion
- p 862 A89-53282 SIMONEAU, ROBERT J.
- CFD in the context of IHPTET The Integrated High Performance Turbine Engine Technology Program [AIAA PAPER 89-2904] p 862 A89-53307 SIMONICH. J. C.
- Noise produced by turbulent flow into a rotor: Users manual for noise calculation
- p 876 N89-29152 [NASA-CR-181790]
- Noise produced by turbulent flow into a rotor: Users manual for atmospheric turbulence prediction and mean flow and turbulence contraction prediction
- p 876 N89-29154 [NASA-CR-181791] SIMPSON, D. L.
- A proposed composite repair methodology for primar p 858 A89-54429 structure SINCLAIR, PETER C.
- Aircraft low level wind shear detection and warning p 838 A89-54848 system SINGH, SAHJENDRA N.
- Asymptotically decoupled variable structure control of systems and large maneuver of aircraft
- p 852 A89-53988 SIRAZETDINOV, T. K. Fixed-sign condition for integral quadratic forms and
- stability of systems with distributed parameters p 875 A89-54540
- SIROVICH, L. Constructing a continuous parameter range of computational flows p 819 A89-53928 SITZ. JOEL R.
- Initial flight qualification and operational maintenance of X-29A flight software [AIAA PAPER 89-3596] p 850 A89-52675
- SLATER, G. L. Parallel dynamic programming for on-line flight path
- otimization [AIAA PAPER 89-3615] p 832 A89-52693

SLIWA, STEVEN M.

Modal techniques for analyzing airplane dynamics AIAA PAPER 89-3609] p 850 A89-52687 SMITH, HOOVER A.

STENGEL, ROBERT F.

- Lubricant evaluation and performance [AD-A208925] p 865 N89-28835
- SMITH, P. R. Comparison of eigenstructure assignment and the
- Salford singular perturbation methods in VSTOL aircraft control law design
- [AIAA PAPER 89-3451] p 844 A89-52550 Comparison of Characteristic Locus and h-infinity methods in VSTOL flight control system design [AIAA PAPER 89-3491] p 846 A89-52584
- SMITH STEVEN D
- Gust front detection algorithm for the Terminal Doppler Weather Radar. II - Performance assessment p 871 A89-54852
- SMOLSKIS, RICHARD K.
- Optimal trajectory generation and design trades for p 855 A89-54009 hypersonic vehicles SMYTHE, GLENN R.
- Evaluation of the 12-station enhanced Low Level Wind Shear Alert System (LLWAS) at Denver Stapleton International Airport p 868 A89-54784 SNELL. ANTHONY
- Nonlinear longitudinal control of a supermaneuverable aircraft p 851 A89-53957 SNELL, S. ANTONY
- Nonlinear control of a supermaneuverable aircraft [AIAA PAPER 89-3486] p 845 A89-52 p 845 A89-52579
- SOBEL. K. M. A systematic approach to gain suppression using
- eigenstructure assignment SOBEL, KENNETH M. p 875 A89-54024
- Design of a modalized observer with eigenvalue sensitivity reduction p 842 A89-51723 SORINE, MICHEL
- Wideband linear quadratic Gaussian control of strapdown dry tuned gyro/accelerometers
- [AIAA PAPER 89-3441] p 837 A89-52540 SORRELLS. JAMES E. Concepts for control of hypervelocity vehicles
- p 853 A89-54347 SPALL, JAMES C.
- Identification of state-space parameters in the presence of uncertain nuisance parameters p 875 A89-54022 SPRING, S. D.
- experimental investigation of heat transfer coefficients and friction factors in passages of different aspect ratios roughened with 45 deg turbulators p 862 A89-53274

Direct User Access Terminal (DUAT) operational

Passive navigation using image irradiance tracking [AIAA PAPER 89-3500] p 828 A89-52592

Rotorcraft deceleration to hover using image-based

Integration of active and passive sensors for obstacle

suppression

Evaluation of a takeoff performance monitoring system

Superconducting Meissner effect bearings for cryogenic

Thrust vectoring effect on time-optimal 90 degrees angle

Singular trajectories for time-optimal half-loop

Maximum principle solutions for time-optimal half-loop

Application of stochastic robustness to aircraft control

STARNES, JAMES H., JR. Current research in composite structures at NASA's

An expert system for wind shear avoidance

of attack pitch up maneuvers of a high alpha fighter

p 854 N89-28524

p 830 A89-54082

p 830 A89-54083

p 850 A89-52688

p 837 A89-51704

p 865 N89-28839

p 847 A89-52612

p 850 A89-52692

p 853 A89-54081

p 861 A89-51692

p 846 A89-52598

p 826 A89-53971

B-9

invariant

using

SPRINGEN, A. L.

[WP-88W00075]

SRIDHAR, BANAVAR

SRINATHKUMAR, S. Active flutter suppressi Zeros/eigensystem assignment [AIAA PAPER 89-3610]

SRIVATSAN, RAGHAVACHARI

turbomachines, phase 1

AIAA PAPER 89-35211

Langley Research Center

[ÁIAA PAPER 89-3505]

STENGEL, ROBERT F.

systems

maneuvers of a high alpha fighter aircraft [AIAA PAPER 89-3614] p 8

maneuvers of a high alpha fighter aircraft

concent

SRIDHAR, B.

guidance

avoidance

display

aircraft

STACY, W. D.

[AD-A209875]

STALFORD, HAROLD

STEPHENS, JOSEPH R.

STEPHENS, JOSEPH R.

Intermetallic and ceramic matrix composites for 815 to 1370 C (1500 to 2500 F) gas turbine engine applications [NASA-TM-102326] p 860 N89-29490 STEPNOV, M. N.

Recovery of the fatigue strength of structural elements of aluminum alloys by surface hardening p 857 A89-52827

STICKLAND, M. T.

A detailed survey of the flow passing through an asymmetric contraction and parallel duct

[BAE-WWT-RP-RES-AXR-000194-] p 823 N89-28501 A detailed survey of the flow passing through an asymmetric contraction and parallel duct

[BAE-WWT-RP-RES-AXR-000194-] p 823 N89-28502 STOETZER, MATTHIAS-WOLFGANG

Competition and safety in air traffic

[TUB-DISS-PAPER-128] p 827 N89-28508 STOW. P.

The development of advanced computational methods p 839 A89-52482 for turbomachinery blade design STRATTON, D. ALEXANDER

An expert system for wind shear avoidance

p 826 A89-53971 STRAWN, ROGER C.

Correlation of Puma airloads: Evaluation of CFD prediction methods p 822 N89-28498 [NASA-TM-102226]

STURDY, JAMES L.

Aircraft trajectory prediction for terminal automatio [AIAA PAPER 89-3634] p 829 A89-52703 SUBRAMANIAN, C.

Performance analysis of voting strategies for a fly-by-wire p 842 A89-52168 system of a fighter aircraft SUBRAMANIAN, D. K.

- Performance analysis of voting strategies for a fly-by-wire system of a fighter aircraft p 842 A89-52168
- SUGANO, T. Full-scale aircraft impact test for evaluation of impact forces. Part 1: Test plan, test method, and test results n 836 N89-29343 p 836 N89-29343 [DE89-009329] Full-scale aircraft impact test for evaluation of impact

force. Part 2: Analysis of results p 836 N89-29344 DE89-009335] SUGIURA. I.

Development of a flight control system for VTOL aircraft supported by ducted fans

p 849 A89-52672 I AIAA PAPER 89-35921 SULLIVAN, R. BRYAN

- The flight control system for the Daedalus human powered aircraft
- AIAA PAPER 89-35931 p 849 A89-52673 SUTTON, OLIVER
- Are the Soviets set to make the big time? p 825 A89-52513 SUZUKI, M.
- Development of a flight control system for VTOL aircraft supported by ducted fans
- [AIAA PAPER 89-3592] p 849 A89-52672 Full-scale aircraft impact test for evaluation of impact forces. Part 1: Test plan, test method, and test results [DE89-009329] p 836 N89-29343
- Full-scale aircraft impact test for evaluation of impact force. Part 2: Analysis of results p 836 N89-29344 DE89-0093351

SWAIM, ROBERT L new technique for aircraft flight control

- reconfiguration [AIAA PAPER 89-3425] p 843 A89-52527
- SYKES, NANCY P. NASA Workshop on Computational Structural Mechanics 1987, part 2
- [NASA-CP-10012-PT-2] p 866 N89-29789 SZADY. M.
- One-degree-of-freedom motion induced by modeled vortex shedding
- [NASA-TM-101038] p 866 N89-28870 SZCZECINSKI, STEFAN
- Calculation of the effect of the location of the jet-engine air inlets on the air flow in front of the inlets p 820 A89-54486
- Noise produced by a jet aircraft during the engine test p 876 A89-54487 run

Т

TA PHUOC. L.

- Numerical simulation and hydrodynamic visualization of transient viscous flow around an oscillating aerofoil p 817 A89-52481
- TACHAU, R. D. M.

Full-scale aircraft impact test for evaluation of impact force. Part 2: Analysis of results [DE89-009335] p 836 N89-29344

B-10

TAGIROV, R. K.

A second-order finite-difference scheme for calculating three-dimensional supersonic flows of an ideal gas p 818 A89-52852

TAKAKURA, YOKO On TVD difference schemes for the three-dimensional Euler equations in general co-ordinates p 817 A89-52484

TAN, C. S.

- Calculations of inlet distortion induced compressor flow field instability p 818 A89-52498 TANG, GUOCAI
- An investigation on stagnation pressure errors due to p 839 A89-52315 rotation state behind a rotor TANG. SHUO
- Dynamic stability and active control of elastic vehicles acting with unsteady aerodynamic forces p 848 A89-52643 [AIAA PAPER 89-3557]
- TASLIM, M. E. An experimental investigation of heat transfer
- coefficients and friction factors in passages of different aspect ratios roughened with 45 deg turbulators p 862 A89-53274
- TAUB. ALAN I. Selecting high-temperature structural intermetallic
- compounds The materials science approach p 858 A89-54671
- TAYLOR, A. C., III Turbulence modeling in a hypersonic inlet p 819 A89-53931
- TERRAB, MOSTAFA
- Ground-holding strategies for ATC flow control [AIAA PAPER 89-3628] p 829 A89-52702 THOMPSON, DANIEL B.
- Linear token passing based bus interface unit for a fault tolerant multiprocessor testbed p 874 A89-53975 THOMS, WILLIAM E.
- Hypersonic flight and the Warsaw Convention p 878 A89-54358
- THORNTON, EARL A. Thermo-viscoplastic analysis of hypersonic structures subjected to severe aerodynamic heating р 825 N89-29328 [NASA-CR-185915]
- THYS. THIERBY N. Aerospace investment casting in the U.S.A. 1988
- p 857 A89-52022 TIMNAT, Y. M.
- Diagnostic techniques for propulsion systems p 839 A89-52960
- TOBIAS, LEONARD Controller evaluations of the descent advisor automation
- [AIAA PAPER 89-3624] p 829 A89-52699
- TOFFOLETTO, R. Incorporation of vortex line and vortex ring hover wake
- models into a comprehensive rotorcraft analysis code [AD-A208036] p 835 N89-29338 TOMLINSON, MICHAEL A.
- Federal plans to satisfy aviation weather information requirements in the 1990's p 872 A89-54865 TORII, KAHORU
- The effects of longitudinal vortices on heat transfer of laminar boundary layers p 860 A89-51680 TOROK, MICHAEL S.
- A coupled rotor aeroelastic analysis utilizing nonlinear aerodynamics and refined wake modeling
- p 831 A89-52041 TRASK, DAVID C.
- Observations and forecasts for runway (pavement) p 826 A89-54802 surfaces TSAI. YEONG-JHY
- Doppler weather radar service at the Chiang Kai-Shek
- International Airport p 871 A89-54840 TSUBOTA. H.
- Full-scale aircraft impact test for evaluation of impact forces. Part 1: Test plan, test method, and test results p 836 N89-29343 [DE89-009329] Full-scale aircraft impact test for evaluation of impact
- force. Part 2: Analysis of results p 836 N89-29344 [DE89-009335]
- TURNBULL, DONALD The FAA Terminal Doppler Weather Radar (TDWR)
- p 871 A89-54855 program TURNEY, GEORGE E.
- Aeronautical applications superconductors of high-temperature
- [AIAA PAPER 89-2142] p 840 A89-53304 TWORZYDLO, W. WOYTEK
 - Thermo-viscoplastic analysis of hypersonic structures subjected to severe aerodynamic heating
- p 825 N89-29328 [NASA-CR-185915]

PERSONAL AUTHOR INDEX

U

UECKER, JERALD The World Area Forecast System p 870 A89-54827

- UHERKA, KENNETH Aeronautical applications superconductors of high-temperature
- [AIAA PAPER 89-2142] p 840 A89-53304 UMMEL, B. R.
- A multivariable control design for the lateral axis autopilot p 852 A89-53980 of a transport aircraft UNAL. A.
- One-degree-of-freedom motion induced by modeled vortex shedding
- [NASA-TM-101038] p 866 N89-28870 UNRUH, JAMES F.
- Aircraft propeller induced structure-borne noise [NASA-CR-4255] p 876 N89-29155
- UTHUS, T. A knowledge based tool for failure propagation nalysis p 874 A89-53970 analysis

v

VACHON, D. J. High temperature adhesive systems

VENKATA KRISHNAIAH, T.

discrete-event simulation

[AIAA PAPER 89-3526]

VINCENT, JAMES H.

VOELCKERS. UWE

Frankfurt, Germany

VOLCKERS, UWE

VON RETH. R. D.

cruising aircraft

aid

AIAA PAPER 89-36271

[AIAA PAPER 89-3624]

[MBB-UD-538-88-PUB]

VONRIESEMANN, W. A.

[DE89-009329]

[DE89-009335]

VOULGARIS, PETROS

WAGNER, ELAINE A.

[AIAA PAPER 89-3456]

ontrol-impaired aircraft [AIAA PAPER 89-3460]

for a 'supermaneuverable' aircraft

VONPRAGENAU, GEORGE L.

turbomachines

VETROV, A. N.

engines

VIAN, JOHN L.

VERSTEEG, M. H. J. B.

[NLR-MP-87006-U]

Computerised design of blade

Airport noise measuring data collction system

Probabilistic methods for estimating the remaining life

Intelligent flight management performance using

Evaluation methods for complex flight control systems [AIAA PAPER 89-3502] p 846 A89-52595

Operational experience with the Computer Oriented

Controller evaluations of the descent advisor automation

EUROFAR - Project for a perpendicularly launched

Full-scale aircraft impact test for evaluation of impact forces. Part 1: Test plan, test method, and test results

Full-scale aircraft impact test for evaluation of impact force. Part 2: Analysis of results

High performance linear-quadratic and H-infinity designs

W

On-board automatic aid and advisory for pilots of

Turbornachinery rotor support with damping [NASA-CASE-MFS-28345-1] p 865

Metering Planning and Advisory System (COMPAS) at

of structural elements of operating aircraft gas turbine

- p 860 N89-28643 [AD-A209166] VÁLAVANI, LEŃA
- High performance linear-quadratic and H-infinity designs for a 'supermaneuverable' aircraft

[AIAA PAPER 89-3456] p 832 A89-52712 VEDDA, JAMES A.

- International Conference on Hypersonic Flight in the 21st Century, 1st, University of North Dakota, Grand Forks, Sept. 20-23, 1986, Proceedings p 855 A89-54326 p 855 A89-54326
- VEESART, JANET LYLE Wake dissipation and total pressure loss in a

two-dimensional compressor cascade with crenulated trailing edges [AD-A209176] p 864 N89-28755

VENACCIO, MICHAEL G. Facilities and support requirements for advanced flight

p 854 A89-54368

elements

p 840 A89-52991

p 855 N89-28526

n 839 A89-52832

p 847 A89-52615

p 846 A89-52595

p 829 A89-52721

p 829 A89-52699

p 833 A89-53308

p 865 N89-28841

p 836 N89-29343

p 836 N89-29344

p 832 A89-52712

p 844 A89-52558

in

PERSONAL AUTHOR INDEX

WAGNER, STEVEN M.

Integrated control and avionics for air superiority -Computational aspects of real-time flight management [AIAA PAPER 89-3463] p 837 A89-52559 WAGNER, TIMOTHY C.

- Plasma torch igniter for scramjets p 858 A89-53355 WAKAIRO, KAORŪ
- An experimental optical coupling device for an airborne digital redundant system p 835 N89-28514 [NAL-TR-1003]
- WALATKA, PAMELA P. Scientific visualization in computational aerodynamics
- at NASA Ames Research Center p 875 A89-54907 WALLER, M. C.
- Aircraft trajectory generation: A literature review [AR-005-609] p 835 N89-29335 WANG, HONGMING
- Flow similarity in ignition process of jet engine p 839 A89-52323

WANG, LICHENG

Solution for two-dimensional inviscid transonic cascade flows with multiple-grid algorithm p 817 A89-52308 Application of upwind factor method to transonic p 817 A89-52309 cascade calculation

WARREN ANTHONY

Application of total energy	control for high performance
aircraft vertical transitions	
[AIAA PAPER 89-3559]	p 848 A89-52644

- WARWICK, GRAHAM p 815 A89-52975 Closing the gap WASIKOWSKI, MARK E.
- Optimal output feedback for linear time-periodic systems [AIAA PAPER 89-3574] p 873 A89-52657
- WASIUTA, H. ROBERT Hypersonic flight - Future commercial potential

WATANABE, AKIRA

An experimental optical coupling device for an airborne digital redundant system

p 878 A89-54353

- p 835 N89-28514 [NAL-TR-1003] WATANABE, TOSHINORI
- Theoretical study on the unsteady aerodynamic
- characteristics of an oscillating cascade with tip clearance - In the case of a nonloaded cascade p 816 A89-51678

WATSON, ANDREW B.

Supercomputer requirements for selected disciplines nportant to aerospace p 874 A89-53152 important to aerospace WATSON, VAL

- Scientific visualization in computational aerodynamics p 875 A89-54907 at NASA Ames Research Center WEBB. STEVEN G.
- Time periodic control of a multi-blade helicopter [AIAA PAPER 89-3449] p 843 A89-52548
- WEBER, MARK E. Weather sensing with airport surveillance radars p 869 A89-54789
- WELCH. JERRY D.
- Aircraft trajectory prediction for terminal automation [AIAA PAPER 89-3634] p 829 A89-52703 WENDEL, THOMAS R.
- Flight control synthesis for an unstable fighter aircraft using the LOG/LTR methodology
- [AIAA PAPER 89-3452] p 844 A89-52551 WENZEL, DENNIS J.
- An optimal material removal strategy for automated p 874 A89-53416 repair of aircraft canopies
- WESTBROOK, S. R.

A survey of JP-8 and JP-5 properties [AD-A207721] p p 860 N89-28661 WHEELER, R. E.

