



Aeronautical
Engineering
A Continuing
Bibliography
with Indexes

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August 1985



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Space Administration

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STAR (N-10000 Series) N85-22342 – N85-25167

IAA (A-10000 Series) A85-30223 – A85-33354

AERONAUTICAL ENGINEERING

A CONTINUING BIBLIOGRAPHY WITH INDEXES

(Supplement 190)

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 July 1985 in

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

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INTRODUCTION

Under the terms of an interagency agreement with the Federal Aviation Administration this publication has been prepared by the National Aeronautics and Space Administration for the joint use of both agencies and the scientific and technical community concerned with the field of aeronautical engineering. The first issue of this bibliography was published in September 1970 and the first supplement in January 1971.

This supplement to *Aeronautical Engineering -- A Continuing Bibliography* (NASA SP-7037) lists 510 reports, journal articles, and other documents originally announced in July 1985 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.

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All publications abstracted in this bibliography are available to the public through the sources as indicated in the *STAR Entries* and *IAA Entries* sections. It is suggested that the bibliography user contact his own library or other local libraries prior to ordering any publication inasmuch as many of the documents have been widely distributed by the issuing agencies, especially NASA.

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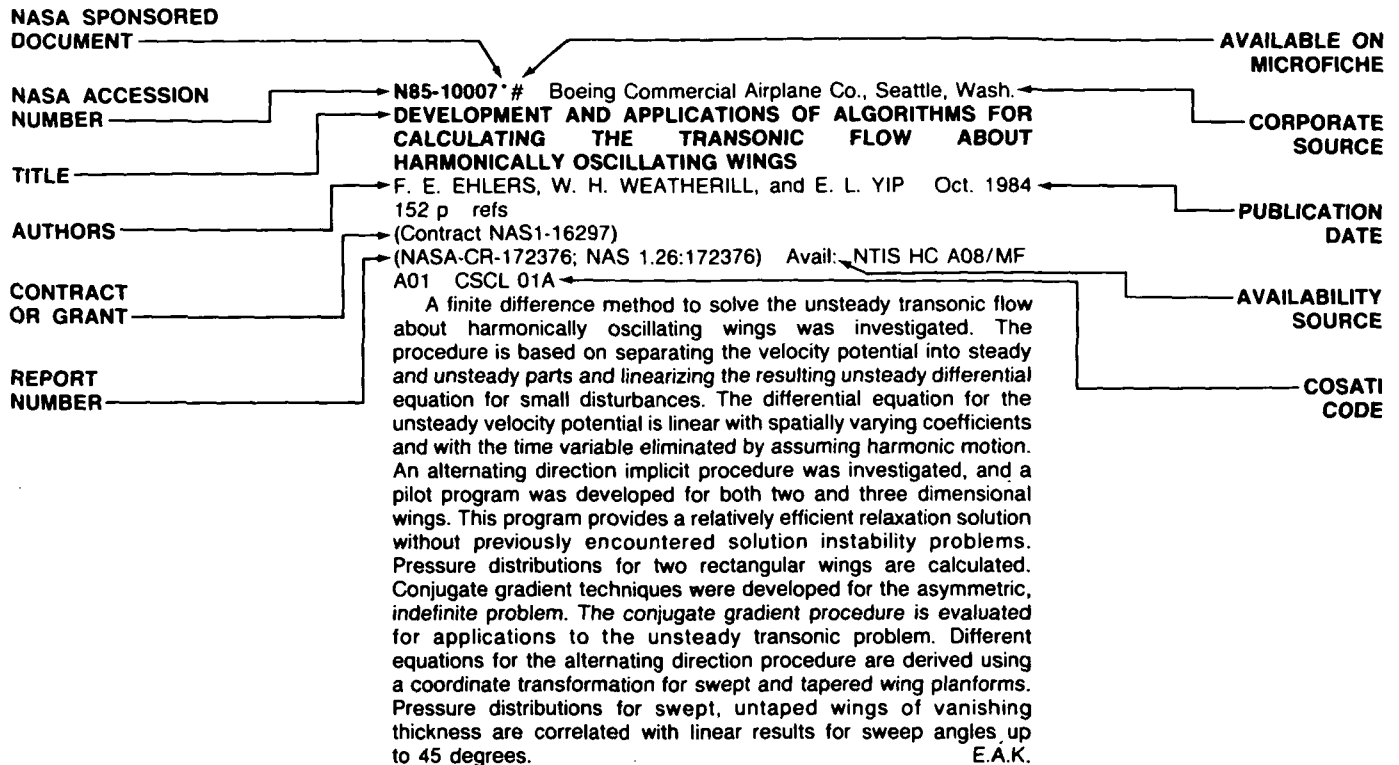
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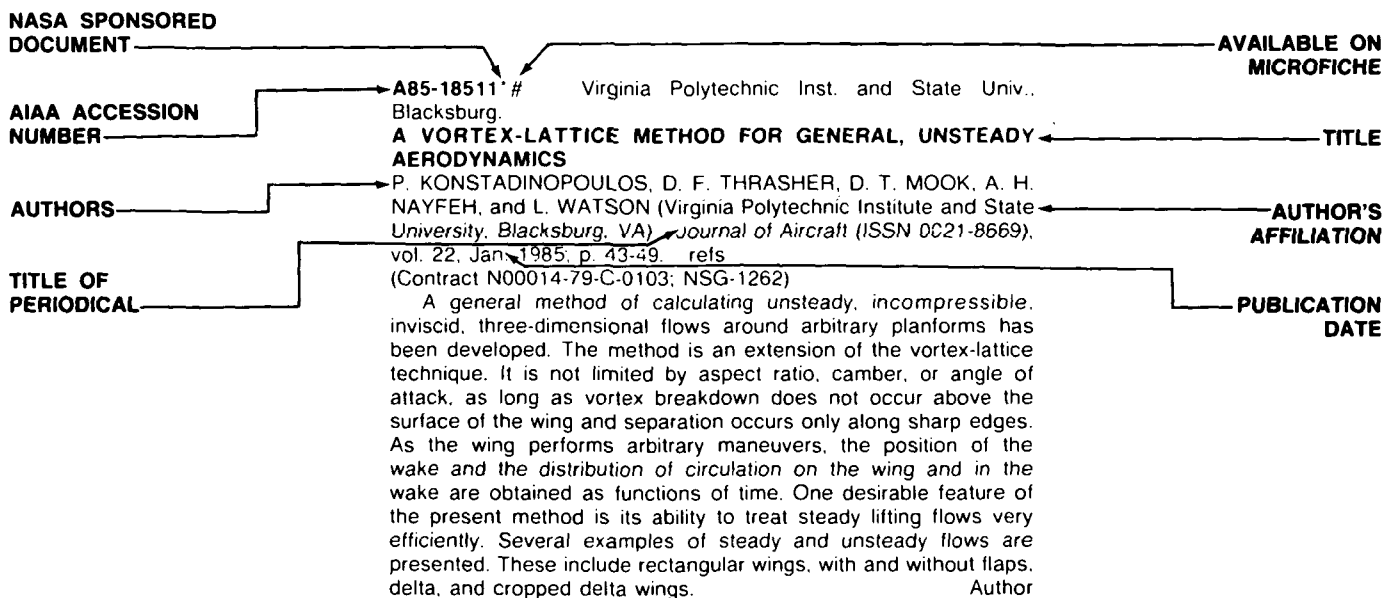
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AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 190)

AUGUST 1985

01

AERONAUTICS (GENERAL)

A85-31951

AMERICAN HELICOPTER SOCIETY, ANNUAL FORUM, 40TH, ARLINGTON, VA, MAY 16-18, 1984, PROCEEDINGS

Alexandria, VA, American Helicopter Society, 1984, 638 p. For individual items see A85-31952 to A85-32008.

Among the topics discussed are the use of a turbulence distortion theory to predict helicopter broadband noise, the stability and control of a twin lift helicopter system, recent insights into helicopter air combat maneuverability, the establishment of helicopter structural component parts lives, the application of geodetic construction to helicopter airframes, the Dynaflex main rotor system, full authority digital fuel control flight test results, techniques for early detection of gear and bearing failures, and emerging technology effects on future rotorcraft weight. Also covered are advanced quality control methods for composite rotor blades, maintenance and supply support for multimission helicopters, a generalized wake geometry for rotors in forward flight, transonic flow prediction for advancing rotors, an aeroelastic stability analysis for a composite rotor blade, JVX design updates, the reliability of derivative helicopter engines, and the TF34 convertible engine control system design. O.C.

A85-31979#

AH-64A PRODUCTION LINE AUTOMATIC TEST EQUIPMENT

J. B. DAVIES (Hughes Helicopters, Inc., Mesa, AZ) and D. TALLEY (Design Engineering Laboratories, Inc., Torrance, CA) IN: American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Proceedings. Alexandria, VA, American Helicopter Society, 1984, p. 305-313.

It is pointed out that the AH-64A Apache helicopter contains a broad range of sophisticated electronic and electro-optic subsystems which must be functionally tested on board a fully integrated aircraft as part of the production line assembly process. Two autonomous Automatic Test Equipment (ATE) systems are utilized for the performance of the required tests. The systems include the DIT-MCO Series 9100 and the Integration Test and Alignment System (ITAS). The DIT-MCO Series 9100 is employed to test the wire and the connectors which comprise the onboard aircraft wire harness. The ITAS is used to perform functional tests on the fully integrated aircraft subsystems. Both systems are computer controlled. G.R.

A85-31980#

ARMY AVIATION MAINTENANCE DATA AND SUPPORTABILITY INTERFACE

T. A. GEOFFROY and T. V. STOKES (U.S. Army, Aviation Systems Command, St. Louis, MO) IN: American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Proceedings. Alexandria, VA, American Helicopter Society, 1984, p. 315-318. refs

The Sample Data Collection (SDC) programs, designed to meet the reliability, availability, and maintainability requirements to the

Army aviation weapon systems, are detailed, including the Unscheduled Maintenance SDC for fielded equipment and the Manpower Authorization Criteria SDC. Furthermore, the development of the Logistic Support Analysis Record (LSAR), intended for engineering estimates, is discussed. The discussion centers on the fielding, support modeling, evaluations performed to this date, and unit management of the SDC and LSAR programs. It is noted that since the SDC is recognized as the best source of maintenance data, policy guidance is required to maximize its applications to support analyses and management. L.T.

A85-31982#

JVX LCC REDUCTION THROUGH FRONT-END LOGISTICS

J. J. DOUGHERTY, III (Boeing Vertol Co., Philadelphia, PA), C. D. ELMORE (U.S. Naval Air Systems Command, Washington, DC), and A. W. MOFFATT (Bell Helicopter Textron, Fort Worth, TX) IN: American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Proceedings. Alexandria, VA, American Helicopter Society, 1984, p. 325-334.

This paper deals with the steps taken to minimize JVX Life Cycle Cost (LCC) through front-end logistics. The JVX program as described in this paper is unique in terms of the interjection of the Integrated Logistic Support (ILS) disciplines into the configuration development process during the Preliminary Design phase. This involvement of ILS elements early in the program allows for full consideration of the ILS impact of design decisions prior to their commitment to expensive (and difficult to change) detailed design. As such, it is anticipated that JVX logistics-related costs will be controlled to the maximum extent practical, with a corresponding beneficial influence on program LCC. Author

A85-31983#

COST-EFFECTIVE AIRFRAME DEPOT LEVEL REPAIR THROUGH THE AIRFRAME CONDITION EVALUATION (ACE) PROGRAM

L. NERI (U.S. Army, Aviation Systems Command, Corpus Christi, TX) and H. LAW (CACI, Inc., Advanced Technology and Systems Simulation Dept., St. Louis, MO) IN: American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Proceedings. Alexandria, VA, American Helicopter Society, 1984, p. 335-341.

A program called ACE, Airframe Condition Evaluation was established to evaluate aircraft structural integrity. The objective of this technique is to reduce airframe depot level repair costs through profiling the condition of fielded aircraft. This will improve airframe availability by identifying those airframes that should be candidates for depot level repair and by achieving maintenance goals. This paper will address the Army's approach in dealing with the problem of airframe depot repair - its past experience, its current method of on-condition maintenance through profiling the condition of the airframes, and its future plans. Author

01 AERONAUTICS (GENERAL)

A85-31984#

THE DEVELOPMENT OF MAINTENANCE AND SUPPLY SUPPORT OF MULTI-MISSION HELICOPTERS OPERATING FROM MULTIPLE LOCATIONS

R. E. WALKUP (Aerospatiale Helicopter Corp., Grand Prairie, TX)
IN: American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 343-348.

The 90 HH-65A Short Range Recovery (SRR) Helicopters, which are provided by an aerospace company for the U.S. Coast Guard (USCG), are now entering the USCG operational fleet. The present study is concerned with a program which has been developed for supporting these helicopters. A description is given of the USCG SRR Aircraft support concept and the development of an automated provisioning process for the procurement, cataloging, delivery, and configuration control of material resources for a flight training center, 19 operational air stations, and an overhaul repair station. It is pointed out that the SRR Provisioning Program has provided a very flexible system for the analysis and selection of material requirements for helicopter support systems. Substantial cost reductions are obtained by using one central file for parts selection, order processing, receiving, shipping, and invoicing. G.R.

A85-31992#

FAULT DETECTION/LOCATION SYSTEM (FD/LS) - HOW MUCH, HOW LITTLE AND HOW TO IMPLEMENT

H. E. POHLENZ, T. D. DUHAMEL, and G. C. WILTSEY (Hughes Helicopters, Inc., Culver City, CA) IN: American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 439-446.

In the early 1970s, difficulties arose in connection with complex weapons systems which, although meeting performance requirements, caused operating and maintenance problems when fielded. It was found that the maintenance functions were too complex for the skill level of the maintenance personnel. A solution to the problem of excessive troubleshooting times and wasteful inspections appeared at first to be provided by the use of improved Fault Detection/Location Systems (FD/LS). However, it became soon apparent that questions regarding the level and form of FD/LS implementation had to be answered. The present investigation is concerned with developments which occurred in an American aerospace company in relation to the considered questions. The weapons system involved was an advanced attack helicopter, the AH-64A Apache helicopter. G.R.

A85-32010#

SOFTWARE QUALITY ASSURANCE PROGRAM FOR THE AH-64 ADVANCED ATTACK HELICOPTER (AAH)

B. R. GANTZ, L. KENISON, and S. D. KUCHLAK (Hughes Helicopters, Inc., Mesa, AZ) American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Paper. 18 p.

The importance of a Software Quality Assurance (SQA) Program is discussed, taking into account the need for such programs in connection with the requirements of the Department of Defense (DOD), specifications imposed by the DOD, and the Software Quality Assurance Organization. It is pointed out that an effective SQA organization develops a Software Quality Assurance Program Plan (SQAPP) which serves as a guide to monitor, audit, inspect, and report on all software developed. A description is given of the history of the SQA development in the organization of an American aerospace company. In mid-1981, with the first production contract for the AAH-64 in the negotiating stage, it became apparent that the U.S. Army was going to make software quality assurance a part of the production contract. Attention is given to the various developments which led to a Software Quality Assurance Program Plan in December 1982, and its approval by January 1983. G.R.

N85-22344*# Sikorsky Aircraft, Stratford, Conn.

EXPERIMENTAL STUDY OF MAIN ROTOR TIP GEOMETRY AND TAIL ROTOR INTERACTIONS IN HOVER. VOLUME 1. TEXT AND FIGURES Progress Report, Aug. 1982 - Nov. 1983

D. T. BALCH and J. LOMBARDI Feb. 1985 94 p refs 2 Vol.

(Contract NAS2-11266)

(NASA-CR-177336-VOL-1; NAS 1.26:177336-VOL-1) Avail: NTIS HC A05/MF A01 CSCL 01A

A model scale hover test was conducted in the Sikorsky Aircraft Model rotor hover Facility to identify and quantify the impact of the tail rotor on the demonstrated advantages of advanced geometry tip configurations. The test was conducted using the Basic Model Test Rig and two scaled main rotor systems, one representing a 1/5.727 scale UH-60A BLACK HAWK and the others a 1/4.71 scale S-76. Eight alternate rotor tip configurations were tested, 3 on the BLACK HAWK rotor and 6 on the S-76 rotor. Four of these tips were then selected for testing in close proximity to an operating tail rotor (operating in both tractor and pusher modes) to determine if the performance advantages that could be obtained from the use of advanced geometry tips in a main rotor only environment would still exist in the more complex flow field involving a tail rotor. The test showed that overall the tail rotor effects on the advanced tip configurations tested are not substantially different from the effects on conventional tips. B.W.

N85-22345*# Sikorsky Aircraft, Stratford, Conn.

EXPERIMENTAL STUDY OF MAIN ROTOR TIP GEOMETRY AND TAIL ROTOR INTERACTIONS IN HOVER. VOLUME 2: RUN LOG AND TABULATED DATA Progress Report, Aug. 1982 - Nov. 1983

D. T. BALCH and J. LOMBARDI Feb. 1985 235 p 2 Vol.

(Contract NAS2-11266)

(NASA-CR-177336-VOL-2; NAS 1.26:177336-VOL-2) Avail: NTIS HC A11/MF A01 CSCL 01A

A model scale hover test was conducted in the Sikorsky Aircraft Model Rotor hover Facility to identify and quantify the impact of the tail rotor on the demonstrated advantages of advanced geometry tip configurations. The existence of mutual interference between hovering main rotor and a tail rotor was acknowledged in the test. The test was conducted using the Basic Model Test Rig and two scaled main rotor systems, one representing a 1/5.727 scale UH-60A BLACK HAWK and the others a 1/4.71 scale S-76. Eight alternate rotor tip configurations were tested, 3 on the BLACK HAWK rotor and 6 on the S-76 rotor. Four of these tips were then selected for testing in close proximity to an operating tail rotor (operating in both tractor and pusher modes) to determine if the performance advantages that could be obtained from the use of advanced geometry tips in a main rotor only environment would still exist in the more complex flow field involving a tail rotor. This volume contains the test run log and tabulated data. B.W.

N85-22346*# Analytical Methods, Inc., Redmond, Wash.

STUDY FOR PREDICTION OF ROTOR/WAKE/FUSELAGE INTERFERENCE, PART 1 Final Report, 1 Jun. 1980 - 1 Nov. 1983

D. R. CLARK and B. MASKEW Mar. 1985 92 p refs 2 Vol.

(Contract NAS2-10620)

(NASA-CR-177340-VOL-1; NAS 1.26:177340-VOL-1; REPT-8304-I-VOL-1) Avail: NTIS HC A05/MF A01 CSCL 01A

A method was developed which allows the fully coupled calculation of fuselage and rotor airloads for typical helicopter configurations in forward flight. To do this, an iterative solution is carried out based on a conventional panel representation of the fuselage and a blade element representation of the rotor where fuselage and rotor singularity strengths are determined simultaneously at each step and the rotor wake is allowed to relax (deform) in response to changes in rotor wake loading and fuselage presence. On completion of the iteration, rotor loading and inflow, fuselage singularity strength (and, hence, pressure and velocity distributions) and rotor wake are all consistent. The results of a fully coupled calculation of the flow around representative helicopter configurations are presented. The effect of fuselage

components on the rotor flow field and the overall wake structure is detailed and the aerodynamic interference between the different parts of the aircraft is discussed.
R.J.F.

N85-22347*# Analytical Methods, Inc., Redmond, Wash.
STUDY FOR PREDICTION OF ROTOR/WAKE/FUSELAGE INTERFERENCE. PART 2: PROGRAM USERS GUIDE Final Report, 1 Jun. 1980 - 1 Nov. 1983
D. R. CLARK and B. MASKEW Mar. 1985 94 p refs 2 Vol.
(Contract NAS2-10620)
(NASA-CR-177340-VOL-2; NAS 1.26:177340-VOL-2; REPT-8304-I-VOL-2) Avail: NTIS HC A05/MF A01 CSDL 01A

A method was developed which permits the fully coupled calculation of fuselage and rotor airloads for typical helicopter configurations in forward flight. To do this, an iterative solution is carried out based on a conventional panel representation of the fuselage and a blade element representation of the rotor where fuselage and rotor singularity strengths are determined simultaneously at each step and the rotor wake is allowed to relax (deform) in response to changes in rotor wake loading and fuselage presence. On completion of the iteration, rotor loading and inflow, fuselage singularity strength (and, hence, pressure and velocity distributions) and rotor wake are all consistent. The results of a fully coupled calculation of the flow around representative helicopter configurations are presented. The effect of fuselage components on the rotor flow field and the overall wake structure is discussed as well as the aerodynamic interference between the different parts of the aircraft. Details of the computer program are given.
R.J.F.

N85-22349# Naval Postgraduate School, Monterey, Calif. Dept. of Administrative Science.

AVIATION MAINTENANCE COMPUTERIZED MANAGEMENT INFORMATION SYSTEMS: PERSPECTIVE FOR THE FUTURE M.S. Thesis

J. F. DERRICK and T. A. MILLER Jun. 1984 89 p
(AD-A150637) Avail: NTIS HC A05/MF A01 CSDL 01C

The Naval Aviation Logistics Command Management Information System (NALCOMIS) is the next generation solution to the information assimilation gap faced by Naval Aviation maintenance managers. This thesis examines the scope of the problem at the Organizational and Intermediate levels of maintenance, and the intended effect of NALCOMIS and three peripheral information systems. The underlying concepts of the four systems investigated are used to explore Artificial Intelligence as the logical augmentation or follow-on to the NALCOMIS program. Recommendations regarding the implementation of AI and expert systems are made.
GRA

N85-22350# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).

GROUND AND FLIGHT TESTING FOR AIRCRAFT GUIDANCE AND CONTROL

R. ONKEN, ed. (DFVLR, Brunswick, West Germany) and H. A. REDIESS, ed. (Hydraulic Research Textron, Inc., Irving, Calif.)
Loughton, England Dec. 1984 195 p refs
(AGARD-AG-262; ISBN-92-835-1482-3) Avail: NTIS HC A09/MF A01

Aircraft guidance and control functions, components, and systems are evaluated with emphasis on specific examples of user oriented test programs rather than descriptions of the facilities. Topics include control handling and active control testing; tests on flight path control; navigation system testing; combat guidance and control evaluation; and testing of flight-crucial digital systems in guidance and control.

N85-23683*# National Aeronautics and Space Administration, Washington, D. C.

MODEL RESEARCH: THE NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS, 1915-1958, VOLUME 1

A. ROLAND 1984 432 p refs 2 Vol.
(NASA-SP-4103-VOL-1; NAS 1.21:4103-VOL-1) Avail: NTIS HC A19/MF A01; also available from SOD HC \$26.00 as set of 2 CSDL 01B

The National Advisory Committee for Aeronautics, the predecessor of NASA, was the premier aeronautical research organization in the United States. It conducted scientific study of the problems of flight with a view to their practical solution. This institutional history traces the birth and evolution of the NACA and analyzes such recurrent themes as the roles of science and engineering, the influence of politics on technology, the way in which the institution shapes technology and technology shapes the institution, the contributions of key individuals, the nature of the research process, and the relation between military and civilian aviation.
Author

N85-23684*# National Aeronautics and Space Administration, Washington, D. C.

MODEL RESEARCH: THE NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS, 1915-1958, VOLUME 2

A. ROLAND 1985 414 p refs 2 Vol.
(NASA-SP-4103-VOL-2; NAS 1.21:4103-VOL-2) Avail: NTIS HC A18/MF A01; also available from SOD HC \$26.00 as set of 2 CSDL 01B

Appendices providing comprehensive data on personnel, organization, funding, research programs, and publications of the National Advisory Committee for Aeronautics (NACA) are presented. Information concerning NACA-related legislation and research facilities is also included.
M.G.

N85-23685*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

FUTURE DIRECTIONS IN AEROPROPULSION TECHNOLOGY

N. T. SAUNDERS and A. J. GLASSMAN 6 Sep. 1985 39 p refs
Proposed for presentation at 7th Intern. Symp. on Air Breathing Eng., Beijing, China, 2-6 Sep. 1985
(NASA-TM-87010; E-2553; NAS 1.15:87010) Avail: NTIS HC A03/MF A01 CSDL 01B

Future directions in aeropropulsion technology that have been identified in a series of studies recently sponsored by the U.S. Government are discussed. Advanced vehicle concepts that could become possible by the turn of the century are presented along with some of their projected capabilities. Key building-block propulsion technologies that will contribute to making these vehicle concepts a reality are discussed along with projections of their status by the year 2000. Some pertinent highlights of the NASA aeropropulsion program are included in the discussion.
Author

N85-23686# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ACTA AERONAUTICA ET ASTRONAUTICA SINICA, SELECTED ARTICLES

4 Oct. 1984 63 p refs Transl. into ENGLISH from Hangkong Xuebao (China), v. 4, no. 4, 1983 p 1-10; 11-19; 39-47; 101-104
(AD-A147304; FTD-ID(RS)T-1120-84) Avail: NTIS HC A04/MF A01 CSDL 20D

The transonic small disturbance (TSDH) equation to calculate the transonic flows over three-dimensional swept wings was used to consider the leading edge boundary conditions and leading edge velocity potential equation suitable for the blunt leading edge of wings. The expanded form of the Jameson scheme in the unequal stop length grid for the discretization of the TSDH equation into a set of finite difference equations was applied, afterwards a rarefied grid in the calculation space was arranged, a dense grid near the wing was arranged and alternate iteration of the rarefied and dense meshes was carried out to accelerate convergence and raise calculation precision. Calculations of the supercritical without shock wave and with shock wave conditions of the ONERA

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M6 wing show that there is good agreement between the TSDH solution and the FVP solution and wind tunnel tests. E.A.K.

N85-23687# Rolls-Royce Ltd., Derby (England).
FLEXIBLE MANUFACTURING SYSTEM FOR THE PRODUCTION OF AIRCRAFT PARTS

M. WECK, Y., K. ZENNER, and D. ZUEHLKE 13 Nov. 1984
16 p refs Transl. into ENGLISH from Ind. Anzeiger (West Germany), v. 10, no. 32, 20 Apr. 1979 p 42-46
(PNR-90237; TRANS-16495/TLT-00913) Avail: NTIS HC A02/MF A01

A system for machining integral aircraft components is presented. It comprises control functions for numerical control machines and material flow, and a processing system for organizational data. Automatic data feedback from the production line, and prompt availability of data to the associated sectors of the firm contribute to shorter planning and decision times. The creation of subsystems which can operate independently means that they can be used as stages in a gradual expansion of a manufacturing system. Author (ESA)

N85-23689# Joint Publications Research Service, Arlington, Va.
MINISTER BUGAYEV ON CIVIL AVIATION IN 1984, PLANS FOR 1985

In its USSR Rept.: Transportation (JPRS-UTR-85-005) p 1-6
25 Mar. 1985 Transl. into ENGLISH from Vozdushnyy Transport (Moscow), 19 Jan. 1985 p 1-2
Avail: NTIS HC A05/MF A01

The Expanded Session of the Ministry of Civil Aviation Collegium and the Aviation Workers Trade Union Central Committee Presidium took place in Moscow. Its participants analyzed the activities of that industry for the past year thoroughly and in detail and discussed missions for Aeroflot labor collectives in developing socialist competition. The completion ahead of schedule of the 1985 plan and the five-year-plan in general was also discussed. Author

N85-23694# Joint Publications Research Service, Arlington, Va.
USSR REPORT: TRANSPORTATION

21 Mar. 1984 112 p refs Transl. into ENGLISH from various Russian articles
(JPRS-UTR-84-008) Avail: NTIS HC A06

Many facets of transportation in the U.S.S.R. are discussed. Included among these topics are civil aviation, motor vehicles and highways, rail transportation, maritime and river fleets and ports and transshipment centers.

N85-23695# Joint Publications Research Service, Arlington, Va.
MINISTER BUGAYEV REVIEWS 1983 CIVIL AVIATION WORK, SETS COURSE FOR 1984

B. P. BUGAYEV *In its* USSR Rept.: Transportation (JPRS-UTR-84-008) p 1-8 21 Mar. 1984 Transl. into ENGLISH from Grazhdanskaya Aviats. (Moscow), no. 1, Jan. 1984 p 2-5
Avail: NTIS HC A06

Civil aviation work is reviewed for the year 1983. Industry in U.S.S.R. is examined. The policies and plans of the Soviets are given in light of aviation personnel. The minister sets the course for 1984. E.R.

N85-23696# Joint Publications Research Service, Arlington, Va.
BUGAYEV ON CIVIL AVIATION MINISTRY'S 1983 ACHIEVEMENTS

B. P. BUGAYEV *In its* USSR Rept.: Transportation (JPRS-UTR-84-008) p 9-14 21 Mar. 1984 Transl. into ENGLISH from Ekon. Gazeta (Moscow), no. 7, Feb. 1984 p 2
Avail: NTIS HC A06

Aeroflot, the U.S.S.R. commercial airline, has its achievements for 1983 recorded. Emphasis is placed on the conservation of aviation fuel and how it impacts on the nation's economy. Plans for 1984 are outlined. E.R.

N85-23697# Joint Publications Research Service, Arlington, Va.
MINISTRY OFFICIALS ON IMPROVING AIRCRAFT TECHNICAL SERVICING

A. SOLOVYEV and V. GORLOV *In its* USSR Rept.: Transportation (JPRS-UTR-84-008) p 15-18 21 Mar. 1984 Transl. into ENGLISH from Vozdushnyy Transp. (Moscow), 15 Nov. 1983 p 2-3
Avail: NTIS HC A06

The problem of improving the technical servicing of aircraft is discussed. The need for higher efficiency in the operation of costly aviation hardware and the increasingly strict requirements concerning the safety and regularity of flights is expressed. The design and production of modern and automated diagnostic and nondestructive control devices is reviewed. E.R.

N85-23698# Joint Publications Research Service, Arlington, Va.
RIGA INSTITUTE SEEKING FASTER INTRODUCTION OF NEW TECHNOLOGY

V. MAKEYEV *In its* USSR Rept.: Transportation (JPRS-UTR-84-008) p 18-21 21 Mar. 1984 Transl. into ENGLISH from Grazhdanskaya Aviats. (Moscow), no. 10, Oct. 1983 p 24
Avail: NTIS HC A06

An automated system to analyze the quality of repair and reliability of aircraft engines has been introduced into industrial use, which has made it possible to significantly increase the operating life of TV-2-117 engines between overhauls. An automated system for diagnosing the basic functions of the systems of the I1-86 aircraft based on the accumulation, correlation and analysis of information from the flight data recorder is discussed. Introduction of the system ensures a high level of organization in the technical maintenance of the I1-86. The economic gain from these systems is analyzed. E.R.

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AERODYNAMICS

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

A85-30320*# National Aeronautics and Space Administration.
Langley Research Center, Hampton, Va.

UNSTEADY TRANSONIC FLOW CALCULATIONS FOR TWO-DIMENSIONAL CANARD-WING CONFIGURATIONS WITH AEROELASTIC APPLICATIONS

J. T. BATINA (NASA, Langley Research Center, Loads and Aeroelasticity Div., Hampton, VA) IN: Structures, Structural Dynamics, and Materials Conference, 26th, Orlando, FL, April 15-17, 1985, Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, 1985, p. 1-9. refs (AIAA PAPER 85-0585)

Unsteady transonic flow calculations for aerodynamically interfering airfoil configurations are performed as a first-step toward solving the three-dimensional canard-wing interaction problem. These calculations are performed by extending the XTRAN2L two-dimensional unsteady transonic small-disturbance code to include an additional airfoil. Unsteady transonic forces due to plunge and pitch motions of a two-dimensional canard and wing are presented. Results for a variety of canard-wing separation distances reveal the effects of aerodynamic interference on unsteady transonic airloads. Aeroelastic analyses employing these unsteady airloads demonstrate the effects of aerodynamic interference on aeroelastic stability and flutter. For the configurations studied, increases in wing flutter speed result with the inclusion of the aerodynamically interfering canard. Author

A85-30321*# Purdue Univ., Lafayette, Ind.
VISCOUS EFFECTS ON TRANSONIC AIRFOIL STABILITY AND RESPONSE

H. M. BERRY, T. Y. YANG (Purdue University, West Lafayette, IN), and J. T. BATINA (NASA, Langley Research Center, Loads and Aeroelasticity Div., Hampton, VA) IN: Structures, Structural Dynamics, and Materials Conference, 26th, Orlando, FL, April 15-17, 1985, Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, 1985, p. 10-22. refs (Contract NAG1-372)
 (AIAA PAPER 85-0586)

An integral boundary layer model coupled to the inviscid XTRAN2L transonic small disturbance code is used to investigate viscous effects on transonic airfoil stability and response. A pulse transfer function analysis is employed for the computation of unsteady transonic airloads which yields forces for a wide range of reduced frequencies in a single flowfield computation. Nonlinear, time-marching aeroelastic solutions are obtained which exhibit the effects of viscosity on airfoil response behavior and flutter. A state-space aeroelastic model using Pade approximants to describe unsteady airloads is used to study viscosity effects on transonic airfoil stability. The state-space dynamic pressure root loci are in good general agreement with time marching damping and frequency estimates.
 O.C.

A85-30325#
A NEW APPROACH TO APPLY THE POTENTIAL GRADIENT METHOD FOR SUPERSONIC UNSTEADY AIRLOADS

K. APPA (Northrop Corp., Aircraft Div., Hawthorne, CA) IN: Structures, Structural Dynamics, and Materials Conference, 26th, Orlando, FL, April 15-17, 1985, Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, 1985, p. 50-55. refs
 (AIAA PAPER 85-0596)

This technical paper discusses a new approach of applying the potential gradient method to compute the generalized aerodynamic forces on wing-like lifting surfaces. An aerodynamic influence coefficient formulation relating the downwash and the panel pressure distributions has been derived. The formulation is such that there is no need to consider the wake or the diaphragm elements in the analysis. Since there is no series expansion of the frequency term in this method, computations at low supersonic Mach numbers and high reduced frequencies can be performed with no convergence difficulties. In terms of the basic data and panel organization, the potential gradient method presented in this paper is similar to the doublet lattice method used in the subsonic flow.
 Author

A85-30326#
THE COMPUTATION OF SECOND-ORDER ACCURATE UNSTEADY AERODYNAMIC GENERALIZED FORCES

B. VAN NIEKERK (Stanford University, Stanford, CA) IN: Structures, Structural Dynamics, and Materials Conference, 26th, Orlando, FL, April 15-17, 1985, Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, 1985, p. 56-63. refs
 (Contract AF-AFOSR-84-0099)
 (AIAA PAPER 85-0597)

A classical variational principle is used to derive special properties of a weighted residual method. It is shown that some weighted integral of the sought solution can be obtained to second-order accuracy in the solution to the original and adjoint problems. For aerodynamic problems, it is assumed that the reverse flow problem is adjoint to the original problem. Examples on airfoils and panel methods demonstrate the fast convergence of generalized aerodynamic forces on airfoils and wings. The singular behavior of aerodynamic problems is shown to be the factor that makes the application of these techniques in aerodynamics so attractive.
 Author

A85-30327*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

MEASURED UNSTEADY TRANSONIC AERODYNAMIC CHARACTERISTICS OF AN ELASTIC SUPERCRITICAL WING WITH AN OSCILLATING CONTROL SURFACE

D. A. SEIDEL, M. C. SANDFORD, and C. V. ECKSTROM (NASA, Langley Research Center, Loads and Aeroelasticity Div., Hampton, VA) IN: Structures, Structural Dynamics, and Materials Conference, 26th, Orlando, FL, April 15-17, 1985, Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, 1985, p. 64-71. refs
 (AIAA PAPER 85-0598)

Transonic steady and unsteady aerodynamic data were measured on a large elastic wing in the NASA Langley Transonic Dynamics Tunnel. The wing had a supercritical airfoil shape and a leading-edge sweepback of 28.8 deg. The wing was heavily instrumented to measure both static and dynamic pressures and deflections. A hydraulically driven outboard control surface was oscillated to generate unsteady airloads on the wing. Representative results from the wind tunnel tests are presented and discussed, and the unexpected occurrence of an unusual dynamic wing instability, which was sensitive to angle of attack, is reported.
 Author

A85-30328#
COUPLING LINEARIZED FAR-FIELD BOUNDARY CONDITIONS WITH NON-LINEAR NEAR-FIELD SOLUTIONS IN TRANSONIC FLOW

W. S. ROWE and F. E. EHLERS (Boeing Commercial Airplane Co., Seattle, WA) IN: Structures, Structural Dynamics, and Materials Conference, 26th, Orlando, FL, April 15-17, 1985, Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, 1985, p. 72-82. refs
 (Contract F49620-83-C-0118)
 (AIAA PAPER 85-0599)

A research investigation has been conducted to evaluate the feasibility of coupling linearized far field solutions with near-field finite differencing equations to reduce the size of grid networks required in present transonic flow calculations. Procedural changes made to an existing finite differencing program involves distributing sources on the solution interface boundary in order to develop the proper far-field outgoing wave boundary condition on a reduced size grid network. Validation of the modification procedure is established for zero-thickness airfoils by comparing predicted two-dimensional results with results obtained from an exact procedure. A criterion based on the gradient of the flow field Mach number was developed for use in establishing the minimum size grid network necessary for accurate finite thickness unsteady loading predictions. Acceptable loading predictions may be achieved for a nominal 5:1 grid size reduction ratio and a 40 percent reduction in computer usage costs.
 Author

A85-30329*# Purdue Univ., Lafayette, Ind.
NON-ISENTROPIC UNSTEADY TRANSONIC SMALL DISTURBANCE THEORY

D. F. FUGLSANG and M. H. WILLIAMS (Purdue University, West Lafayette, IN) IN: Structures, Structural Dynamics, and Materials Conference, 26th, Orlando, FL, April 15-17, 1985, Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, 1985, p. 83-95. refs
 (Contract NAG1-372)
 (AIAA PAPER 85-0600)

Modifications to transonic small disturbance theory (TSD) which more accurately model the Euler equations and seem to remove the problem of nonunique potential flow solutions are presented. The modifications are implemented in the two-dimensional computer code XTRAN2L, and steady and unsteady flow calculations made for the NACA 0012, NLR 7301, and NACA 64A010A airfoils. Comparisons are made with unmodified and modified TSD, Euler, and full potential theories and with experimental data. The modified theory requires only minor coding changes in existing algorithms for calculating small disturbance

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flows, and results in relatively small increases in computational cost. Author

A85-30349#

KARMAN VORTEX SHEDDING - FRIEND OR FOE OF THE STRUCTURAL DYNAMICIST?

L. E. ERICSSON (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA) IN: Structures, Structural Dynamics, and Materials Conference, 26th, Orlando, FL, April 15-17, 1985, Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, 1985, p. 238-250. Research supported by Martin Marietta Aerospace. refs (AIAA PAPER 85-0661)

The analysis presently conducted for rectangular cross sections, encompassing the coupling between Karman vortex shedding and body motions, indicates the way in which this type of shedding can eliminate large amplitude response in the case of the 'galloping' cable over large reduced velocity regions. In the absence of the galloping phenomenon, however, as in the case where a cross section has positive aerodynamic damping, the Karman vortex shedding will become the divergent oscillation-generating flow phenomenon. O.C.

A85-30407*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

TRANSONIC CALCULATIONS FOR A FLEXIBLE SUPERCRITICAL WING AND COMPARISON WITH EXPERIMENT

R. M. BENNETT, D. A. SEIDEL, and M. C. SANDFORD (NASA, Langley Research Center, Loads and Aeroelasticity Div., Hampton, VA) AIAA, ASME, ASCE, and AHS, Structures, Structural Dynamics, and Materials Conference, 26th, Orlando, FL, Apr. 15-17, 1985. 18 p. refs (AIAA PAPER 85-0665)

Pressure data measured on the flexible DAST ARW-2 wing are compared with results calculated using the transonic small perturbation code XTRAN3S. A brief description of the analysis is given and a recently developed grid coordinate transformation is described. Calculations are presented for the rigid and flexible wing for Mach numbers from 0.60 to 0.90 and dynamic pressures from 0 to 1000 psf. Calculated and measured static pressures and wing deflections are compared, and calculated static aeroelastic trends are given. Attempts to calculate the transonic instability boundary of the wing are described. Author

A85-30525

REYNOLDS NUMBER DEPENDENCE OF VORTEX PATTERNS IN ACCELERATED FLOW AROUND AIRFOILS

P. FREYMUTH, W. BANK, and M. PALMER (Colorado, University, Boulder, CO) Experiments in Fluids (ISSN 0723-4864), vol. 3, no. 2, 1985, p. 109-112. (Contract AF-AFOSR-81-0037)

Reynolds number dependence of vortical patterns visualized by smoke technique in accelerating flow behind airfoils is documented in photographic sequences at angles of attack 20 and 60 deg. At low Reynolds numbers the vortical pattern development is quite simple. With increasing Reynolds numbers these patterns become increasingly complex, and onset of turbulence occurs early and generates large-scale turbulent vortex patterns. Author

A85-30673

FURTHER EXPERIMENTAL EVIDENCE OF VORTEX SPLITTING

P. FREYMUTH, W. BANK, and M. PALMER (Colorado, University, Boulder, CO) Journal of Fluid Mechanics (ISSN 0022-1120), vol. 152, March 1985, p. 289-299. refs (Contract AF-AFOSR-81-0037)

Flow visualization data on vortex splitting in wakes in accelerating and steady flows are presented. NACA 0015 airfoil was placed in a 0.9 x 0.9-m square cross section wind tunnel capable of producing uniform flow accelerations of up to 2.4 m/s² and steady speeds of up to 12 m/s; angles of attack tried in

the experiments included 20, 60, 80, and 90 deg, with Reynolds numbers associated with the vortex splitting of 350, 44, 5200, and 124. It is noted that at angles of attack of less than 20 deg the vortex splitting becomes difficult to ascertain. Splitting was also observed in an accelerating flow around a circular 2.54 cm in diameter. L.T.

A85-30773

A NOTE ON TOWER WAKE/BLADE INTERACTION NOISE OF A WIND TURBINE

S. FUJII, K. TAKEDA, and H. NISHIWAKI (National Aerospace Laboratory, Chofu, Tokyo, Japan) Journal of Sound and Vibration (ISSN 0022-460X), vol. 97, Nov. 22, 1984, p. 333-336. Research supported by the Environmental Protection Agency of Japan.

The results of an experimental investigation of wind turbine tower wake/blade interaction are presented. Results for circular, elliptical, and square sections of the support tower legs are compared. The test facility was a scale model of a two bladed wind turbine 1.5 m in diameter. The freestream velocity of the turbine was 8 m/s. It is shown that the slender elliptical tower leg configuration was the quietest, while the square leg configuration was the loudest. Baseline acoustic frequency spectra for the different configurations are provided. I.H.

A85-30942

PRESSURE DISTRIBUTIONS ON A HELICOPTER SWEEP TIP FROM FLIGHT TESTS AND FROM CALCULATIONS

M. J. RILEY (Royal Aircraft Establishment, Bedford, England) and J. V. MILLER (Royal Aircraft Establishment, Farnborough, Hants., England) (European Rotorcraft and Powered Lift Aircraft Forum, 9th, Stresa, Italy, Sept. 13-15, 1983) Vertica (ISSN 0360-5450), vol. 8, no. 4, 1984, p. 323-335. refs

Swept and rectangular planforms have been flight tested simultaneously on a single rotor and surface pressure distributions compared. The results demonstrate the benefit of tip sweep in suppressing supercritical flow. Comparisons with theory on the advancing blade show a large measure of agreement in the prediction of supercritical flow. Some discrepancy is evident in the initial formation of shock waves, and when present in the second quadrant, the shock waves are further back along the chord than predicted. Author

A85-30994

AN INTEGRAL METHOD FOR CALCULATING THE EFFECTS ON TURBULENT BOUNDARY-LAYER DEVELOPMENT OF SWEEP AND TAPER

P. R. ASHILL and P. D. SMITH (Royal Aircraft Establishment, Farnborough, Hants., England) Aeronautical Journal (ISSN 0001-9240), vol. 89, Feb. 1985, p. 43-54. refs

A simple modification is described to the integral method of Smith for calculating turbulent boundary layers on infinite yawed wings to allow for wing planform taper. A comparison has been made between the modified and general methods for calculating three-dimensional boundary layers. This suggests that the modified method is useful for obtaining a rapid indication of the separate effects on the boundary layer of wing sweep and planform taper. Author

A85-30995

UPSTREAM INFLUENCE ON TURBULENT JET FLOWS FROM CRUCIFORM NOZZLES

W. R. QUINN (Saint Francis Xavier University, Antigonish, Nova Scotia, Canada) and G. F. MARSTERS (Canadian Air Transportation Administration Airworthiness Branch, Ottawa, Canada) Aeronautical Journal (ISSN 0001-9240), vol. 89, Feb. 1985, p. 55-58. Sponsorship: Natural Sciences and Engineering Research Council of Canada. refs (Contract NSERC-A-4310)

It has been suggested that cruciform exit nozzle shapes may improve downstream mixing effects, and therefore thrust augmentation, in STOL aircraft. Detailed mean streamwise velocity and streamwise turbulence intensity measurements have been made by hot wire anemometry in one quadrant of the flow of the

fully three-dimensional complex flowfield of a turbulent jet issuing from a cruciform nozzle. These measurements were limited to the developing region, since STOL aircraft ejectors require rapid mixing over short downstream distances. Attention is given to the effects of the upstream shape of the nozzle. O.C.

A85-30996
SPURIOUS ENTROPY PRODUCTION AND VERY ACCURATE SOLUTIONS TO THE EULER EQUATIONS

A. RIZZI (Flygtekniska Forsöksanstalten, Bromma; Kungl. Tekniska Hogskolan, Stockholm, Sweden) *Aeronautical Journal* (ISSN 0001-9240), vol. 89, Feb. 1985, p. 59-71. refs

Entropy can vary along streamlines in the numerical solution of the Euler equations, depending on the solution's accuracy, even if the flow is isentropic. This level of spurious entropy has been used as one of the primary criteria for judging the most accurate solutions of the Euler equations in a variety of different test problems. Boundary conditions and the artificial viscosity model used are found to be the greatest contributors to error level. An accurate, shock-free supercritical solution is presented for the case of a NACA 0012 airfoil profile at freestream Mach of 0.721 and alpha of 0.194 deg. O.C.

A85-30997
THE INTERACTION OF A WAKE WITH A TURBULENT BOUNDARY LAYER

M. D. ZHOU (Nanjing Aeronautical Institute, Nanjing, People's Republic of China; Cambridge University, Cambridge, England) and L. C. SQUIRE (Cambridge University, Cambridge, England) *Aeronautical Journal* (ISSN 0001-9240), vol. 89, Feb. 1985, p. 72-81. refs

In the flow over high-lift aerofoils there is a strong interaction between the wake from one element and the boundary layer on another element immediately downstream. A number of experimental investigations of these types of flow have been made but these studies do not allow the effects associated with the various parameters of the aerofoil to be seen easily. This paper presents the results of extensive measurements of mean and fluctuating quantities made in merging layers in zero and adverse pressure gradients downstream of aerofoils of various shapes. A general description of the emerging process is given and the effects of wake characteristics and pressure gradient are considered. The paper also contains a discussion of the modelling of the Reynolds shear stress in the merging layer. Author

A85-31183
THE KUTTA CONDITION IN UNSTEADY FLOW

D. G. CRIGHTON (Leeds University, Leeds, England) IN: Annual review of fluid mechanics. Volume 17. Palo Alto, CA, Annual Reviews, Inc., 1985, p. 411-445. refs

The theoretical basis and matching physical phenomena necessary for the satisfaction of the Kutta condition in unsteady flows are reviewed, along with applications and avenues deserving of further investigation. The Kutta condition is illustrated by an analysis of the diffraction of a plane acoustics wave by a sharp edged rigid plate. Any velocity singularity in the outer flow region is shown amenable to treatment by relating it to a flow potential within the inner flow region, usually through consideration of viscosity. The thrust of the technique is to account for large-scale, incoherent flow phenomena through eigensolutions of coherent boundary layer structures which have a feedback and affect the outer flow. Applications of the Kutta-Joukowski hypothesis to leading and trailing edge flows, separated flows, nozzle flows and oscillating airfoils are discussed. Further work with the Kutta condition in triple-deck theory and the associated unsteady disturbances with a turbulent mean state are indicated. M.S.K.

A85-31339#
THE NONLINEAR MODEL FOR PREDICTING ROTATING STALL IN MULTISTAGE AXIAL-FLOW COMPRESSORS

D. TANG (Northwestern Polytechnical University, Journal, vol. 3, Jan. 1985, p. 31-46. In Chinese, with abstract in English. refs

A nonlinear model for predicting rotating stall in multistage axial-flow compressors is presented. Blade rows in the model are simulated by a series of 'semi-actuator disks'. The vorticity-transport equation and the stream-function equation are used as the basic equations describing the flow in the blade spacings. Numerical examples involving one and two-stage compressors are given. The formation and development of stall cells is described, and the rotating stall features are obtained along with the left branch stage characteristics. A theoretical limit for the stabilization of stall cells is derived and used as a criterion for choosing the left boundary condition of the vorticity-transport equations. C.D.

A85-31451
THE FUNCTIONAL STRUCTURE OF THE AERODYNAMIC COEFFICIENTS OF A PARACHUTE DUE TO SYMMETRY [FUNKSIONAL'NAIA STRUKTURA AERODINAMICHESKIKH KOEFFITSIENTOV PARASHIUTA VSLEDSTVIE SIMMETRII]

E. A. ALEKSASHINA and V. V. PUSTOVALOV *Aviatsionnaia Tekhnika* (ISSN 0579-2975), no. 4, 1984, p. 3-6. In Russian.

An analysis is made of the aerodynamic behavior of an axisymmetric parachute with a point load in a calm atmosphere. The interaction between the parachute and the atmosphere is taken into account by introducing attached mass coefficients and aerodynamic coefficients depending on the instantaneous values of angle of attack and angular velocity. For such a parachute, a most general functional representation is obtained for the aerodynamic coefficients reflecting the natural constraints due to the properties of symmetry. V.L.