- Update 89 Additional results with the multifunction RLG svstem
- [AIAA PAPER 89-3583] p 837 A89-52716 WHITE, MICHAEL J.
- A model of the National Airspace System [AIAA PAPER 89-3626] p 829 p 829 A89-52701
- WIENER, GERRY Microburst detection and display by TDWR - Shape,
- extent, and alarms p 868 A89-54785 WIESEL, WILLIAM E.
- Time periodic control of a multi-blade helicopter [AIAA PAPER 89-3449] p 843 A89-52548
- WILLIAMS, PEGGY S.
- Study of a pursuit-evasion guidance law for high performance aircraft p 853 A89-54084 WILLIAMS, ROBERT M.
- Forces for change and the future of hypersonic flight p 856 A89-54327 in the 21st century WILLIAMS, ROGER M.
- Analysis of verification parameters for non-convective Sigmets p 870 A89-54825

- WILLIAMS, S. J.
- Comparison of Characteristic Locus and h-infinity methods in VSTOL flight control system design [AIAA PAPER 89-3491] p 846 A89-52584
- WILSON, F. WELSEY, JR. Microburst detection from mesonet data
- p 868 A89-54783 WILSON, F. WESLEY, JR.
- Microburst detection and display by TDWR Shape extent, and alarms p 868 A89-54785 Divergence estimation by a single Doppler rada

p 868 A89-54786 WILSON, K. J.

- Noncircular jet dynamics in supersonic combustion p 863 A89-53353
- Combustion-related shear-flow dynamics in elliptic supersonic jets p 819 A89-53930 WILSON, TIM A.
- Small scale model tests in small wind and water tunnels at high incidence and pitch rates. Volume 1: Test program and discussion of results
- p 821 N89-28488 [AD-A2086471 WILSON, W. J.
- Airborne rain mapping radar p 837 A89-53313 WILSON, WESLEY
- Gust front detection algorithm for the Terminal Doppler Weather Radar. II - Performance assessment p 871 A89-54852
- WINTERFELD, G.
- Supersonic combustion at the DFVLR: Results and experiences
- p 859 N89-28610 [DFVLR-88-044] WITT, ARTHUR
- Gust front detection algorithm for the Terminal Doppler Weather Radar. II - Performance assessment p 871 A89-54852
- WLEZIEN, R. W. Nozzle geometry effects on supersonic jet interaction
- p 876 A89-53932 WOJCIECHOWSKI, ZDZISLAW
- Calculation of the effect of the location of the jet-engine air inlets on the air flow in front of the inlets
- p 820 A89-54486 WOLF, MICHAEL
- Finite element analysis of gyroscopic effects p 863 A89-53499
- WOOD, RICHARD D. Hypersonic flight and world tourism p 878 A89-54352

WUEBBLES, DONALD J.

A study of the sensitivity of stratospheric ozone to p 867 A89-54363 hypersonic aircraft emissions

Х

- XIA. NAN
- Numerical simulation of rolling of up leading/trailing-edge vortex sheets for slender wings p 819 A89-53926

XING, JUNBO

- Study on boundary layer of hypersonic inlets p 820 A89-54129
- XU. LIPING Active control of inlet distorted flow field in compressor p 817 A89-52316

Υ

- YAMANAKA, TATSUO
- NAL's research for hypersonic flight p 856 A89-54331 Perspective on Japanese Space Plane research and development p 856 A89-54332
- YAMANE, H. Design of tunable digital set-point tracking PID
- controllers for gas turbines with unmeasurable outputs [AIAA PAPER 89-3577] p 839 A89-52660 YAMAUCHI, KUNIHIKO
- Study on a design method for the lateral stability of the airplane by the conditions for the steady horizontal turn with control surfaces fixed p 851 A89-53640 YAN. HENGYUAN
- Dynamic stability and active control of elastic vehicles
- acting with unsteady aerodynamic forces [AIAA PAPER 89-3557] p (p 848 A89-52643 YANAGIHARA, JURANDIR ITIZO
- The effects of longitudinal vortices on heat transfer of p 860 A89-51680 laminar boundary layers YATES, L. A.
- One-degree-of-freedom motion induced by modeled vortex shedding [NASA-TM-101038] p 866 N89-28870

YEH. HSI-HAN

A surrogate system approach to robust control design [AIAA PAPER 89-3492] p 873 A89-52585 p 873 A89-52585 YIN, XIE-YUAN

ZORINA, I. S.

- Numerical simulation of rolling up of leading/trailing-edge vortex sheets for slender wings p 819 A89-53926
- YOSHIDA, NORINOBU
- Analysis of absorbing characteristics of thin-type absorber for generalized conditions of incident way p 861 A89-52105

YOUN, SUNG-KIE

- Thermo-viscoplastic analysis of hypersonic structures subjected to severe aerodynamic heating NASA-CR-185915] p 825 N89-29328 YOUNG, JIEH-SHIAN
- An improved pseudo state method for aircraft controller design p 851 A89-53955
- YOUNG, KEVIN
- The status of the FAA Central Weather Processor (CWP) p 872 A89-54857 program YOUSSEF, H. M.
- Stability analysis of flexible body dynamics for a highly maneuverable fighter aircraft [AIAA PAPER 89-3471]
- p 845 A89-52565 YU. PING
- Time domain numerical calculations of unsteady vortical flows about a flat plate airfoil
- [NASA-TM-102318] p 866 N89-29726 YÚ. W.
- A systematic approach to gain suppression using p 875 A89-54024 eigenstructure assignment

Diagnostics and control of the fuel systems of aircraft

Optimum design for geometric parameters of

Application of upwind factor method to transonic

A method for calculation of matching point of inlet and

Optimum design for geometric parameters of axisymmetric converging-diverging nozzle

Effect of geometric parameters on internal performance

Construction of general-purpose supersonic nozzles of

p 841 A89-54881

p 839 A89-52319

p 817 A89-52309

p 840 A89-54132

p 839 A89-52319

p 839 A89-52320

p 848 A89-52646

p 821 A89-54624

B-11

Ζ

axisymmetric converging-diverging nozzle

ZARIN, ALEKSANDR A.

engines

ZHANG, HUIMIN

ZHAO, JINGYUN

ZHAO, YIYUAN

ZORINA, I. S.

cascade calculation

of convergent-divergent nozzle

[AIAA PAPER 89-3561]

conical cross section

Optimal paths through downbursts

ZHANG, XUELIANG

ZEN, JUN

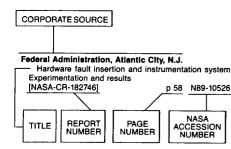
enaine

CORPORATE SOURCE INDEX

AERONAUTICAL ENGINEERING / A Continuing Bibliography (Supplement 247)

January 1990

Typical Corporate Source Index Listing



Listings in this index are arranged alphabetically by corporate source. The title of the document is used to provide a brief description of the subject matter. The page number and the accession number are included in each entry to assist the user in locating the abstract in the abstract section. If applicable, a report number is also included as an aid in identifying the document.

А

Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France) Special Course on Aerothermodynamics of Hypersonic

Vahiclas [AGARD-R-761] p 823 N89-29306

- Aeronautical Research Inst. of Sweden Stockholm. Wind tunnel tests of 16 percent thick airfoil with 30 percent trailing edge flap at high angles of attack and with flap angles [FFA-TN-1985-58]
- p 823 N89-28500 Aeronautical Research Labs., Melbourne (Australia). Comparison of flow-visualised vortices with computed eometry over thin delta wings
- p 821 N89-28489 [AD-A209083] Aerodynamic model tests of exhaust augmentors for
- F/A-18 engine run-up facility at RAAF Williamtown p 841 N89-28518 [AD-A208110]
- Stresses and strains in a cold-worked annulus p 866 N89-28871 [AR-005-548]
- Flutter calculations for a model wing using the MSC NASTRAN structural analysis program p 824 N89-29318 [AD-A209244]
- Aircraft trajectory generation: A literature review p 835 N89-29335 [AR-005-609]
- Incorporation of vortex line and vortex ring hover wake models into a comprehensive rotorcraft analysis code [AD-A208036] p 835 N89-29338 p 835 N89-29338
- A user's manual for the ARL mathematical model of the Sea King Mk-50 helicopter. Part 1: Basic use p 835 N89-29339 [AD-A208058]
- A user's manual for the ABL mathematical model of the Sea King Mk-50 helicopter. Part 2: Use with ARL flight data
- [AD-A208059] p 836 N89-29340 Identification of an adequate model for collective response dynamics of a Sea King helicopter in hove [AD-A208060] p 836 N89-29341

A modified least squares estimator for gas turbine identification

- [AD-A207911] p 842 N89-29348 Aerospace Medical Research Labs., Wright-Patterson AFB. OH.
- Specifications and measurement procedures and aircraft transparencies [AD-A209396] p 834 N89-28511
- Air Force Inst. of Tech., Wright-Patterson AFB, OH, Glider ground effect investigation
- p 821 N89-28490 [AD-A209152] Wake dissipation and total pressure loss in a two-dimensional compressor cascade with crenulated
- trailing edges [AD-A209176] p 864 N89-28755 Air Force Wright Aeronautical Labs., Wright-Patterson
- AFB, OH. Aerothermodynamic instrumentation
- p 866 N89-29310 Air Research and Development Command.
- Wright-Patterson AFB, OH.
- CFD in the context of IHPTET The Integrated High Performance Turbine Engine Technology Program [AIAA PAPER 89-2904] p 862 A89-53307 [AIAA PAPER 89-2904]
- Akron Univ., OH. Computerized life and reliability modeling for turboprop transmissions p 863 A89-53364
- Analytical Mechanics Associates, Inc., Mountain View, CA
- Rotorcraft deceleration to hover using image-based p 830 A89-54082 guidance Argonne National Lab., IL.
- Aeronautical applications of high-temperature superconductors
- [AIAA PAPER 89-2142] p 840 A89-53304 Arizona State Univ., Tempe.
- Integrated structure/control law design by multilevel optimization
- [AIAA PAPER 89-3470] p 873 A89-52564 On the control of elastic vehicles - Model simplification and stability robustness
- [AIAA PAPER 89-3558] p 873 A89-52715 Army Aviation Research and Development Command, Cleveland, OH.
- Computerized life and reliability modeling for turboprop p 863 A89-53364 transmissions
- Army Aviation Systems Command, Cleveland, OH. Fuel properties effect on the performance of a small
- high temperature rise combustor [AIAA PAPER 89-2901] p 838 A89-52025

B

- Bailey Controls Co., Wickliffe, OH.
- ngine combustion optimization by exhaust analysis p 859 N89-28588 [PB89-195788] Boeing Commercial Airplane Co., Seattle, WA.
- Design of integrated autopilot/autothrottle for NASA TSRV airplane using integral LQG methodology
- p 849 A89-52674 [AIAA PAPER 89-3595] British Aerospace Public Ltd. Co., Preston (England). A detailed survey of the flow passing through an
- asymmetric contraction and parallel duct [BAE-WWT-RP-RES-AXR-000194-] p 823 N89-28501
- A detailed survey of the flow passing through an asymmetric contraction and parallel duct [BAE-WWT-RP-RES-AXR-000194-] p 823 N89-28502

С

- California Polytechnic State Univ., San Luis Obispo. Analysis of leading edge separation using a low order oanel method p 822 N89-28493 [NASA-CR-185892]
- California Univ., Berkeley. On the design of nonlinear controllers for flight control
- [AIAA PAPER 89-3489] p 845 A89-52582

- California Univ., Davis.
- Self-tuning Generalized Predictive Control applied to errain following flight [AIAA PAPER 89-3450] n 843 A89-52549
- Evaluation of a technique for predicting longitudinal pilot-induced-oscillations
- [AIAA PAPER 89-3517] p 847 A89-52609 Calspan Corp., Buffalo, NY.
- Species composition measurements in nonequilibrium high-speed flows p 824 N89-29312 Cambridge Univ. (England).
- Calculations of inlet distortion induced compressor flow field instability p 818 A89-52498
- Centre d'Etudes et de Recherches, Toulouse (France). Experimental investigation of a three dimensional wake in the vicinity of a wing-body junction
- p 825 N89-29325 [CERT-0A-29/5025-AYD] Cincinnati Univ., OH.
- Parallel dynamic programming for on-line flight path optimization [AIAA PAPER 89-3615] p 832 A89-52693
- Colorado State Univ., Fort Collins. Supersonic jet studies of fluorene clustered with water,
- ammonia and piperidine [AD-A209562] p 860 N89-29497
- Creare, Inc., Hanover, NH. Superconducting Meissner effect bearings for cryogenic turbomachines, phase 1
- [AD-A209875] p 865 N89-28839

D

Dayton Univ., OH.

- Lubricant evaluation and performance p 865 [AD-A208925] N89-28835 Display characteristics of example light-valve
- projectors [AD-A209580] p 877 N89-29193
- Deutsche Forschungs- und Versuchsanstalt fuer Luft-und Raumfahrt, Cologne (Germany, F.R.).
- Activities report in aerospace research in Germany, F.R [ISSN-0070-3966] p 815 N89-28485
- Supersonic combustion at the DFVLR: Results and experiences p 859 N89-28610 [DFVLR-88-044]
- Deutsche Forschungs- und Versuchsanstalt fuer Luftund Raumfahrt, Goettingen (Germany, F.R.).
- Evaluation of LDA 3-component velocity data on a 65 deg delta wing at M = 0.85 and first results of an analysis [DFVLR-FB-89-19]
- p 823 N89-28505 DieselDyne Corp., Morrow, OH.
- A study of an advanced variable cycle diesel as applied to an RPV: Evaluation of an RPV variable cycle diesel
- engine [AD-A207754] p 842 N89-29347

F

Federal Aviation Administration, Washington, DC.

- Accomplishments under the airport improvement program: Fiscal year 1988 p 855 N89-29352
- [AD-A208200] Florida Atlantic Univ., Boca Raton.
- Prediction of inplane damping from deterministic and stochastic models p 832 A89-52042 Forschungsinstitut fuer Hochfrequenzphysik,
- Werthhoven (Germany, F.R.). Acoustical tracking of fast maneuvering aircraft by
- distributed sensors [REPT-6-88] p 877 N89-29156

G

- General Dynamics Corp., Fort Worth, TX. Small scale model tests in small wind and water tunnels
- at high incidence and pitch rates. Volume 1: Test program and discussion of results [AD-A208647]
 - p 821 N89-28488

General Electric Co., Cincinnati, OH.

Revolutionary opportunities for materials and structures study, addendum

[NASA-CR-179642-ADD] p 842 N89-29351 Georgia Inst. of Tech., Atlanta,

Study of aircraft cruise p 831 A89-51703 Thrust vectoring effect on time-optimal 90 degrees angle of attack pitch up maneuvers of a high alpha fighter aircraft

[AIAA PAPER 89-3521] p 847 A89-52612 Singular trajectories for time-optimal half-loop maneuvers of a high alpha fighter aircraft

[AIAA PAPER 89-3614] p 850 A89-52692 Maximum principle solutions for time-optimal half-loop maneuvers of a high alpha fighter aircraft

n 853 A89-54081 Study of a pursuit-evasion guidance law for high p 853 A89-54084 performance aircraft A real-time guidance algorithm for aerospace plane optimal ascent to low earth orbit p 855 A89-54085

Н

High Technology Corp., Hampton, VA. Transition flight experiments on a swept wing with

suction p 819 A89-53830 Honeywell Systems and Research Center, Minneapolis,

MN Nonlinear control of a supermaneuverable aircraft

[AIAA PAPER 89-3486] p 845 A89-52579 Nonlinear longitudinal control of a supermaneuverable aircraft p 851 A89-53957

Huff and Associates, Cleveland, OH.

Unsteady heat transfer in turbine blade ducts - Focus p 862 A89-53286 on combustor sources Hughes Aircraft Co., El Segundo, CA.

High temperature adhesive systems [AD-A209166]

p 860 N89-28643

Indian Inst. of Science, Bangalore.

- Prediction of inplane damping from deterministic and p 832 A89-52042 stochastic models Information and Control Systems, Inc., Hampton, VA.
- A variable-gain output feedback control design approach [ALAA DAPER 89-3575] p 873 A89-52658
- Institut Franco-Allemand de Recherches, Saint-Louis (France).
- Study of the wing-vortex interaction in three dimensional flows (incompressible inviscid flow)
- p 822 N89-28494 [ISL-R-123/87] Profile-vortex interactions p 822 N89-28495 [ISL-R-125/87]
- Measurements of mean-flow and turbulence characteristics in a turbojet exhaust using a laser velocimete
- [ISL-CO-226/88] p 841 N89-28519 Laser velocimetry in the close wake of an axisymmetric rear body
- [ISL-R-114/87] p 865 N89-28774 integrated Systems, Inc., Santa Clara, CA. A real-time expert system for self-repairing flight
- control p 843 A89-52528 [AIAA PAPER 89-3427]

J

Jet Propulsion Lab., California Inst. of Tech., Pasadena.

Airborne rain mapping radar p 837 A89-53313 JPL realtime weather processor system developed fo p 875 A89-54858 FAA

Κ

Kansas Univ. Center for Research, Inc., Lawrence. Evaluation of a takeoff performance monitoring system p 837 A89-51704 display

Μ

- Maryland Univ., College Park.
- Inviscid and viscous hypersonic aerodynamics: A review of the old and new p 823 N89-29308 Massachusetts inst. of Tech., Cambridge.
- Calculations of inlet distortion induced compressor flow p 818 A89-52498 field instability High performance linear-quadratic and H-infinity designs for a 'supermaneuverable' aircraft [AIAA PAPER 89-3456] p 832 A89-52712

The influence of ice accretion physics on the forecasting of aircraft icing conditions p 826 A89-54803 McDonnell-Douglas Missile Systems Co., Saint Louis,

MO. Chaotic response of aerosurfaces with structural nonlinearities

- p 824 N89-29316 [AD-A2084331 Midwest Research Inst., Golden, CO.
- Three-dimensional airfoil performance measurements on a rotating wing [DE89-009443] p 821 N89-28487
- Minnesota Univ., Minneapolis,
- Nonlinear control of a supermaneuverable aircraft [AIAA PAPER 89-3486] n 845 A89-52579 Nonlinear longitudinal control of a supermaneuverable p 851 A89-53957
- Mississippi State Univ., Mississippi State. Extended observability of linear time-invariant systems
- under recurrent loss of output data n 873 A89-52603 [AIAA PAPER 89-3510] An observer-based compensator for distributed delays
- in integrated control systems [AIAA PAPER 89-3541] p 847 A89-52628
- Mitre Corp., McLean, VA. Collision avoidance operational concept
- [WP-88W00418] p 831 N89-28509 Direct User Access Terminal (DUAT) operational concept
- [WP-88W00075] p 854 N89-28524 Muto Inst. of Structural Mechanics, Tokyo (Japan).
- Full-scale aircraft impact test for evaluation of impact forces. Part 1: Test plan, test method, and test results [DE89-009329] p 836 N89-29343 Full-scale aircraft impact test for evaluation of impact
- force. Part 2: Analysis of results p 836 N89-29344 [DE89-0093351

Ν

- National Aeronautical Establishment, Ottawa (Ontario). Flight investigation of helicopter low-speed response p 842 A89-51702 requirements
- National Aeronautical Lab., Bangalore (India). Flow calculation over a delta-wing using the thin-layer Navier-Stokes equations
- p 822 N89-28497 [PD-CF-8924] National Aeronautics and Space Administration. Ames
- Research Center, Moffett Field, CA. Prediction of secondary separation in shock wave boundary-layer interactions p 816 A89-51760
- On the design of nonlinear controllers for flight control evetome [AIAA PAPER 89-3489] p 845 A89-52582
- Passive navigation using image irradiance tracking [AIAA PAPER 89-3500] p 828 A89-52592
- Flight-test evaluation of civil helicopter terminal pproach operations using differential GPS [AIAA PAPER 89-3635] p 828 A89-52594
- Controller evaluations of the descent advisor automation aid
- p 829 A89-52699 [AIAA PAPER 89-3624] Piloted simulation of a ground-based time-control concept for air traffic control
- [AIAA PAPER 89-3625] p 829 A89-52700 Supercomputer requirements for selected disciplines important to aerospace p 874 A89-53152
- Rotorcraft deceleration to hover using image-based quidance p 830 A89-54082 Integration of active and passive sensors for obstacle
- p 830 A89-54083 avoidance Scientific visualization in computational aerodynamics at NASA Ames Research Center p 875 A89-54907
- Correlation of Puma airloads: Evaluation of CFD prediction methods
- [NASA-TM-102226] p 822 N89-28498 One-degree-of-freedom motion induced by modeled vortex shedding
- [NASA-TM-101038] p 866 N89-28870 Boundary-layer measurements on a transonic low-aspect ratio wing
- [NASA-TM-88214] p 823 N89-29305 National Aeronautics and Space Administration.
- Goddard Space Flight Center, Greenbelt, MD.
- Observability studies of inertial navigation systems NAA PAPER 89-3580 p 829 A89-52663 [AIAA PAPER 89-3580]
- National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Facility, Edwards, CA.
- Parameter estimation for flight vehicles p 831 A89-51701 self-repairing flight A real-time expert system for control [AIAA PAPER 89-3427] p 843 A89-52528 A design procedure for the handling gualities
- otimization of the X-29A aircraft [AIAA PAPER 89-3428] o 843 A89-52529

Modeling of aerodynamic forces in the Laplace domain with minimum number of augmented states for the design of active flutter suppression systems AIAA PAPER 89-34661 p 844 A89-52561

- Initial flight qualification and operational maintenance of X-29A flight software
- p 850 A89-52675 AIAA PAPER 89-35961
- Transition flight experiments on a swept wing with p 819 A89-53830 suction

Study of a pursuit-evasion guidance law for high p 853 A89-54084 performance aircraft

National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

Current research in composite structures at NASA's Langley Research Center

- p 861 A89-51692 Evaluation of a takeoff performance monitoring system display p 837 A89-51704
- Integrated structure/control law design by multilevel optimization AIAA PAPER 89-34701 p 873 A89-52564
- Application of Artificial Intelligence (AI) programming
- techniques to tactical guidance for fighter aircraft [AIAA PAPER 89-3525] p 815 A89-52614
- A multiloop, digital flutter suppression control law synthesis case study
- [AIAA PAPER 89-3556] p 848 A89-52642 Application of variable-gain output feedback for
- high-alpha control [AIAA PAPER 89-3576] p 848 A89-52659
- Modal techniques for analyzing airplane dynamics [AIAA PAPER 89-3609] p 850 A89-52687
- Active flutter suppression invariant usina zeros/eigensystem assignment
- [AIAA PAPER 89-3610] p 850 A89-52688 Technical communication in aeronautics - Results of an
- exploratory study p 877 A89-53330 Mixing augmentation technique for hypervelocity
- scramiets
- cramiets p 840 A89-53351 Plasma torch igniter for scramjets p 858 A89-53355
- Transition flight experiments on a swept wing with p 819 A89-53830 suction
- Low-speed static and dynamic force tests of a generic

supersonic cruise fighter configuration [NASA-TM-4138] n 821 N89-28486

Five year ground exposure of composite materials used on the Bell Model 206L flight service evaluation

[NASA-TM-101645] p 859 N89-28579 Some effects of aerodynamic spoilers on wing flutter p 825 N89-29324

on

CSM research: Methods and application studies

National Aeronautics and Space Administration, Lewis

Fuel properties effect on the performance of a small

Integrated flight/propulsion control system design based

Unsteady heat transfer in turbine blade ducts - Focus n combustor sources p 862 A89-53286

Integrated flight/propulsion control system design based

CFD in the context of IHPTET - The Integrated High

Computerized life and reliability modeling for turboprop

Turbofan engine control system design using the QG/LTR methodology p 840 A89-53956

High speed corner and gap-seal computations using an

Tribological properties of alumina-boria-silicate fabric

A real time microcomputer implementation of sensor

STOL and STOVL hot gas ingestion and airframe heating

Intermetallic and ceramic matrix composites for 815 to

1370 C (1500 to 2500 F) gas turbine engine applications

tests in the NASA Lewis 9- by 15-foot low-speed wind

Performance Turbine Engine Technology Program

of

. rt 2

Research Center, Cleveland, OH.

Heat transfer in aerospace propulsion

on a decentralized, hierarchical approach

high temperature rise combustor

Computational

Structural

p 866 N89-29789

p 867 N89-29794

p 838 A89-52025

p 847 A89-52611

p 862 A89-53282

p 851 A89-53301

high-temperature

p 840 A89-53304

p 862 A89-53307

p 863 A89-53364

p 863 A89-54424

p 859 A89-54982

p 876 N89-29032

p 824 N89-29323

p 860 N89-29490

[NASA-TM-101632]

Mechanics 1987, pa

NASA Workshop

[NASA-CP-10012-PT-2]

[AIAA PAPER 89-2901]

AIAA PAPER 89-35201

on combustor sources

[AIAA PAPER 89-3519]

[AIAA PAPER 89-2142]

[AIAA PAPER 89-2904]

LQG/LTR methodology

[AIAA PAPER 89-2669]

failure detection for turbofan engines

superconductors

transmissions

LU-SGS scheme

from 25 C to 850 C

[NASA-TM-102327]

[NASA-TM-102101]

[NASA-TM-102326]

tunnel

Aeronautical applications

on a centralized approach

CORPORATE SOURCE

Wisconsin Univ.

- Time domain numerical calculations of unsteady vortical flows about a flat plate airfoil [NASA-TM-102318] p 866 N89-29726
- Computational structural mechanics engine structures p 866 N89-29792 computational simulator
- The 3-D inelastic analyses for computational structural mechanics p 867 N89-29804 National Aeronautics and Space Administration

Marshall Space Flight Center, Huntsville, AL.

- Turbomachinery rotor support with damping [NASA-CASE-MFS-28345-1] p 865 N89-28841 National Aerospace Lab., Amsterdam (Netherlands). Airport noise measuring data collction system [NLR-MP-87006-U] p 855 Ni
- p 855 N89-28526 National Aerospace Lab., Tokyo (Japan). Some computations of unsteady Navier-Stokes flow around oscillating airfoil/wing
- [NAL-TR-1004T] p 822 N89-28492
- An experimental optical coupling device for an airborne digital redundant system [NAL-TR-1003] p 835 N89-28514
- Finite element analysis of incompressible viscous flows around single and multi-element aerofoils in high Reynolds number region [NAL-TR-1010T]
- p 865 N89-28765 Use of high-resolution upwind scheme for vortical flow simulations
- [NASA-CR-185910] p 824 N89-29321 National Transportation Safety Board, Washington, DC.
- Aircraft accident/incident summary reports: Belleville, Illinois, August 22, 1987; Pensacola, Florida, December 27, 1987
- [PB89-910405] p 827 N89-28507 Naval Air Propulsion Test Center, Trenton, NJ.
- Statistics on aircraft gas turbine engine rotor failures that occurred in US commercial aviation during 1984 p 841 N89-28516 [NAPC-PE-185] p 841 N89-28516 Statistics on aircraft gas turbine engine rotor failures
- that occurred in US commercial aviation during 1985 [NAPC-PE-1881 p 841 N89-28517
- Naval Civil Engineering Lab., Port Hueneme, CA. Joint sealants for airport pavements. Phase 1: Laboratory and field investigations
- [DOT/FAA/DS-89/2-PHASE-1] p 854 N89-28523
- Naval Postgraduate School, Monterey, CA. Composite material repair and reliability
- p 859 N89-28574 (AD-A2091501 Flight test method development for a quarter-scale aircraft with minimum instrumentation [AD-A207896] p 835 N89-29337

North Dakota Univ., Grand Forks. International Conference on Hypersonic Flight in the 21st

- Century, 1st, University of North Dakota, Grand Forks, Sept. 20-23, 1988, Proceedings p 855 A89-54326 Nuclear Regulatory Commission, Washington, DC.
- Technical communication in aeronautics Results of an kploratory study p 877 A89-53330 exploratory study

0

Office National d'Etudes et de Recherches

- Aerospatiales, Parls (France). Physical mechanisms and disturbances related to the attachment of an electric arc to a conductive cylinder [ONERA-NT-1988-2] p 866 N89-29698 [ONERA-NT-1988-2]
- Office of Naval Research, London (England). Workshop proceedings on Certification and Airworthiness Composite Aircraft
- [AD-A209321] p 835 N89-29336 Office of the Secretary of Defense, Washington, DC. Operational test plan concept for evaluation of close air support alternative aircraft
- [AD-A208185] p 835 N89-28513 Old Dominion Univ., Norfolk, VA.
- Technical communication in aeronautics Results of an p 877 A89-53330 exploratory study Thermo-viscoplastic analysis of hypersonic structures subjected to severe aerodynamic heating

p 825 N89-29328 [NASA-CR-185915]

P

- Pennsylvania State Univ., University Park.
- Extended observability of linear time-invariant systems inder recurrent loss of output data
- p 873 A89-52603 [AIAA PAPER 89-3510] An observer-based compensator for distributed delays in integrated control systems
- [AIAA PAPER 89-3541] p 847 A89-52628 Planning Research Corp., Hampton, VA.
- A multiloop, digital flutter suppression control law synthesis case study
- [AIAA PAPER 89-3556] p 848 A89-52642

Pratt and Whitney Aircraft, East Hartford, CT. Boundary elements for structural analysis

p 867 N89-29800

- Pratt and Whitney Aircraft, West Palm Beach, FL. Fuel properties effect on the performance of a small high temperature rise combustor [AIAA PAPER 89-2901]
- p 838 A89-52025 PRC Kentron, Inc., Hampton, VA.
- Transition flight experiments on a swept wing with suction p 819 A89-53830
- Princeton Univ., NJ. Application of stochastic robustness to aircraft control systems

[AIAA PAPER 89-3505] p 846 A89-52598 An expert system for wind shear avoidance

p 826 A89-53971

R

- Rensselaer Polytechnic Inst., Troy, NY.
- Technical communication in aeronautics Results of an exploratory study p 877 A89-53330 RJO Enterprises, Inc., Lanham, MD.
- Accident/incident data analysis database summaries, volume 1
- [DOT/FAA/DS-89/17-1] p 827 N89-29332 Accident/incident data analysis database summaries, volume 2
- [DOT/FAA/DS-89/17-2] p 828 N89-29333

S

- Sandia National Labs., Albuquerque, NM.
- Full-scale aircraft impact test for evaluation of impact forces. Part 1: Test plan, test method, and test results p 836 N89-29343 [DE89-009329] Full-scale aircraft impact test for evaluation of impact force. Part 2: Analysis of results
- [DE89-009335] p 836 N89-29344 School of Aerospace Medicine, Brooks AFB, TX.
- Towards a physiologically based HUD (Head-Up Display) symbology [AD-A207748] p 838 N89-28515
- Scientific Research Associates, Inc., Glastonbury, CT. Hypersonic vehicle environment simulation, phase 1 p 864 N89-28754 [AD-A209030]
- Southampton Univ. (England). The acoustic calibration of aircraft fuselage structures,
- [ISVR-TR-169-PT-1] p 877 N89-29158
- Southwest Research Inst., San Antonio, TX. A survey of JP-8 and JP-5 properties
- p 860 N89-28661 [AD-A207721] Aircraft propeller induced structure-borne noise [NASA-CR-4255] p 876 N89-29155
- Stanford Univ., CA. Optimal paths through downbursts
 - [AIAA PAPER 89-3561] p 848 A89-52646 Representation and display of vector field topology in uid flow data sets p 875 A89-54904 Control of separated flow past a cylinder using tangential fluid flow data sets
- jet blowing (NASA-CR-185918) p 825 N89-29326
- Sverdrup Technology, Inc., Cleveland, OH. Integrated flight/propulsion control system design based on a centralized approach
- [AIAA PAPER 89-3520] p 847 A89-52611
- Integrated flight/propulsion control system design based on a decentralized, hierarchical approach [AIAA PAPER 89-3519] p 851 A89-53301
- Turbofan engine control system design using the LQG/LTR methodology p 840 A89-53956 Interfacing modules for integrating discipline specific
- structural mechanics codes p 866 N89-29793 Systems Technology, Inc., Hawthorne, CA.
- p 842 A89-51702 requirements

Т

- Technion Israel Inst. of Tech., Haifa. Extended observability of linear time-invariant systems under recurrent loss of output data
- [AIAA PAPER 89-3510] p 873 A89-52603 Diservability studies of inertial navigation systems [AIAA PAPER 89-3580] p 829 AR9-52
- p 829 A89-52663 Technische Univ., Berlin (Germany, F.R.).
- Competition and safety in air traffic [TUB-DISS-PAPER-128] p 827 N89-28508 Status and development potential of the fly by light technology in civil aircraft [ILR-MITT-212] p 854 N89-28522

Piezoelectric foils as sensors in experimental flow mechanics

- [ILR-MITT-214] p 865 N89-28800 Technische Univ., Delft (Netherlands). The angles of the Kolibrie rotor tipvanes on the rods
- and on the blades (IW-B515) p 822 N89-28499

U

United Technologies Research Center, East Hartford, CT

- Noise produced by turbulent flow into a rotor: Users manual for noise calculation
- (NASA-CR-181790) p 876 N89-29152 Noise produced by turbulent flow into a rotor. Users manual for atmospheric turbulence prediction and mean flow and turbulence contraction prediction
 - [NASA-CR-181791] p 876 N89-29154

ν

- Virginia Polytechnic Inst. and State Univ., Blacksburg. Plasma torch igniter for scramjets p 858 A89-53355 Turbulence modeling in a hypersonic inlet p 819 A89-53931
- Vrije Univ., Brussels (Belgium). Transition and turbulence structure in the boundary layers of an oscillating airfoil
 - [AD-A208968] p 824 N89-29317

w

Wisconsin Univ., Madison,

Design by functional feature for aircraft structure p 836 N89-29345

Flight investigation of helicopter low-speed response

FOREIGN TECHNOLOGY INDEX

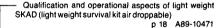
AERONAUTICAL ENGINEERING / A Continuing Bibliography (Supplement 247)

January 1990

Typical Foreign Technology Index Listing



CANADA





Listings in this index are arranged alphabetically by country of intellectual origin. The title of the document is used to provide a brief description of the subject matter. The page number and the accession number are included in each entry to assist the user in locating the citation in the abstract section. If applicable, a report number is also included as an aid in identifying the document.

Δ

AUSTRALIA

- Comparative durability of six coating systems on first-stage gas turbine blades in the engines of a long-range maritime patrol aircraft p 858 A89-54255
- p 854 A89-54349 Australian hypersonic facilities Comparison of flow-visualised vortices with computed eometry over thin delta wings
- p 821 N89-28489 [AD-A209083] Aerodynamic model tests of exhaust augmentors for engine run-up facility at RAAF Williamtow
- p 841 N89-28518 [AD-A208110] Stresses and strains in a cold-worked annulus
- p 866 N89-28871 [AR-005-548] Flutter calculations for a model wing using the MSC
- NASTRAN structural analysis program p 824 N89-29318 [AD-A209244]
- Aircraft trajectory generation: A literature review p 835 N89-29335 [AR-005-6091
- Incorporation of vortex line and vortex ring hover wake models into a comprehensive rotorcraft analysis code [AD-A2080361 p 835 N89-29338
- A user's manual for the ARL mathematical model of the Sea King Mk-50 helicopter. Part 1: Basic use p 835 N89-29339 [AD-A208058]

A user's manual for the ARL mathematical model of the Sea King Mk-50 helicopter. Part 2: Use with ARL flight data

[AD-A208059] p 836 N89-29340 Identification of an adequate model for collective response dynamics of a Sea King helicopter in hover [AD-A208060] p 836 N89-29341

A modified	least	squares	estimator	for	gas	turbine
identification						
[AD-A207911	1		D	842	N8	9-29348

В

BELGIUM

Transition and turbulence structure in the boundary layers of an oscillating airfoil [AD-A208968] n 824 N89-29317

С

CANADA

Phenomena and modelling of flow-induced vibrations of bluff bodies p 861 A89-52961 Flash lamp planar imaging p 863 A89-54348 A proposed composite repair methodology for primary p 858 A89-54429 structure

CHINA, PEOPLE'S REPUBLIC OF A multi-objective optimum design method for a radial-axial flow turbine with the optimum criteria of blade p 838 A89-52306 twist at outlet of blades Computation of the detached shock shape in a supersonic or transonic cascade p 816 A89-52307 Solution for two-dimensional inviscid transonic cascade flows with multiple-grid algorithm p 817 A89-52308 Application of upwind factor method to transonic p 817 A89-52309 cascade calculation An investigation on stagnation pressure errors due to rotation state behind a rotor p 839 A89-52315 Active control of inlet distorted flow field in compressor p 817 A89-52316 inlet Flight tests for air intake flowfield and engine operating stability p 839 A89-52317 Optimum design for geometric parameters of axisymmetric converging-diverging nozzle p 839 A89-52319 Effect of geometric parameters on internal performance of convergent-divergent nozzle p 839 A89-52320 Flow similarity in ignition process of jet engine p 839 A89-52323 Dynamic stability and active control of elastic vehicles acting with unsteady aerodynamic forces p 848 A89-52643 (AIAA PAPER 89-35571 Numerical simulation of rollina up of leading/trailing-edge vortex sheets for slender wings p 819 A89-53926 Fatigue life of dovetail joints - Verification of a simple biaxial model p 863 A89-54119 Study on boundary layer of hypersonic inlets

p 820 A89-54129 Research on surge monitoring system of turboiet engine p 840 A89-54131 on active service A method for calculation of matching point of inlet and p 840 A89-54132 engine

F

FRANCE

p 857 A89-51860 Turbulent reactive flows Numerical simulation and hydrodynamic visualization of transient viscous flow around an oscillating aerofoil A89-52481 p 817

Wideband linear quadratic Gaussian control of strapdown dry tuned gyro/accelerometers [AIAA PAPER 89-3441] p 837 A89-52540