A85-31456
USING THE DISCRETE VORTEX METHOD FOR CALCULATING POTENTIAL FLOW PAST A HIGH-LIFT WING IN THE PRESENCE OF A SCREEN [PRIMENENIE METODA DISKRETNYYKH VIKHREI K RASCHETU POTENTIAL'NOGO OBTAKANIIA PROFILIA MEKHAZIROVANNOGO KRYLA V PRISUTSTVII EKRANA]

S. D. ERMOLENKO and E. A. RIAGUZOV *Aviatsionnaia Tekhnika* (ISSN 0579-2975), no. 4, 1984, p. 26-31. In Russian.

The efficiency of the discrete vortex method is demonstrated for the case of flow past a complex combination of airfoils in the presence of a screen, a problem that is difficult or impossible to solve by other methods. It is shown that the accuracy of the solution depends both on the number of vortices and on their distribution over the airfoil. The effect of the screen on the aerodynamic characteristics of the wing is determined, and the results are shown to be in good agreement with an exact solution. V.L.

A85-31476
AN EXPERIMENTAL AND NUMERICAL STUDY OF FLOW PAST A WEDGE OF FINITE WIDTH AT ANGLES OF SIDESLIP [EKSPERIMENTAL'NOE I RASCHETNOE ISSLEDOVANIE OBTAKANIIA KLINA KONECHNOI SHIRINY NA UGLAKH SKOL'ZHENIIA]

V. V. DUGANOV and O. K. IVANOV *Aviatsionnaia Tekhnika* (ISSN 0579-2975), no. 4, 1984, p. 108-111. In Russian.

Results of wind-tunnel tests (Mach 2.1, Re = 10 to the 8th) are presented for a wedge with an apex angle of 10 deg, 100 mm long and 90 mm wide, for angles of sideslip of 0, 5, and 10 deg. An analysis of wind-tunnel data indicates the presence of two vortices at the side surface of the wedge which are associated with two static pressure minima. Supersonic flow past the wedge has also been determined numerically using a finite-difference scheme. The results obtained are found to be in qualitative agreement with the experimental data. V.L.

02 AERODYNAMICS

A85-31491

THE EFFECT OF THE MACH NUMBER ON THE AERODYNAMIC CHARACTERISTICS OF A DEFORMABLE BODY DURING ITS NONSTATIONARY MOTION [VPLIV CHISEL MAKHA NA AERODINAMICHNI KHARAKTERISTIKI DEFORMIVNOGO TILA PRI IOGO NESTATSIONARNOMU RUSI]

S. O. BANNIKOVA (Kiiiv'skii Derzhavnii Universitet, Kiev, Ukrainian SSR) Akademiia Nauk Ukrains'koi RSR, Dopovid, Seriia A Fiziko-Matematichni ta Tekhnichni Nauki (ISSN 0002-3531), Feb. 1985, p. 25-28. In Ukrainian.

An analysis is made of nonstationary supersonic flow of a gas past elongated bodies with bends in the generatrix. The gas dynamic equations are linearized with respect to the small values of angles of attack and deflections of the tail part of the body as well as their time derivatives. The resulting systems of equations are solved numerically. The effect of the nonstationary nature of the flow and deformation on the aerodynamic coefficients of the bodies is discussed. V.L.

A85-31753#

STUDY OF FLOW FIELD IN THE NEAR WAKE OF DELTA WINGS

V. S. HOLLA, S. P. GOVINDARAJU (Indian Institute of Science, Bangalore, India), and B. M. HIREMATH Aeronautical Society of India, Journal (ISSN 0001-9267), vol. 36, Feb. 1984, p. 17-27. refs

An experimental study of vortex flow field on as well as in the near wake of a plane delta wing with sharp leading edges is presented. Complete velocity measurements in this three dimensional flow field are obtained by means of a blunt conical nosed five hole probe. The probe is mounted on a traversing mechanism with three linear degrees of freedom and the probe is precalibrated for yaw and pitch. The vortex core location is also measured by total heat survey using a Kiel tube. The results are plotted in the form of equi-velocity contours as well as cross flow velocity contours at each of the chordwise cross flow planes and also in the wake region. Using these plots, the vortex core location, its growth and development along the wing, and its subsequent motion in the near wake are studied. The experimental data on the vortex core location on the wing surface are found to be in good agreement with the available theoretical data. Author

A85-31777#

A NUMERICAL ANALYSIS OF THE AERODYNAMIC PROPERTIES OF WINGS USING A MINICOMPUTER [NUMERYCZNA ANALIZA AERODYNAMICZNA SKRZYDEL NA MINIKOMPUTERACH]

M. ANTOSIEWICZ Instytut Lotnictwa, Prace (ISSN 0509-6669), no. 97, 1984, p. 19-39. In Polish. refs

The Weber method for calculating pressure distribution over a wing in subcritical flow has been implemented numerically using a minicomputer. The use of the least-squares approximation of the geometry of wing cross sections has made it possible to considerably simplify calculations while improving accuracy. A comparison of the calculated pressure and force distributions with numerical calculations and experimental data in the literature confirms the correctness of the approach used. V.L.

A85-31781#

A METHOD FOR COMPUTING THE DRAG RISE MACH NUMBER FOR ANY AEROFOIL SECTION [METODA OBLICZENIOWA WYZNACZANIA LICZBY MACHA WZROSTU OPORU DOWOLNEGO PROFILU]

M. ANTOSIEWICZ and W. KANIA Instytut Lotnictwa, Prace (ISSN 0509-6669), no. 98, 1984, p. 23-37. In Polish. refs

The method presented here, which makes it possible to compute the drag rise Mach number for any airfoil section is based on the semiempirical criterion, given by Sinnott (1962), for determining the beginning of the processes connected with the occurrence of a shock wave. The pressure distribution in an incompressible inviscid flow is determined by the Weber method of distribution of singularities along the chord. The use of a third order spline function to approximate the form of the airfoil section simplifies considerably

the computation procedure and makes it possible to analyze numerically a profile of any class. The results obtained are confronted with experimental results for certain airfoil sections of the NPL family as well as the NACA 63-212, NACA 64A210, and NACA 0010 airfoil sections. The use of the method for the construction of new airfoil sections with increased drag rise Mach number is discussed. Author

A85-31889

MODELING OF GAS FLOWS WITH SHOCK WAVES [MODELIROVANIE TECHENII GAZA S UDARNYMI VOLNAMI]

M. M. GILINSKII, M. G. LEBEDEV, and I. R. IAKUBOV Moscow, Izdatel'stvo Mashinostroenie, 1984, 192 p. In Russian. refs

Methods and results of numerical and analog (Zhukovskii's gas-hydraulic analogy) studies of steady and unsteady supersonic gas flows are discussed in relation to problems in external aerogasdynamics. Attention is given to plane and axisymmetric problems of the interaction of shock waves with obstacles and problems related to applications of numerical methods and hydraulic analog modeling of gasdynamic phenomena in engineering practice. V.L.

A85-31886*#

United Technologies Research Center, East Hartford, Conn.

GENERALIZED WAKE GEOMETRY FOR A HELICOPTER IN FORWARD FLIGHT AND EFFECT OF WAKE DEFORMATION ON AIRLOADS

T. A. EGOLF and A. J. LANDGREBE (United Technologies Research Center, East Hartford, CT) IN: American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Proceedings. Alexandria, VA, American Helicopter Society, 1984, p. 359-376. Research supported by the United Technologies Corp. refs

(Contract NAS1-14568; DAAJ02-70-C-0009)

An analytical investigation was conducted to develop a first level generalization of the predicted distorted wake geometry of a helicopter rotor in level steady forward flight and to demonstrate the influence of wake deformation on the prediction of rotor airloads. Distortions of the tip vortex relative to the classical undistorted geometry are generalized in terms of vortex age, blade azimuth, advance ratio, thrust coefficient, and number of blades for a representative rotor. A computer module and charts were developed for approximating wake geometry and identifying wake boundaries and locations of blade-vortex passage. Predicted H-34 airloads for several inflow/wake models are compared with data for selected flight conditions. The occurrence of close blade-vortex passages and the high sensitivity of predicted airloads to small deviations of blade to tip vortex distance demonstrate the requirement for improved blade-vortex interaction models. The airload correlations indicate that refined distorted wake methodology has the potential to provide more accurate airload prediction. Author

A85-31888*#

Army Research and Technology Labs., Moffett Field, Calif.

THE PREDICTION OF TRANSONIC FLOWS ON ADVANCING ROTORS

C. TUNG, F. X. CARADONNA, D. A. BOXWELL (U.S. Army, Aeromechanics Laboratory, Moffett Field, CA), and W. R. JOHNSON (NASA, Ames Research Center, Moffett Field, CA) IN: American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Proceedings. Alexandria, VA, American Helicopter Society, 1984, p. 389-399. refs

The object of this investigation was to find and demonstrate a means of performing efficient finite-difference computations of rotor loading for a trimmed rotor in high-speed, advancing flight. The essence of the scheme that was developed is a loose-coupled iteration procedure between a finite difference and a comprehensive integral rotor code. The coupling involves a transfer of appropriate load and inflow data between the two codes such that consistency is maintained. Sample computations, including a limited comparison with model rotor data, are presented. The scheme converges rapidly. The finite-difference computation of

one rotor revolution with this scheme may provide sufficient accuracy for many purposes. Author

A85-31989*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

COMPUTERIZED AERODYNAMIC DESIGN OF A TRANSONICALLY 'QUIET' BLADE

M. E. TAUBER (NASA, Ames Research Center, Moffett Field, CA) IN: American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Proceedings. Alexandria, VA, American Helicopter Society, 1984, p. 401-418. refs

The high noise levels produced by helicopters are major sources of concern. There are many sources of the noise, but during high-speed forward flight, impulsive noise dominates the noise spectrum. The cause of the high-speed impulsive noise is the propagation into the far field of shock waves that form on the advancing blade. This mechanism has been labeled 'delocalization'. It has been shown, however, that by judicious design of the blade-tip planform, delocalization can be prevented. The objective of the present study is to illustrate how blade-tip configurations (both planform and airfoil shape) can be systematically varied to identify shapes that avoid delocalization and simultaneously improve aerodynamic performance. This has been done using the latest version of the ROT22 transonic, full-potential, quasi-steady, rotor flow-field code. A hypothetical modern rotor blade was postulated, and tip modifications consisting of taper, sweep, and airfoil section alterations were investigated. Planform modifications were found to be most effective in eliminating delocalization. Author

A85-32001#
TOWARD A UNIFIED AERODYNAMIC MODEL FOR USE IN ROTOR BLADE STABILITY ANALYSES

D. A. PETERS (Washington University, St. Louis, MO) IN: American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Proceedings. Alexandria, VA, American Helicopter Society, 1984, p. 525-538. refs

(Contract DAAG29-80-C-0092; DAAG29-83-K-0133)

This paper presents a modification of the ONERA dynamic-stall, lift model. This modification includes the pitch-plunge distinction, the unsteady free-stream, large angles of attack, and reversed flow. Numerical applications to a flapping rotor show that the new model is stable, in contrast to the original ONERA model which can become unstable. The new model is also more consistent than the old one in that it reduces to Greenberg theory for small angles of attack and further reduces to Theodorsen theory for steady free stream. Author

A85-32501#
THE CONTRIBUTION OF ELIE CARAFOLI TO THE DEVELOPMENT OF THE THEORY OF WINGS WITH LATERAL JETS

M. NEAMTU (Institutul National Pentru Creatie Stiintifica si Tehnica, Bucharest, Rumania) Studii si Cercetari de Mecanica Aplicata (ISSN 0039-4017), vol. 43, May-June 1984, p. 201-206. In Romanian. refs

After a short presentation of Carafoli's work on aerodynamics and its global import, the paper covers some of the research done on the use of the lateral jets to augment the lift of aircraft wings. A physical-mathematical model developed by Carafoli, is discussed, noting its two clusters simplifying hypotheses: (1) the fluid wing and (2) the clusters of jets. The pressure field, and lift distribution effects are additional elements. Finally, the wing span determination is discussed and applications to the F-15 take-off length reduction are noted. N.D.

A85-32506#
AERODYNAMIC PROPERTIES OF SOME FLEXIBLE PROFILES

V. N. CONSTANTINESCU, S. GALETUSE, and P. MARINESCU (Bucuresti, Institutul Politehnic, Bucharest, Rumania) Studii si Cercetari de Mecanica Aplicata (ISSN 0039-4017), vol. 43, Sept.-Dec. 1984, p. 587-599. In Romanian.

The aerodynamic properties of the Vlaicu wing proposed for the prototype aircraft Vlaicu I are studied qualitatively. The wing is

rectangular, of length lambda approximately equal to four with the cloth assumed perfectly stretched initially. The deformations of the profile are mainly due to the action of the pressure distributions, with the phenomenon considered as a two-dimensional problem. For more exact computations an integrodifferential equation is proposed with a possible numerical solution. Some recent solutions may have an influence on delta wing calculations. N.D.

A85-32517
AERODYNAMICS OF SWEEPED WINGS OF MEDIUM AND SMALL ASPECT RATIOS. I [AERODINAMIKA STRELOVIDNYKH KRYL'EV SREDNIKH I MALYKH UDLENENII. I]

V. V. STRUMINSKII Moscow, Akademiia Nauk SSSR, 1983, 56 p. In Russian. refs

Theoretical and experimental work on the aerodynamics of swept wings and the theory of the slip effect developed by the author over the period 1942-44 in a series of papers on the three-dimensional boundary layer are reviewed. First, the general theory of flow past yawed and swept wings is briefly discussed, and the slip effect is examined with allowance for the influence of air viscosity. This is followed by a discussion of the characteristics of flow past cross-sections of swept wings. V.L.

A85-32583#
A HARMONIC GRADIENT METHOD FOR UNSTEADY SUPERSONIC FLOW CALCULATIONS

P.-C. CHEN (Northrop Corp., Aircraft Div., Hawthorne, CA) and D. D. LIU (Arizona State University, Tempe, AZ) (Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 2, p. 237-252) Journal of Aircraft (ISSN 0021-8669), vol. 22, May 1985, p. 371-379. Previously cited in issue 12, p. 1697, Accession no. A83-29834. refs

A85-32587*# Gates Learjet Corp., Wichita, Kans.
AERODYNAMIC CANARD/WING PARAMETRIC ANALYSIS FOR GENERAL-AVIATION APPLICATIONS

M. W. KEITH (Gates Learjet Corp., Wichita, KS) and B. P. SELBERG (Missouri-Rolla, University, Rolla, MO) Journal of Aircraft (ISSN 0021-8669), vol. 22, May 1985, p. 401-408. Previously cited in issue 06, p. 712, Accession no. A84-18164. refs (Contract NAG1-26)

A85-32590*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
IMPACT OF FUSELAGE INCIDENCE ON THE SUPERSONIC AERODYNAMICS OF TWO FIGHTER CONFIGURATIONS

R. M. WOOD and D. S. MILLER (NASA, Langley Research Center, High-Speed Aerodynamics Div., Hampton, VA) Journal of Aircraft (ISSN 0021-8669), vol. 22, May 1985, p. 423-428. Previously cited in issue 20, p. 2845, Accession no. A84-41345. refs

A85-32602*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ANALYSIS OF AEROTHERMAL LOADS ON SPHERICAL DOME PROTUBERANCES

G. C. OLSEN and R. E. SMITH (NASA, Langley Research Center, Hampton, VA) AIAA Journal (ISSN 0001-1452), vol. 23, May 1985, p. 650-656. Previously cited in issue 14, p. 1971, Accession no. A83-32775. refs

A85-32603#
UNSTEADY FLOW ABOUT A JOUKOWSKI AIRFOIL IN THE PRESENCE OF MOVING VORTICES

C.-Y. CHOW (Colorado, University, Boulder, CO), M.-K. HUANG, and C.-Z. YAN (Nanjing Aeronautical Institute, Nanjing, People's Republic of China; Colorado, University, Boulder, CO) AIAA Journal (ISSN 0001-1452), vol. 23, May 1985, p. 657, 658. Previously cited in issue 05, p. 580, Accession no. A83-16542. (Contract AF-AFOSR-82-0037)

02 AERODYNAMICS

A85-32607#

COMPUTATION OF THREE-DIMENSIONAL TURBULENT SHEAR FLOWS IN CORNERS

J. J. GORSKI, T. R. GOVINDAN, and B. LAKSHMINARAYANA (Pennsylvania State University, University Park, PA) *AIAA Journal* (ISSN 0001-1452), vol. 23, May 1985, p. 685-692. Previously cited in issue 17, p. 2507, Accession no. A83-38092. refs

A85-32609*# North Carolina State Univ., Raleigh.

A NEW STREAM FUNCTION FORMULATION FOR THE STEADY EULER EQUATIONS

H. L. ATKINS and H. A. HASSAN (North Carolina State University, Raleigh, NC) (Computational Fluid Dynamics Conference, 6th, Danvers, MA, July 13-15, 1983, Collection of Technical Papers, p. 390-397) *AIAA Journal* (ISSN 0001-1452), vol. 23, May 1985, p. 701-706. Previously cited in issue 18, p. 2636, Accession no. A83-39393. refs
(Contract NCC1-22)

A85-32610*# Boeing Commercial Airplane Co., Seattle, Wash. **TRANSONIC SHOCK-WAVE/TURBULENT BOUNDARY-LAYER INTERACTIONS IN A CIRCULAR DUCT**

D. OM (Boeing Commercial Airplane Co.; Washington, University, Seattle, WA), J. R. VIEGAS (NASA, Ames Research Center, Experimental Fluid Dynamics Branch, Moffett Field, CA), and M. E. CHILDS (Washington, University, Seattle, WA) *AIAA Journal* (ISSN 0001-1452), vol. 23, May 1985, p. 707-714. Previously cited in issue 15, p. 2345, Accession no. A82-31951. refs
(Contract NGR-48-002-047; NGR-48-002-041)

A85-32612*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

VISCOUS SHOCK-LAYER FLOWFIELD ANALYSIS BY AN EXPLICIT-IMPLICIT METHOD

R. N. GUPTA, P. A. GNOFFO (NASA, Langley Research Center, Space Systems Div., Hampton, VA), and R. W. MACCORMACK (Washington, University, Seattle, WA) *AIAA Journal* (ISSN 0001-1452), vol. 23, May 1985, p. 723-732. Previously cited in issue 14, p. 1970, Accession no. A83-32702. refs

A85-32616*# Cincinnati Univ., Ohio.

THE HIGH REYNOLDS NUMBER FINITE FLAT-PLATE CASCADE

R. T. DAVIS (Cincinnati, University, Cincinnati, OH) and A. P. ROTHMAYER (Computational Fluid Dynamics Conference, 6th, Danvers, MA, July 13-15, 1983, Collection of Technical Papers, p. 222-229) *AIAA Journal* (ISSN 0001-1452), vol. 23, May 1985, p. 758, 759. Previously cited in issue 18, p. 2635, Accession no. A83-39372.
(Contract NGT-36-004-800; N00014-76-C-0364)

A85-32618#

EXPERIMENTAL INVESTIGATION OF A SIMULATED COMPRESSOR AIRFOIL TRAILING-EDGE FLOWFIELD

R. W. PATERSON (United Technologies Research Center, East Hartford, CT) and H. D. WEINGOLD (United Technologies Corp., Pratt and Whitney Group, East Hartford, CT) *AIAA Journal* (ISSN 0001-1452), vol. 23, May 1985, p. 768-775. Previously cited in issue 06, p. 704, Accession no. A84-17883. refs
(Contract N00019-80-C-0633)

A85-32624*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

SOME ITERATIVE SCHEMES FOR TRANSONIC POTENTIAL FLOWS

Y. S. WONG (NASA, Langley Research Center, Institute for Computer Applications in Sciences and Engineering, Hampton, VA; Alberta, University, Edmonton; McGill University, Montreal, Canada) and M. M. HAFEZ (Computer Dynamics, Inc., Virginia Beach, VA) *AIAA Journal* (ISSN 0001-1452), vol. 23, May 1985, p. 808-810. refs
(Contract NAS1-5810; NAS1-6394)

The minimal residual (MR) method for the numerical solution of transonic potential flows is closely related to the conjugate

gradient method, which has found widespread use in the solution of large sparse, symmetric, and positive-definite linear equations. The primary advantage of the MR method is its applicability to both symmetric and nonsymmetric matrices. O.C.

A85-32632* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

ACOUSTIC SHOCKS IN A VARIABLE AREA DUCT CONTAINING NEAR SONIC FLOWS

S. I. HARIHARAN (NASA, Langley Research Center, Institute for Computer Applications in Science and Engineering, Hampton, VA; Tennessee, University, Space Institute, Tullahoma, TN) and H. C. LESTER (NASA, Langley Research Center, Hampton, VA) *Journal of Computational Physics* (ISSN 0021-9991), vol. 58, March 1985, p. 134-145. Previously announced in STAR as N84-15897. refs
(Contract NAS1-17070; NAS1-17130)

Acoustic shock waves in a variable area duct which contains near sonic flows are considered. The problem is modeled after an aeroengine inlet. Area variation of a duct and high Mach number mean the flow reduces acoustical energy yielding substantial noise reduction. One possible reason for this is acoustic shock. The use of an explicit accurate numerical method which captures shocks is described. Comparison of the results are made with an existing asymptotic theory for Mach numbers close to unity. When shock occurs reduction of sound pressure levels are shown by example. Author

A85-32633

GRID GENERATION FOR INLET CONFIGURATIONS USING CONFORMAL MAPPING

K. INOUE (National Aerospace Laboratory, Chofu, Tokyo, Japan) *Journal of Computational Physics* (ISSN 0021-9991), vol. 58, March 1985, p. 146-154.

An orthogonal grid generation method for inlet geometries is developed using conformal mapping. In this method, the region on the physical plane is mapped onto the computational plane by one or two steps of conformal mapping; the mapping functions are determined numerically. A simple extension of this method allows the generation of three-dimensional grids for asymmetric geometries. Grids of H-type are also generated through the fundamental mapping function for C-type grids. Author

A85-32799

MBB STUDIES VARIABLE CAMBER WINGS TO IMPROVE LIFT, EXPAND FLEET UNIFORMITY

M. FEAZEL *Aviation Week and Space Technology* (ISSN 0005-2175), vol. 122, April 29, 1985, p. 163, 165, 167.

Variable camber wings (VCW) could be used to change the shape of transport aircraft wings in-flight and thereby potentially offer 6 percent fuel savings. Also, VCW might allow one aircraft to fly on different route lengths. Wind tunnel tests show a 3 percent L/D enhancement compared to conventional wings and 9 percent in some regions of the flight envelope. It is suggested that an on-board computerized system select an optimized flap setting for a given flight plan or a flight phase. The wings could be lighter and longer, a configuration which raises the problem of wing strength if the flap system fails. Finally, changing the camber during low speed flight could increase drag momentarily and cause buffeting. Further tests with larger models than thus far available are necessary to get a handle on the perceived problems. M.S.K.

A85-32961*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

ASSESSMENT OF THREE-DIMENSIONAL INVISCID CODES AND LOSS CALCULATIONS FOR TURBINE AERODYNAMIC COMPUTATIONS

L. A. POVINELLI (NASA, Lewis Research Center, Cleveland, OH) ASME, Transactions, Journal of Engineering for Gas Turbines and Power (ISSN 0022-0825), vol. 107, April 1985, p. 265-275; Discussion, p. 275, 276; Author's Closure, p. 276. Previously announced in STAR as N84-16142. refs (ASME PAPER 84-GT-187)

An assessment of several three dimensional inviscid turbine aerodynamic computer codes and loss models used at the NASA Lewis Research Center is presented. Five flow situations are examined, for which both experimental data and computational results are available. The five flows form a basis for the evaluation of the computational procedures. It was concluded that stator flows may be calculated with a high degree of accuracy, whereas, rotor flow fields are less accurately determined. Exploitation of contouring, leaning, bowing, and sweeping will require a three dimensional viscous analysis technique. Author

A85-32963*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

INVESTIGATION OF FLOW PHENOMENA IN A TRANSONIC FAN ROTOR USING LASER ANEMOMETRY

A. J. STRAZISAR (NASA, Lewis Research Center, Cleveland, OH) ASME, Transactions, Journal of Engineering for Gas Turbines and Power (ISSN 0022-0825), vol. 107, April 1985, p. 427-435. Previously announced in STAR as N84-17143. refs (ASME PAPER 84-GT-199)

Several flow phenomena including flowfield periodicity, rotor shock oscillation, and rotor shock system geometry were investigated in a transonic low aspect ratio fan rotor using laser anemometry. Flow periodicity is found to increase with increasing rotor pressure rise, and to correlate with blade geometry variations. Analysis of time-accurate laser anemometer data indicates that the rotor shock oscillates about its mean location with an amplitude of 3 to 4 percent of rotor chord. The shock surface is nearly two-dimensional for levels of rotor pressure rise at and above the peak efficiency level but becomes more complex for lower levels of pressure rise. Spanwise shock lean generates radial flows due to streamline deflection in the hub-to-shroud streamsurface. Author

A85-32964*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

DESIGN AND PERFORMANCE OF A FIXED, NONACCELERATING GUIDE VANE CASCADE THAT OPERATES OVER AN INLET FLOW ANGLE RANGE OF 60 DEG

J. M. SANZ (NASA, Lewis Research Center, Cleveland, OH; Universities Space Research Association, Columbia, MD), E. R. MCFARLAND, N. L. SANGER, T. F. GELDER, and R. H. CAVICCHI (NASA, Lewis Research Center, Cleveland, OH) ASME, Transactions, Journal of Engineering for Gas Turbines and Power (ISSN 0022-0825), vol. 107, April 1985, p. 477-484. Previously announced in STAR as N84-14120. refs (ASME PAPER 84-GT-75)

A unique set of wind tunnel guide vanes are designed with an inverse design code and analyzed with a panel method and an integral boundary layer code developed at the NASA Lewis Research Center. The fixed guide vanes, 80 feet long with 6-foot chord length, were designed for the NASA Ames 40 x 80/80 x 120 ft Wind Tunnel. Low subsonic flow is accepted over a 60 deg range of inlet angle from either the 40 x 80 leg or the 80 x 120 leg of the wind tunnel, and directed axially into the main leg of the tunnel where drive fans are located. Experimental tests of 1/10-scale models were conducted to verify design calculations. Author

A85-32965*# Iowa State Univ. of Science and Technology, Ames.