Algebraic loop transfer recovery - An application to the design of a helicopter output feedback control law A89-52662 [AIAA PAPER 89-3579] p 849

Lateral electric flight control laws of a civil aircraft based upon eigenstructure assignment technique [AIAA PAPER 89-3594]

p 851 A89-52718 Turbulent shear flows 6; International Symposium, 6th, Universite de Toulouse III, France, Sept. 7-9, 1987, p 861 A89-52943 Selected Papers The Locstar radiodetermination satellite system p 830 A89-53660 Study of the wing-vortex interaction in three dimensional

[ISL-R-123/87]	p 822	N89-28494
Profile-vortex interactions [ISL-R-125/87]	- 000	N89-28495
[ISL-H-125/6/]	p 622	1109-20495

Measurements of mean-flow and turbulence characteristics in a turbojet exhaust using a laser velocimeter

[ISL-CO-226/88] p 841 N89-28519 Laser velocimetry in the close wake of an axisymmetric rear bodv

[ISL-R-114/87] p 865 N89-28774 Special Course on Aerothermodynamics of Hypersonic Vahiclas

[AGARD-R-761] p 823 N89-29306 Experimental investigation of a three dimensional wake

in the vicinity of a wing-body junction [CERT-0A-29/5025-AYD] p 825 N89-29325

Physical mechanisms and disturbances related to the attachment of an electric arc to a conductive cylinder [ONERA-NT-1988-2] p 866 N89-29698

G

GERMANY, FEDERAL REPUBLIC OF
Optimal control for maximum energy extraction from wind shear
[AIAA PAPER 89-3490] p 846 A89-52583
Operational experience with the Computer Oriented
Metering Planning and Advisory System (COMPAS) at Frankfurt, Germany
[AIAA PAPER 89-3627] p 829 A89-52721
EUROFAR - Project for a perpendicularly launched cruising aircraft
[MBB-UD-538-88-PUB] p 833 A89-53308
Visual and sensory aids for helicopters in the year
2000 [MBB-UD-541-89-PUB] p 837 A89-53309 i
High-performance fiber composite materials with
thermoplastic matrix [MBB-Z-0257-89-PUB] p 857 A89-53310
Rotorcraft research and technology advances at MBB
[MBB-UD-0537-88-PUB] p 815 A89-53334
Finite element analysis of gyroscopic effects
p 863 A89-53499
Injection moulded ceramic rotors - Comparison of SiC
and Si3N4 p 858 A89-53658
MLS 1989 - Status report from the perspective of the
airline companies p 830 A89-53663
Differing development of the velocity profiles of three-dimensional turbulent boundary layers
p 819 A89-53947
Saenger: An advanced space transport system for Europe - Program overview and key technology needs p 856 A89-54329
Application of modern optimization tools for the design
of aircraft structures p 834 A89-54471
Camouflage cap allows aircraft to disappear
p 838 A89-54482
History of low-power jet engines p 841 A89-54483 Development along different paths
p 820 A89-54484
Activities report in aerospace research in Germany, E.R.
[ISSN-0070-3966] p 815 N89-28485
Evaluation of LDA 3-component velocity data on a 65
deg delta wing at M = 0.85 and first results of an analysis
[DFVLR-FB-89-19] p 823 N89-28505
Competition and safety in air traffic [TUB-DISS-PAPER-128] p 827 N89-28508
Status and development potential of the fly by light
technology in civil aircraft [ILR-MITT-212] p 854 N89-28522
Supersonic combustion at the DFVLR: Results and
experiences [DFVLR-88-044] p 859 N89-28610
Piezoelectric foils as sensors in experimental flow
mechanics
[ILR-MITT-214] p 865 N89-28800

Acoustical tracking of fast maneuvering aircraft by distributed sensors [REPT-6-88] p 877 N89-29156 INDIA

INDIA

Performance analysis of voting strategies for a fly-by-wire p 842 A89-52168 system of a fighter aircraft Adaptive control of high performance unstable aircraft

p 851 A89-52989 - A review Computerised design of blade elements in p 840 A89-52991 turbomachines

Environmental effects on composite structures A89-52994 p 857

Overview of buckling in aircraft design p 834 A89-54462

Aerospace Industry in India - Past, present and future p 815 A89-54472

Gas turbine research and development in India p 841 A89-54473

Flow calculation over a delta-wing using the thin-layer Navier-Stokes equations p 822 N89-28497 [PD-CF-8924]

ISRAEL

Improved guidance law design based on the p 828 A89-51716 mixed-strategy concept Pseudo-spectral and asymptotic sensitivity investigation

p 861 A89-51755 of counter-rotating vortices Sensitivity derivatives of flutter characteristics and stability margins for aeroservoelastic design

[AIAA PAPER 89-3467] D 845 A89-52562 Diagnostic techniques for propulsion systems

p 839 A89-52960 Out-of-band response of VHF/UHF airborne antennae p 830 A89-53484

Interlaminar fracture toughness and toughening of laminated composite materials - A review p 858 A89-54426

ITALY Separated flow past three-dimensional bodies as a singular perturbation problem p 861 A89-52507 AE monitoring of airframe structure during full scale p 863 A89-53322 fatique test

J

JAPAN

D-2

Theoretical study on the unsteady aerodynamic characteristics of an oscillating cascade with tip clearance - in the case of a nonloaded cascade

p 816 A89-51678 Secondary flow control and loss reduction in a turbine cascade using endwall fences p 816 A89-51679 The effects of longitudinal vortices on heat transfer of

p 860 A89-51680 laminar boundary layers Analysis of absorbing characteristics of thin-type absorber for generalized conditions of incident wave p 861 A89-52105

On TVD difference schemes for the three-dimensional Euler equations in general co-ordinates

p 817 A89-52484 Modification of trim point and feedback gains for failed aircraft

[AIAA PAPER 89-3507] p 846 A89-52600 Robust control system design with multiple model

approach and its application to active flutter control [AIAA PAPER 89-3578] p 849 A89-5 p 849 A89-52661 Development of a flight control system for VTOL aircraft

pported by ducted fans [AIAA PAPER 89-3592] p 849 A89-52672 Study on a design method for the lateral stability of the airplane by the conditions for the steady horizontal turn p 851 A89-53640 with control surfaces fixed A new hybrid airship ('Heliship') for commuter transport p 833 A89-53641

NAL's research for hypersonic flight p 856 A89-54331

Perspective on Japanese Space Plane research and p 856 A89-54332 development Some computations of unsteady Navier-Stokes flow

around oscillating airfoil/wing [NAL-TR-1004T] p 822 N89-28492 An experimental optical coupling device for an airborne

digital redundant system p 835 N89-28514 [NAL-TR-1003]

Finite element analysis of incompressible viscous flows around single and multi-element aerofoils in high Reynolds number region [NAL-TR-1010T] p 865 N89-28765

Use of high-resolution upwind scheme for vortical flow imulations

[NASA-CR-185910] p 824 N89-29321

The influence of ice accretion physics on the forecastin p 826 A89-54803 of aircraft icing conditions

Κ

LYBIA Thin aerofoil with multiple slotted flap p 816 A89-51625

Ν

NETHERLANDS

The angles of the Kolibrie rotor tipvanes on the rods and on the blades

p 822 N89-28499 [IW-R515] Airport noise measuring data collction syste p 855 N89-28526 [NLR-MP-87006-U] NEW ZEALAND

Verification of aerodrome forecasts

p 870 A89-54824 Very short-range aerodrome forecasts using regression techniques p 870 A89-54831

Ρ

POLAND

Calculation of the effect of the location of the iet-engine air inlets on the air flow in front of the inlets A89-54486

p 820 Noise produced by a jet aircraft during the engine test p 876 A89-54487 run

Constant monitoring of the fatigue damage of aircraft p 863 A89-54488 lifting structures

S

SOUTH AFRICA, REPUBLIC OF

The Trisonic aerospace motor - Propulsion vehicle for the 21st century p 856 A89-54359 SWEDEN

Navier-Stokes computation of transonic vortices over p 817 A89-52483 a round leading edge delta wing

MET 90, a project for the development of the future Swedish aviation weather system p 870 A89-54817 Wind tunnel tests of 16 percent thick airfoil with 30 percent trailing edge flap at high angles of attack and

with flap angles [FFA-TN-1985-58] p 823 N89-28500 SWITZERLAND

Are the Soviets set to make the big time? p 825 A89-52513

Mi-28 Havoc is still tomorrow's tank-buster p 832 A89-52514

Т

TAIWAN

An improved pseudo state method for aircraft controller design p 851 A89-53955 Doppler weather radar service at the Chiang Kai-Shek nternational Airport p 871 A89-54840 International Airport A case study of local severe weather at Chang Kai Shek International Airport p 871 A89-54846

U

U.S.S.R.

Denormalized product of the adsorptive zeolite extraction of paraffins as a jet fuel component p 857 A89-52775

Precision characteristics of a coordinate device for estimating the velocity of an object p 830 A89-52779 Asymptotic solution of a nonlinear boundary value problem with a partly unknown boundary

p 874 A89-52802 Recovery of the fatigue strength of structural elements

of aluminum alloys by surface hardening p 857 A89-52827

Fatigue life of ZhS6U alloy with protective coatings under p 857 A89-52830 thermal cycling loading Probabilistic methods for estimating the remaining life of structural elements of operating aircraft gas turbine p 839 A89-52832 enaines

A three-dimensional boundary layer in finite-span thin p 818 A89-52843 wings

A second-order finite-difference scheme for calculating three-dimensional supersonic flows of an ideal gas p 818 A89-52852

development of aviation and rocket and space science p 879 A89-52923

plane or axisymmetric body p 820 A89-54535 Fixed-sign condition for integral quadratic forms and p 875 A89-54540

A study of the stress-strain state of connections in an thotropic material p 864 A89-54585 Solution of the inverse boundary value problem of orthotropic material

aerohydrodynamics with allowance for the boundary p 864 A89-54611 layer Theory for separated flow around the trailing edge of

a thin profile p 820 A89-54614 Separated flow past a concave conical wing of large

transverse curvature at small angles of attack p 820 A89-54619

Construction of general-purpose supersonic nozzles of p 821 A89-54624 conical cross section

Optimal permeability of wind tunnel walls at low supersonic velocities p 821 A89-54625

Diagnostics and control of the fuel systems of aircraft p 841 A89-54881 engines

Jet engines for high supersonic flight velocities (2nd revised and enlarged edition) p 841 A89-54884 UNITED KINGDOM

Analysis of reattachment during ramp down tests

p 816 A89-52043 Proportional hazards modelling of aircraft cargo door complaints p 825 A89-52325 The development of advanced computational methods p 839 A89-52482 p 832 A89-52525 for turbomachinery blade design Glazing into the future

Comparison of eigenstructure assignment and the Salford singular perturbation methods in VSTOL aircraft control law design

[AIAA PAPER 89-3451] p 844 A89-52550 Comparison of Characteristic Locus and h-infinity methods in VSTOL flight control system design

[AIAA PAPER 89-3491] p 846 A89-52584 Design of adaptive digital model-following flight-mode control systems for high-performance aircraft

[AIAA PAPER 89-3495] p 846 A89-52587 Design of tunable digital set-point tracking PID controllers for gas turbines with unmeasurable outputs [AIAA PAPER 89-3577] p 839 A89-52660

Robust eigenstructure assignment for flight control using the Ctrl-C design package [AIAA PAPER 89-3607] p 850 A89-52685

Some aspects of aircraft dynamic loads due to flow p 832 A89-52959 separation

Saenger aerospaceplane gains momentum 100 5007

	P 655	A09-02973
ensitive skins	p 837	A89-52974

Closing the gap p 815 A89-52975 Heat transfer characteristics of an aero-engine intake

fitted with a hot air jet impingement anti-icing system p 833 A89-53255

HOTOL - A European aerospaceplane for the 21st p 856 A89-54330

A detailed survey of the flow passing through an asymmetric contraction and parallel duct

[BAE-WWT-RP-RES-AXR-000194-] p 823 N89-28501 A detailed survey of the flow passing through an symmetric contraction and parallel duct

[BAE-WWT-RP-RES-AXR-000194-] p 823 N89-28502 The acoustic calibration of aircraft fuselage structures,

ISVR-TR-169-PT-11 p 877 N89-29158 Workshop proceedings Composite Aircraft on Certification and Airworthiness p 835 N89-29336 [AD-A2093211

Investigations in the history and theory of the

FOREIGN TECHNOLOGY INDEX

and technology, No. 6 Calculation of transonic flow past the tail section of a

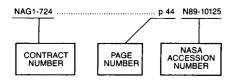
stability of systems with distributed parameters

CONTRACT NUMBER INDEX

AERONAUTICAL ENGINEERING / A Continuing Bibliography (Supplement 247)

January 1990

Typical Contract Number Index Listing



Listings in this index are arranged alphanumerically by contract number. Under each contract number, the accession numbers denoting documents that have been produced as a result of research done under the contract are arranged in ascending order with the AIAA accession numbers appearing first. The accession number denotes the number by which the citation is identified in the abstract section. Preceding the accession number is the page number on which the citation may be found.

AF PROJ. 2308	p 824	N89-29316
AF-AFOSR-86-0274	p 861	A89-52507
AF-AFOSR-86-0355	p 828	A89-51716
AF-AFOSR-87-0073	p 845	A89-52580
BMVG-T/RF-31/G-0022/G-1312	p 877	N89-29156
	•	
CNR-86,02073,01	p 861	A89-52507 A89-52507
CNR-87,01011,01	p 861	
C99066G DA PROJ. 1L2-63001-D-150	p 866	N89-29726 N89-28661
	p 860	A89-20001
DAAG29-82-K-0093 DAAH01-88-C-0660	р 832 р 842	N89-52044
		N89-29347 N89-28661
DAAK70-87-C-0043 DAAL03-87-G-0004	р 860 р 852	A89-53988
	p 852 p 831	A89-53966 A89-52041
		A89-52041 A89-52657
	р 873 р 864	N89-28754
	p 824	N89-29317
	p 842	N89-29317
DARPA ORDER 5916 DE-AC02-83CH-10093	p 821	N89-29347
DE-AC02-63CH-10093	p 867	A89-54363
DE-AC04-76DP-00789	p 836	N89-29343
	p 836	N89-29344
DOT/FA71NA-AP98	p 841	N89-28516
501/11/11/11/11/00	p 841	N89-28517
DRET-84-34-020-000	p 817	A89-52481
DRET-85-031	p 822	N89-28495
DTFA01-80-Y-10524	p 868	A89-54787
DTFA01-82-Y-10503	p 868	A89-54786
DTFA01-82-Y-10513	p 868	A89-54785
	p 853	A89-54799
	p 869	A89-54806
	p 870	A89-54813
DTFA01-82-7-10513	p 868	A89-54783
DTFA01-86-1-02015	p 854	N89-28523
DTFA01-87-C-00019	p 826	A89-54805
	p 869	A89-54806
	р 827	A89-54821
	p 827	A89-54838
DTFA01-89-C-00001	p 831	N89-28509
	p 854	N89-28524
F08635-87-K-0031	p 832	A89-52712
F33615-84-C-0066	p 877	N89-29193
F33615-85-C-2507	p 865	N89-28835
F33615-86-C-2623	p 864	A89-54981
F33615-87-C-0012	p 877	N89-29193
F33615-88-C-3601	p 844	A89-52555
F42650-86-C-3276	p 874	A89-53416
F49620-87-C-0116	р 850	A89-52694
F49620-87-R-0004	p 842	A89-51723
F49620-88-C-0047	p 824	N89-29316
F49620-88-C-0053	p 852	A89-53959

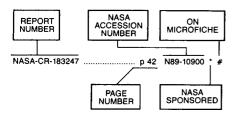
F49620-88-C-0137	p 865	N89-28839
GRI-5083-231-0956	p 859	N89-28588
NAG1-59	p 850	A89-52692
NAG1-758	p 873	A89-52715
NAG1-784	p 855	A89-54085
NAG1-821	p 845	A89-52579
NAG1-834	p 851 p 826	A89-53957 A89-53971
NAG1-834 NAG1-959	p 847	A89-52612
	p 853	A89-54081
NAG2-175	p 832	A89-52693
NAG2-191	p 848	A89-52646
NAG2-221	p 843	A89-52549
NAG2-243	p 845	A89-52582
NAG2-297	p 832	A89-52712
NAG2-463	p 828	A89-52592
NAG2-489	p 875	A89-54904
NAG2-490	p 847	A89-52609
NAG3-666	p 826	A89-54803
NAG3-676 NAG3-823	р 819 р 873	A89-53931 A89-52603
NAG3-623	p 847	A89-52603 A89-52628
NAS1-17493	p 873	A89-52658
NAS1-17763	p 876	N89-29152
	p 876	N89-29154
NAS1-17921	p 876	N89-29155
NAS1-18027	p 849	A89-52674
NAS1-18336	p 867	A89-54777
NAS2-11304	p 842	A89-51702
NAS2-11978	p 831	A89-51703
NAS3-24622	p 842	N89-29351
NCC2-226	p 822	N89-28493
NCC2-55 NGL-22-009-640	p 825 p 826	N89-29326 A89-54803
NGL-22-009-640 NGL-31-001-252	p 846	A89-52598
NSF ATM-84-20980	p 838	A89-54848
NSF ATM-87-57013	p 869	A89-54788
NSF CDR-88-03012	, p 845	A89-52580
NSF DMC-87-07648	p 873	A89-52603
NSF ECS-86-57561	p 845	A89-52580
NSF MSM-85-04105	p 849	A89-52661
NSG-1321	p 825	N89-29328
NSG-3208	p 818	A89-52498
N00014-79-C-0647	p 860	N89-29497
N00014-83-K-0136 N00014-85-C-0419	p 818 p 821	A89-52945 N89-28488
N00014-85-C-0881	p 860	N89-28643
N00014-86-C-0353	p 858	A89-54671
N00039-87-C-5301	p 875	A89-54022
N00140-83-C-8899	p 838	A89-52025
N00167-85-C-0134	p 819	A89-53934
N00421-85-D-0155	р 846	A89-52595
STPA-85-95004-35 W-7405-ENG-48	p 825	N89-29325
	p 867 p 866	A89-54363 N89-28870
505-60-01	p 821	N89-28486
505-62-01	p 876	N89-29032
505-62-21	p 866	N89-29726
505-62-71	p 824	N89-29323
505-63-01-06	p 859	N89-28579
505-63-01-10	p 866	N89-29789
505-63-21-02	p 825	N89-29324
505-63-51	p 876 p 876	N89-29152 N89-29154
505-69-61	p 842	N89-29154 N89-29351
510-01-0A	p 860	N89-29490
532-06-11	p 823	N89-29305
535-03-11-03	p 876	N89-29155
992-21-01	р 822	N89-28498

REPORT NUMBER INDEX

AERONAUTICAL ENGINEERING / A Continuing Bibliography (Supplement 247)

January 1990

Typical Report Number Index Listing



Listings in this index are arranged alphanumerically by report number. The page number indicates the page on which the citation is located. The accession number denotes the number by which the citation is identified. An asterisk (*) indicates that the item is a NASA report. A pound sign (#) indicates that the item is available on microfiche.

A-86133	p 823	N89-29305 * #
A-88302	p 866	N89-28870 * #
A-89223	p 822	N89-28498 * #
	•	
AAMRL-TR-88-058	p 834	N89-28511 #
AD-A207721	p 860	N89-28661 #
AD-A207748	p 838	N89-28515 #
AD-A207754	p 842	N89-29347 #
AD-A207896	р 835	N89-29337 #
AD-A207911	p 842	N89-29348 #
AD-A208036	p 835	N89-29338 #
AD-A208058	p 835	N89-29339 #
AD-A208059	p 836	N89-29340 #
AD-A208060	p 836	N89-29341 #
AD-A208110	p 841	N89-28518 #
AD-A208185	p 835	N89-28513 #
AD-A208200	p 855	N89-29352 #
AD-A208433	p 824	N89-29316 #
AD-A208647	p 821	N89-28488 #
AD-A208925	p 865	N89-28835 #
AD-A208968	p 824	N89-29317 #
AD-A209030	p 864	N89-28754 #
AD-A209083	p 821	N89-28489 #
AD-A209150	p 859	N89-28574 #
AD-A209152	p 821	N89-28490 #
AD-A209166	p 860	N89-28643 #
AD-A209176	p 864	N89-28755 #
AD-A209244	p 824	N89-29318 #
AD-A209321	p 835	N89-29336 #
AD-A209396	p 834	N89-28511 #
AD-A209562	p 860	N89-29497 #
AD-A209580	p 877	N89-29193 #
AD-A209875	p 865	N89-28839 #
AD-E900860	p 860	N89-29497 #
AFHRL-TR-88-44	p 877	N89-29193 #
AFIT/GAE/ENY/89J-2	p 821	N89-28490 #
AFIT/GAE/ENY/89J-3	p 864	N89-28755 #
	P	
AFOSR-89-0651TR	p 824	N89-29316 #
AFOSR-89-0825TR	p 865	N89-28839 #
AFWAL-TR-89-2008	p 865	N89-28835 #
AGARD-R-761	p 823	N89-29306 #
AIAA PAPER 89-2109	p 833	A89-54200 #
AIAA PAPER 89-2142	p 840	A89-53304 * #
AIAA PAPER 89-2669	p 863	A89-54424 * #
	p 838	A89-52025 * #
	•	
AIAA PAPER 89-2904	p 862	A89-53307 * #
AIAA PAPER 89-3425	p 843	A89-52527 #

AIAA PAPER 89-3427		p 843	A89-52528	*	#
AIAA PAPER 89-3428		p 843	A89-52529	*	#
AIAA PAPER 89-3441		р 837	A89-52540		#
AIAA PAPER 89-3448		p 843	A89-52547		#
AIAA PAPER 89-3449			A89-52548		
		p 843			#
AIAA PAPER 89-3450		p 843	A89-52549		#
AIAA PAPER 89-3451		p 844	A89-52550		#
AIAA PAPER 89-3452		p 844	A89-52551		#
AIAA PAPER 89-3453		p 844	A89-52552		#
AIAA PAPER 89-3456		p 832	A89-52712	-	#
AIAA PAPER 89-3457		p 844	A89-52555		#
AIAA PAPER 89-3460		p 844	A89-52558		#
AIAA PAPER 89-3463	••••••	p 837	A89-52559		#
AIAA PAPER 89-3466	·····	p 844	A89-52561		#
AIAA PAPER 89-3467	•••••	p 845	A89-52562		#
AIAA PAPER 89-3468	•••••	p 845	A89-52563		#
AIAA PAPER 89-3470		p 873	A89-52564	-	#
AIAA PAPER 89-3471	•••••	p 845	A89-52565		#
AIAA PAPER 89-3486	•••••	p 845	A89-52579	•	#
AIAA PAPER 89-3487		p 845	A89-52580		#
AIAA PAPER 89-3488		p 845	A89-52581		#
AIAA PAPER 89-3489		p 845	A89-52582	*	#
AIAA PAPER 89-3490		p 846	A89-52583		#
AIAA PAPER 89-3491	•••••	p 846	A89-52584		#
AIAA PAPER 89-3492		p 873	A89-52585		#
AIAA PAPER 89-3495		p 846	A89-52587		#
AIAA PAPER 89-3498	•••••	p 828	A89-52590		#
AIAA PAPER 89-3499		p 828	A89-52591		#
AIAA PAPER 89-3500		p 828	A89-52592	٠	#
AIAA PAPER 89-3502		p 846	A89-52595		#
AIAA PAPER 89-3505		p 846	A89-52598	٠	#
AIAA PAPER 89-3507		p 846	A89-52600		#
AIAA PAPER 89-3509		p 847	A89-52602		#
AIAA PAPER 89-3510		p 873	A89-52603	٠	#
AIAA PAPER 89-3517		p 847	A89-52609	*	#
AIAA PAPER 89-3519		p 851	A89-53301	٠	#
AIAA PAPER 89-3520		p 847	A89-52611	*	#
AIAA PAPER 89-3521		p 847	A89-52612	٠	#
AIAA PAPER 89-3523		p 854	A89-52613		#
AIAA PAPER 89-3525		p 815	A89-52614	*	#
AIAA PAPER 89-3526		p 847	A89-52615		#
AIAA PAPER 89-3541		p 847	A89-52628	*	#
AIAA PAPER 89-3556	•••••	p 848	A89-52642	•	#
AIAA PAPER 89-3557		p 848	A89-52643		#
AIAA PAPER 89-3558		p 873	A89-52715	*	#
AIAA PAPER 89-3559		p 848	A89-52644		#
AIAA PAPER 89-3560		p 848	A89-52645		#
AIAA PAPER 89-3561	•••••	p 848	A89-52646	*	#
AIAA PAPER 89-3574		p 873	A89-52657		#
AIAA PAPER 89-3575		p 873	A89-52658	*	#
AIAA PAPER 89-3576		p 848	A89-52659	*	#
AIAA PAPER 89-3577		p 839	A89-52660		#
AIAA PAPER 89-3578	•••••	p 849	A89-52661		#
AIAA PAPER 89-3579	•••••	p 849	A89-52662		#
AIAA PAPER 89-3580	••••••	p 829	A89-52663	-	#
AIAA PAPER 89-3583		p 837	A89-52716		#
AIAA PAPER 89-3584		p 837	A89-52717		#
AIAA PAPER 89-3591		p 849	A89-52671		#
AIAA PAPER 89-3592		p 849	A89-52672		#
AIAA PAPER 89-3593		p 849	A89-52673		#
AIAA PAPER 89-3594		p 851	A89-52718		#
AIAA PAPER 89-3595		p 849	A89-52674	2	#
AIAA PAPER 89-3596		p 850	A89-52675	-	#
AIAA PAPER 89-3607			A89-52685		#
AIAA PAPER 89-3609			A89-52687	2	#
AIAA PAPER 89-3610			A89-52688	ĩ	#
AIAA PAPER 89-3612			A89-52690		#
AIAA PAPER 89-3614			A89-52692	÷	#
AIAA PAPER 89-3615			A89-52693	•	#
AIAA PAPER 89-3616			A89-52694		#
AIAA PAPER 89-3624			A89-52699	÷	#
AIAA PAPER 89-3625			A89-52700	1	#
AIAA PAPER 89-3626	•••••		A89-52701		#
AIAA PAPER 89-3627			A89-52721		#
AIAA PAPER 89-3628			A89-52702		#
AIAA PAPER 89-3634			A89-52703		#
AIAA PAPER 89-3635		h 958	A89-52594	Ċ	#
AD 005 549			N00 00074		μ
			N89-28871		#
	••••••		N89-28518		#
An*003*009	•••••	h 092	N89-29335		#
ARL-AERO-PROP-TM	445	D 840	N80.20240		#
AUTURE OF UNITED		P 042	N89-29348		#

ARL-AERO-PROP-TM-458	p 841	N89-28518	#
ARL-AERO-TM-399 ARL-AERO-TM-406-PT-1 ARL-AERO-TM-407-PT-2	p 835	N89-29341 N89-29339 N89-29340	# # #
ARL-FLIGHT-MECH-TM-408 ARL-FLIGHT-MECH-TM-409	p 835 p 821	N89-29338 N89-28489	# #
ARL-STRUC-R-434	p 866	N89-28871	#
ARL-STRUC-TM-495	p 824	N89-29318	#
ARL-SYS-TM-121	p 835	N89-29335	#
ARO-26239.1-EG-SBI	p 864	N89-28754	#
AVSCOM-TM-89-B-007	p 859	N89-28579	* #
BAE-WWT-RP-RES-AXR-000194-P T-A		N89.28501	
BAE-WWT-RP-RES-AXR-000194-P T-B			
BFLRF-253		N89-28661	#
CERT-0A-29/5025-AYD			" #
CONF-890717-2			#
CONF-890855-13	p 926	N89-29344	#
CONF-890855-6		N89-29343	#
CREARE-TM-1352		N89-28839	" #
DDC-89-01			" #
DERAT-29/5025-20			#
DE89-009329			" #
DE89-009335			#
DE89-009443	p 821	N89-28487	#
DFVLR-FB-89-19			" #
DFVLR-88-044			#
	•		
DODA-AR-004-577		N89-29348	#
DODA-AR-005-544	p 824	N89-29318	#
DODA-AR-005-586	p 835	N89-29338	#
DOT/FAA/CT-89/6	n 841	N89-28516	#
DOT/FAA/CT-89/7		N89-28517	#
DOT/FAA/DS-89/17-1	p 827	N89-29332	#
DOT/FAA/DS-89/17-2	p 828	N89-29333	#
DOT/FAA/DS-89/2-PHASE-1		N89-28523	#
DOT/FAA/DS-89/27	p 831	N89-28509	#
DOT/FAA/DS-89/28		N89-28524	#
DOT/FAA/RP-89/3			
E-4864		N89-29323	#
E-5014	p 866	N89-29726 1	#
E-5027		N89-29490 ' N89-29032 '	
E-5029	p 0/0	1103-23032	π
ETN-89-94312	p 823	N89-28500	#
ETN-89-94381		N89-28610	#
ETN-89-94382		N89-28485	#
ETN-89-94401 ETN-89-94421		N89-29156 N89-28508	#
ETN-89-94421 ETN-89-94562		N89-28522	# #
ETN-89-94563		N89-28800	#
ETN-89-94855	p 865	N89-28774	#
ETN-89-94856	p 822	N89-28494	#
ETN-89-94858		N89-28495	#
ETN-89-94958 ETN-89-94959		N89-28501 N89-28502	
ETN-89-94961		N89-29158	#
ETN-89-95033		N89-28519	#
ETN-89-95278		N89-29325	#
ETN-89-95288		N89-29698	#
ETN-89-95314		N89-28505	#
	-		