A NOTE ON BLADE WAKE INTERACTION INFLUENCE ON COMPRESSOR STATOR ROW AERODYNAMIC PERFORMANCE

T. H. OKIISHI, J. L. HANSEN (Iowa State University of Science and Technology, Ames, IA), and M. D. HATHAWAY (U.S. Army, Propulsion Laboratory, Cleveland, OH) ASME, Transactions, Journal of Engineering for Gas Turbines and Power (ISSN 0022-0825), vol. 107, April 1985, p. 549-551. refs (Contract F49620-83-K-0023; NAG3-356)

Attention is given to the effect of blade wake interactions on the performance of an axial flow compressor's stator row, for the case of compressor and fan stator flows without shocks. The measured midspan loss of total pressure can be related to stator surface boundary layers, the chopped rotor wakes passing through the stator row, and the interaction between these flows. The interaction between rotor blade wake segments and stator blade surface boundary layers generates much higher losses than expected in both the stator wake and in the region of flow between stator boundary layers/wakes, if interaction effects are ignored. O.C.

A85-33014#

NUMERICAL OPTIMIZATION METHOD FOR AIRFOIL DESIGN

J. RENEAUX (ONERA, Chatillon-sous-Bagneaux, Hauts-de-Seine, France) La Recherche Aerospatiale (English Edition) (ISSN 0379-380X), no. 5, 1984, p. 1-19. Research supported by the Direction des Recherches, Etudes et Techniques. refs

The numerical optimization method developed at ONERA combines a new method that analyzes a transonic viscous flow around airfoils with a constrained minimization method. It is used to modify or design airfoils to meet aerodynamic criteria without violating aerodynamic and geometrical requirements. Examples of applications for the design of airfoils for general aviation, propellers, rotor blades and transport aircraft are described to illustrate the effectiveness of the method as compared with the usual approaches to airfoil design and the potential of numerical optimization in aerodynamics. Author

A85-33350#

THE PRELIMINARY DESIGN OF AERODYNAMIC PROFILES [SUL PROGETTO PRELIMINARE DI PROFILI AERODINAMICI]

A. BARON and S. DE PONTE (Milano, Politecnico, Milan, Italy) Ingegneria (ISSN 0035-6263), Jan.-Feb. 1985, p. 12-21. In Italian. refs

Boundary-layer theory is applied to the initial phase of airfoil design. Assumptions and approximations are developed which permit the velocity distribution on the surface of the airfoil to be determined from the desired lift, drag, and pitching moment, taking empirical data on turbulent boundary layers into account; iterative methods can then be employed to obtain an optimal profile which will produce the predetermined velocity distribution. Graphs and diagrams of sample problems are provided. T.K.

A85-33354#

COMPARISON OF VARIOUS NUMERICAL TECHNIQUES IN GAS DYNAMICS

H. SHIGEFUJI (Shinnihon Steel Co., Kitakyushu, Japan) and T. MATSUDA (Kyoto University, Kyoto, Japan) Kyoto University, Faculty of Engineering, Memoirs (ISSN 0023-6063), vol. 46, Oct. 1984, p. 7-23. refs

In search of reliable numerical methods for gas dynamic flow problems, the MacCormack method algorithm and two new algorithms are applied to two representative problems in gas dynamics. The MacCormack method, which is most commonly employed in aerodynamics, proves to be good for the time developing problem. The explicit Satofuka method, which is claimed to be stable even if the CFL condition is violated, turns out to be rather inaccurate for a problem with a CFL number larger than unity. It is found that the new MacCormack implicit method is suitable for the time steady problem. Author

02 AERODYNAMICS

N85-22363 Princeton Univ., N. J.
AERODYNAMIC BEHAVIOR OF VENTILATED WIND TUNNEL WALLS Ph.D. Thesis

P. J. LU 1984 288 p

Avail: Univ. Microfilms Order No. DA8425698

A new approach is developed to study the wall behavior which indicates the mutual interference between wall perforations in the presence of the non-uniform pressure field induced by the model. In the global analysis, the method of matched asymptotic expansions is employed to form and explain the idea of an averaged wall boundary condition. With the use of a wavy wall model problem, the appropriate boundary condition for perforated walls in subsonic flow is derived. The newly obtained perforated wall condition contains an extra term which has not been identified in the classical formulation. A local analysis is also used to study the flow through an isolated hole in the wind tunnel wall. Both inviscid irrotational (potential) and rotational (shear) flows are considered. A value for the cross-flow resistance constant, which takes into account all the geometrical and Mach number effects, is derived, analytically.

Dissert. Abstr.

N85-22365*# Tekworld Co., Hampton, Va.
EFFECTS OF LEADING-EDGE DEVICES ON THE LOW-SPEED AERODYNAMIC CHARACTERISTICS OF A HIGHLY-SWEPT ARROW-WING

S. J. SCOTT, O. W. NICKS, and P. K. IMBRIE Feb. 1985 67 p

(Contract NASA PURCHASE ORDER L-69215B)

(NASA-CR-172531; NAS 1.26:172531) Avail: NTIS HC A04/MF

A01 CSCL 01A

An investigation was conducted in the Texas A&M University 7 by 10 foot Low Speed Wind Tunnel to provide a direct comparison of the effect of several leading edge devices on the aerodynamic performance of a highly swept wing configuration. Analysis of the data indicates that for the configuration with undeflected leading edges, vortex separation first occurs on the outboard wing panel for angles of attack of approximately 2, and wing apex vortices become apparent for α or = 4 deg. However, the occurrence of the leading edge vortex flow may be postponed with leading edge devices. Of the devices considered, the most promising were a simple leading edge deflection of 30 deg and a leading edge slat system. The trailing edge flap effectiveness was found to be essentially the same for the configuration employing either of these more promising leading edge devices. Analysis of the lateral directional data showed that for all of the concepts considered, deflecting leading edge downward in an attempt to postpone leading edge vortex flows, has the favorable effect of reducing the effective dihedral.

B.W.

N85-22366*# National Aeronautics and Space Administration.
Langley Research Center, Hampton, Va.

THE APPLICATION OF SOME LIFTING-BODY REENTRY CONCEPTS TO MISSILE DESIGN

M. L. SPEARMAN Mar. 1985 29 p refs Presented at the AIAA 23rd Aerospace Sci. Meeting, Reno, Nev., 14-17 Jan. 1985 Previously announced in IAA as A85-19791

(NASA-TM-86394; NAS 1.15:86394; AIAA-85-0497) Avail: NTIS HC A03/MF A01 CSCL 01A

The aerodynamic characteristics of some lifting-body concepts are examined with a view to the applicability of such concepts to the design of missiles. A considerable amount of research has been done in past years with vehicle concepts suitable for manned atmospheric-entry and atmospheric flight. Some of the concepts appear to offer some novel design approaches for missiles for a variety of missions and flight profiles, including long-range orbital/reentry with transatmospheric operation for strategic penetration, low altitude penetration, and battlefield tactical. The concepts considered include right triangular pyramidal configurations, a lenticular configuration, and various 75-degree triangular planform configurations with variations in body camber and control systems. The aerodynamic features are emphasized but some observations are also made relative to other factors such as heat transfer, structures, carriage, observability, propulsion, and volumetric efficiency.

Author

N85-22367*# Kansas Univ., Lawrence. The Flight Research Lab.

CALCULATION OF VORTEX-FLAP AERODYNAMIC CHARACTERISTICS Status Report, 1 Oct. 1984 - 31 Mar. 1985

C. E. LAN and C. C. HSING 22 Apr. 1985 7 p refs

(Contract NAG1-396)

(NASA-CR-175624; NAS 1.26:175624) Avail: NTIS HC A02/MF A01 CSCL 01A

The lateral-directional characteristics for configurations with vortex flaps were calculated by the VORSTAB code. In view of the poor correlation between the VORSTAB results and the data, it was decided to examine in detail the reasons behind the discrepancy. After corrections in the data, the characteristics were recalculated. The prediction of dihedral effect is now largely improved.

B.G.

N85-22368*# Hamilton Standard, Windsor Locks, Conn.
LARGE-SCALE ADVANCED PROPFAN (LAP) PERFORMANCE, ACOUSTIC AND WEIGHT ESTIMATION, JANUARY, 1984

D. PARZYCH, A. SHENKMAN, and S. COHEN Feb. 1985 61 p

(Contract NAS3-23051)

(NASA-CR-174782; NAS 1.26:174782; SP-06A83) Avail: NTIS HC A04/MF A01 CSCL 01A

In comparison to turbo-prop applications, the Prop-Fan is designed to operate in a significantly higher range of aircraft flight speeds. Two concerns arise regarding operation at very high speeds: aerodynamic performance and noise generation. This data package covers both topics over a broad range of operating conditions for the eight (8) bladed SR-7L Prop-Fan. Operating conditions covered are: Flight Mach Number 0 - 0.85; blade tip speed 600-800 ft/sec; and cruise power loading 20-40 SHP/D2. Prop-Fan weight and weight scaling estimates are also included.

Author

N85-22369*# Vigan Research Associates, Inc., Hampton, Va.
METHOD FOR THE PREDICTION OF THE INSTALLATION AERODYNAMICS OF A PROPFAN AT SUBSONIC SPEEDS Final Report, 1 Aug. 1981 - 31 Dec. 1984

B. CHANDRASEKARAN Washington NASA Apr. 1985 124 p refs

(Contract NAS1-16742)

(NASA-CR-3887; NAS 1.26:3887) Avail: NTIS HC A06/MF A01 CSCL 01A

A subsonic flow panel code has been modified to handle the effects of a propeller wake. The effects of the propeller were modelled by a system of ring vortices of constant strength. Principles based on the blade element theory, the vortex theory and the momentum theory were used to evaluate the axial velocity increase, the swirl velocity and the pressure increase across the propeller. Theoretical calculations are compared to experimental results at Mach numbers up to 0.70 over a range of angles of attack. The discrepancies between the theory and the experimental results are analyzed. Suggestions for improvements to enhance the accuracy of the theoretical prediction are indicated.

Author

N85-22370*# National Aeronautics and Space Administration.
Langley Research Center, Hampton, Va.

AERODYNAMIC HEATING RATE DISTRIBUTIONS INDUCED BY TRAILING EDGE CONTROLS ON HYPERSONIC AIRCRAFT CONFIGURATIONS AT MACH 8

L. G. KAUFMAN, II (Grumman Aerospace Corp., Bethpage, N.Y.) and C. B. JOHNSON Aug. 1984 186 p refs

(NASA-TM-87453; RM-799; NAS 1.15:87453) Avail: NTIS HC A09/MF A01 CSCL 01A

Aerodynamic surface heating rate distributions in three dimensional shock wave boundary layer interaction flow regions are presented for a generic set of model configurations representative of the aft portion of hypersonic aircraft. Heat transfer data were obtained using the phase change coating technique (paint) and, at particular spanwise and streamwise stations for sample cases, by the thin wall transient temperature technique (thermocouples). Surface oil flow patterns are also shown. The good accuracy of the detailed heat transfer data, as attested in

part by their repeatability, is attributable partially to the comparatively high temperature potential of the NASA-Langley Mach 8 Variable Density Tunnel. The data are well suited to help guide heating analyses of Mach 8 aircraft, and should be considered in formulating improvements to empiric analytic methods for calculating heat transfer rate coefficient distributions. Author

N85-22371# George Washington Univ., Washington, D.C. School of Engineering and Applied Science.
ON THE SOLUTION OF THE THREE-DIMENSIONAL FLOWFIELD ABOUT A FLOW-THROUGH NACELLE Ph.D. Thesis
 W. B. COMPTON, III 5 May 1985 159 p refs
 (NASA-TM-87448; NAS 1.15:87448) Avail: NTIS HC A08/MF A01 CSDL 01A

The solution of the three dimensional flow field for a flow through nacelle was studied. Both inviscid and viscous inviscid interacting solutions were examined. Inviscid solutions were obtained with two different computational procedures for solving the three dimensional Euler equations. The first procedure employs an alternating direction implicit numerical algorithm, and required the development of a complete computational model for the nacelle problem. The second computational technique employs a fourth order Runge-Kutta numerical algorithm which was modified to fit the nacelle problem. Viscous effects on the flow field were evaluated with a viscous inviscid interacting computational model. This model was constructed by coupling the explicit Euler solution procedure with a flag entrainment boundary layer solution procedure in a global iteration scheme. The computational techniques were used to compute the flow field for a long duct turbofan engine nacelle at free stream Mach numbers of 0.80 and 0.94 and angles of attack of 0 and 4 deg. Author

N85-22372# Royal Aircraft Establishment, Farnborough (England).
INVESTIGATIONS INTO THE EFFECTS OF SCALE AND COMPRESSIBILITY ON LIFT AND DRAG IN THE RAE 5M PRESSURISED LOW-SPEED WIND TUNNEL

S. P. FIDDES, D. A. KIRBY, D. S. WOODWARD, and D. H. PECKHAM Jun. 1984 22 p refs
 (RAE-TM-AERO-2006; BR93111) Avail: NTIS HC A02/MF A01
 Results from experiments in a 5m low speed wind tunnel capable of operation over pressures from 1 to 3 atm so that the effects of Mach and Reynolds number may be separated are presented. This decoupling of scale and compressibility effects enables reliable extrapolation of test results to full-scale conditions and gives greater insight into the underlying flow mechanisms. The large size of the tunnel, combined with pressurization to 3 atm enables tests on small combat/trainer aircraft and on bomblike stores to be carried out at full scale. Prediction and improvement of the high-lift performance of specific aircraft; optimization of high-lift devices on generalized research models; and work on the drag of stores carried externally on combat aircraft are discussed. Author (ESA)

N85-22791# Joint Publications Research Service, Arlington, Va.
FLIGHT DYNAMICS OF AXISYMMETRICAL ROTATING BODIES IN AIR MEDIUM Abstract Only
 I. T. BORISENOK, B. Y. LOKSHIN, and V. A. PRIVALOV *In its* USSR Rept.: Eng. and Equipment (JPRS-UEQ-85-003) p 8 12 Mar. 1985 Transl. into ENGLISH from *Izv. Akad. Nauk SSSR: Mekhan. Tverdogo Tela* (Moscow), no. 2, Feb. 1984 p 35-42
 Avail: NTIS HC A06

The free flight motion of a rigid axisymmetric body due to the action of its own weight, aerodynamic effects (autorotation), and possible reactive forces is examined. It is assumed that the central ellipsoid of inertia of the body is an ellipsoid of rotation about the axis of symmetry, and that the center of gravity is at the geometric center of the body. The region of stability of vertical descent is approximated by dividing a system of characteristic equations into fast and slow parts. It is shown that, for given gyroscopic forces, the presence of the nonconservative Magnus moment may lead to a loss of stability of this type of motion. The stability of the case of planar motion, where the Magnus force and weight form

an equilibrium force system, and of the case of spiral motion is considered. Stability is also studied for the case of the center of mass at an arbitrary point on the axis of symmetry, and for the case of an axisymmetric body not having an equatorial plane of symmetry. Conditions for the equilibrium and procession of a rotating parachute in a wind tunnel are identified. J.N.

N85-22792# Joint Publications Research Service, Arlington, Va.
HYPERSONIC FLOW ABOUT TRIANGULAR AIRFOIL AT LARGE ANGLES OF ATTACK Abstract Only
 V. N. GOLUBKIN *In its* USSR Rept.: Eng. and Equipment (JPRS-UEQ-85-003) p 9 12 Mar. 1985 Transl. into ENGLISH from *Prikl. Mat. i Mekhan.* (Moscow), v. 48, no. 3, May - Jun. 1984 p 376-382
 Avail: NTIS HC A06

The thin shock layer method is employed to investigate a previously unknown flow mode about a triangular airfoil with angles of attack close to $\pi/2$. A formulation is given for the flow problem, and analytical expressions are derived for the gas dynamic functions, as well as equations which connect the shape of the wing surface and the shock wave. The method is presented for solving inverse problems of flow about solid airfoils with attached shock. A flow mode about a triangular wing is demonstrated in which the shock wave is attached to the apex of the wing, but which can be either attached or detached from the leading edge. Author

N85-22793# Joint Publications Research Service, Arlington, Va.
ABSOLUTE STABILITY OF UNSTEADY MOVEMENT OF AXISYMMETRICAL ROTATING FLIGHT VEHICLE Abstract Only
 V. I. SKORODINSKIY *In its* USSR Rept.: Eng. and Equipment (JPRS-UEQ-85-003) p 9 12 Mar. 1985 Transl. into ENGLISH from *Izv. Akad. Nauk SSSR: Mekhan. Tverdogo Tela* (Moscow), no. 3, May - Jun. 1984 p 17-21
 Avail: NTIS HC A06

Linear-rectilinear horizontal flight movement of an axisymmetrical rotating finned flight vehicle in air is examined. Unsteady flow about the vehicle is taken into account, as well as Magnus-type effects due to the fins and the rotation about the axis of symmetry. The problem is solved by methods from the theory of absolute stability. A necessary and sufficient condition for the absolute stability of unsteady movements is identified. The complete region of absolute stability obtained is larger than the region found with the help of the Yakubovich criterion. The assumption of an unsteady flow is found to have no effect on the stability of the class of constrained movements of an axisymmetrical rotating flight vehicle examined, indicating that it is necessary and sufficient to examine only steady-state movements within that class in order to investigate the asymptotic stability of the entire class of unsteady movements. Author

N85-23699 Colorado Univ., Boulder.
THE UNSTEADY BOUNDARY LAYER ON AN ELLIPTIC CYLINDER FOLLOWING THE IMPULSIVE ONSET OF TRANSLATIONAL AND ROTATIONAL MOTION Ph.D. Thesis
 D. F. BILLINGS 1984 146 p
 Avail: Univ. Microfilms Order No. DA8428635

For dynamic stall unsteadiness and delayed flow separation are essential. The fluid motion about an elliptic cylinder impulsively set into translational and rotational motion is studied by the method of matched asymptotic expansions for small times and large Reynolds number. Streamlines vorticity contours, and turning point diagrams marking the appearance and spread of reverse flow over the surface are generated and compared for various initial angles of attack and rates of rotation. A significant delay in the appearance of the leading edge separation bubble is found. The pressure distribution, and moment coefficients are calculated. Although in general these are dominated by the effects of the impulsive start, surprising variation with initial angle of attack, rotation rate, and location of the rotation leads to speculation on whether or not quite impulsive starting effects might be used by flying insects. Dissert. Abstr.

02 AERODYNAMICS

N85-23701*# National Aeronautics and Space Administration, Washington, D. C.

OSCILLATING AIRFOILS AND THEIR WAKE

W. SEND Apr. 1985 17 p refs Transl. into ENGLISH from "Schwingende Tragflaechen und ihr Nachlauf" rept. 42 DVFLR, Goettingen, West Germany, Jun. 1984 p 13-18 Original language document was announced in IAA as A84-42570 Transl. by The Corporate Word, Inc., Pittsburgh (Contract NASW-4006) (NASA-TM-77831; NAS 1.15:77831; REPT-42) Avail: NTIS HC A02/MF A01 CSCL 01A

The unsteady phenomena in the wake of an oscillating wing or rotor blade are examined theoretically using the Prandtl approximation of the vortex-transport equation. A mathematical model is developed and applied to such problems as the effect of winglets on the performance of fixed wings and the possibility of employing similar designs in rotor blades. Model predictions for several profiles are compared with published and experimental measurements, and good agreement is found. Graphs and diagrams are provided. Author

N85-23702*# Grumman Aerospace Corp., Bethpage, N.Y.

F-14A AIRCRAFT HIGH-SPEED FLOW SIMULATIONS

C. W. BOPPE and B. S. ROSEN Apr. 1985 204 p refs (Contract NAS1-14732) (NASA-CR-172559; NAS 1.26:172559) Avail: NTIS HC A10/MF A01 CSCL 01A

A model of the Grumman/Navy F-14 aircraft was developed for analyses using the NASA/Grumman Transonic Wing-Body Code. Computations were performed for isolated wing and wing fuselage glove arrangements to determine the extent of aerodynamic interference effects which propagate outward onto the main wing outer panel. Additional studies were conducted using the full potential analysis, FLO 22, to calibrate any inaccuracies that might accrue because of small disturbance code limitations. Comparisons indicate that the NASA/Grumman code provides excellent flow simulations for the range of wing sweep angles and flow conditions that will be of interest for the upcoming F-14 Variable Sweep Flight Transition Experiment. Author

N85-23703*# Notre Dame Univ., Ind. Dept. of Aerospace and Mechanical Engineering.

THE STRUCTURE OF SEPARATED FLOW REGIONS OCCURRING NEAR THE LEADING EDGE OF AIRFOILS, INCLUDING TRANSITION Semiannual Status Report, Nov. 1984 - Apr. 1985

T. J. MUELLER Apr. 1985 30 p refs (Contract NSG-1419) (NASA-CR-175670; NAS 1.26:175670) Avail: NTIS HC A03/MF A01 CSCL 01A

The structure and behavior of the separation bubble including transition and the redeveloping boundary layer after reattachment over an airfoil at low Reynolds numbers was studied. The intent is to further the understanding of the complex flow phenomena so that analytic methods for predicting their formation and development can be improved. These analytic techniques have applications in the design and performance prediction of airfoils operating in the low Reynolds number flight regime. G.L.C.

N85-23704*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

ESTIMATING UNSTEADY AERODYNAMIC FORCES ON A CASCADE IN A THREE-DIMENSIONAL TURBULENCE FIELD

T. NORMAN and W. JOHNSON Mar. 1985 31 p refs (NASA-TM-86701; A-85166; NAS 1.15:86701) Avail: NTIS HC A03/MF A01 CSCL 01A

An analytical method has been developed to estimate the unsteady aerodynamic forces caused by flow field turbulence on a wind tunnel turning vane cascade system (vane set). This method approximates dynamic lift and drag by linearly perturbing the appropriate steady state force equations, assuming that the dynamic loads are due only to free stream turbulence and that this turbulence is homogeneous, isotropic, and Gaussian.

Correlation and unsteady aerodynamic effects are also incorporated into the analytical model. Using these assumptions, equations relating dynamic lift and drag to flow turbulence, mean velocity, and vane set geometry are derived. From these equations, estimates for the power spectra and rms (root mean squared value, delta) loading of both lift and drag can be determined. Author

N85-23705*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

BIFURCATION THEORY APPLIED TO AIRCRAFT MOTIONS

W. H. HUI (Waterloo Univ., Ontario) and M. TOBAK Mar. 1985 17 p refs (Contract NAGW-575) (NASA-TM-86704; REPT-85171; NAS 1.15:86704) Avail: NTIS HC A02/MF A01 CSCL 01A

Bifurcation theory is used to analyze the nonlinear dynamic stability characteristics of single-degree-of-freedom motions of an aircraft or a flap about a trim position. The bifurcation theory analysis reveals that when the bifurcation parameter, e.g., the angle of attack, is increased beyond a critical value at which the aerodynamic damping vanishes, a new solution representing finite-amplitude periodic motion bifurcates from the previously stable steady motion. The sign of a simple criterion, cast in terms of aerodynamic properties, determines whether the bifurcating solution is stable (supercritical) or unstable (subcritical). For the pitching motion of a flap-plate airfoil flying at supersonic/hypersonic speed, and for oscillation of a flap at transonic speed, the bifurcation is subcritical, implying either that exchanges of stability between steady and periodic motion are accompanied by hysteresis phenomena, or that potentially large aperiodic departures from steady motion may develop. On the other hand, for the rolling oscillation of a slender delta wing in subsonic flight (wing rock), the bifurcation is found to be supercritical. This and the predicted amplitude of the bifurcation periodic motion are in good agreement with experiments. Author

N85-23706*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

HOVER TEST RESULTS OF A SMALL-SCALE TWIN-TILT NACELLE MODEL

S. B. SCHMIDT Mar. 1985 29 p refs (NASA-TM-86665; REPT-85061; NAS 1.15:86665) Avail: NTIS HC A03/MF A01 CSCL 01A

Characteristics in hover of an 11/36%-scale, powered, twin-tilt nacelle model were measured in the NASA Ames Research Center's 40- by 80-Foot Wind Tunnel. The model was powered by two high-pressure air-driven turbofan propulsion simulators. The position of the sting-mounted model was fixed and a movable ground plane was used to vary ground height and orientation. Hover characteristics were investigated in and out of ground effect for roll angles of -2 deg to +14 deg and pitch angles of -15 deg to +10 deg. Results for the basic configurations are compared with data from hover tests of the full-scale tilt nacelle model. Two methods were investigated to increase vertical vane effectiveness: (1) extending the maximum vane deflection from 20 deg to 70 deg, and (2) adding a third vertical vane. The goal was to increase the roll-control capability to significantly reduce or balance the strong, unfavorable rolling moment created by the loss of one engine. Results indicate that the three-vertical-vane configuration is more effective than two vertical vanes and that extended vane deflections significantly reduce the engine-out roll in hover. Author

N85-23708*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

LOW-SPEED STABILITY AND CONTROL WIND-TUNNEL INVESTIGATIONS OF EFFECTS OF SPANWISE BLOWING ON FIGHTER FLIGHT CHARACTERISTICS AT HIGH ANGLES OF ATTACK

D. R. SATRAN, W. P. GILBERT, and E. L. ANGLIN May 1985 46 p refs

(NASA-TP-2431; L-15851; NAS 1.60:2431) Avail: NTIS HC A03/MF A01 CSCL 01A

The effects of spanwise blowing on two configurations representative of current fighter airplanes were investigated. The two configurations differed only in wing planform, with one incorporating a trapezoidal wing and the other a 60 delta wing. Emphasis was on determining the lateral-directional characteristics, particularly in the stall/departure angle-of-attack range; however, the effects of spanwise blowing on the longitudinal aerodynamics were also determined. The-tunnel tests included measurement of static force and forced-oscillation aerodynamic data, visualization of the airflow changes created by the spanwise blowing, and free-flight model tests. The effects of blowing rate, chordwise location of the blowing ports, asymmetric blowing, and blowing on the conventional aerodynamic control characteristics were investigated. In the angle-of-attack regions in which the spanwise blowing substantially improved the wing upper-surface flow field (i.e., provided reattachment of the flow aft of the leading-edge vortex), improvements in both static and dynamic lateral-directional stability were observed. Blowing effects on stability could be proverse or adverse depending on blowing rate, blowing port location, and wing planform. Free-flight model tests of the trapezoidal wing confirmed the beneficial effects of spanwise blowing measured in the static and dynamic force tests. A.R.H.

N85-23709*# Flow Simulations, Inc., Sunnyville, Calif.

COMPUTATIONS OF TWO-DIMENSIONAL AIRFOIL-VORTEX INTERACTIONS Final Report

G. R. SRINIVASAN Washington NASA May 1985 88 p refs

(Contract NAS2-11331)

(NASA-CR-3885; NAS 1.26:3885; FSI-84-01) Avail: NTIS HC A05/MF A01 CSCL 01A

A procedure for calculating the interaction of a vortex with a two dimensional airfoil in a uniform free stream is presented along with results for several test cases. A Lamb like analytical vortex having a finite core and convect in a uniform free stream interacts with the flowfield of NACA 0012 or NACA 64A006 airfoil in transonic and subsonic flow. Euler and thin layer Navier-Stokes solutions are computed and the results are compared with the results from transonic small disturbance code and available experimental results. For interactions within the limits of transonic small disturbance assumptions, the three methods gave qualitatively similar results of a two bladed helicopter rotor and suggest that the time lag effects of the free stream velocity approaching the blade may be important and should be considered in the analysis. In general, the results show a tremendous influence of the interacting vortex on the flowfield around the airfoil. This is particularly true when the vortex is stationary. For a convecting vortex, the most dramatic changes in the flowfield seem to occur when the vortex is within one chord of the airfoil. A.R.H.

N85-23710*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

RECENT TRANSONIC UNSTEADY PRESSURE MEASUREMENTS AT THE NASA LANGLEY RESEARCH CENTER

M. C. SANDFORD, R. H. RICKETTS, and R. W. HESS Apr. 1985 21 p refs Presented at the 2nd Intern. Symp. on Aeroelasticity and Struct. Dyn., Aachen, 1-3 Apr. 1985

(NASA-TM-86408; NAS 1.15:86408; PAPER-85-23) Avail: NTIS HC A02/MF A01 CSCL 01A

Four semispan wing model configurations were studied in the Transonic Dynamics Tunnel (TDT). The first model had a clipped delta planform with a circular arc airfoil, the second model had a

high aspect ratio planform with a supercritical airfoil, the third model has a rectangular planform with a supercritical airfoil and the fourth model had a high aspect ratio planform with a supercritical airfoil. To generate unsteady flow, the first and third models were equipped with pitch oscillation mechanisms and the first, second and fourth models were equipped with control surface oscillation mechanisms. The fourth model was similar in planform and airfoil shape to the second model, but it is the only one of the four models that has an elastic wing structure. The unsteady pressure studies of the four models are described and some typical results for each model are presented. Comparison of selected experimental data with analytical results also are included.

Author

N85-23712# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Inst. fuer Experimentelle Stroemungsmechanik.

BOUNDARY LAYER CONTROL BY TRANSITION FIXING

Sep. 1984 145 p refs Partly in ENGLISH and GERMAN Proc. of DGLR-Fachausschusses Versuchswesen der Fluid- u. Thermodyn., Berlin, 24-25 Nov. 1983 Report will also be announced as translation (ESA-TT-909)

(DFVLR-MITT-84-17; ISSN-0176-7739; AD-B088413L) Avail: NTIS HC A07/MF A01; DFVLR, Cologne DM 39

Application of wind tunnel results to aerodynamic performance of large aircraft is treated. Boundary layer transition control for takeoff and landing configurations; transition fixing for transonic transport-type aircraft configurations; transition fixing in the high speed range for the development of civil aircraft wings; and transition fixing on wings in industrial wind tunnels are discussed. The influence of transition strips on the pressure distribution on transonic profiles; and the development of an artificial boundary layer for different outlet flows are presented. The conditions for tripping transition with roughness elements and their influence on boundary layer development are discussed. Transition fixing and simulation of high Reynolds number flow at transonic velocities are treated. Transition detection using surface pressure holes, and the detection of boundary layer transitions by wall shear stress and wall pressure fluctuation measurements are discussed.

N85-23713# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (West Germany). Unternehmensbereich Transport- und Verkehrsflugzeuge.

PROBLEMS OF THE APPLICATION OF WIND TUNNEL RESULTS TO AERODYNAMIC PERFORMANCE OF LARGE AIRCRAFT [PROBLEME DER UEBERTRAGUNG VON WINDKANAL-ERGEBNISSEN AUF DIE AERODYNAMISCHEN LEISTUNGEN DER GROSSFLUGZEUGE]

R. HILBIG In DFVLR Boundary Layer Control by Transition Fixing p 9-17 1924 In GERMAN

Avail: NTIS HC A07/MF A01

The utilization of unambiguous, reproducible wind tunnel results as a basis for the prediction of large aircraft performances and properties under flight conditions is discussed. It is shown that unambiguous wind tunnel results are absolutely required in the different aircraft development phases. This unambiguity is only possible with a transition fixing which is demonstrated to be laminar-turbulent. The boundary layer falsification by size and position and the fixing measures has to be minimized. This leads to requirements for the minimum Reynolds number domain that has to be reached in the wind tunnel. Additional experimental information about the boundary layer development under three-dimensional conditions and about the blow-away field are necessary to improve the numerical-experimental method to apply wind tunnel results to flight conditions. Author (ESA)

02 AERODYNAMICS

N85-23714# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (West Germany). Unternehmensbereich Transport- und Verkehrsflugzeuge.

BOUNDARY LAYER TRANSITION CONTROL FOR TAKEOFF AND LANDING CONFIGURATIONS [GRENZSCHICHT-UMSCHLAGSTEUERUNG FUER STARTUNG-UND LANDE-KONFIGURATIONEN]

H. P. FRANZ *In* DFVLR Boundary Layer Control by Transition Fixing p 19-31 1924 refs *In* GERMAN

Avail: NTIS HC A07/MF A01

Wind tunnel test results were scaled to predict aircraft performance at low speed phases, taking into account Reynolds number effects. A possibility to define scaling laws is to fix the boundary layer transition from laminar to turbulent spatially in the model by artificial surface roughness. The boundary layer transition control has to be demonstrated by preliminary tests. The practical realization of surface roughness taking into account the required Mach-Reynolds combination and lift value is discussed. The method allows scaling to large aircraft of project-aerodynamic performance prediction. Author (ESA)

N85-23715# National Aerospace Lab., Amsterdam (Netherlands).

EXPERIENCES WITH TRANSITION FIXATION IN THE HIGH-SPEED REGIME AT NLR

A. ELSENAAR *In* DFVLR Boundary Layer Control by Transition Fixing p 33-54 1924

Avail: NTIS HC A07/MF A01

Transition fixing for transonic transport-type aircraft configurations is discussed. The use of wind tunnel measurements for flight prediction is explained, and practical problems of the fixing technique are discussed. Tests with free transition are qualitatively not representative for full scale. In order to predict flight conditions, extrapolation of Reynolds number trends is preferred; the aft-fixing technique is complementary when separations are expected at (low) tunnel Reynolds numbers. Author (ESA)

N85-23716# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (West Germany). Unternehmensbereich Transport- und Verkehrsflugzeuge.

TRANSITION FIXING IN THE HIGH SPEED RANGE FOR THE DEVELOPMENT OF CIVIL AIRCRAFT WINGS [TRANSITIONSFIXIERUNG IM HOCHGESCHWINDIGKEITSBEREICH BEI DER FLUEGELENTWICKLUNG FUER ZIVILE FLUGZEUGE]

W. BURGSMUELLER *In* DFVLR Boundary Layer Control by Transition Fixing p 55-79 Sep. 1984 *In* GERMAN

Avail: NTIS HC A07/MF A01

Boundary layer transition fixing for the prediction of Airbus performance is discussed. Comparative measurements were conducted on competing aircraft. The effects of strip position and grain size on transition fixing are presented. The Delta method is used to determine the difference between wind tunnel tests and flight tests. The method to predict aircraft performances based on wind tunnel tests is explained. The presented fixing technique is very time consuming. Comparison between wing profiles are possible under certain conditions. The scaling by the Delta method provides usable results. Author (ESA)

N85-23717# Office National d'Etudes et de Recherches Aeronautiques, Paris (France).

TRANSITION FIXING ON WINGS IN INDUSTRIAL WIND TUNNELS AND ASSOCIATED PROBLEMS [UMSCHLAGFIXIERUNG AM TRAGFLUEGEL IN INDUSTRIEWINDKANALEN UND DAMIT BEHAFTETE PROBLEME]

V. SCHMITT *In* DFVLR Boundary Layer Control by Transition Fixing p 81-87 Sep. 1984 refs *In* GERMAN

Avail: NTIS HC A07/MF A01

A method for transition fixing on wings, based on the utilization of carborundum strips to produce an homogeneous turbulent boundary layer is presented. The choice of strip position and grain

size is explained. The transition is visualized by thermography using an IR camera. The influence of the transition fixing is demonstrated. Problems in scaling the simulation results for high Reynolds numbers to large aircraft are discussed. Author (ESA)

N85-23718# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Entwurfsaerodynamik.

THE INFLUENCE OF TRANSITION STRIPS ON THE PRESSURE DISTRIBUTION ON TRANSONIC PROFILES [DER EINFLUSS VON TRANSITIONSTREIFEN AUF DIE DRUCKVERTEILUNG BEI TRANSSONISCHEN PROFILEN]

R. MUELLER *In* its Boundary Layer Control by Transition Fixing p 89-99 Sep. 1984 refs *In* GERMAN

Avail: NTIS HC A07/MF A01

Transonic wind tunnel tests were performed to determine the influence of transition strips on pressure distribution. Measurements were performed on three transport aircraft profiles, covering the Mach number range from 0.70 to 0.80. The transition strips are produced with Korund grain 22.0k according to the DFVLR-TWB standard method and have a width of 1% of the model profile depth. The influence of the strips on the upper surface of the profile is extremely large, even far downstream, and also for high Reynolds numbers. The influence on the lower surface in the rear loading domain strongly decreases for high Reynolds numbers. The Reynolds number effect in free transition is orders of magnitude lower. At constant Reynolds number an increasing Mach number enhances the influence on the rear loading of the lower surface. The influence of the strips on the pressure distribution is shown for several cases. Author (ESA)

N85-23720# Office National d'Etudes et de Recherches Aeronautiques, Toulouse (France). Dept. of Aerothermodynamics. **INVESTIGATION OF THE CONDITIONS FOR TRIPPING TRANSITION WITH ROUGHNESS ELEMENTS AND THEIR INFLUENCE ON BOUNDARY LAYER DEVELOPMENT**

R. MICHEL and D. ARNAL *In* DFVLR Boundary Layer Control by Transition Fixing p 103-113 1924

Avail: NTIS HC A07/MF A01

Boundary layer tripping with transverse wires or carborundum bands, in zero and nonzero pressure gradients, was experimentally studied using a flat plate in incompressible flow, for a great number of tripping devices. It appears that high turbulence intensities are not created on the roughness itself, but rather in the downstream separated region. The critical grain size required for fixing transition at the roughness location is plotted. Increasing the grain size produces an overthickness of the boundary layer due to the roughness drag. The drag coefficient increases when the roughness height is larger than the boundary layer thickness. Similar results are obtained in negative and positive pressure gradients. Applications on wing profiles in incompressible and compressible flows are presented. Author (ESA)

N85-23721# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Inst. fuer Experimentelle Stroemungsmechanik.

TRANSITION FIXING AND SIMULATION OF HIGH REYNOLDS NUMBER FLOW AT TRANSONIC VELOCITIES

E. STANEWSKY *In* its Boundary Layer Control by Transition Fixing p 115-129 Sep. 1984 refs

Avail: NTIS HC A07/MF A01

The simulation of two-dimensional high Reynolds flow was investigated. Airfoil tests up to relatively high Reynolds numbers, using airfoils of various sensitivities to Reynolds number changes, show that the initial displacement thickness has a dominant influence on the flow development about transonic airfoils. The duplication of the initial displacement thickness seems adequate to simulate high Reynolds number flow with shock waves, at least for free stream conditions without excessive separated regions. The possible errors associated with such a simulation and the simultaneous simulation of all aerodynamic parameters are considered. This simulation seems to be applicable to separated

flow. It is concluded that the method allows simulation of two-dimensional high Reynolds number flow. Author (ESA)

N85-23725# Naval Ship Research and Development Center, Bethesda, Md. Aviation and Surface Effects Dept.
LOW-SPEED CHARACTERISTICS OF A CIRCULATION CONTROL AIRFOIL WITH AFT CAMBER AND A SPIRAL TRAILING EDGE Final Report

J. ABRAMSON Dec. 1984 41 p
(AD-A150851; DTNSRDC/ASED-84/07) Avail: NTIS HC A03/MF A01 CSCL 20D

A circulation control elliptic airfoil section with a 15-percent thickness-to-chord ratio which incorporates a spiral trailing edge was evaluated subsonically to determine its aerodynamic characteristics. The spiral-shaped Coanda surface was previously evaluated with a different leading edge. The airfoil, designated NCCR 1505-7567S, has an uncambered forward half and a cambered aft portion resulting in a 0.005-percent camber for the profile. This particular combination of camber was selected because it was analytically predicted to have good critical Mach number characteristics in the range of interest. The range of momentum coefficient was limited due to the relatively early onset of Coanda jet-tunnel floor interference; however, lift coefficients in the excess of 4.25 were produced at momentum coefficients of 0.16. Equivalent lift-to-drag ratios in excess of 40 were also produced when lift coefficient reached approximately 1.0. GRA

N85-23726# Institut Franco-Allemand de Recherches, St. Louis (France).

INVESTIGATION OF THE TURBULENT SEPARATED FLOW BEHIND A SPOILER [UNTERSUCHUNG DER TURBULENTEN ABGEOESTEN STROEMUNG HINTER EINEM SPOILER]

P. MEYER, G. KOERBER, and B. C. JAEGGY 15 Nov. 1983 28 p refs In GERMAN Presented at 4th DGLR Fachsymp. ueber Stroemungen mit Abloesung, Goettingen, West Germany, 10-12 Oct. 1983 Original contains color illustrations (Contract DRET-82/318) (ISL-CO-240/83) Avail: NTIS HC A03/MF A01

The flow around a wing profile equipped with a spoiler was studied in a subsonic wind channel using two-dimensional laser anemometry. The profile is a supercritical RA16-SC1 wing with a spoiler at the upper side, the angle of attack of which can be 10, 20, and 40 deg. The Reynolds number determined with the profile depth is 400,000. For comparison measurements are also conducted without spoiler. The average values of the velocity components, the turbulent quantities, and the turbulent shear stress are determined with the laser anemometer. For each spoiler angle of attack, the aerodynamic field around the wing is determined by 40 to 60 velocity and fluctuation profiles. The pressure coefficients are determined by 78 pressure measurement points in the profile.

Author (ESA)

N85-23727# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Abt. Aeroelastik bei abgeloester Stroemung.

INVESTIGATION OF THE AERODYNAMIC FORCES ON BLUFF BODIES AT HIGH REYNOLDS NUMBERS Final Report

G. SCHEWE Nov. 1984 33 p refs In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-914)

(Contract DFG-FO-84/6; DFG-FO-84/7; DFG-FO-85/8-3; DFG-FO-84/8-4) (DFVLR-MITT-84-19; ISSN-0176-7739) Avail: NTIS HC A03/MF A01; DFVLR, Cologne DM 13

Steady and unsteady forces acting on a circular cylinder, a square-section cylinder and an H-profile (Tacoma Bridge) were investigated in a pressurized wind tunnel (very high Reynolds numbers). The forces were measured by a piezo-multicomponent balance, with a large dynamic range, low interference and a high natural frequency. The Reynolds number (Re) range between 20,000 and 7 million is investigated with the same circular cylinder and balance by varying flow velocity and air density. In the critical Reynolds number range, bistable asymmetric flow states are

observed, which can be controlled by a very small perturbation. The investigation of the square section reveals no strong Reynolds number effects in the range Re between 100,000 and 4 million. The Tacoma profile is shown to be aeroelastically unstable in torsion mode. Author (ESA)

N85-24107# Joint Publications Research Service, Arlington, Va.
EFFECT OF DRAG BEHIND NOZZLE ARRAY ON ITS FORCE AND ENERGY CHARACTERISTICS Abstract Only

D. N. PYASIK and M. S. KOLOMIYETS In its USSR Rept.: Eng. and Equipment (JPRS-UEQ-84-001) p 71-72 9 Feb. 1984 Transl. into ENGLISH from Energomashinostroyeniye (Moscow), no. 6, Jun. 1983 p 10-11
Avail: NTIS HC A06

The effect of drag behind a straight nozzle array of an air turbine on the velocity distribution and thus on the forces and moment at a section of a tilted guide vane was measured with a set of three elastic strain gauges deflecting proportionally to the aerodynamic forces, axial and circumferential, and to the twisting moment respectively. The experiment was performed with an N-4 linear array of 11 uniformly spaced nozzle blades and a cylindrical rod (shaft) with guide vanes movable closer to or farther from the array, at the nozzle exit. These experimental data and theoretical relations were used to determine the dependence of the axial force, the circumferential force, and the twisting moment on the shaft displacement, the dependence of the distance from the lines of action of both forces to the axis of the vane suspension system on the blading form factor, and the dependence of the integral velocity factor and of the stream exit angle on the form factor.

B.W.

N85-24110# Joint Publications Research Service, Arlington, Va.
STABILITY OF VORTEX STRUCTURES DURING SEPARATION FLOW PAST ARRAY OF WINGS Abstract Only

A. A. KARASK, S. M. LOMOV, and M. I. NISHT In its USSR Rept.: Eng. and Equipment (JPRS-UEQ-84-001) p 73 9 Feb. 1984 Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 272, no. 6, Oct. 1983 p 1318-1321
Avail: NTIS HC A06

The useful separation effect, formation of promontory vortices at the front edge of wings, provides useful suction for an aircraft. A study was made concerning the stability of such a vortex structure in an air stream during flow past an array of two thin delta wings with the same small aspect ratio, both wings remaining always in parallel planes as their angle of attack varies and the one ahead simulating a tail. In the theoretical part the problem was analyzed numerically on a computer, with the aspect ratio of both wings varied and their relative position varied widthwise and heightwise. In the experimental part the pattern of vortex formation and collapse in a semiopen subsonic wind tunnel with a bilateral Euler chamber was visualized by the shadow method, with an IAB-451 instrument using a cruciform knife edge and a cruciform slit. The results indicate that interaction of vortices at one wing with those at the other tends to improve the stability of both vortex arrays as the angle of attack becomes so large that vortices at one wing alone would become unstable.

B.W.

N85-24179# Joint Publications Research Service, Arlington, Va.
PROBLEM OF REDUCTION TO IDEAL TUBE IN EXPERIMENTAL AERODYNAMICS Abstract Only

N. N. YANENKO, Y. Y. VOSKOBOYNIKOV, and N. G. PREOBRAZHENSKIY In its USSR Rept.: Eng. and Equipment (JPRS-UEQ-84-005) p 44 19 Jul. 1984 Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 274, no. 6, Feb. 1984 p 1209-1312
Avail: NTIS HC A04

A linearized statement of the problem of eliminating the spread function (reduction to ideal tube) in measuring the amplitude of pulsations of a turbulent flow is examined. Regularization methods are used to eliminate the distorting influence of the spread function of the aerodynamic tube and to solve the problem of reduction to an ideal tube when investigating the distribution density of amplitude pulsations of a turbulent flow. Author

03 AIR TRANSPORTATION AND SAFETY

03

AIR TRANSPORTATION AND SAFETY

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

A85-30358#

A DYNAMIC TIRE/SOIL CONTACT SURFACE INTERACTING MODEL FOR AIRCRAFT GROUND OPERATIONS

W. S. PI (Northrop Corp., Aircraft Div., Hawthorne, CA) IN: Structures, Structural Dynamics, and Materials Conference, 26th, Orlando, FL, April 15-17, 1985, Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, 1985, p. 321-329. Research supported by the Northrop Independent Research and Development Program. refs
(AIAA PAPER 85-0708)

The present dynamic soil/tire contact surface interaction model for aircraft ground operations uses a finite element kernel function approach and is based on the quasi-steady motion of constant speed rolling on a linear viscoelastic layer representing the soil. Because the soil model treats the Young's modulus, Poisson's ratio, and shear modulus as three independent parameters, and inertia and viscous damping effects are included, the contact pressure distribution, soil deformation pattern, and tire footprint area shape can be predicted. Numerical examples are given whose predicted drag ratio vs. speed values compare well with test data trends for various soil properties. All soil parameters play significant roles in soil characteristic and response determination. O.C.

A85-30422

USAF R&D EXPERIENCE WITH ENCLOSED ESCAPE SYSTEMS

J. M. PETERS (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, OH) SAFE Journal, vol. 15, Spring 1985, p. 4-10.

The purpose of this paper is to examine USAF R&D efforts involving encapsulated seats and escape capsules and to identify areas of potential improvements in light of today's escape system technologies. The major attributes of enclosed escape systems are the potential for increased crew performance while operating in a 'shirt sleeve' environment, protection from windblast, and temperature extremes, expanded escape envelope in the high speed and high altitude regions, and improved survival when landing in water. Some deficiencies of enclosed escape systems are longer times to parachute inflation that reduce the low altitude recovery capability, higher landing impact forces, higher aircraft weight penalty, and higher life cycle costs. Author

A85-31774

A MINIMUM-EXPOSURE, MINIMUM-ELEVATION MILITARY AIRCRAFT HEURISTIC ROUTE SELECTION MODEL

M. J. DORSETT (U.S. Army, Missile Command, Redstone Arsenal, AL) and R. M. WYSKIDA (Alabama, University, Huntsville, AL) Applied Mathematical Modelling (ISSN 0307-904X), vol. 9, April 1985, p. 131-138. refs

The present investigation is concerned with an heuristic method for selecting a minimum-exposure, minimum-elevation route for the flight of a terrain following aircraft through defended terrain. Aspects regarding the given tactical scenario are discussed, taking into account the location of the air defense sites, the task for the attacker to select a route which maximizes his probability of reaching the target, models employed to evaluate the tactical situation, factors related to sensor coverage, terrain data, procedures used in model development, questions of model validation, small area analysis, and large area analysis. G.R.

A85-31968#

CIVIL CERTIFICATION OF A U.S. GOVERNMENT PROCURED HELICOPTER

J. C. HART (Aerospatiale Helicopter Corp., Grand Prairie, TX) IN: American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Proceedings. Alexandria, VA, American Helicopter Society, 1984, p. 203-205.