REPORT

ETN-89-95410

ETN-89-95410		
ETN-89-95428	. p 822	N89-28499 #
FFA-TN-1985-58	. p 823	N89-28500 #
FIP-12/10		
GRI-88/0312		
HAC-REF-F7896-F		N89-28643 #
ICOMP-89-19	. p 866	N89-29726 * #
ILR-MITT-212 ILR-MITT-214		N89-28522 # N89-28800 #
ISBN-90-627-5496-1 ISBN-92-835-0515-8		N89-28499 # N89-29306 #
ISL-CO-226/88	. p 841	N89-28519 #
ISL-R-114/87	. p 865	N89-28774 #
ISL-R-123/87 ISL-R-125/87	p 822	N89-28494 # N89-28495 #
ISSN-0070-3966 ISSN-0078-3781		N89-28485 # N89-29698 #
ISSN-0078-3781		N89-28505 #
ISSN-0389-4010		N89-28492 #
ISSN-0389-4010		N89-28514 #
ISSN-0389-4010	p 865	N89-28765 #
ISSN-0389-4010	p 824	N89-29321 * #
ISVR-TR-169-PT-1	p 877	N89-29158 #
IW-R515	p 822	N89-28499 #
JIAA-TR-93	p 825	N89-29326 * #
L-16599	p 821	N89-28486 *
LFD-275		N89-29156
MBB-UD-0537-88-PUB MBB-UD-538-88-PUB MBB-UD-541-89-PUB	p 833	A89-53334 # A89-53308 # A89-53309 #
MBB-0D-041-09-F0B	p 637	A09-0000 #
MBB-Z-0257-89-PUB	p 857	A89-53310 #
MDC-ATN-E466-014	p 824	N89-29316 #
MDC-ATN-E466-014	•	N89-29316 # N89-28514 #
NAL-TR-1003 NAL-TR-1004T	р 835 р 822	N89-28514 # N89-28492 #
NAL-TR-1003 NAL-TR-1004T NAL-TR-1007T	р 835 р 822 р 824	N89-28514 # N89-28492 # N89-29321 * #
NAL-TR-1003 NAL-TR-1004T	р 835 р 822 р 824	N89-28514 # N89-28492 #
NAL-TR-1003 NAL-TR-1004T NAL-TR-1007T	p 835 p 822 p 824 p 865 p 841	N89-28514 # N89-28492 # N89-29321 * #
NAL-TR-1003 NAL-TR-1004T NAL-TR-1007T NAL-TR-1010T NAPC-PE-185 NAPC-PE-188	p 835 p 822 p 824 p 865 p 841 p 841	N89-28514 # N89-28492 # N89-29321 * # N89-28765 # N89-28516 #
NAL-TR-1003 NAL-TR-1004T NAL-TR-1007T NAL-TR-1010T NAPC-PE-185 NAPC-PE-188 NAS 1.15:101038 NAS 1.15:101632	p 835 p 822 p 824 p 865 p 841 p 841 p 866	N89-28514 # N89-28492 # N89-29321 * # N89-28765 # N89-28516 # N89-28517 # N89-28870 * #
NAL-TR-1003 NAL-TR-1004T NAL-TR-1007T NAL-TR-1010T NAPC-PE-185 NAPC-PE-188 NAS 1.15:101632 NAS 1.15:101645	p 835 p 822 p 824 p 865 p 841 p 841 p 866 p 825 p 859	N89-28514 # N89-28492 # N89-28321 * # N89-28765 # N89-28516 # N89-28670 * # N89-28670 * #
NAL-TR-1003 NAL-TR-1004T NAL-TR-1007T NAL-TR-1010T NAPC-PE-185 NAPC-PE-188 NAS 1.15:101038 NAS 1.15:101632 NAS 1.15:101645 NAS 1.15:102101	p 835 p 822 p 824 p 865 p 841 p 841 p 866 p 825 p 859 p 824	N89-28514 # N89-28492 # N89-29321 * N89-28765 # N89-28516 # N89-28517 # N89-28870 * N89-28324 * N89-29323 * N89-29323 *
NAL-TR-1003 NAL-TR-1004T NAL-TR-1007T NAL-TR-1010T NAPC-PE-185 NAPC-PE-188 NAS 1.15:101632 NAS 1.15:101645 NAS 1.15:102101 NAS 1.15:102226	p 835 p 822 p 824 p 865 p 841 p 841 p 866 p 825 p 859 p 824 p 822	N89-28514 # N89-28492 # N89-282321 * N89-283765 # N89-28516 # N89-286517 # N89-286570 * N89-28679 * N89-28679 * N89-28637 * N89-28639 *
NAL-TR-1003 NAL-TR-1004T NAL-TR-1007T NAL-TR-1010T NAPC-PE-185 NAPC-PE-188 NAS 1.15:101632 NAS 1.15:101645 NAS 1.15:102101 NAS 1.15:102226	p 835 p 822 p 824 p 865 p 841 p 841 p 866 p 825 p 859 p 824 p 822	N89-28514 # N89-28492 # N89-282321 * N89-283765 # N89-28516 # N89-286517 # N89-286570 * N89-28679 * N89-28679 * N89-28637 * N89-28639 *
NAL-TR-1003 NAL-TR-1004T NAL-TR-1007T NAL-TR-1010T NAPC-PE-185 NAPC-PE-188 NAS 1.15:101038 NAS 1.15:101645 NAS 1.15:101645 NAS 1.15:102216 NAS 1.15:102318 NAS 1.15:102326 NAS 1.15:102326	p 835 p 822 p 824 p 865 p 841 p 841 p 841 p 841 p 845 p 859 p 824 p 825 p 859 p 824 p 866 p 866 p 866 p 866	N89-28514 # N89-28492 # N89-28212 * N89-282765 # N89-28516 # N89-28517 # N89-28240 * N89-28232 * N89-28232 * N89-28249 * N89-28249 * N89-28249 * N89-28490 * N89-28490 *
NAL-TR-1003 NAL-TR-1004T NAL-TR-1007T NAL-TR-1010T NAPC-PE-185 NAPC-PE-188 NAS 1.15:101038 NAS 1.15:101632 NAS 1.15:101645 NAS 1.15:102101 NAS 1.15:10226 NAS 1.15:102326 NAS 1.15:102327 NAS 1.15:102327	p 8355 p 822 p 824 p 865 p 841 p 866 p 825 p 859 p 824 p 825 p 829 p 824 p 822 p 866 p 825 p 824 p 822 p 866 p 822	N89-28514 # N89-28492 # N89-28210 # N89-282765 # N89-28516 # N89-286507 # N89-28670 # N89-28670 # N89-28670 # N89-28632 # N89-28632 # N89-28498 # N89-28498 # N89-29490 # N89-29430 # N89-29430 # N89-29430 #
NAL-TR-1003 NAL-TR-1004T NAL-TR-1007T NAL-TR-1010T NAPC-PE-185 NAPC-PE-188 NAS 1.15:101632 NAS 1.15:101635 NAS 1.15:101645 NAS 1.15:102101 NAS 1.15:10226 NAS 1.15:102318 NAS 1.15:102327 NAS 1.15:102327 NAS 1.15:88214	p 835 p 822 p 824 p 865 p 841 p 841 p 846 p 825 p 854 p 822 p 822 p 822 p 824 p 822 p 824 p 822 p 824 p 822	N89-28514 # N89-28492 # N89-28492 # N89-28214 # N89-28516 # N89-28517 # N89-28240 * N89-28232 * N89-28232 * N89-28233 * N89-28498 * N89-28498 * N89-28490 * N89-29032 * N89-28030 * N89-28030 * N89-280305 *
NAL-TR-1003 NAL-TR-1004T NAL-TR-1007T NAL-TR-1010T NAPC-PE-185 NAPC-PE-188 NAS 1.15:101038 NAS 1.15:101632 NAS 1.15:101645 NAS 1.15:102226 NAS 1.15:102226 NAS 1.15:102318 NAS 1.15:102327 NAS 1.15:102327 NAS 1.15:4138 NAS 1.15:88214 NAS 1.15:68214	p 835 p 824 p 824 p 865 p 841 p 841 p 846 p 825 p 859 p 824 p 825 p 859 p 824 p 866 p 826 p 860 p 876 p 823 p 842	N89-28514 # N89-28492 # N89-28492 # N89-28321 * N89-28765 # N89-28765 # N89-28517 # N89-28670 * N89-28670 * N89-28670 * N89-28670 * N89-28637 * N89-28498 * N89-29032 * N89-29032 * N89-29305 * N89-29305 *
NAL-TR-1003 NAL-TR-1004T NAL-TR-1007T NAL-TR-1010T NAPC-PE-185 NAPC-PE-188 NAS 1.15:101038 NAS 1.15:101632 NAS 1.15:101645 NAS 1.15:102226 NAS 1.15:102226 NAS 1.15:102318 NAS 1.15:102327 NAS 1.15:102327 NAS 1.15:4138 NAS 1.15:88214 NAS 1.15:68214	p 835 p 824 p 824 p 865 p 841 p 841 p 846 p 825 p 859 p 824 p 825 p 859 p 824 p 866 p 826 p 860 p 876 p 823 p 842	N89-28514 # N89-28492 # N89-28492 # N89-28321 * N89-28765 # N89-28765 # N89-28517 # N89-28670 * N89-28670 * N89-28670 * N89-28670 * N89-28637 * N89-28498 * N89-29032 * N89-29032 * N89-29305 * N89-29305 *
NAL-TR-1003 NAL-TR-1004T NAL-TR-1007T NAL-TR-1010T NAPC-PE-185 NAPC-PE-188 NAS 1.15:101632 NAS 1.15:101645 NAS 1.15:102101 NAS 1.15:10226 NAS 1.15:10226 NAS 1.15:102328 NAS 1.15:102327 NAS 1.15:102327 NAS 1.15:8214 NAS 1.26:179642-ADD NAS 1.26:181790 NAS 1.26:181791	P 835 p 822 p 824 p 865 p 841 p 846 p 825 p 859 p 824 p 859 p 825 p 859 p 826 p 866 p 866 p 866 p 821 p 823 p 822 p 876	N89-28514 # N89-28492 # N89-28492 # N89-28214 # N89-28765 # N89-28516 # N89-28517 # N89-28670 # N89-28324 # N89-28370 # N89-28370 # N89-28373 # N89-28498 # N89-28490 # N89-28032 # N89-28032 # N89-28032 # N89-28032 # N89-28035 # N89-28035 # N89-28035 # N89-28035 # N89-29315 * N89-29152 * N89-29154 *
NAL-TR-1003 NAL-TR-1004T NAL-TR-1010T NAL-TR-1010T NAPC-PE-185 NAPC-PE-188 NAS 1.15:101038 NAS 1.15:101645 NAS 1.15:102101 NAS 1.15:102226 NAS 1.15:102327 NAS 1.15:102327 NAS 1.15:102327 NAS 1.15:102327 NAS 1.15:102327 NAS 1.26:179642-ADD NAS 1.26:181790 NAS 1.26:181791 NAS 1.26:181791	P 835 p 822 p 824 p 865 p 841 p 841 p 846 p 825 p 859 p 824 p 859 p 824 p 826 p 859 p 824 p 826 p 876 p 821 p 842 p 876 p 822	N89-28514 # N89-28492 # N89-28492 # N89-28765 # N89-28765 # N89-28617 # N89-28617 # N89-28670 * N89-28670 * N89-280323 * N89-280323 * N89-28498 * N89-29032 * N89-29032 * N89-29032 * N89-28466 * N89-28351 * N89-28351 * N89-280352 * N89-290352 * N89-29152 * N89-29154 * N89-28493 *
NAL-TR-1003 NAL-TR-1004T NAL-TR-1010T NAL-TR-1010T NAPC-PE-185 NAPC-PE-188 NAS 1.15:101038 NAS 1.15:101645 NAS 1.15:102101 NAS 1.15:102226 NAS 1.15:102327 NAS 1.15:102327 NAS 1.15:102327 NAS 1.15:102327 NAS 1.15:102327 NAS 1.26:179642-ADD NAS 1.26:181790 NAS 1.26:181791 NAS 1.26:181791	P 835 p 822 p 824 p 865 p 841 p 841 p 846 p 825 p 859 p 824 p 859 p 824 p 826 p 859 p 824 p 826 p 876 p 821 p 842 p 876 p 822	N89-28514 # N89-28492 # N89-28492 # N89-28765 # N89-28765 # N89-28617 # N89-28617 # N89-28670 * N89-28670 * N89-280323 * N89-280323 * N89-28498 * N89-29032 * N89-29032 * N89-29032 * N89-28466 * N89-28351 * N89-28351 * N89-280352 * N89-290352 * N89-29152 * N89-29154 * N89-28493 *
NAL-TR-1003 NAL-TR-1004T NAL-TR-1007T NAL-TR-1010T NAPC-PE-185 NAPC-PE-188 NAS 1.15:101632 NAS 1.15:101645 NAS 1.15:102101 NAS 1.15:10226 NAS 1.15:10226 NAS 1.15:102328 NAS 1.15:102327 NAS 1.15:102327 NAS 1.15:8214 NAS 1.26:179642-ADD NAS 1.26:181790 NAS 1.26:181791	P 835 p 822 p 824 p 865 p 841 p 841 p 846 p 825 p 824 p 866 p 825 p 824 p 860 p 824 p 860 p 876 p 823 p 842 p 842 p 876 p 822 p 822	N89-28514 # N89-28492 # N89-28492 # N89-282492 # N89-282765 # N89-28765 # N89-28516 # N89-28517 # N89-28070 # N89-28070 # N89-28070 # N89-28032 # N89-28032 # N89-280490 # N89-280305 # N89-28035 # N89-28037 # N89-280328 #
NAL-TR-1003 NAL-TR-1004T NAL-TR-1010T NAL-TR-1010T NAL-TR-1010T NAL-TR-1010T NAPC-PE-185 NAPC-PE-188 NAS 1.15:101038 NAS 1.15:101632 NAS 1.15:101645 NAS 1.15:102226 NAS 1.15:102226 NAS 1.15:102318 NAS 1.15:102327 NAS 1.15:102327 NAS 1.15:102327 NAS 1.15:102327 NAS 1.15:102328 NAS 1.15:102329 NAS 1.26:1879642-ADD NAS 1.26:181791 NAS 1.26:185912 NAS 1.26:185915 NAS 1.26:185915 NAS 1.26:185918 NAS 1.26:185918	P 835 p 822 p 824 p 865 p 841 p 841 p 866 p 825 p 824 p 825 p 824 p 825 p 824 p 826 p 876 p 821 p 822 p 876 p 824 p 825 p 824 p 825 p 824 p 825 p 826 p 876 p 825 p 825 p 826 p 826 p 826 p 827 p 826 p 827 p 827	N89-28514 # N89-28492 # N89-28492 # N89-28765 # N89-28765 # N89-28670 # N89-28032 # N89-28498 # N89-29302 # N89-29302 # N89-29303 # N89-29304 * N89-29305 # N89-29305 # N89-29315 # N89-29321 # N89-29322 * N89-29328 # N89-29328 * N89-29328 * N89-29328 * N89-29326 * N89-29326 * N89-29355 *
NAL-TR-1003 NAL-TR-1004T NAL-TR-1007T NAL-TR-1010T NAL-TR-1010T NAL-TR-1010T NAL-TR-1010T NAPC-PE-185 NAPC-PE-185 NAPC-PE-185 NAS 1.15:101632 NAS 1.15:101645 NAS 1.15:102101 NAS 1.15:102226 NAS 1.15:102326 NAS 1.15:102326 NAS 1.15:102327 NAS 1.15:102326 NAS 1.15:102327 NAS 1.15:102326 NAS 1.15:102327 NAS 1.15:102327 NAS 1.26:179642-ADD NAS 1.26:181790 NAS 1.26:181791 NAS 1.26:185910 NAS 1.26:185910 NAS 1.26:185915 NAS 1.26:185915 NAS 1.26:185918 NAS 1.26:185918 NAS 1.26:10012-PT-2	P 835 p 822 p 824 p 865 p 841 p 841 p 846 p 825 p 824 p 866 p 825 p 824 p 860 p 824 p 826 p 826 p 826 p 876 p 822 p 8422 p 8422 p 8422 p 825 p 825 p 825 p 825 p 825 p 825 p 826 p 8	N89-28514 # N89-28492 # N89-28492 # N89-28492 # N89-2816 # N89-28516 # N89-28517 # N89-28517 # N89-28517 # N89-28370 # N89-28370 # N89-28370 # N89-28370 # N89-28323 # N89-29326 # N89-29032 # N89-29032 # N89-29032 # N89-29035 # N89-29315 # N89-29315 # N89-29321 # N89-29326 # N89-29326 # N89-29326 # N89-29326 # N89-29326 # N89-29326 # N89-29355 # N89-29389 # N89-29365 # N89-29365
NAL-TR-1003 NAL-TR-1004T NAL-TR-1010T NAL-TR-1010T NAL-TR-1010T NAL-TR-1010T NAL-TR-1010T NAPC-PE-185 NAPC-PE-188 NAS 1.15:101038 NAS 1.15:101632 NAS 1.15:102101 NAS 1.15:102226 NAS 1.15:102327 NAS 1.15:102326 NAS 1.15:102327 NAS 1.15:102327 NAS 1.15:102327 NAS 1.26:179642-ADD NAS 1.26:181791 NAS 1.26:185910 NAS 1.26:185915 NAS 1.26:185918	P 835 p 822 p 824 p 865 p 841 p 841 p 846 p 825 p 854 p 825 p 854 p 822 p 866 p 822 p 866 p 876 p 821 p 822 p 876 p 822 p 824 p 825 p 822 p 824 p 825 p 825 p 824 p 825 p 825 p 826 p 825 p 826 p 826 p 825 p 826 p 825 p 826 p 825 p 826 p 825 p 825 p 826 p 825 p 825 p 826 p 825 p 826 p 825 p 835 p 835 p 835	N89-28514 # N89-28492 # N89-28492 # N89-28765 # N89-28765 # N89-28617 # N89-28617 # N89-28617 # N89-28617 # N89-28023 # N89-28032 # N89-28498 # N89-29032 # N89-29032 # N89-28046 * N89-29032 # N8
NAL-TR-1003 NAL-TR-1004T NAL-TR-1010T NAL-TR-1010T NAL-TR-1010T NAL-TR-1010T NAL-TR-1010T NAPC-PE-185 NAPC-PE-188 NAS 1.15:101038 NAS 1.15:101632 NAS 1.15:101645 NAS 1.15:102101 NAS 1.15:102226 NAS 1.15:102327 NAS 1.15:102327 NAS 1.15:102327 NAS 1.26:179642-ADD NAS 1.26:181790 NAS 1.26:185912 NAS 1.26:185915 NAS 1.26:185915 NAS 1.26:185918	P 835 p 822 p 824 p 865 p 841 p 841 p 846 p 825 p 824 p 824 p 825 p 824 p 824 p 822 p 866 p 824 p 823 p 824 p 823 p 823 p 824 p 825 p 824 p 825 p 825 p 825 p 825 p 825 p 825 p 826 p 825 p 826 p 825 p 826 p 856 p 854	N89-28514 # N89-28492 # N89-28492 # N89-28161 # N89-28576 # N89-28570 # N89-28037 # N89-28323 # N89-28323 # N89-28498 * N89-28498 * N89-28490 # N89-28490 * N89-28032 * N89-28032 * N89-28032 * N89-29032 * N89-29032 * N89-29035 * N89-29032 * N8
NAL-TR-1003 NAL-TR-1004T NAL-TR-1010T NAPC-PE-185 NAPC-PE-188 NAS 1.15:101645 NAS 1.15:102162 NAS 1.15:10226 NAS 1.15:102326 NAS 1.15:102326 NAS 1.15:102326 NAS 1.15:102327 NAS 1.15:102326 NAS 1.15:102327 NAS 1.26:185910 NAS 1.26:185910 NAS 1.26:185910 NAS 1.26:185910 NAS 1.26:185910 NAS 1.26:185918 NAS 1.26:185918 NAS 1.26:185918 NAS 1.26:185918 NAS 1.26:185918 NAS 1.26:185918 NAS 1.26:10012-PT-2 NAS 1.26:10012-PT-2 NAS 1.26:10012-PT-2 NAS 1.26:10012-PT-2 NAS	P 835 p 822 p 824 p 865 p 841 p 841 p 846 p 825 p 824 p 826 p 825 p 824 p 826 p 826 p 826 p 826 p 826 p 827 p 822 p 842 p 822 p 842 p 825 p 822 p 822 p 825 p 822 p 825 p 825 p 825 p 825 p 825 p 825 p 825 p 825 p 825 p 826 p 825 p 826 p 826 p 826 p 826 p 826 p 826 p 825 p 826 p 825 p 826 p 825 p 824 p 825 p 825 p 826 p 826 p 826 p 825 p 826 p 825 p 825 p 826 p 825 p 826 p 825 p 8866 p 885 p 885	N89-28514 # N89-28492 # N89-28492 # N89-28492 # N89-28492 # N89-28765 # N89-28765 # N89-28517 # N89-28579 # N89-2879 # N89-2879 # N89-2879 # N89-2879 # N89-2879 # N89-28493 # N89-29302 # N89-29305 # N89-29305 # N89-29315 # N89-29315 # N89-29315 # N89-29328 # N89-29328 # N89-29328 # N89-29328 # N89-29378 # N89-29378 # N89-28841 * N89-28841 * N89-28524 # N89-28509 #
NAL-TR-1003 NAL-TR-1004T NAL-TR-1010T NAL-TR-1010T NAL-TR-1010T NAL-TR-1010T NAPC-PE-185 NAPC-PE-188 NAS 1.15:101038 NAS 1.15:101632 NAS 1.15:101645 NAS 1.15:102226 NAS 1.15:102327 NAS 1.15:102326 NAS 1.15:102327 NAS 1.15:102327 NAS 1.15:102326 NAS 1.15:102327 NAS 1.15:102327 NAS 1.15:102326 NAS 1.26:1858214 NAS 1.26:18791 NAS 1.26:181791 NAS 1.26:185915 NAS 1.26:185915 NAS 1.26:185915 NAS 1.26:185918 NAS 1.51:0012-PT-2 NAS 1.51:0012-PT-2 NAS 1.71:MFS-28345-1 NAS-R-DUAT NAS-CASE-MFS-28345-1	P 835 p 822 p 824 p 865 p 841 p 841 p 846 p 825 p 854 p 825 p 824 p 826 p 824 p 826 p 824 p 826 p 824 p 826 p 822 p 824 p 825 p 822 p 824 p 825 p 822 p 824 p 825 p 825 p 824 p 825 p 825 p 824 p 825 p 824 p 825 p 825 p 824 p 825 p 825 p 824 p 825 p 835 p 835	N89-28514 # N89-28492 # N89-282492 # N89-282765 # N89-282765 # N89-28517 # N89-28203 * N89-28233 # N89-28233 # N89-28233 # N89-282498 # N89-29323 # N89-29490 # N89-29032 # N89-29032 # N89-29032 # N89-29032 # N89-29032 # N89-29351 # N89-293154 # N89-293154 # N89-29326 # N89-29326 # N89-29326 # N89-29326 # N89-29326 # N89-29326 # N89-28041 # N89-28509 # N89-28641 # N89-28641 #
NAL-TR-1003 NAL-TR-1004T NAL-TR-1010T NAL-TR-1010T NAL-TR-1010T NAL-TR-1010T NAPC-PE-185 NAPC-PE-188 NAS 1.15:101038 NAS 1.15:101632 NAS 1.15:101645 NAS 1.15:102226 NAS 1.15:102327 NAS 1.15:102326 NAS 1.26:18791 NAS 1.26:181791 NAS 1.26:185915 NAS 1.26:185915 NAS 1.26:185915 NAS 1.26:185918 NAS 1.71:MFS-28345-1 NASA-CASE-MFS-2834	P 835 p 822 p 824 p 865 p 824 p 865 p 841 p 841 p 841 p 846 p 825 p 824 p 825 p 824 p 826 p 824 p 826 p 824 p 826 p 822 p 824 p 822 p 824 p 825 p 822 p 824 p 825 p 822 p 824 p 825 p 826 p 825 p 825 p 826 p 826	N89-28514 # N89-28492 # N89-28765 # N89-28765 # N89-28765 # N89-28617 # N89-28617 # N89-28870 # N89-28870 # N89-28032 # N89-28032 # N89-28032 # N89-29323 # N89-28490 # N89-29032 # N89-29032 # N89-29032 # N89-29032 # N89-29032 # N89-29351 # N89-29351 # N89-29326 # N89-29326 # N89-29326 # N89-29326 # N89-29326 # N89-29326 # N89-28031 # N89-28041 # N89-280509 # N89-280841 # N89-280841 # N89-280789 # <t< td=""></t<>
NAL-TR-1003 NAL-TR-1004T NAL-TR-1007T NAL-TR-1010T NAS 1.5:101645 NAS 1.5:10218 NAS 1.5:102326 NAS 1.5:102326 NAS 1.5:102326 NAS 1.5:102327 NAS 1.5:102327 NAS 1.6:18:10230 NAS 1.26:18:1919 NAS 1.26:18:1791 NAS 1.26:18:5910 NAS 1.26:18:5910 NAS 1.26:18:5910 NAS 1.26:18:5910 NAS 1.26:18:5918 NAS 1.26:18:5918 NAS 1.26:18:5919 NAS 1.26:18:5910	P 835 p 822 p 824 p 865 p 824 p 866 p 824 p 841 p 841 p 846 p 825 p 824 p 826 p 825 p 824 p 826 p 826 p 826 p 826 p 827 p 822 p 842 p 825 p 822 p 825 p 822 p 825 p 822 p 825 p 822 p 825 p 826 p 825 p 826 p 825 p 826 p 825 p 826 p 825 p 826 p 825 p 825 p 826 p 825 p 825	N89-28514 # N89-28492 # N89-28492 # N89-28492 # N89-28492 # N89-28765 # N89-28765 # N89-28516 # N89-28517 # N89-28579 # N89-28579 # N89-28579 # N89-28579 # N89-28493 # N89-29302 # N89-29490 # N89-29490 # N89-29490 # N89-29302 # N89-29305 # N89-2931 # N89-29328 # N89-29328 # N89-29328 # N89-29328 # N89-29328 # N89-29328 # N89-29329 # N89-28509 # N89-28641 # N89-28051 # N89-29351
NAL-TR-1003 NAL-TR-1004T NAL-TR-1010T NAL-TR-1010T NAL-TR-1010T NAL-TR-1010T NAL-TR-1010T NAPC-PE-185 NAPC-PE-188 NAS 1.15:101038 NAS 1.15:101632 NAS 1.15:101645 NAS 1.15:102101 NAS 1.15:10226 NAS 1.15:102326 NAS 1.15:102327 NAS 1.15:102327 NAS 1.15:102327 NAS 1.15:102327 NAS 1.15:102327 NAS 1.26:179642-ADD NAS 1.26:181791 NAS 1.26:185915 NAS 1.26:10012-PT-2 NASA-CR-1325	P 835 p 822 p 824 p 865 p 824 p 866 p 824 p 841 p 841 p 846 p 825 p 824 p 826 p 824 p 822 p 860 p 824 p 823 p 824 p 823 p 824 p 823 p 824 p 825 p 826 p 825 p 825 p 825 p 826 p 825 p 826 p 825 p 826 p 826	N89-28514 # N89-28492 # N89-28492 # N89-28165 # N89-28166 # N89-28517 # N89-28517 # N89-28234 * N89-28324 * N89-28323 * N89-28323 * N89-28498 * N89-28498 * N89-28498 * N89-28498 * N89-28490 * N89-28490 * N89-29325 * N89-29351 * N89-29355 * N89-29326 * N89-29327 * N89-29328 * N89-29328 * N89-29328 * N89-29328 * N89-29328 * N89-29328 * N89-28031 * N89-28509 * N89-28651 * N89-28651 * N89-28650 * N8
NAL-TR-1003 NAL-TR-1004T NAL-TR-1010T NAL-TR-1010T NAL-TR-1010T NAL-TR-1010T NAL-TR-1010T NAPC-PE-185 NAPC-PE-188 NAS 1.15:101038 NAS 1.15:101632 NAS 1.15:101645 NAS 1.15:102266 NAS 1.15:102226 NAS 1.15:102327 NAS 1.15:102326 NAS 1.15:102327 NAS 1.15:102327 NAS 1.15:102327 NAS 1.15:102327 NAS 1.15:102327 NAS 1.26:1879642-ADD NAS 1.26:185910 NAS 1.26:185910 NAS 1.26:185915 NAS 1.26:185915 >	P 835 p 822 p 824 p 865 p 824 p 865 p 824 p 866 p 824 p 825 p 824 p 825 p 824 p 826 p 824 p 826 p 824 p 826 p 824 p 826 p 824 p 826 p 824 p 825 p 824 p 822 p 824 p 825 p 826 p 825 p 825 p 826 p 825 p 826 p 825 p 825 p 826 p 826	N89-28514 # N89-28492 # N89-282492 # N89-282492 # N89-282765 # N89-282765 # N89-282617 # N89-282617 # N89-282617 # N89-282617 # N89-282323 # N89-282490 # N89-28490 # N89-28032 # N89-29032 # N89-29032 # N89-29032 # N89-29032 # N89-29035 # N89-29035 # N89-29351 # N89-29351 # N89-29326 # N89-29326 # N89-29326 # N89-29326 # N89-29326 # N89-28041 # N89-28050 # N89-28050 # N89-28051 # N89-280841 * N89-280841 *
NAL-TR-1003 NAL-TR-1004T NAL-TR-1007T NAL-TR-1010T NAS 1.5:101645 NAS 1.5:10216 NAS 1.5:102326 NAS 1.5:102326 NAS 1.5:102327 NAS 1.5:102327 NAS 1.26:185910	P 835 p 822 p 824 p 865 p 824 p 865 p 841 p 841 p 846 p 825 p 824 p 826 p 826 p 826 p 826 p 826 p 826 p 827 p 822 p 842 p 842 p 842 p 825 p 822 p 825 p 822 p 825 p 822 p 825 p 822 p 825 p 826 p 826 p 825 p 826 p 826	N89-28514 # N89-28492 # N89-28492 # N89-28492 # N89-28492 # N89-28765 # N89-28765 # N89-28516 # N89-28517 # N89-28518 # N89-2879 # N89-2876 # N89-28498 * N89-28498 * N89-28498 * N89-29302 * N89-29490 * N89-29490 * N89-29302 * N89-29303 * N89-2931 * N89-29328 * N89-29321 * N89-29328 * N89-29328 * N89-29328 * N89-29328 * N89-29329 * N89-28041 * N89-28050 # N89-28051 * N89-29351 </td
NAL-TR-1003 NAL-TR-1004T NAL-TR-1007T NAL-TR-1010T NAL-TR-1010T NAL-TR-1010T NAL-TR-1010T NAL-TR-1010T NAL-TR-1010T NAL-TR-1010T NAPC-PE-185 NAPC-PE-188 NAS 1.15:101038 NAS 1.15:101645 NAS 1.15:102101 NAS 1.15:102226 NAS 1.15:102326 NAS 1.15:102326 NAS 1.15:102327 NAS 1.15:102327 NAS 1.15:102327 NAS 1.15:102327 NAS 1.15:102327 NAS 1.26:18791 NAS 1.26:18790 NAS 1.26:18791 NAS 1.26:185915	P 835 p 822 p 824 p 865 p 824 p 865 p 824 p 866 p 824 p 825 p 824 p 825 p 824 p 825 p 824 p 826 p 824 p 825 p 824 p 826 p 824 p 825 p 825 p 824 p 825 p 826 p 825 p 826 p 825 p 826 p 825	N89-28514 # N89-28492 # N89-28492 # N89-281765 # N89-281765 # N89-28516 # N89-28517 # N89-28030 # N89-28032 # N89-29032 # N89-29032 # N89-29032 # N89-29035 # N89-29035 # N89-29154 # N89-28050 # N89-28050 # N89-28051 # N89-280524 # N89-28050 # N89-28051 # N89-28051 # N89-28051 # <td< td=""></td<>
NAL-TR-1003 NAL-TR-1004T NAL-TR-1007T NAL-TR-1010T NAS 1.5:101645 NAS 1.5:10216 NAS 1.5:102326 NAS 1.5:102326 NAS 1.5:102327 NAS 1.5:102327 NAS 1.26:185910	P 835 p 822 p 824 p 865 p 824 p 865 p 824 p 866 p 824 p 825 p 824 p 825 p 824 p 825 p 824 p 826 p 824 p 826 p 824 p 822 p 824 p 822 p 824 p 822 p 824 p 825 p 825 p 825 p 826 p 825 p 825 p 825 p 825 p 826 p 825 p 825	N89-28514 # N89-28492 # N89-282492 # N89-282492 # N89-282765 # N89-28576 # N89-28577 # N89-28579 # N89-28232 * N89-28233 # N89-282498 * N89-282498 * N89-28498 * N89-28490 * N89-29032 * N89-29032 * N89-29032 * N89-29032 * N89-29032 * N89-29035 * N89-29035 * N89-29035 * N89-29351 * N89-29326 * N89-28524 # N89-28524 # N89-28524 # N89-28525 # N89-28641 * N89-28526 # N89-28521 * N89-28152 * N89-28152 * <