In June 1979, the U.S. Coast Guard awarded to an aerospace company a contract for the production of 90 helicopters to replace the aging H-52. This new helicopter, the HH-65A, would be used in the Short Range Recovery rescue role which includes such objectives as drug interdiction, fishing law enforcement, and coastal patrol. The new helicopter was to be qualified according to both military and civil standards. In connection with these qualifications, it was found that with respect to certain items a conflict exists between the desires of the Coast Guard and the regular requirements of the Federal Aviation Agency (FAA). Difficulties arising in connection with the attempt to satisfy the various requirements are discussed, and the lessons learned are evaluated. G.R.

A85-31981#

NEW MODEL INTRODUCTION - THE OPERATORS' PERSPECTIVE

D. A. FORD (Bell Helicopter Textron, Customer Support and Service Div., Fort Worth, TX) IN: American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Proceedings. Alexandria, VA, American Helicopter Society, 1984, p. 319-323.

During the design and introduction of a new model helicopter, it is crucial to the survival of that model for the manufacturer to focus on the needs of the operator. This paper presents a case history of Bell Helicopter's most recent new model introduction, the Model 214ST Super Transport. With the aid of a little hindsight, specific actions taken are examined to determine if the requirements of the operator were in fact met. Particular emphasis is placed on the changing operator profile over the last decade and through the remainder of the 1980s. Author

A85-31995#

DESIGN CONSIDERATIONS FOR HELICOPTER EFFECTIVENESS IN AIR-TO-AIR COMBAT

D. DELONG (United Technologies Corp., Sikorsky Aircraft Div., Stratford, CT) and W. B. HERBST (Messerschmitt-Boelkow-Blohm GmbH, Munich, West Germany) IN: American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Proceedings. Alexandria, VA, American Helicopter Society, 1984, p. 471-480.

In tomorrow's battles, helicopters will play a key role. However, in performing their various functions, helicopters will also face an increasingly powerful threat. Such a threat is represented by well-armed, high-speed hostile helicopters with turreted guns, command-guided missiles, and rockets. The present study is concerned with the approaches required to make the helicopter effective for combat with enemy aircraft. Attention is given to the win factors for air-to-air combat, measures of effectiveness, an escort scenario, an attack interceptor scenario, a design for maneuverability and agility, helicopter missile options, search and acquisition systems, an evaluation methodology, a sample engagement run with a helicopter air combat model, and aspects of validation and verification. G.R.

A85-32591#

RECENT DATA FROM THE AIRLINES LIGHTNING STRIKE REPORTING PROJECT

J. A. PLUMER (Lightning Technologies, Inc., Pittsfield, MA), N. O. RASCH, and M. S. GLYNN (FAA, Technical Center, Atlantic City, NJ) Journal of Aircraft (ISSN 0021-8669), vol. 22, May 1985, p. 429-433. Previously cited in issue 03, p. 5, Accession no. A85-13513.

A85-33278*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

TIME SCHEDULING OF A MIX OF 4D EQUIPPED AND UNEQUIPPED AIRCRAFT

L. TOBIAS (NASA, Ames Research Center, Moffett Field, CA)
IN: Conference on Decision and Control, 22nd, San Antonio, TX, December 14-16, 1983, *Proceedings. Volume 1*. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, p. 483-488. Previously announced in STAR as N83-19721. refs

In planning for a future automated air traffic system, it is necessary to confront the transition situation in which some percentage of the traffic must be handled by conventional means. A safe, efficient transition system is needed since initially not all aircraft will be able to respond to a more automated system. The specific problem addressed was that of time scheduling a mix of 4D-equipped aircraft (aircraft that can accurately meet a controller specified time schedule at selected way points in the terminal area) when operating in conjunction with unequipped aircraft (aircraft that require air traffic handling by means of standard vectoring techniques). First, a relationship between time separation and system capacity was developed. The time separations were incorporated into a set of scheduling algorithms which contain the required elements of flexibility needed for terminal-area operation, such as delaying aircraft and changing time separations. The problem of reducing the size of time separations allotted for vectored aircraft by means of computer assists to the controller was also addressed. B.G.

N85-22374# Ametek, Santa Barbara, Calif. Offshore Research and Engineering Div.

AIRCRAFT SKIN PENETRATOR AND AGENT APPLICATOR. VOLUME 1: WORKING MODEL DEVELOPMENT AND CONSTRUCTION Final Report, 17 Sep. 1982 - 15 Mar. 1983

R. H. CUTHBERTSON Tyndall AFB, Fla. AF Engineering and Services Center Nov. 1984 64 p
(Contract F08635-82-C-0472)
(AD-A150498; AFESC/ESL-TR-84-12) Avail: NTIS HC A04/MF A01 CSCL 01B

This report covers development of an aircraft skin penetrator device to provide rapid penetration and allow placement of a suitable fire-suppressing agent onto the base of the aircraft fire. Volume 1 discusses in detail the research conducted on the development of the proposed working model of the Aircraft Skin Penetrator/Agent Applicator. The report contains photographs of the different concepts considered. Volume 2 has detailed drawings showing the construction of the working model Penetrator and sketches which show how the Penetrator may be used to fight aircraft fires. GRA

N85-23690# Joint Publications Research Service, Arlington, Va.
1ST DEPUTY MINISTER ON CIVIL AVIATION SUPPORT OF ECONOMY

M. KASHEVNIK *In its* USSR Rept.: Transportation (JPRS-UTR-85-005) p 7-9 25 Mar. 1985 Transl. into ENGLISH from Sov. Rossiya (Moscow), 3 Feb. 1985 p 2
Avail: NTIS HC A05/MF A01

An interview with the U.S.S.R. first deputy minister of civil aviation is given. The effect of civil aviation on the overall national economy is discussed. New aircraft being entered into the national airline is also discussed. E.R.

N85-23693# Joint Publications Research Service, Arlington, Va.
IMPROVEMENTS IN PERSONNEL NEEDED FOR BETTER FLIGHT SAFETY

Y. KOLESNIKOV *In its* USSR Rept.: Transportation (JPRS-UTR-85-005) p 17-20 25 Mar. 1985 Transl. into ENGLISH from Vozdushny Transport (Moscow), 24 Jan. 1985 p 2
Avail: NTIS HC A05/MF A01

Flight safety is that generalized indicator in accordance with which the level of professional skill is evaluated along with the quality of training of flight controller, and engineering and technical personnel. The status of organized operation and discipline in

flight subunits, in the traffic services, and in the technical maintenance services of air maintenance bases is also evaluated. The ground services and the effectiveness of organizational and political education work in a collective is reviewed. Author

N85-23729*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

PROCEEDINGS: SEVENTH ANNUAL WORKSHOP ON METEOROLOGICAL AND ENVIRONMENTAL INPUTS TO AVIATION SYSTEMS Final Report

D. W. CAMP, ed., W. FROST, ed., and L. W. HERSHMAN, ed.
Apr. 1984 143 p refs Workshop held in Tullahoma, Tenn., 26-28 Oct. 1983 Previously announced in IAA as A85-18324 Prepared in cooperation with Tennessee Univ. Space Inst., Tullahoma
(Contract NAS8-36177)

(NASA-CP-2312; NAS 1.55:2312) Avail: NTIS HC A07/MF A01
Reports and recommendations resulting from the Workshop on Meteorological and Environmental Inputs to Aviation Systems are presented. The topics covered included winds and shear, turbulence, fog, visibility and ceiling, lightning and atmospheric electricity, icing, frost and snow, rain ozone and acid rain. The recommendations issued included a denser meteorological network with more automated stations, the development of radar systems for icing forecasts and wind shear alerts, the accumulation of a greater data base on convective cells and lightning strikes, and further study of the impact of rain on aircraft performance.

N85-23730*# Federal Aviation Administration, Washington, D.C. Weather Coordination Program Staff.

OVERVIEW OF METEOROLOGICAL INPUTS TO NASP

J. C. DZIUK *In* NASA. Marshall Space Flight Center Proc.: 7th Ann. Workshop on Meteorol. and Environ. Inputs to Aviation Systems p 13-16 Apr. 1984
Avail: NTIS HC A07/MF A01 CSCL 01C

The key elements of the present aviation weather system are reviewed and short and long term planned system improvements are described. Unmet information needs are also identified. Some of the near term activities include: revised pilot briefing procedures, Central Weather Service Unit directive revision, the radar remote weather display system program, enhanced Low Level Wind Shear Alert System, and Automated Weather Observation System demonstration. Long term programs include: the National Airspace Data Interchange network, central weather processor, next generation weather radar, and the mode-S data link. M.G.

N85-23734*# Federal Aviation Administration, Atlantic City, N.J.
OVERVIEW OF FAA'S AIRCRAFT ICING PROGRAM

L. CZEKALSKI *In* NASA. Marshall Space Flight Center Proc.: 7th Ann. Workshop on Meteorol. and Environ. Inputs to Aviation Systems p 26-29 Apr. 1984
Avail: NTIS HC A07/MF A01 CSCL 01C

The aircraft icing accident statistics which prompted the Federal Aviation Administration (FAA) to initiate an icing program are examined and some of the history of user needs is reviewed. The FAA icing program funding plan and research and development requirements are described. Atmospheric and aircraft performance characterization, analytical and simulation methods, certification criteria, and the development of an international data base are discussed. M.G.

N85-23735*# National Aeronautics and Space Administration, Washington, D. C.

OVERVIEW OF NASA'S PROGRAMS

A. R. TOBIASON *In* NASA. Marshall Space Flight Center Proc.: 7th Ann. Workshop on Meteorol. and Environ. Inputs to Aviation Systems p 30-35 Apr. 1985
Avail: NTIS HC A07/MF A01 CSCL 01C

The NASA programs which deal with the investigation of flight hazards and aviation meteorology are described. The major projects discussed include icing, clear and turbulence, fog, and landing systems. M.G.

03 AIR TRANSPORTATION AND SAFETY

N85-23736*# Coast Guard, Elizabeth City, N.C.
ADVERSE WEATHER IMPACT ON AVIATION SAFETY, INVESTIGATION AND OVERSIGHT

M. J. SMITH *In* NASA. Marshall Space Flight Center Proc.: 7th Ann. Workshop on Meteorol. and Environ. Inputs to Aviation Systems p 37-42 Apr. 1984

Avail: NTIS HC A07/MF A01 CSDL 01C

Flight experiences of Coast Guard personnel are related. Helicopter flight is emphasized and severe storm, winds, lightning, and icing conditions are discussed. M.G.

N85-23741*# Tennessee Univ. Space Inst., Tullahoma. Atmospheric Science Div.

LABORATORY MODEL OF FLIGHT THROUGH WIND SHEAR

W. FROST *In* NASA. Marshall Space Flight Center Proc.: 7th Ann. Workshop on Meteorol. and Environ. Inputs to Aviation Systems p 58-61 Apr. 1984

Avail: NTIS HC A07/MF A01 CSDL 01C

Techniques used to simulate an airplane flying through a downdraft, or microburst for a commercial television program are described. A model airplane was used for the demonstration. High speed photographs show the plane as it flies into the wind shear, loses lift, pitches up, and hits the ground. It is suggested that a microburst is a cold outflow moving down towards the ground and spreading out in all directions, but not perfectly symmetrically. A.R.H.

N85-23743# National Transportation Safety Board, Washington, D. C.

SAFETY RECOMMENDATION(S), A-84-65

9 Jul. 1984 3 p

(REPT-3908) Avail: NTIS HC A02/MF A01

On February 15, 1983, the captain of an Eastern Airlines Boeing 727-225, N8831E, made an international gear-up landing at Miami International Airport after the actuating system of the left main landing gear had malfunctioned following takeoff from the West Palm Beach Airport. The Safety Board's preliminary investigation of the incident disclosed that the tires of the left main landing gear were jammed in the wheel-well door, which prevented extension of the gear either normally or manually, and that the attachment fitting for the landing gear door actuator as loose enough to move laterally. Consequently, the Safety Board issued Safety Board Recommendation A-83-2 on March 4, 1983, for correction of this condition. G.L.C.

N85-23744# National Transportation Safety Board, Washington, D. C.

SAFETY RECOMMENDATION(S), A84-111 THROUGH -115

25 Oct. 1984 4 p refs

(REPT-4011C/27) Avail: NTIS HC A02/MF A01

At 1926, on November 24, 1983, Air Canada Flight 965, a Lockheed L-1011, C-FTNJ, encountered severe clear air turbulence about 105 miles off the coast of Charleston, South Carolina. One flight attendant and three passengers, seriously injured during the encounter, were treated immediately by two physicians aboard the flight. The flight continued to its destination and landed without further incident about 1 1/2 hours later. The METTA controller had been relieved of the responsibility of broadcasting SIGMETS under the terms of the FAA's Hazardous Inflight Weather Advisory Service (HIWAS). The flightcrew was not aware of a SIGMET 2 was in effect. The FAA Notice N 7110.658 directs that controllers at terminal and en route facilities discontinue broadcasting SIGMET information, and that FSS facilities discontinue broadcasting certain weather advisories and that SIGMET information be broadcast over selected very high frequency omni range (VOR) facilities instead. Recommendations are made to postpone implementation of HIWAS until broadcasting procedures are improved and information is widely disseminated and to designate communication frequencies within the 118 to 135 MHz band for each air traffic control center to broadcast. A.R.H.

N85-23745# National Transportation Safety Board, Washington, D. C.

SAFETY RECOMMENDATION(S), A-84-103

31 Aug. 1984 2 p

(REPT-3909B/101B) Avail: NTIS HC A02/MF A01

On May 28, 1983, Republic Airlines Flight 366, a DC-9-30, was on a scheduled passenger flight from Fresno, California, to Phoenix, Arizona, when the flightcrew determined en route that the airplane was nearly out of fuel. The fuel low-pressure warning light for the right engine illuminated and the fuel quantity transfer relay circuit breaker opened. After the flightcrew closed the circuit breaker, the fuel quantity gages indicated that the fuel tanks were nearly empty. The flight was landed safely about 20 miles short of the destination airport. Post incident calculations established that Flight 366 departed Fresno with about 7,000 pounds of fuel rather than 15,000 pounds indicated on the fuel quantity totalizer. It is recommended that the FAA require all carrier operations inspectors to make fuel awareness on the part of the flightcrews, including fuel consumption planning and familiarity with the functioning of the fuel system and its instrument, a subject of special attention during the inspectors' flight check and surveillance duties. A.R.H.

N85-23746# National Transportation Safety Board, Washington, D. C.

SAFETY RECOMMENDATION(S), A-84-93 THROUGH -95

15 Aug. 1984 6 p refs

(REPT-3983/33) Avail: NTIS HC A02/MF A01

About 0514 eastern standard time, on March 30, 1983, Central Airlines Flight 27, a Gates Learjet model 25, crashed during a landing attempt on runway 4 right at Newark International Airport, Newark, New Jersey. Flight 27 was operating as a nonscheduled cancelled bank check courier under 14 CFR Part 135. The airplane was destroyed on impact and the two pilots died as a result of the accident. The National Transportation Safety Board determined that the probable cause of the accident was: (1) loss of control following ground contact; (2) an unstabilized approach; and (3) likely impairment of the flightcrew's judgement, decisionmaking, and flying abilities by a combination of physiological and psychological factors. G.L.C.

N85-23747# Federal Aviation Administration, Washington, D.C. Office of Aviation Policy and Plans.

FAA AVIATION FORECASTS: FISCAL YEARS 1985-1996

Feb. 1985 108 p

(AD-A151050; FAA-APO-85-2) Avail: NTIS HC A06/MF A01 CSDL 01E

This report contains the Fiscal Years 1985-1996 Federal Aviation Administration (FAA) forecasts of aviation activity at FAA facilities. These include airports with FAA control towers, air route traffic control centers, and flight service stations. Detailed forecasts were made for the four major users of the national aviation system: air carriers, air taxi/commuters, general aviation and the military. The forecasts have been prepared to meet the budget and planning needs of the constituent units of the FAA and to provide information that can be used by state and local authorities, by the aviation industry and the general public. The overall outlook for the forecast period is for strong economic growth, relatively stable real fuel prices, and moderate inflation. Based upon these assumptions, aviation activity is forecast to increase by Fiscal Year 1996 by 62 percent at towered airports (commuters, 70 percent; air carrier, 28 percent; general aviation, 74 percent; military, 0 percent), 44 percent at air route traffic control centers (commuters 102 percent; air carriers, 38 percent; general aviation, 51 percent; military, -2 percent), and 47 percent in flight services performed. Hours flown by general aviation is forecast to increase 45 percent and helicopter hours flown 84 percent. Scheduled domestic revenue passenger miles (RPM's) are forecast to increase 78 percent, with scheduled international RPM's forecast to increase by 82 percent commuter RPM's forecast to increase by 100 percent. Author (GRA)

AIRCRAFT COMMUNICATIONS AND NAVIGATION

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

A85-31273**AUTOMATED VOR GROUND CHECK TECHNIQUES**

E. J. MARTIN (Wilcox Electric Co., Inc., Kansas City, MO) IEEE Transactions on Aerospace and Electronic Systems (ISSN 0018-9251), vol. AES-21, March 1985, p. 257-261. refs

Field conversions of many conventional VOR and VORTAC facilities to remote maintenance monitoring, which includes provisions for automated VOR ground check procedures, has been under way in the United States since 1982. A question that has arisen as a result of this effort concerns the minimum number of ground-check points that must be used in order that the bearing-error function can be resolved into its octantal as well as its quadrantal and 'duantal' components. Some fundamental considerations relating to that question are examined here.

Author

A85-31745**AN ASPECT OF THE ROLE OF THE CLOCK IN A GPS RECEIVER**

E. M. COPPS (Intermetrics, Inc., Huntington Beach, CA) Navigation (ISSN 0028-1522), vol. 31, Fall 1984, p. 233-242.

Analytic solutions for the least squares covariance and for steady state optimal estimate covariance have been derived. These solutions define and succinctly describe the relationship between clock performance, satellite geometry and system accuracy. It is seen that the clock attenuates the 'bad geometry' effect associated with one-way ranging. The steady state solutions obtained depend on certain specializations of the system dynamics and on limit cases where the clock is either much better than or much worse than the position dead-reckoner.

Author

A85-31848#**NONLINEAR AND ADAPTIVE FILTERS FOR AIRCRAFT TRACKING [NICHTLINEARE UND ADAPTIVE FILTER FUEER DIE FLUGZEUGVERFOLGUNG]**

P. T. FRUEH Zuerich, Eidgenoessische Technische Hochschule, Dr. der Technischen Wissenschaften Dissertation, 1984, 225 p. In German. refs

The filtering problem in the tracking of aircraft with radars providing high-data-rate three-dimensional position information is investigated analytically, and filters are developed and evaluated by means of computer simulations using a simple nonlinear first-order-Markov-process target model. A number of adaptive and nonadaptive filters and filter arrays, all employing a ninth-order extended Kalman filter as estimator, are compared; the results are presented in tables and graphs; and it is found that a parallel array of 13 simple estimators, each adapted to a particular set of parameter values, with a posteriori probability computation and parameter weighting gives better results than a more complex model using direct parameter estimation, and at similar computational cost.

T.K.

A85-31993*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

NASA-FAA HELICOPTER MICROWAVE LANDING SYSTEM CURVED PATH FLIGHT TEST

H. N. SWENSON (NASA, Ames Research Center, Moffett Field, CA), J. R. HAMLIN (NASA, Ames Research Center, Moffett Field, CA; USAF, Washington, DC), and G. W. WILSON (U.S. Army, Aeromechanics Laboratory, Moffett Field, CA) IN: American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 447-459. Previously announced in STAR as N84-23617. refs

An ongoing series of joint NASA/FAA helicopter Microwave Landing System (MLS) flight tests was conducted at Ames Research Center. This paper deals with tests done from the spring through the fall of 1983. This flight test investigated and developed solutions to the problem of manually flying curved-path and steep glide slope approaches into the terminal area using the MLS and flight director guidance. An MLS-equipped Bell UH-1H helicopter flown by NASA test pilots was used to develop approaches and procedures for flying these approaches. The approaches took the form of Straight-in, U-turn, and S-turn flightpaths with glide slopes of 6 deg, 9 deg, and 12 deg. These procedures were evaluated by 18 pilots from various elements of the helicopter community, flying a total of 221 hooded instrument approaches. Flying these curved path and steep glide slopes was found to be operationally acceptable with flight director guidance using the MLS.

Author

A85-32194**AN AUSTERE GPS RECEIVER FOR AIRBORNE APPLICATIONS**

R. W. BLANK and G. F. KNOERNSCHILD (Rockwell International Corp., Collins Government Avionics Div., Cedar Rapids, IA) IN: NTC '83; Proceedings of the National Telesystems Conference, San Francisco, CA, November 14-16, 1983 . New York, Institute of Electrical and Electronics Engineers, Inc., 1983, p. 130-137.

The structure of the Navstar Global Positioning System (GPS) and its capabilities are briefly discussed, and its space, control, and user segments are characterized. The concept of an austere GPS receiver is then summarized, and system studies addressing the quantity of signal tracking channels, sequencing rate, dual frequency vs single frequency operation, and precision code vs coarse code implementation are presented. The final receiver concept providing a real-time position accuracy of 55 meters (spherical error probable) is discussed, and the operational system performance is examined to illustrate flexibility and user benefit.

V.L.

A85-32195**LOW COST GPS RECEIVER DESIGN CONSIDERATIONS**

A. J. VAN DIERENDONCK (Stanford Telecommunications, Inc., Sunnyvale, CA) IN: NTC '83; Proceedings of the National Telesystems Conference, San Francisco, CA, November 14-16, 1983 . New York, Institute of Electrical and Electronics Engineers, Inc., 1983, p. 138-142. refs

A dual channel C/A code GPS receiver has been integrated into an Aero Commander and flight tested for the FAA. This receiver has the architecture of a simple low cost civil receiver. The two channels are designated as a navigation channel and a data channel, although they are functionally identical and interchangeable. The purpose of the navigation channel is to sequence rapidly between all satellites in view, while the primary purposes of the data channel are to acquire new satellites as they came into view and to collect navigation data messages from the satellites as required. In a degraded mode a single channel can perform both functions, collecting data a word at a time. In order to facilitate the rapid sequencing, no phase-lock-loop is implemented in either channel. The more robust AFC loop is utilized with varying bandwidths instead. Data are detected as differential PSK (DPSK) using a dot product computation over bit boundaries.

Author

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

A85-32198

THE DEVELOPMENT AND APPLICATIONS OF GPS DETERMINED ATTITUDE

W. S. BURGETT, S. D. ROEMERMAN, and P. W. WARD (Texas Instruments, Inc., Lewisville, TX) IN: NTC '83; Proceedings of the National Telesystems Conference, San Francisco, CA, November 14-16, 1983. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, p. 155-160. refs

Using interferometric techniques, the NAVSTAR Global Positioning System satellite signals may be used to precisely determine the attitude of a rigid body such as a pipeline, ship, or weapon platform. This paper reviews the development of an algorithm based on these techniques which may be implemented using currently available GPS receiver technology. Potential military and commercial applications are identified and briefly discussed. This technique is an alternative to inertial technology, thus offering for the first time a practical six-degree-of-freedom navigator not based on mechanical technology. The GPS method is shown to possess unique attributes that make it superior to inertial methods for some applications. Integrating GPS with an inertial system is potentially beneficial for many other applications, especially those involving alignment of aircraft inertial systems. Author

A85-32199

MICROWAVE SCANNING BEAM LANDING SYSTEM PERFORMANCE DURING SHUTTLE LANDINGS

M. C. ROBEL and P. L. HARTON (Lockheed Engineering and Management Services Co., Inc., Houston, TX) IN: NTC '83; Proceedings of the National Telesystems Conference, San Francisco, CA, November 14-16, 1983. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, p. 168-175. refs

Operational performance of the Microwave Scanning Beam Landing System has been evaluated for each of the Space Transportation System (STS) Shuttle landings, from STS-1 through STS-6. The system is 'chalking up' a performance history which has already established an enviable reputation. Evaluation of the STS mission data includes a comparison of the actual acquisition points with predicted acquisition points and a comparison of MSBLS measurements with reference measurements that are derived from best estimates of the trajectories. The Shuttle landing system is designed to provide an automatic landing capability, requiring no assistance from the astronauts, and to provide the astronaut an indication of the Shuttle position along the planned landing profile. When the astronaut elects a manual landing procedure, he still has the indication of Shuttle position along the profile, as reference information. Azimuth and elevation measurement error estimates have been found to be less than 0.05 degrees, over most of the coverage volume that has been used during the STS landing operations; distance error estimates are almost always less than 100 feet. Author

A85-32201

GPS EQUIPMENTS FOR TEST RANGE APPLICATIONS

T. J. MACDONALD and H. L. JONES (Analytic Sciences Corp., Reading, MA) IN: NTC '83; Proceedings of the National Telesystems Conference, San Francisco, CA, November 14-16, 1983. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, p. 187-193. refs

The Global Positioning System (GPS) is a space-based radio navigation system designed to provide users with world-wide, three-dimensional position and velocity information, along with coordinated universal time (UTC). In an investigation regarding the potential use of GPS for test range applications it was found that GPS could be effectively utilized for the majority of range applications with a relatively modest capital investment consisting primarily of user equipment and test range data link (telemetry) system upgrades. It was recommended to develop a family of GPS range instrumentation. The present investigation is concerned with the potential benefits of GPS as a test range asset and the functional requirements regarding the recommended family of GPS range equipment. G.R.