NASA-TM-101038	p 866	N89-28870 * #
NASA-TM-101632	p 825	N89-29324 * #
NASA-TM-101645	p 859	N89-28579 * #
NASA-TM-102101		N89-29323 * #
NASA-TM-102226		N89-28498 * #
NASA-TM-102318		N89-29726 * #
		N89-29490 * #
NASA-TM-102327		N89-29032 * #
NASA-TM-4138	p 821	N89-28486 *
NASA-TM-88214	p 823	N89-29305 * #
NLR-MP-87006-U	p 855	N89-28526 #
	- 007	N00 00507 #
NTSB/AAR-89/02/SUM	p 827	N89-28507 #
ONERA-NT-1988-2	p 866	N89-29698 #
ONRL-8-017-R	p 835	N89-29336 #
PB89-195788	p 859	N89-28588 #
PB89-910405	p 827	N89-28507 #
PD-CF-8924	o 822	N89-28497 #
	p 022	
R/D-2835A-AN	n 824	N89-29317 #
H/D-2030A-AN	p 024	103-23317 #
REPT-6-88	- 077	NO0 00450
HEP1-0-88	p 8//	N89-29156
SAND-89-0345C		N89-29343 #
SAND-89-0619C	p 836	N89-29344 #
SAWE PAPER 1854	p 877	A89-52024
SERI/TP-217-3505	p 821	N89-28487 #
SME PAPER EM88-533	p 864	A89-54890
SME PAPER EM88-549		A89-54900
SME PAPER EM88-551		A89-54901
SIVIE FAFER EN100-331		
	p 034	N03-34301
	•	
SRI-04-8542-1	•	N89-29155 * #
	р 876	N89-29155 * #
SRI-04-8542-1	р 876	
TR-54	р 876 р 860	N89-29155 * # N89-29497 #
	р 876 р 860	N89-29155 * #
TR-54 TUB-DISS-PAPER-128	p 876 p 860 p 827	N89-29155 * # N89-29497 #
TR-54	p 876 p 860 p 827	N89-29155 * # N89-29497 #
TR-54 TUB-DISS-PAPER-128	p 876 p 860 p 827 p 877	N89-29155 * # N89-29497 # N89-28508 #
TR-54 TUB-DISS-PAPER-128 UDR-TR-88-124	p 876 p 860 p 827 p 877	N89-29155 * # N89-29497 # N89-28508 # N89-29193 #
TR-54 TUB-DISS-PAPER-128 UDR-TR-88-124 UDR-TR-88-95	p 876 p 860 p 827 p 877 p 865	N89-29155 * # N89-29497 # N89-28508 # N89-29193 # N89-28835 #
TR-54 TUB-DISS-PAPER-128 UDR-TR-88-124	p 876 p 860 p 827 p 877 p 865	N89-29155 * # N89-29497 # N89-28508 # N89-29193 #
TR-54 TUB-DISS-PAPER-128 UDR-TR-88-124 UDR-TR-88-95 US-PATENT-APPL-SN-364743	p 876 p 860 p 827 p 877 p 865 p 865	N89-29155 * # N89-29497 # N89-28508 # N89-28835 # N89-28841 * #
TR-54 TUB-DISS-PAPER-128 UDR-TR-88-124 UDR-TR-88-95	p 876 p 860 p 827 p 877 p 865 p 865	N89-29155 * # N89-29497 # N89-28508 # N89-29193 # N89-28835 #
TR-54 TUB-DISS-PAPER-128 UDR-TR-88-124 UDR-TR-88-95 US-PATENT-APPL-SN-364743 USAAVSCOM-TM-89-A-001	p 876 p 860 p 827 p 877 p 865 p 865 p 822	N89-29155 * # N89-29497 # N89-28508 # N89-28508 # N89-28835 # N89-28841 * # N89-28498 * #
TR-54 TUB-DISS-PAPER-128 UDR-TR-88-124 UDR-TR-88-95 US-PATENT-APPL-SN-364743	p 876 p 860 p 827 p 877 p 865 p 865 p 822	N89-29155 * # N89-29497 # N89-28508 # N89-28835 # N89-28841 * #
TR-54 TUB-DISS-PAPER-128 UDR-TR-88-124 UDR-TR-88-95 US-PATENT-APPL-SN-364743 USAAVSCOM-TM-89-A-001 USAFSAM-TR-88-25	p 876 p 860 p 827 p 877 p 865 p 865 p 822 p 838	N89-29155 * # N89-29497 # N89-28508 # N89-28355 # N89-28841 * # N89-28498 * # N89-28495 #
TR-54 TUB-DISS-PAPER-128 UDR-TR-88-124 UDR-TR-88-95 US-PATENT-APPL-SN-364743 USAAVSCOM-TM-89-A-001	p 876 p 860 p 827 p 877 p 865 p 865 p 822 p 838	N89-29155 * # N89-29497 # N89-28508 # N89-28355 # N89-28841 * # N89-28498 * # N89-28495 #
TR-54 TUB-DISS-PAPER-128 UDR-TR-88-124 UDR-TR-88-95 US-PATENT-APPL-SN-364743 USAAVSCOM-TM-89-A-001 USAFSAM-TR-88-25 VUB-STR-16	p 876 p 860 p 827 p 877 p 865 p 865 p 822 p 838 p 824	N89-29155 * # N89-29497 # N89-28508 # N89-28835 # N89-28841 * # N89-28498 * # N89-28515 # N89-29317 #
TR-54 TUB-DISS-PAPER-128 UDR-TR-88-124 UDR-TR-88-95 US-PATENT-APPL-SN-364743 USAAVSCOM-TM-89-A-001 USAFSAM-TR-88-25 VUB-STR-16 WP-88W00075	p 876 p 860 p 827 p 877 p 865 p 865 p 865 p 822 p 838 p 824 p 854	N89-29155 * # N89-29497 # N89-28508 # N89-28355 # N89-28841 * # N89-28498 * # N89-28495 #
TR-54 TUB-DISS-PAPER-128 UDR-TR-88-124 UDR-TR-88-95 US-PATENT-APPL-SN-364743 USAAVSCOM-TM-89-A-001 USAFSAM-TR-88-25 VUB-STR-16	p 876 p 860 p 827 p 877 p 865 p 865 p 865 p 822 p 838 p 824 p 854	N89-29155 * # N89-29497 # N89-28508 # N89-28835 # N89-28841 * # N89-28498 * # N89-28515 # N89-29317 #

REPORT NUMBER INDEX

- ----

į

T

i

i

1

ACCESSION NUMBER INDEX

AERONAUTICAL ENGINEERING / A Continuing Bibliography (Supplement 247)

January 1990

p 864

p 820 p 820

p 821 p 821 p 858 p 867 p 867

p 868 p 868 p 868

p 868 p 868

p 868 p 868

p 869 p 869

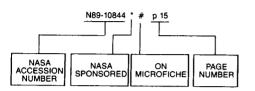
D 869 p 869

p 853 p 869

p 826 p 826 p 826

p 826 p 869 p 827 p 870 p 870 p 870 p 827 p 827 p 870 р 870 р 870 p 870 p 827 p 871 p 871 p 871 p 871 p 838 p 871 p 871 p 871 p 871 p 872 p 875 p 831 p 872 p 872 p 879 p 872 p 872 p 872 p 872 p 841 p 841 p 864 p 864 p 834 p 875 p 875 p 879 p 864 p 859

Typical Accession Number Index Listing



Listings in this index are arranged alphanumerically by accession number. The page number listed to the right indicates the page on which the citation is located. An asterisk (*) indicates that the item is a NASA report. A pound sign (#) indicates that the item is available on microfiche.

A89-51625	p 816	A89-52550 #	p 844
A89-51678	p 816	A89-52551 #	p 844
A89-51679	p 816	A89-52552 #	p 844
A89-51680	p 860	A89-52555 #	p 844
A89-51692 *	p 861	A89-52558 #	p 844
A89-51701 * #	p 831		
A89-51702 * #	p 842		p 837
A89-51703 * #	p 831	A89-52561 * #	p 844
A89-51704 * #	p 837	A89-52562 #	p 845
A89-51716 #	p 828	A89-52563 #	p 845
A89-51723 #	p 842	A89-52564 #	p 873
A89-51755	p 861	A89-52565 #	p 845
A89-51756	p 816	A89-52579 * # A89-52580 #	p 845
A89-51760 *	p 816		p 845
A89-51860	p 857	A89-52581 #	p 845
A89-51898	p 831	A89-52582 * # A89-52583 #	p 845
A89-52022	p 857		p 846
A89-52024	p 877	A89-52584 # A89-52585 #	p 846
A89-52025 * #			p 873
A89-52041	p 831		p 846
A89-52042	p 832		p 828
A89-52043	p 816	A89-52591 # A89-52592 * #	p 828
A89-52044	p 832	A89-52592 #	p 828
A89-52105	p 861	A89-52594 #	р 828 р 846
A89-52168	p 842	A89-52598 * #	p 846 p 846
A89-52201	p 832	A89-52600 #	p 846
A89-52306 #	p 838	A89-52602 #	p 847
A89-52307 # A89-52308 #	p 816	A89-52602 #	p 873
	p 817	A89-52609 * #	p 847
A89-52309 # A89-52315 #	р 817 р 839	A89-52611 *#	p 847
A89-52315 #	p 839 p 817	A89-52612 * #	p 847
A89-52317 #	p 839	A89-52613 #	p 854
A89-52319 #	p 839	A89-52614 * #	p 815
A89-52320 #	p 839	A89-52615 #	p 847
A89-52323 #	p 839	A89-52628 * #	p 847
A89-52325	p 825	A89-52642 *#	p 848
A89-52481	p 817	A89-52643 #	p 848
A89-52482	p 839	A89-52644 #	p 848
A89-52483	p 817	A89-52645 #	p 848
A89-52484	p 817	A89-52646 * #	р 848
A89-52485	p 818	A89-52657 #	p 873
A89-52498 *	p 818	A89-52658 * #	p 873
A89-52507	p 861	A89-52659 *#	p 848
A89-52513	p 825	A89-52660 #	p 839
A89-52514	p 832	A89-52661 #	p 849
A89-52525	p 832	A89-52662 #	p 849
A89-52526	p 842	A89-52663 *#	p 829
A89-52527 #	p 843	A89-52671 #	p 849
A89-52528 * #	p 843	A89-52672 #	p 849
A89-52529 * #	p 843	A89-52673 #	p 849
	•	A89-52674 *#	p 849
	p 837	A89-52675 * #	p 850
A89-52547 #	p 843	A89-52685 #	p 850
A89-52548 #	р 843	A89-52687 *#	p 850
A89-52549 *#	р 843	A89-52688 * #	p 850
			•

A89-52690 #	p 850
A89-52692 *#	p 850
A89-52693 *#	p 832
A89-52694 #	p 850
A89-52699 *#	p 829
A89-52700 * #	p 829
A89-52701 #	p 829
A89-52702 #	p 829
A89-52703 #	p 829
A89-52712 * #	p 832
A89-52715 * #	p 873
	p 837
	p 837
	p 851
A89-52721 #	p 829
A89-52775	p 857
A89-52779	p 830
A89-52802	p 874
A89-52827	p 857
A89-52830	p 857
A89-52832	p 839
A89-52843	p 818
A89-52852	p 818
A89-52923	p 879
A89-52943	p 861
A89-52945	p 818
A89-52950	p 815
A89-52959	р 832
A89-52960	p 839
A89-52961	p 861
A89-52973	p 855
A89-52974	p 837
A89-52975	p 815
A89-52989 #	p 851
A89-52991 #	p 840
A89-52994 #	p 857
A89-53152 *#	p 874
A89-53254 #	p 862
A89-53255 #	
	p 833
	p 862
	p 862
A89-53286 * #	p 862
A89-53289 #	p 862
A89-53301 * #	p 851
A89-53304 * #	p 840
A89-53307 *#	p 862
A89-53308 #	p 833
A89-53309 #	p 837
A89-53310 #	p 857
A89-53313 *	p 837
A89-53322	p 863
A89-53330 *	p 877
A89-53334 #	p 815
A89-53351 *#	p 840
A89-53353 #	p 863
A89-53355 * #	p 858
A89-53364 * #	p 863
A89-53366 #	p 840
A89-53367 #	p 818
A89-53416	p 874
A89-53474	p 825
A89-53476 #	p 854
A89-53484	p 830
A89-53499	p 863
A89-53570	p 818
A89-53630	p 833
A89-53631	p 833
A89-53640	p 851
A89-53641	p 833
A89-53658	p 858
A89-53660 #	p 830
A89-53663 #	p 830
A89-53793 #	p 826
A89-53830 *#	p 819
A89-53926 #	p 819
A89-53928 #	p 819
A89-53930 #	p 819
A89-53931 *#	p 819
A89-53932 #	p 876
A89-53934 #	p 819
A89-53944 #	
	p 819
A89-53945 #	p 876
A89-53947 #	p 819