A85-32202

A FIELD TEST PROGRAM FOR TEST AND TRAINING APPLICATIONS OF THE NAVSTAR/GLOBAL POSITIONING SYSTEM

E. T. FICKAS (SRI International, Menlo Park, CA) IN: NTC '83; Proceedings of the National Telesystems Conference, San Francisco, CA, November 14-16, 1983. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, p. 194-201. (Contract DAEA18-81-G-0062)

A85-32203

TIME DIVISION MULTIPLE ACCESS DIFFERENTIAL GPS

A. J. VAN DIERENDONCK (Stanford Telecommunications, Inc., Sunnyvale, CA) IN: NTC '83; Proceedings of the National Telesystems Conference, San Francisco, CA, November 14-16, 1983. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, p. 202-208. refs

For Navstar Global Positioning System range applications, it has been proposed to use pseudo-satellites (or ground transmitters) for an augmentation of the GPS satellite constellation. One of the two reasons for such a proposal is related to a desire to use the GPS system prior to the time when it is fully operational. The second reason is related to the aim to provide an aid to range instrumentation users when satellite visibility is impaired by obstructions (buildings, hills, ravines). Certain problems arise in connection with the ground transmitter augmentation. In cases of close proximity to these ground-based transmitters, jamming results with respect to both the GPS satellites and other more distant transmitters. Since close proximities cannot always be avoided, multiple access means must be utilized to overcome the jamming problem. In a study of the considered situation, it is found that in the case of 95 percent of the GPS range applications, the requirements can be satisfied with GPS C/A code receivers. G.R.

A85-32204

USE OF GPS FOR DETERMINING POSITION OF DRIFTING BUOYS

L. L. WARNKE and E. E. WESTERFIELD (Johns Hopkins University, Laurel, MD) IN: NTC '83; Proceedings of the National Telesystems Conference, San Francisco, CA, November 14-16, 1983. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, p. 209-213.

A85-32205

A GPS FAST ACQUISITION RECEIVER

E. D. HOLM and E. E. WESTERFIELD (Johns Hopkins University, Laurel, MD) IN: NTC '83; Proceedings of the National Telesystems Conference, San Francisco, CA, November 14-16, 1983. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, p. 214-218.

In many operations at the various national test ranges, the position of a test object has to be determined as a function of time. The needed data can be obtained with the aid of the Air Force Global Positioning System (GPS). For range safety purposes, the data must be available in real time. It is, therefore, necessary that the GPS receivers can acquire the signal from the satellites within short time periods. The present investigation is concerned with a fast acquisition receiver channel which can operate in a standard configuration with certain operational characteristics. Attention is given to a block diagram of the receiver system, a down converter block diagram, a block diagram of the digital tracking receiver, a fast acquisition receiver block diagram, and aspects of predicted performance. G.R.

A85-32206* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

HIGH DYNAMIC, LOW VOLUME GPS RECEIVER

W. J. HURD (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) IN: NTC '83; Proceedings of the National Telesystems Conference, San Francisco, CA, November 14-16, 1983. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, p. 219-225. USAF-sponsored research. (Contract NAS7-100)

A new GPS receiver concept and design are presented to meet the high dynamic and low volume requirements for range applications in missiles and drones. The receiver has the potential to satisfy all range requirements with one basic receiver, which has significant potential economic benefit over the alternate approach of using a family of receivers, each tailored for specific applications. The main new concept is to use approximate maximum likelihood estimates of pseudo range and range-rate, rather than tracking with carrier phase locked loops and code delay locked loops. Preliminary analysis indicates that receivers accelerating at 50 g or more can track with position errors due to acceleration of approximately 0.2 m/g, or 10 m at 50 g. Implementation is almost entirely digital to meet the low volume requirements. Author

A85-32207

TRAJECTORY ESTIMATION USING TRANSLATED GPS SIGNALS

R. A. BROOKS IN: NTC '83; Proceedings of the National Telesystems Conference, San Francisco, CA, November 14-16, 1983. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, p. 246-253. refs (Contract F04701-83-R-0064)

The Triservices test and training range community has considerable interest in scenarios in which test vehicle trajectory estimation is performed by translation of undemodulated Global Positioning System (GPS) signals, received at the vehicle, to one or more surveyed telemetry receiving stations for subsequent signal and data processing. The present investigation is concerned with trajectory estimation performance for GPS translator applications. Attention is given to GPS translator geometry, measurement models, performance assessments for GPS trajectory estimation, and a computer program which has been developed to provide quantitative position and time dilation of precision results for GPS translator applications. The computer program inputs include Navstar ephemerides, translator position (latitude, longitude, and height), and the minimum elevation angle for satellite acceptance in the solution. G.R.

A85-32208

REAL TIME TRANSLATOR DESIGN CONSIDERATIONS

T. D. WARD and R. C. BADEWITZ (Cubic Corp., Defense Systems Div., San Diego, CA) IN: NTC '83; Proceedings of the National Telesystems Conference, San Francisco, CA, November 14-16, 1983. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, p. 254-259.

The Global Positioning System (GPS) is now being considered for many range applications for time-space position instrumentation. GPS translators offer size, weight and cost advantages over GPS receivers, especially where destructive testing is involved. This paper describes an approach to real time airborne tracking of translated GPS signals which is compatible with existing range telemetry receiving and recording equipment. An existing GPS receiver is employed to provide the real time determination of the test vehicle navigation solution. Author

A85-32209

TRANSLATED GPS REAL-TIME TRACKING

L. L. WELLS (Interstate Electronics Corp., Anaheim, CA) IN: NTC '83; Proceedings of the National Telesystems Conference, San Francisco, CA, November 14-16, 1983. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, p. 260-264.

In a study regarding the application of the Global Positioning System (GPS) to test and training range activities, it was found that a translator-based GPS tracking system could solve a number

of range problems, taking into account, in particular, problems involving destructive testing and cases in which a limited number of test vehicles are active. The system concept involved is discussed. Retransmitted signals are received on the ground by the master station's tracking receiver, where they are processed for tracked-vehicle position and velocity. The master station has also a reference GPS receiver which operates on the direct satellite signals. Attention is given to the measurement set generated by the translation process. G.R.

A85-32219

THE GEOSTAR POSITION DETERMINATION AND DIGITAL MESSAGE SYSTEM

G. K. ONEILL and L. O. SNIVELY (Geostar Corp., Princeton, NJ) IN: NTC '83; Proceedings of the National Telesystems Conference, San Francisco, CA, November 14-16, 1983. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, p. 312-314.

The Geostar Satellite System, which is to be operational in 1987, will provide position determination with an rms radial range of better than five meters and will display that information at both the user communicator and at a central 'dispatch' if such a configuration is desired. The proposed first-generation, minimal Geostar system will employ three satellites in orbit above the equator at fixed longitudes. Satellite S1 will be over the Atlantic, S2 on a longitude corresponding to the central United States, and S3 over the Pacific. The communicator can be on a car, truck, boat, aircraft, or building, or can be hand-carried. In the considered system, satellite communication technology, high-speed computers, and mass-produced microwave semiconductor components have been combined to produce a reliable, simple, inexpensive, and accurate method to determine the position of a communicator. G.R.

A85-32232#

AIRBORNE COMMUNICATIONS RESTORAL/RELAY

S. H. STERNICK and M. A. BRUSUELAS (USAF, Electronic Systems Div., Bedford, MA) IN: NTC '83; Proceedings of the National Telesystems Conference, San Francisco, CA, November 14-16, 1983. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, p. 425-430.

It is pointed out that the Airborne Communications Restoral/Relay (ACRR) concept addresses some serious shortfalls in today's communications systems. One problem is related to the great investment in satellite communication (SATCOM) systems and the lack of a reliable and responsive backup system, while the second problem is caused by the limited and often insufficient range of line-of-sight (LOS) radio communications. In many situations, an effective use of LOS equipment is, therefore, impossible. The present investigation is concerned with a solution which involves the use of airborne platforms with the appropriate communications relay packages to provide a quick reacting and robust SATCOM restoral capability. The relay package provides also the potential for extending the range of LOS radio communications. G.R.

A85-32233

CONSTRAINTS ON THE UNLIMITED APPLICATIONS OF THE NAVSTAR GLOBAL POSITIONING SYSTEM

L. J. JACOBSON (Magnavox Advanced Products and Systems Co., Torrance, CA) IN: NTC '83; Proceedings of the National Telesystems Conference, San Francisco, CA, November 14-16, 1983. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, p. 431-436. refs

The NAVSTAR Global Positioning System (GPS) has unlimited military and civil applications. However, there are some limitations. The constraints inherent in the NAVSTAR Global Positioning System are explored. The technical limits include: coverage, signal strength, propagation media, and other parameters. Limits to civil use and accuracy are stated in accordance with current U.S. Government policy. The circumstances under which U.S. and foreign firms could enter the GPS market are described. Schedule constraints are given which limit near term applications. Limitations of differential and space operations are shown. The various aspects

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

of 'technology insertion' are described which determine the potential cost of user equipments. Selective availability and user charges capabilities are described as they affect NAVSTAR usage. Author

A85-32485

GEOSTAR - A MULTI-PURPOSE SATELLITE SYSTEM TO SERVE CIVIL AVIATION NEEDS

G. K. ONEILL ICAO Bulletin, vol. 40, March 1985, p. 12-17.

The history and features of a proposed Geostar communications/navigation/positioning system for linking mobile terrestrial terminals are outlined. The system would interface with ground control stations for relaying signals. Transceivers on board the satellites would operate in the burst, spread spectrum mode to accommodate multiple access. Six spacecraft and three ground terminals would be sufficient for global coverage. Technical standards are now being defined for the system. The ground-based transceivers would each have a unique identification code embedded at the factory. Intended for civil use, the system would provide pilots with altitude and timing accuracies of 3 m and 7 nsec, respectively, if the position is sufficiently far from the equator. Geostar would be capable of handling all U.S. air traffic, complete with position fixes every 10 sec, and automatic cut-offs near military airspace. M.S.K.

A85-32486

MARRIAGE OF INERTIAL-REFERENCE AND AIR-DATA SYSTEMS NOW ASSURED

P. LLORET (Societe d'Applications Generales d'Electricite et de Mecanique, Paris, France) ICAO Bulletin, vol. 40, March 1985, p. 18, 19.

Hybrid inertial navigation/air data (ADIRS) systems for commercial aircraft are reaching an advanced state of development. The ADIRS are possible due to the advances in ring laser and microprocessor technologies. Plug-in ADIRS feature two pressure taps, static and total, and can have modular construction for ease of repair. The data processing can be handled by the INS electronics, which previously had an excess capacity. The system can also interface with inertial gyroscope systems. It is expected that the A320 Airbus will be the first aircraft with an integrated ADIRS. M.S.K.

A85-32489

NEW AIRBORNE SYSTEMS DEVELOPED FOR NAVAIDS TEST AND CALIBRATION

P. QUILLARD (Societe de Fabrication d'Instruments de Mesure, Massy, Essonne, France) ICAO Bulletin, vol. 40, March 1985, p. 28, 29, 33.

Features of a family of enhanced performance computerized systems for calibrating ground-based radionavigation aids are described as examples of efforts to upgrade the efficiency and lower the costs of calibration systems. The CARNAC 1, 2 and 3 systems have a common architecture but varying levels of complexity. CARNAC 1 is applicable for any type of monitoring and can compute test aircraft positions from ground-based signals or from an internal INS. It has 2 MB storage and 20 card slots, and performs file management, real-time flight data processing and tabular and graphic printout functions. Flight paths are tracked to 0.01 deg azimuth, high altitudes to 0.1 n. mi., and range to 3 m at 220 km. CARNAC 2 is smaller, or lighter aircraft, has fewer sensors for signal reception. The CARNAC 3 model can be used for simultaneous calibration of VOR-ILS systems and is amenable to connection to peripherals that are integrated in the CARNAC 1. M.S.K.

A85-32498

COMPUTER UNDERSTANDING OF AIR TRAFFIC CONTROL DISPLAYS

S. E. CROSS (USAF, Institute of Technology, Wright-Patterson AFB, OH) IEEE Transactions on Systems, Man, and Cybernetics (ISSN 0018-9472), vol. SMC-15, Jan.-Feb. 1985, p. 133-135. refs

Possible aircraft collisions from a display of many aircraft are perceived by a human air traffic controller. In the work described here, the computer understands the displayed aircraft conflict data by processing a global semantic representation of the displayed data. Understanding implies that the computer can represent and interpret the the displayed data in a manner suggestive of an experienced human controller. The representation is called the conflict structure. The conflict structure and its use by an expert system that performs portions of the enroute air traffic control task is described in this correspondence. An example from a 'live' air traffic control training problem is discussed. Author

A85-32778*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

MIXING FOUR-DIMENSIONAL EQUIPPED AND UNEQUIPPED AIRCRAFT IN THE TERMINAL AREA

L. TOBIAS, H. ERZBERGER, H. Q. LEE (NASA, Ames Research Center, Moffett Field, CA), and P. J. OBRIEN (FAA, Technical Center, Atlantic City, NJ) (Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, Collection of Technical Papers, p. 570-579) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 8, May-June 1985, p. 296-303. Previously cited in issue 19, p. 2796, Accession no. A83-41717. refs

A85-32793#

A NEW GUIDANCE LAW FOR HOMING MISSILES

H. S. CHO, Z. BIEN (Korea Advanced Institute of Science and Technology, Seoul, Republic of Korea), and Y. S. KIM Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 8, May-June 1985, p. 402-404. refs

This paper presents a new type of guidance law for homing missiles. The design concept is based upon the minimization of time duration for homing. It is shown that to realize this guidance concept an algorithm to predict the collision course and a guidance command generator to turn the heading of the missile toward the direction of the predicted collision course are necessary. A prediction algorithm for the collision course is derived and the realized overall guidance law is shown to be easily implementable. Simulation results are given to demonstrate the minimum time behavior and the widened launching envelope. Author

A85-33045

TIME REFERENCE ERRORS OF ANGLE-MEASURING SIGNALS AT THE OUTPUT OF AN ENVELOPE DETECTOR UNDER MULTIPATH CONDITIONS [OSHBKI FIKSATSII VREMENNOGO POLOZHENIYA UGLOMERNYKH SIGNALOV NA VYKHODE DETEKTORA OGIBAIUSHCHEI PRI NALICHII POMEKH TIPA PEREOTRAZHENII]

V. V. KASHINOV, V. I. BABUROV, and F. A. ENIKEEV Radioelektronika (ISSN 0021-3470), vol. 28, April 1985, p. 66-68. In Russian. refs

The time reference errors of angle-measuring signals in TRSB (time reference scanning beam) systems under multipath conditions are analyzed. It is shown that the character of the error relationship depends significantly on the interference structure of the radiation pattern in the vertical plane. A formula is presented for determining the time reference error at the output of an envelope detector under multipath conditions. B.J.

N85-22358# Royal Aircraft Establishment, Farnborough (England).

REFERENCE SYSTEMS FOR THE EVALUATION OF DEAD-RECKONING NAVIGATION EQUIPMENT

R. F. STOKES and S. G. SMITH *In* AGARD Ground and Flight Testing for Aircraft Guidance and Control 17 p Dec. 1984
Original language document was announced as N84-34406
Avail: NTIS HC A09/MF A01

Aircraft dead reckoning navigation systems present particular problems in their assessment, and diagnosis in development where a continuous measurement of their error pattern is required. The need for long range, long duration flights with a continuous high accuracy reference led to the development of an integrated navigation system. The recorded data is processed post-flight in a Kalman filter which is used to estimate the inertial system errors. The final reference is formed by compensating the inertial outputs for these errors and has the properties of high accuracy, low noise, and continuous availability. Although simple in concept the implementation of such a scheme is complex. The major problem lies in constructing suitable mathematical models of the various equipments, and the technique of pre-processing is described. The second difficult area is that of obtaining the statistical information regarding the performance of the equipment in a form suitable for inclusion in the models. Although the reference is produced off-line, it is possible to implement the techniques on-line. R.S.F.

N85-22375# Lincoln Lab., Mass. Inst. of Tech., Lexington.
TCAS II: DESIGN AND VALIDATION OF THE HIGH-TRAFFIC-DENSITY SURVEILLANCE SUBSYSTEM
W. H. HERMAN and R. S. KENNEDY 12 Feb. 1985 157 p refs

(Contract DOT-FA77-WAI-817)
(DOT/FAA/PM-84/5; ATC-126; AD-A153892) Avail: NTIS HC A08/MF A01

Lincoln Laboratory is developing an airborne collision avoidance system (TCAS II), concentrating primarily on the air-to-air surveillance subsystem. The surveillance functions required are to detect the presence of nearby transponder equipped aircraft, and then generate a surveillance track on each aircraft, issuing range and altitude reports once per second. The development effort from mid-1981 to the present focused on the surveillance problems associated with high aircraft density. A number of surveillance techniques to deal with the high density environment were identified and evaluated mainly through airborne measurements. A TCAS II design was synthesized, and this design was subjected to in-flight testing in the Los Angeles Basin using a Boeing 727. Results indicate that the performance objectives were met. R.J.F.

N85-22376# Federal Aviation Administration, Washington, D.C.
PLANNED OFFICE AND FACILITY CONSOLIDATIONS: TO IMPROVE SYSTEM EFFECTIVENESS AND EFFICIENCY, FY 1985-87

1 Dec. 1984 106 p
(AD-A150441) Avail: NTIS HC A06/MF A01 CSCL 01E

This revised plan, which was directed by House Report 98-1159 accompanying the FY-1985 Continuing Appropriations Resolution, has the same basic objectives as the FY-1984 effort. Perhaps the most important difference is that the need to implement it is even more compelling. The program outlined below updates the previously published plan for field office and facility consolidations, and encompasses actions through fiscal year 1987. Flight Service Station (FSS) Modernization/Consolidation, Airport Traffic Control Tower (ATCT) Closures, Consolidation of the Functions of the Terminal Radar Approach Control Facilities (TRACON) and the Air Route Traffic Control Centers (ARTCC), Realignment of the Airway Facilities Sector Offices (AFSO's), Consolidation of Aviation Standards (AVS) Field Offices. GRA

N85-23748# National Transportation Safety Board, Washington, D. C.

SAFETY RECOMMENDATION(S), A-84-82 THROUGH -84

13 Aug. 1984 8 p
(REPT-3957) Avail: NTIS HC A02/MF A01

Between 4 p.m. and 5 p.m. on March 8, 1984, the National Transportation Safety Board received several telephone calls from witnesses who had observed aircraft flying close to toll buildings located in the Rosslyn, Virginia, area. These aircraft were conducting approaches to land at Washington National Airport, Washington, D.C. As a result of the reports and because of previous similar incidents investigated by the Safety Board, the Safety Board conducted a comprehensive investigation of the incidents. Ground witnesses, flight crews, and air traffic controllers were interviewed, flight data recorders (FDR) from involved aircraft were read out, and recorded radar data were plotted. An analysis of this information uncovered several safety hazards which warrant corrective action by the FAA. These involve the interpretation of descent profile altitude restrictions on instrument approach procedure charts, effectiveness of the minimum safe altitude warning system (MSAW), 1/ and air traffic controller procedures for issuing safety advisories to aircraft. A.R.H.

N85-23749# Federal Aviation Administration, Washington, D.C. Office of Aviation Policy and Plans.

AN ANALYSIS OF THE IMPACTS OF THE AIRPORT RADAR SERVICE AREA (ARSA)

K. GEISINGER Nov. 1984 42 p
(AD-A150954; FAA-APO-85-1) Avail: NTIS HC A03/MF A01 CSCL 171

The Airport Radar Services Area (ARSA) is a new concept in thermal airspace design that has been proposed as a replacement for the Terminal Radar Service Area (TRSA) which has been installed at 137 locations in the U.S. The primary difference between them is that pilots can enter the TRSA without communicating with Air Traffic Control (ATC), while in the ARSA ATC service is mandatory. This report contains an analysis of data gathered both before and after the implementation of the ARSA at two lead sites. The analysis concludes that the ARSA produces a significant reduction in a collision risk at a moderate increase in controller workload with no significant impact on ATC service to the pilots. GRA

N85-23816*# Federal Aviation Administration, Washington, D.C.
DEVELOPMENT CONCERNS FOR SATELLITE-BASED AIR TRAFFIC CONTROL SURVEILLANCE SYSTEMS

K. D. MCDONALD *In* NASA. Langley Research Center Large Space Antenna Systems Technol., 1984 p 39-62 Apr. 1985 refs

Avail: NTIS HC A20/MF A01 CSCL 17G

Preliminary results of an investigation directed toward the configuration of a practical system design which can form the baseline for assessing the applications and value of a satellite based air traffic surveillance system for future use in the National Airspace System (NAS) are described. This work initially studied the characteristics and capabilities of a satellite configuration which would operate compatibly with the signal structure and avionics of the next generation air traffic control secondary surveillance radar system, the Mode S system. A compatible satellite surveillance system concept is described and an analysis is presented of the link budgets for the various transmission paths. From this, the satellite characteristics are established involving a large multiple feed L band antenna of approximately 50 meter aperture dimension. Trade offs involved in several of the alternative large aperture antennas considered are presented as well as the influence of various antenna configurations on the performance capabilities of the surveillance system. The features and limitations of the use of large aperture antenna systems for air traffic surveillance are discussed. Tentative results of this continuing effort are summarized with a brief description of follow on investigations involving other space based antenna systems concepts. M.G.

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

N85-24081# Joint Publications Research Service, Arlington, Va. **FLIGHT SIMULATION FOR INERTIAL NAVIGATION SYSTEM** **Abstract Only**

V. V. ALEKSANDROV *In its* USSR Rept.: Eng. and Equipment (JPRS-UEQ-84-001) p 46 9 Feb. 1984 Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. 1: Mat. Mekhan. (Moscow), no. 4, Jul. - Aug. 1983 p 95-99
Avail: NTIS HC A06

An inertial navigation system consisting of two accelerometers is considered for flight simulation tests. The accelerometers are mounted on a leveled and gyroscopically stabilized platform absolutely free to move along the azimuthal coordinate. The aircraft with a digital computer on board is assumed to move on a sphere concentric with the Earth. The control law in matrix form is derived from the equations describing ideal performance of this navigation and to be simulated on the aircraft computer. The inertial force acting on the masses of accelerometer sensors is simulated with the force of gravity and the dynamic simulation of aircraft flight is aided by another digital computer controlling the test stand. On this basis is then established the feasibility of simulating nonideal performance of the navigation system during perturbations, also the feasibility of flight simulation for a navigation system consisting of three accelerometers and corresponding operating with six signals: three accelerometer readings and three angles defining the aircraft orientation.

Author

05

AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

A85-30234# **FINITE ELEMENT ANALYSIS OF AN ULTRALIGHT AIRCRAFT**

T. V. BAUGHN and P. F. PACKMAN (Southern Methodist University, Dallas, TX) IN: Structures, Structural Dynamics, and Materials Conference, 26th, Orlando, FL, April 15-17, 1985, Technical Papers. Part 1 . New York, American Institute of Aeronautics and Astronautics, 1985, p. 71-78.
(AIAA PAPER 85-0616)

A finite element analysis was conducted to determine the structural integrity of a high wing cable supported ultralight aircraft. A simple symmetrical half structure, macro model was analyzed, subjected to level flight loading, and two wheel landing loading conditions. Flexural and bending stiffness for the supported and unsupported wing were also determined. A preliminary damage tolerance analysis was conducted in which selected cable elements and wing compression struts were removed, and the redistributed loads calculated and possible aircraft flight configurations examined. The model can generate all cable loads, displacement of each structural node, for each loading condition, generate displacement plots, and locate potential highly stressed regions.

Author

A85-30244*# Missouri Univ., Rolla. **ESTIMATING THE WEIGHT OF GENERALLY CONFIGURED DUAL WING SYSTEMS**

D. L. CRONIN and R. J. SOMNAY (Missouri-Rolla, University, Rolla, MO) IN: Structures, Structural Dynamics, and Materials Conference, 26th, Orlando, FL, April 15-17, 1985, Technical Papers. Part 1 . New York, American Institute of Aeronautics and Astronautics, 1985, p. 173-177. refs
(Contract NAG1-26)
(AIAA PAPER 85-0641)

Formulas available for the weight estimation of monoplane wings cannot be said to be appropriate for the estimation of generally configured dual wing systems. In the present paper a method is described which simultaneously generates a structural weight estimate and a fully stressed, quasi-optimal structure for a model

of a dual wing system. The method is fast and inexpensive. It is ideally suited to preliminary design. To illustrate the method, a dual wing system and a conventional wing system are sized. Numerical computation is shown to be suitably fast for both cases and, for both cases, convergence to a final configuration is shown to be quite rapid. To illustrate the validity of the method, a conventional wing is sized and its weight obtained by the present method is compared to its weight determined by a reputable weight estimation formula. The results are shown to be very close.