A89-53949 #	p 820	A89-54611
A89-53951	р 874	A89-54614
A89-53955	p 851	A89-54619
A89-53956 *	p 840	A89-54624 A89-54625
A89-53957 * A89-53959	p 851	A89-54671
A89-53969	р 852 р 830	A89-54776
A89-53970	p 874	A89-54777 A89-54779
A89-53971 * A89-53975	p 826	A89-54780
A89-53975 A89-53976	р 874 р 852	A89-54783
A89-53977	p 852	A89-54784 A89-54785
A89-53978	p 852	A89-54786
A89-53979 A89-53980	p 852 p 852	A89-54787
A89-53988	p 852	A89-54788
A89-54006	p 833	A89-54789 A89-54795
A89-54007 A89-54009	p 874 p 855	A89-54797
A89-54022	p 875	A89-54799
A89-54024	p 875	A89-54801 A89-54802
A89-54066 A89-54080	p 833	A89-54803
A89-54080	р 853 р 853	A89-54804
A89-54082 *	p 830	A89-54805 A89-54806
A89-54083 *	p 830	A89-54806 A89-54807
A89-54084 * A89-54085 *	р 853 р 855	A89-54809
A89-54106	p 875	A89-54813
A89-54119	p 863	A89-54817 A89-54821
A89-54129 #	p 820	A89-54823
A89-54131 # A89-54132 #	р 840 р 840	A89-54824
A89-54200 #	p 833	A89-54825 A89-54827
A89-54255	p 858	A89-54827 A89-54831
A89-54326 A89-54327	p 855 p 856	A89-54838
A89-54328	p 840	A89-54840
A89-54329	p 856	A89-54841 A89-54844
A89-54330 A89-54331	p 856	A89-54846
A89-54331 A89-54332	p 856 p 856	A89-54848
A89-54337	p 877	A89-54852 A89-54854
A89-54338	p 834	A89-54855
A89-54340 A89-54344	р 856 р 834	A89-54856
A89-54345	p 834 p 838	A89-54857
A89-54347	p 853	A89-54858 * A89-54859
A89-54348 A89-54349	p 863	A89-54860
A89-54349 A89-54351	р 854 р 878	A89-54862
A89-54352	p 878	A89-54863 A89-54865
A89-54353 A89-54354	р 878 р 878	A89-54866
A89-54354	p 856	A89-54868
A89-54356	p 878	A89-54881 A89-54884
A89-54357	p 878	A89-54890
A89-54358 A89-54359	р 878 р 856	A89-54900
A89-54363	p 867	A89-54901 A89-54904 *
A89-54364	p 878	A89-54904 A89-54907 *
A89-54366 A89-54368	p 831 p 854	A89-54908
A89-54370	p 834	A89-54981
A89-54371	p 853	A89-54982 * A89-54986
A89-54372	p 834	100-04000
A89-54373 A89-54424 *#	p 820 p 863	N89-28485
A89-54426	p 858	N89-28486 * N89-28487
A89-54429	p 858	N89-28488
A89-54462 # A89-54471 #	р 834 р 834	N89-28489
A89-54472 #	p 815	N89-28490
A89-54473 #	p 841	N89-28492 N89-28493 *
A89-54482	p 838	N89-28493
A89-54483 A89-54484	р 841 р 820	N89-28495
A89-54486 #	p 820	N89-28497
A89-54487 #	p 876	N89-28498 * N89-28499
A89-54488 # A89-54535	p 863	N89-28500
A89-54535 A89-54540	р 820 р 875	N89-28501
A89-54585	p 864	N89-28502

p 859

p 815 ŧ

p 821 p 821

p 822 p 822 p 822 p 822

p 823

G-1

######### p 821 p 821 p 821 p 822 p 822 p 822 p 822

p 822

#

p 823 p 823

N89-28505

I.

l

Ì

1

i

i I

1403-20303	
N89-28505 #	p 823
N89-28507 #	p 827
N89-28508 #	р 827 р 831
N89-28509 # N89-28511 #	p 831 p 834
N89-28513 #	p 835
N89-28514 #	p 835
N89-28515 #	p 838
N89-28516 # N89-28517 #	р 841 р 841
N89-28517 # N89-28518 #	p 841
N89-28519 #	p 841
N89-28522 #	p 854
N89-28523 #	p 854
N89-28524 # N89-28526 #	р 854 р 855
N89-28574 #	p 859
N89-28579 *#	p 859
N89-28588 #	p 859
N89-28610 # N89-28643 #	р 859 р 860
N89-28661 #	p 860
N89-28754 #	p 864
N89-28755 #	p 864
N89-28765 #	р 865 р 865
N89-28774 # N89-28800 #	p 865
N89-28835 #	p 865
N89-28839 #	p 865
N89-28841 * #	p 865
N89-28870 * # N89-28871 #	р 866 р 866
N89-28871 # N89-29032 *#	p 876
N89-29152 * #	p 876
N89-29154 *#	p 876
N89-29155 * #	p 876
N89-29156 N89-29158 #	р 877 р 877
N89-29193 #	p 877
N89-29305 *#	p 823
N89-29306 #	p 823
N89-29308 # N89-29310 #	p 823 p 866
N89-29312 #	p 824
N89-29316 #	p 824
N89-29317 #	р 824 р 824
N89-29318 # N89-29321 * #	р 824 р 824
N89-29323 *#	p 824
N89-29324 *#	p 825
N89-29325 #	p 825
N89-29326 * # N89-29328 * #	p 825 p 825
N89-29332 #	p 827
N89-29333 #	p 828
N89-29335 #	p 835
N89-29336 # N89-29337 # N89-29338 # N89-29339 #	p 835 p 835
N89-29338 #	р 835 р 835
N89-29339 #	p 835
N89.29340 #	p 836
N89-29341 #	р 836 р 836
N89-29343 # N89-29344 #	p 836 p 836
N89-29345	p 836
N89-29347 #	p 842
N89-29348 #	p 842
N89-29351 *# N89-29352 #	p 842 p 855
N89-29352 #	p 860
N89-29497 #	p 860
N89-29698 #	p 866
N89-29726 * # N89-29789 * #	р 866 р 866
N89-29789 * # N89-29792 * #	р 866 р 866
N89-29793 *#	p 866
N89-29794 *#	p 867
N89-29800 * #	p 867
N89-29804 *#	p 867

AVAILABILITY OF CITED PUBLICATIONS

IAA ENTRIES (A89-10000 Series)

Publications announced in *IAA* are available from the AIAA Technical Information Service as follows: Paper copies of accessions are available at \$10.00 per document (up to 50 pages), additional pages \$0.25 each. Microfiche⁽¹⁾ of documents announced in *IAA* are available at the rate of \$4.00 per microfiche on demand. Standing order microfiche are available at the rate of \$1.45 per microfiche for *IAA* source documents and \$1.75 per microfiche for AIAA meeting papers.

Minimum air-mail postage to foreign countries is \$2.50. All foreign orders are shipped on payment of pro-forma invoices.

All inquiries and requests should be addressed to: Technical Information Service, American Institute of Aeronautics and Astronautics, 555 West 57th Street, New York, NY 10019. Please refer to the accession number when requesting publications.

STAR ENTRIES (N89-10000 Series)

One or more sources from which a document announced in *STAR* is available to the public is ordinarily given on the last line of the citation. The most commonly indicated sources and their acronyms or abbreviations are listed below. If the publication is available from a source other than those listed, the publisher and his address will be displayed on the availability line or in combination with the corporate source line.

Avail: NTIS. Sold by the National Technical Information Service. Prices for hard copy (HC) and microfiche (MF) are indicated by a price code preceded by the letters HC or MF in the *STAR* citation. Current values for the price codes are given in the tables on NTIS PRICE SCHEDULES.

Documents on microfiche are designated by a pound sign (#) following the accession number. The pound sign is used without regard to the source or quality of the microfiche.

Initially distributed microfiche under the NTIS SRIM (Selected Research in Microfiche) is available at greatly reduced unit prices. For this service and for information concerning subscription to NASA printed reports, consult the NTIS Subscription Section, Springfield, Va. 22161.

NOTE ON ORDERING DOCUMENTS: When ordering NASA publications (those followed by the * symbol), use the N accession number. NASA patent applications (only the specifications are offered) should be ordered by the US-Patent-Appl-SN number. Non-NASA publications (no asterisk) should be ordered by the AD, PB, or other *report number* shown on the last line of the citation, not by the N accession number. It is also advisable to cite the title and other bibliographic identification.

Avail: SOD (or GPO). Sold by the Superintendent of Documents, U.S. Government Printing Office, in hard copy. The current price and order number are given following the availability line. (NTIS will fill microfiche requests, as indicated above, for those documents identified by a # symbol.)

(1) A microfiche is a transparent sheet of film, 105 by 148 mm in size containing as many as 60 to 98 pages of information reduced to micro images (not to exceed 26.1 reduction).

- Avail: BLL (formerly NLL): British Library Lending Division, Boston Spa, Wetherby, Yorkshire, England. Photocopies available from this organization at the price shown. (If none is given, inquiry should be addressed to the BLL.)
- Avail: DOE Depository Libraries. Organizations in U.S. cities and abroad that maintain collections of Department of Energy reports, usually in microfiche form, are listed in *Energy Research Abstracts.* Services available from the DOE and its depositories are described in a booklet, *DOE Technical Information Center - Its Functions and Services* (TID-4660), which may be obtained without charge from the DOE Technical Information Center.
- Avail: ESDU. Pricing information on specific data, computer programs, and details on ESDU topic categories can be obtained from ESDU International Ltd. Requesters in North America should use the Virginia address while all other requesters should use the London address, both of which are on the page titled ADDRESSES OF ORGANIZATIONS.
- Avail: Fachinformationszentrum, Karlsruhe. Sold by the Fachinformationszentrum Energie, Physik, Mathematik GMBH, Eggenstein Leopoldshafen, Federal Republic of Germany, at the price shown in deutschmarks (DM).
- Avail: HMSO. Publications of Her Majesty's Stationery Office are sold in the U.S. by Pendragon House, Inc. (PHI), Redwood City, California. The U.S. price (including a service and mailing charge) is given, or a conversion table may be obtained from PHI.
- Avail: NASA Public Document Rooms. Documents so indicated may be examined at or purchased from the National Aeronautics and Space Administration, Public Documents Room (Room 126), 600 Independence Ave., S.W., Washington, D.C. 20546, or public document rooms located at each of the NASA research centers, the NASA Space Technology Laboratories, and the NASA Pasadena Office at the Jet Propulsion Laboratory.
- Avail: Univ. Microfilms. Documents so indicated are dissertations selected from *Dissertation Abstracts* and are sold by University Microfilms as xerographic copy (HC) and microfilm. All requests should cite the author and the Order Number as they appear in the citation.
- Avail: US Patent and Trademark Office. Sold by Commissioner of Patents and Trademarks, U.S. Patent and Trademark Office, at the standard price of \$1.50 each, postage free. (See discussion of NASA patents and patent applications below.)
- Avail: (US Sales Only). These foreign documents are available to users within the United States from the National Technical Information Service (NTIS). They are available to users outside the United States through the International Nuclear Information Service (INIS) representative in their country, or by applying directly to the issuing organization.
- Avail: USGS. Originals of many reports from the U.S. Geological Survey, which may contain color illustrations, or otherwise may not have the quality of illustrations preserved in the microfiche or facsimile reproduction, may be examined by the public at the libraries of the USGS field offices whose addresses are listed in this Introduction. The libraries may be queried concerning the availability of specific documents and the possible utilization of local copying services, such as color reproduction.
- Avail: Issuing Activity, or Corporate Author, or no indication of availability. Inquiries as to the availability of these documents should be addressed to the organization shown in the citation as the corporate author of the document.

PUBLIC COLLECTIONS OF NASA DOCUMENTS

DOMESTIC: NASA and NASA-sponsored documents and a large number of aerospace publications are available to the public for reference purposes at the library maintained by the American Institute of Aeronautics and Astronautics, Technical Information Service, 555 West 57th Street, 12th Floor, New York, New York 10019.

EUROPEAN: An extensive collection of NASA and NASA-sponsored publications is maintained by the British Library Lending Division, Boston Spa, Wetherby, Yorkshire, England for public access. The British Library Lending Division also has available many of the non-NASA publications cited in *STAR*. European requesters may purchase facsimile copy or microfiche of NASA and NASA-sponsored documents, those identified by both the symbols # and * from ESA – Information Retrieval Service European Space Agency, 8-10 rue Mario-Nikis, 75738 CEDEX 15, France.

FEDERAL DEPOSITORY LIBRARY PROGRAM

In order to provide the general public with greater access to U.S. Government publications, Congress established the Federal Depository Library Program under the Government Printing Office (GPO), with 50 regional depositories responsible for permanent retention of material, inter-library loan, and reference services. At least one copy of nearly every NASA and NASA-sponsored publication, either in printed or microfiche format, is received and retained by the 50 regional depositories. A list of the regional GPO libraries, arranged alphabetically by state, appears on the inside back cover. These libraries are *not* sales outlets. A local library can contact a Regional Depository to help locate specific reports, or direct contact may be made by an individual.

STANDING ORDER SUBSCRIPTIONS

NASA SP-7037 and its supplements are available from the National Technical Information Service (NTIS) on standing order subscription as PB89-914100 at the price of \$10.50 domestic and \$21.00 foreign. The price of the annual index is \$16.50. Standing order subscriptions do not terminate at the end of a year, as do regular subscriptions, but continue indefinitely unless specifically terminated by the subscriber.

ADDRESSES OF ORGANIZATIONS

American Institute of Aeronautics and Astronautics Technical Information Service 555 West 57th Street, 12th Floor New York, New York 10019

British Library Lending Division, Boston Spa, Wetherby, Yorkshire, England

Commissioner of Patents and Trademarks U.S. Patent and Trademark Office Washington, DC 20231

Department of Energy Technical Information Center P.O. Box 62 Oak Ridge, Tennessee 37830

European Space Agency-Information Retrieval Service ESRIN Via Galileo Galilei 00044 Frascati (Rome) Italy

Engineering Sciences Data Unit International P.O. Box 1633 Manassas, Virginia 22110

Engineering Sciences Data Unit International, Ltd. 251-259 Regent Street London, W1R 7AD, England

Fachinformationszentrum Energie, Physik, Mathematik GMBH 7514 Eggenstein Leopoldshafen Federal Republic of Germany

Her Majesty's Stationery Office P.O. Box 569, S.E. 1 London, England

NASA Scientific and Technical Information Facility P.O. Box 8757 BWI Airport, Maryland 21240 National Aeronautics and Space Administration Scientific and Technical Information Division (NTT) Washington, DC 20546

National Technical Information Service 5285 Port Royal Road Springfield, Virginia 22161

Pendragon House, Inc. 899 Broadway Avenue Redwood City, California 94063

Superintendent of Documents U.S. Government Printing Office Washington, DC 20402

University Microfilms A Xerox Company 300 North Zeeb Road Ann Arbor, Michigan 48106

University Microfilms, Ltd. Tylers Green London, England

U.S. Geological Survey Library National Center MS 950 12201 Sunrise Valley Drive Reston, Virginia 22092

U.S. Geological Survey Library 2255 North Gemini Drive Flagstaff, Arizona 86001

U.S. Geological Survey 345 Middlefield Road Menlo Park, California 94025

U.S. Geological Survey Library Box 25046 Denver Federal Center, MS914 Denver, Colorado 80225

NTIS PRICE SCHEDULES

(Effective January 1, 1990)

Schedule A STANDARD PRICE DOCUMENTS AND MICROFICHE

PRICE CODE	NORTH AMERICAN PRICE	FOREIGN PRICE	
A01	\$ 8.00	\$ 16.00	
A02	11.00	22.00	
A03	15.00	30.00	
A04-A05	17.00	34.00	
A06-A09	23.00	46.00	
A10-A13	31.00	62.00	
A14-A17	39.00	78.00	
A18-A21	45.00	90.00	
A22-A25	53.00	106.00	
A99	*	*	
N01	60.00	120.00	
N02	59.00	118.00	
N03	20.00	40.00	

Schedule E EXCEPTION PRICE DOCUMENTS AND MICROFICHE

PRICE CODE	NORTH AMERICAN PRICE	FOREIGN PRICE	
E01	\$10.00	\$ 20.00	
E02	12.00	24.00	
E03	14.00	28.00	
E04	16.50	33.00	
E05	18.50	37.00	
E06	21.50	43.00	
E07	24.00	48.00	
E08	27.00	54.00	
E09	29.50	59.00	
E10	32.50	65.00	
E11	35.00	70.00	
E12	38.50	77.00	
E13	41.00	82.00	
E14	45.00	90.00	
E15	48.50	97.00	
E16	53.00	106.00	
E17	57.50	115.00	
E18	62.00	124.00	
E19	69.00	138.00	
E20	80.00	160.00	
E99	*	*	

* Contact NTIS for price quote.

IMPORTANT NOTICE

NTIS Shipping and Handling Charges U.S., Canada, Mexico — ADD \$3.00 per TOTAL ORDER All Other Countries — ADD \$4.00 per TOTAL ORDER Exceptions — Does NOT apply to:

ORDERS REQUESTING NTIS RUSH HANDLING ORDERS FOR SUBSCRIPTION OR STANDING ORDER PRODUCTS ONLY

NOTE: Each additional delivery address on an order requires a separate shipping and handling charge.

1. Report No.	2. Government Access	sion No.	3. Recipient's Catalog N	10.
NASA SP-7037(247)				
4. Title and Subtitle			5. Report Date	
Aeronautical Engineering A Continuing Bibliography (Supplement 247)			January 1990	
			6. Performing Organiza	tion Code
7. Author(s)			8. Performing Organiza	tion Report No.
			10. Work Unit No.	
9. Performing Organization Name and Address	inistration			
National Aeronautics and Space Administration Washington, DC 20546			11. Contract or Grant N	0.
		· · · · · · · · · · · · · · · · · · ·	13. Type of Report and	Period Covered
12. Sponsoring Agency Name and Address				
		-	14. Sponsoring Agency	Code
15. Supplementary Notes				
16. Abstract				
This bibliography lists 437 reports, and technical information system ir	articles and other do	cuments introduced into	the NASA scientif	IC
and technical mormation system in	December 1903.			
		18. Distribution Statement		
Aeronautical Engineering Unclassified - Unlimited				
Aeronautics Bibliographies				
Bibliographies				
19. Security Classif. (of this report)	20. Security Classif. ((of this page)	21. No. of Pages	22. Price *
Unclassified	Unclassified		128	A07/HC

*For sale by the National Technical Information Service, Springfield, Virginia 22161

i