Author

A85-30245*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va. **OPTIMIZATION METHODS APPLIED TO THE AERODYNAMIC DESIGN OF HELICOPTER ROTOR BLADES**

J. L. WALSH (NASA, Langley Research Center, Interdisciplinary Research Office, Hampton, VA), G. J. BINGHAM (U.S. Army, Structures Laboratory, Hampton, VA), and M. F. RILEY (Kentron International, Inc., Hampton, VA) IN: Structures, Structural Dynamics, and Materials Conference, 26th, Orlando, FL, April 15-17, 1985, Technical Papers. Part 1 . New York, American Institute of Aeronautics and Astronautics, 1985, p. 178-186. refs
(AIAA PAPER 85-0644)

This paper describes a formal optimization procedure for helicopter rotor blade designs which minimizes hover horsepower while assuring satisfactory forward flight performance. The approach is to couple hover and forward flight analysis programs with a general purpose optimization procedure. The resulting optimization system provides a systematic evaluation of the rotor blade design variables and their interaction, thus reducing the time and cost of designing advanced rotor blades. The paper discusses the basis for and details of the overall procedure, describes the generation of advanced blade designs for representative Army helicopters, and compares designs and design effort with those from the conventional approach which is based on parametric studies and extensive cross-plots.

Author

A85-30278# **DESIGN OF A CFRP-WING FOR THE ALPHA-JET MAJOR PANEL TESTS**

D. ROSE, E. HENZE (Dornier GmbH, Friedrichshafen, West Germany), D. WURZEL, and H. SCHELLING (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Stuttgart, West Germany) IN: Structures, Structural Dynamics, and Materials Conference, 26th, Orlando, FL, April 15-17, 1985, Technical Papers. Part 1 . New York, American Institute of Aeronautics and Astronautics, 1985, p. 446-453.
(AIAA PAPER 85-0725)

Dornier Company is presently developing a CFRP-wing for its ground support aircraft Alpha-Jet. It incorporates CFRP-skins and spars, the skins being integrally stiffened with stringer blades and manufactured in one-shot autoclave procedure. Skin design due to in-plane loadings and transverse loads from tank pressure and due to instability on the one hand and the manufacturing on the other are of great risk. To show the efficiency of the design and manufacturing approaches among others two different components of the tank end area were tested at the DFVLR, the German Aerospace Research Establishment. Test results showed a good agreement with the theoretical datas. This allowed the go-ahead in the development. The report describes the design and manufacturing philosophy, the experimental set-up, and the test results in comparison to the expected values.

Author

A85-30302#

TENSILE SKI-JUMP RAMP FOR AIRCRAFT TAKEOFF

E. N. KUZNETSOV (Illinois, University, Urbana, IL), R. P. SCHUMAKER (U.S. Naval Air Systems Command, Washington, DC), and R. C. FERRAGLIO (U.S. Navy, Naval Air Engineering Center, Lakehurst, NJ) IN: Structures, Structural Dynamics, and Materials Conference, 26th, Orlando, FL, April 15-17, 1985, Technical Papers. Part 1. New York, American Institute of Aeronautics and Astronautics, 1985, p. 697-703. (Contract N68335-81-C-5063) (AIAA PAPER 85-0802)

A tensile ski-jump ramp is a prestressed thin steel strip with the exit end fixed at a suitable elevation above the ground. The paper presents the results of a technical feasibility study which involves two interrelated aspects: the structural behavior of the ramp under a traveling aircraft and the aircraft takeoff performance. It was found that a wide range of suspended span lengths and aircraft weights can be safely accommodated with a practical minimum strip thickness of 1/8 inch. The aircraft takeoff path, landing gear loads and fly-away parameters depend on the strip prestress level and exit end elevation. These are easily adjustable so as to suit optimally a mix of aircraft types and missions.

Author

A85-30350#

TIME SERIES APPROXIMATION OF UNSTEADY AERODYNAMICS INCLUDING POLE LOCATIONS AS FREE PARAMETERS

L. D. PETERSON and E. F. CRAWLEY (MIT, Cambridge, MA) IN: Structures, Structural Dynamics, and Materials Conference, 26th, Orlando, FL, April 15-17, 1985, Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, 1985, p. 251-257. refs (AIAA PAPER 85-0663)

The present method, which uses a least squares fit in an algorithm for determining exponential time series approximations to unsteady aerodynamic data at discrete frequencies, differs from previous ones in explicitly including the pole locations of the exponential series approximation in the fit search. The fit simultaneously minimizes the error in both the real and imaginary parts of the approximation. The results obtained demonstrate the accuracy of the fit achieved by including the poles as free parameters. While each of the converged minima represents a good approximation to the aerodynamic data, the poles found in the search are not necessarily those of the true aerodynamic transfer function. Sample approximations of the Theodorsen function are presented to demonstrate this behavior. O.C.

A85-30356*# Grumman Aerospace Corp., Bethpage, N.Y. TRANSONIC TEST OF A FORWARD SWEEP WING CONFIGURATION EXHIBITING BODY FREEDOM FLUTTER

R. CHIPMAN, F. RAUCH, M. RIMER, B. MUNIZ (Grumman Aerospace Corp., Bethpage, NY), and R. H. RICKETTS (NASA, Langley Research Center, Hampton, VA) IN: Structures, Structural Dynamics, and Materials Conference, 26th, Orlando, FL, April 15-17, 1985, Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, 1985, p. 298-312. refs (Contract NAS1-17102) (AIAA PAPER 85-0689)

The aeroelastic dynamic instability designated Body Freedom Flutter (BFF) involves aircraft pitch and wing bending motions characteristic of forward swept wing (FSW) aircraft. Attention is presently given to the results of tests conducted on a 1/2-scale cable-mounted FSW wind tunnel model, with and without relaxed static stability (RSS) control conditions. BFF instability boundaries were found to occur at significantly lower air speeds than those associated with aeroelastic wing divergence on the same model. Servo-aeroelastic stability analyses have been conducted which proved capable of predicting the measured onset of BFF, in both the statically stable and RSS configurations tested. O.C.

A85-30359#

INFLUENCE OF WARPAGE ON COMPOSITE AEROELASTIC THEORIES

G. A. OYIBO and J. H. BERMAN (Fairchild Republic Co., Farmingdale, NY) IN: Structures, Structural Dynamics, and Materials Conference, 26th, Orlando, FL, April 15-17, 1985, Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, 1985, p. 330-336. refs (AIAA PAPER 85-0710)

The aeroelastic equivalent of the aerodynamic similarity rule is used to investigate the influence of warping, defined as the spanwise axial constraints on wing twist, on composite wing aeroelastic oscillations. The results obtained indicate that a high aspect ratio composite wing can aeroelastically behave like a low aspect ratio wing, and vice versa. Similarity parameters are derived which expose conditions in which this reversal can occur, and the analysis indicates that the parameter currently invoked in determinations of warping is inaccurate for composite wings.

O.C.

A85-30361#

THREE DIMENSIONAL NONLINEAR DYNAMIC FINITE ELEMENT ANALYSIS FOR THE RESPONSE OF A THICK LAMINATED SHELL TO IMPACT LOADS

R. E. MCCARTY, D. E. TRUDAN, and A. D. DAVIS (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, OH) IN: Structures, Structural Dynamics, and Materials Conference, 26th, Orlando, FL, April 15-17, 1985, Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, 1985, p. 341-356. refs (AIAA PAPER 85-0713)

The Materially and Geometrically Nonlinear Analysis (MAGNA) nonlinear three-dimensional finite element analysis system is used to simulate the response of the T-38 training aircraft's student cockpit windshield to bird impact loading. This analysis problem is characterized by severe material and geometric nonlinearities, as well as significant fluid/solid interaction. Stress-versus-time, stress contour, and deflection-versus-time plots are used to illustrate the results of the MAGNA analysis, which are found to successfully predict the mechanical failure of a metallic edge member support structure. Also predicted with high accuracy is the maximum displacement of a number of points on the transparency panel in the bird impact region, and the location of panel rupture observed in tests. O.C.

A85-30380*# Hughes Helicopters, Culver City, Calif.

APPLICATION OF THE FINITE-STATE ARBITRARY-MOTION AERODYNAMICS TO ROTOR BLADE AEROELASTIC RESPONSE AND STABILITY IN HOVER AND FORWARD FLIGHT

M. A. H. DINYAVARI (Hughes Helicopters, Inc., Culver City; California, University, Los Angeles, CA) and P. P. FRIEDMANN (California, University, Los Angeles, CA) IN: Structures, Structural Dynamics, and Materials Conference, 26th, Orlando, FL, April 15-17, 1985, Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, 1985, p. 522-535. refs (Contract NAG2-209) (AIAA PAPER 85-0763)

The primary objective of this paper is to illustrate the influence of finite-state arbitrary-motion time-domain aerodynamics on rotor blade aeroelastic stability in hover and forward flight. The essential ingredients of the generalized Greenberg type time-domain unsteady aerodynamics are presented and incorporated in a coupled nonlinear flap-lag analysis. Aeroelastic stability boundaries for both hover and forward flight are obtained using both arbitrary-motion time-domain aerodynamics and quasi-steady aerodynamics. The sensitivity of flap-lag aeroelastic stability boundaries to time-domain arbitrary-motion unsteady aerodynamics is evaluated by comparing the two sets of results for various blade configurations and flight conditions. Author

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

A85-30394*# Kentron International, Inc., Hampton, Va. DYNAMIC LOADS ANALYSES OF FLEXIBLE AIRPLANES - NEW AND EXISTING TECHNIQUES

A. S. POTOTZKY (Kentron International, Inc., Aerospace Technologies Div., Hampton, VA) and B. PERRY, III (NASA, Langley Research Center, Loads and Aeroelasticity Div., Hampton, VA) IN: Structures, Structural Dynamics, and Materials Conference, 26th, Orlando, FL, April 15-17, 1985, Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, 1985, p. 651-663. refs
(AIAA PAPER 85-0808)

This paper reviews existing techniques for calculating dynamic loads for flexible airplanes and presents a new technique. The new technique involves the summation-of-forces method of writing dynamic loads equations. Until now this form of the dynamic loads equations has been formulated in the frequency domain. The new technique uses s-plane approximation methods (previously applied only to the equations of motion) to transform the dynamic loads equations from a second-order frequency-domain formulation with frequency-dependent coefficients into a linear-time-invariant state-space formulation. Several numerical examples demonstrate the usefulness of the new technique and the high quality of the results. In addition, a convergence investigation establishes that the summation-of-forces method converges more quickly (that is, with fewer modes) than does the mode displacement method.

Author

A85-30572

F-14D FOR DIGITAL

G. WARWICK Flight International (ISSN 0015-3710), vol. 127, March 30, 1985, p. 19-22.

The F-14D is an upgraded version of the F-14A and is intended to meet naval interceptor missions into the next century. An interim short production of F-14As, updated with F110 engines, will precede the F-14D, which will feature F110 engines, digital avionics and the APG-XX radar, an apparatus with enhanced ECCM capabilities. The APG radar offers monopulse target tracking, digital scan control, target ID and raid assessment, i.e., the separation of individual members of a group in close formation which would otherwise appear as a single target. The avionics will include a self-protection jammer, decentralized architecture and five databuses. A low-profile HUD is to be developed to fit the cockpit. The F110 engine provides 27,080 lb thrust, has a hot section inspection life of 1500 hr, and has an 82 percent parts commonality with the F-15 and F-16 engines. All development work will be performed under a fixed-price contract. M.S.K.

A85-30943

ROTORCRAFT AIR RESONANCE IN FORWARD FLIGHT WITH VARIOUS DYNAMIC INFLOW MODELS AND AEROELASTIC COUPLINGS

J. NAGABHUSHANAM (Hindustan Aeronautics, Ltd., Bangalore, India) and G. H. GAONKAR (Indian Institute of Science, Bangalore, India) (European Rotorcraft and Powered Lift Aircraft Forum, 9th, Stresa, Italy, Sept. 13-15, 1983) Vertica (ISSN 0360-5450), vol. 8, no. 4, 1984, p. 373-394. refs

Air resonance with dynamic inflow in a forward flight (advance ratio between 0 and 0.4) is modeled using a 3 x 3 model for a 3-blade to 5-blade rotor and a 5 x 5 model for a rotor with 5 or more blades. Effects of such trimming conditions and parameters as lag structural damping, blade and body inertias, and aeroelastic couplings are taken into account. It is noted that air resonance characteristics are independent of the number of blades per rotor. Furthermore, for typical hingeless and bearingless rotors with the common combination of a soft hub and flexible blades a combination of increasing values of the negative pitch-lag coupling and the positive pitch-flap coupling effectively improves air resonance. A close agreement between the two models for the case of a 5-blade rotor is observed. L.T.

A85-31000

ATR42 ACHIEVES FLIGHT-TEST GOALS

G. SEDBON Flight International (ISSN 0015-3710), vol. 127, March 23, 1985, p. 34-37.

The status of the flight testing of the ATR42 40-50-passenger twin-turboprop regional airliner, scheduled for certification by August 1985, is reported. Over 400 h of flight testing of two ATR42s demonstrated that the aircraft met the major design goals, including operational empty weight of 21,206 lb, maximum-weight take-off distance of 3,542 ft, landing distance of 3,149 ft at a maximum landing weight, and cruising speed of 275 kt at 20,000 ft. The aircraft features carbon and Kevlar composite elements, a relatively simple and aerodynamically efficient layout, and an entirely manual flight control system. Furthermore, a study on a stretched version of the aircraft has been completed, with deliveries possible in 1988 or 1989; the stretched version will carry 60 to 66 passengers. L.T.

A85-31225

THE SEARCH FOR FUEL EFFICIENCY

C. L. BLAKE Exxon Air World, vol. 37, no. 1, 1985, p. 27-29.

An evaluation is made of progress made to date and anticipated for the turn of the century in aircraft aerodynamics and propulsion efficiency improvements, with emphasis on large airliners. It is noted that the 757/767 airliners currently entering service, although conventional in appearance, incorporate extensive structural and internal systems improvements, as well as advanced turbofan engines, which constitute a technological generation's advancement over 727, 737, and DC-9 designs; this is reflected in a fuel burn/seat-mile improvement over those aircraft of 50 percent. Among prospective efficiency-enhancing technologies that may be fully developed and mutually integrated by the year 2000, advanced turbofans and propfans, laminar flow control, and structural materials for all-composite primary structures are noted to be both promising and within reach of current development programs. O.C.

A85-31461

DETERMINATION OF LOADS ON A THIN-WALLED STRUCTURE FROM PARAMETERS OF ITS STRESS-STRAIN STATE [K OPREDELENIU NAGRUZOK NA TONKOSTENNUIU KONSTRUKTSIU PO PARAMETRAM EE NAPRIAZHENNO-DEFORMIROVANNOGO SOSTOIANIIA]

IU. G. ODINOKOV and A. IU. ODINOKOV Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 4, 1984, p. 53-58. In Russian. refs

A method is proposed whereby the loads acting on an aircraft are determined from parameters of the stress-strain state of its structure, i.e., deformations of the longitudinal load-bearing elements and the relative twisting angle. The stress-strain state of the structure is described by using a discrete-continuous computational scheme allowing for the warping of cross sections. The efficiency of the algorithm proposed here is demonstrated for the case of a six-spar box. V.L.

A85-31471

COMPUTER-AIDED KINEMATIC AND DYNAMIC ANALYSIS OF THE LANDING-GEAR MECHANISMS OF AIRCRAFT [AVTOMATIZIROVANNYI KINEMATICHESKII I SILOVOI RASCHET MEKHANIZMOV SHASSI SAMOLETA]

V. V. BERDNIKOV, I. P. IAKUPOVA, and A. S. LIVSHITS Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 4, 1984, p. 95, 96. In Russian.

A set of application software has been developed for the kinematic and dynamic analysis of the landing-gear mechanisms of aircraft. The computational algorithm is based on the group method where the kinematic parameters of individual points are represented in the form of projections onto the coordinate axes. The library of subroutines includes subroutines for the analysis of hydraulically driven mechanisms. The dynamic analysis of landing-gear mechanisms is based on the well-known kinetostatic method. V.L.

A85-31778#

A METHOD FOR DETERMINING THE FLIGHT TRAJECTORY OF AN EJECTION SEAT [METODA OKRESLANIA TRAJEKTORII LOTU FOTEŁA KATAPULTOWANEGO]

M. FOLTYNSKI Instytut Lotnictwa, Prace (ISSN 0509-6669), no. 97, 1984, p. 41-51. In Polish.

A method is proposed for determining the theoretical flight trajectory of an ejection seat in a system of coordinates relative to the aircraft. It is noted that the main difficulty is the lack of basic data on ejection seats, and a procedure is presented for obtaining such data from the technical documentation for the aircraft on which the seat is installed. The procedure is illustrated by an example involving a particular ejection seat model. Finally, the sources of possible errors are examined. V.L.

A85-31780#

THE EFFECT OF DESIGN PARAMETERS ON THE GROUND RESONANCE OF HELICOPTERS [WPLYW PARAMETROW KONSTRUKCYJNYCH ŚMIGŁOWCA NA JEGO REZONANS PRZYZIEMNY]

L. ZEREK and D. DYMITRUK Instytut Lotnictwa, Prace (ISSN 0509-6669), no. 98, 1984, p. 3-22. In Polish. refs

Some fundamental problems involved in the analysis of the ground resonance of helicopters are examined, with attention given to physical and mathematical models of this phenomenon. The effect of selected design parameters on the natural vibrations and ground resonance of helicopters is then investigated, and the results obtained are presented in graphical form. V.L.

A85-31952#

APPLICATION OF A TURBULENCE DISTORTION THEORY TO PREDICT HELICOPTER ROTOR BROADBAND NOISE DUE TO INFLOW TURBULENCE AS A FUNCTION OF ROTOR THRUST

M. WILLIAMS and W. L. HARRIS (MIT, Cambridge, MA) IN: American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 1-8. refs

The problem of helicopter rotor low frequency broadband noise, due to inflow turbulence, as a function of rotor mean thrust, is theoretically considered using turbulence rapid distortion theory. Using the linear energy spectral density tensor dynamic equation, the rotor mean loading is related to a distorted, nonisotropic energy spectral density tensor. The objective of the analysis is to determine if inflow turbulence distortion, as a function of rotor mean loading, may be a cause of observed increased sound pressure levels. It is shown that turbulence distortion modifies the shape of the upwash component of the turbulence spectral tensor, causing a maximum to occur for non-zero wavenumbers. A comparison with experimental model rotor data shows that, for a shear type distortion, turbulence distortion as a function of rotor mean loading cannot totally explain observed increases in sound pressures with increased rotor mean thrust. Author

A85-31953*# National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.

COMPARISON OF NOISE PREDICTION FOR THE X-WING SYSTEM AND A CONVENTIONAL ROTOR IN HOVER

R. M. MARTIN (NASA, Langley Research Center, Hampton, VA) IN: American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 9-17. refs

Analytic predictions of X-wing rotor noise levels in hover without circulation control are presented and compared with measured data at two observer locations. Agreement of predictions and data is best in the rotor plane, due to the dominance of thickness noise terms. Predictions are made for the X-wing and a conventional type rotor system and are compared at two locations at the same tip speed and at each rotor's design tip speed. The acoustic signal of the X-wing is more heavily influenced by thickness noise terms than the conventional rotor. The comparison of each rotor's noise levels depends on the observer location and the amount of circulation control blowing employed. Author

A85-31957#

INSIGHTS INTO HELICOPTER AIR COMBAT MANEUVERABILITY

N. D. LAPPOS (United Technologies Corp., Sikorsky Aircraft Div., Stratford, CT) IN: American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 93-103. refs

The author's participation in the U.S. Army Helicopter Air to Air Combat Test Program (D-318) has provided some insight into future helicopter air combat. This paper discusses the specific maneuvers which were performed in the aerial encounters and the handling qualities and performance characteristics which influenced agility and maneuverability. A discussion of the concepts of helicopter maneuvering, considering the relationships of turning flight, excess power and energy management, is presented. Design considerations of an air combat helicopter are also discussed and a set of maneuverability and agility guidelines is presented to allow systematic evaluation of proposed designs and possibly help shape future requirements. Author

A85-31958*# Sikorsky Aircraft, Stratford, Conn.

ENVIRONMENTAL AND STRUCTURAL ASSESSMENT OF FOUR YEAR IN-COMMERCIAL SERVICE COMPOSITE HELICOPTER STRUCTURES

M. B. EZZO and D. W. LOWRY (United Technologies Corp., Sikorsky Aircraft Div., Stratford, CT) IN: American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 105-112. Army-supported research. (Contract NAS1-16542)

This paper presents the technical background for including environmental effects in the design of helicopter composite structures. This effort was supported by test results of components and panels having up to four years of field exposure. The preceding was part of an eight year program to evaluate in-service environmental factors for comparison with laboratory test results. Full scale static and fatigue tests were conducted on composite components removed from S-76 helicopters used in commercial operations in the Gulf Coast region of Louisiana. Small scale tests were conducted using coupons removed from panels exposed to the outdoor environment in Stratford, Connecticut and West Palm Beach, Florida. Panel configurations were representative of S-76 components. Moisture analysis and strength tests on components and panels are reported after two, three and four years of exposure. Moisture levels were compared with predicted values. Mechanical test results were compared to initial certification tests for component strength, and to baseline laboratory coupon testing. Author

A85-31960#

DESIGNING FOR A CRASHWORTHY ALL-COMPOSITE HELICOPTER FUSELAGE

J. K. SEN (Hughes Helicopters, Inc., Culver City, CA) IN: American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 123-134. refs

A building-block approach was taken in developing composite data for designing a crashworthy all-composite helicopter fuselage. The fuselage is one of the elements which protects the occupants in a crash impact environment. This paper identifies the crashworthy design parameters and describes design aspects which constitute energy absorbing features of structural elements. The energy absorbing design features of a structure are material, construction and shape. Materials common in helicopter construction are classified according to their energy absorbing capacities. The method of construction influences failure modes and the magnitude of the energy absorbed. In addition to material and construction, the structural element can be shaped to further enhance and optimize the crashworthy design parameters. The data on design parameters are generated in quasi-static and dynamic tests. The results are presented as a guide to the comparative influences of crashworthy design parameters of composite structural elements. Author

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

A85-31961#

THE APPLICATION OF GEODETIC CONSTRUCTION TO HELICOPTER AIRFRAMES

M. E. LISLE (Westland Helicopters, Ltd., Yeovil, Somerset, England) IN: American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 135-140.

The concept of geodetic construction, where shear loads in a structure are carried over curved surfaces by means of many intersecting geodesic load paths, is described. An analysis technique, developed at WHL, is used to demonstrate the potential benefits of geodetic construction, by designing a weight efficient, battle damage tolerant structure. Manufacturing methods for fibre-reinforced plastic geodetic structures are examined. Filament winding techniques are suggested as a cost-effective route for the production of geodetic structures. Author

A85-31963#

THE SIKORSKY DYNAFLEX ROTOR - AN ADVANCED MAIN ROTOR SYSTEM FOR THE 1990'S

E. A. FRADENBURGH and R. G. CARLSON (United Technologies Corp., Sikorsky Aircraft Div., Stratford, CT) IN: American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 155-170.

A new concept for helicopter main rotor systems, under development at Sikorsky for the past several years, shows considerable promise for future applications. This rotor concept, labeled 'Dynaflex', incorporates an advanced composite structure which flexes to provide a constant speed universal joint action. This allows the hub to tilt relative to the shaft, but with spring restraint. The result is a rotor which has a highly desirable equivalence to an articulated rotor, but with considerable simplification, lighter weight, and lower drag. A number of novel composite structures and fabrication techniques were utilized in the development of a successful dynamically scaled model. Author

A85-31969#

BLADE DESIGN PARAMETERS WHICH AFFECT HELICOPTER VIBRATIONS

B. P. GUPTA (Hughes Helicopters, Inc., Culver City, CA) IN: American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 207-217. refs

Designing the main rotor blades for minimum airframe vibration has been impeded by lack of understanding of vibration producing mechanisms. The experiences gained during two flight test programs namely Higher Harmonic Controls (HHC) and Composite Main Rotor Blade (CMRB) are described in this paper. These investigations provide insight into the role of aerodynamics in producing vibrations. Testing of CMRB on the Army's Advanced Attack Helicopter produced an airframe vibration problem which prompted a flight test program described herein. The vibration problem was subsequently solved by modifying the flight set of blades. The HHC produced major reductions in airframe vibration. Author

A85-31970#

IMPACT OF EMERGING TECHNOLOGY ON THE WEIGHT OF FUTURE ROTORCRAFT

R. A. SHINN (U.S. Army, Aviation Systems Command, St. Louis, MO) IN: American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 219-227. refs

Trend equations describing the contributions of the various aircraft systems, taking into account the effect of such new technologies as advanced composites, digital optical control systems, very high-speed integrated circuits, and advanced rotorcraft configurations, are defined. The majority of the equations presented were derived using a multiple linear regression analysis computer program and weights data collected on existing gas-turbine-powered U.S. helicopters. Moreover, predictions are

made concerning weight reductions possible through new technologies in the rotor, structures, propulsion, and flight controls system groups. Finally, mission equipment capabilities of the AH-1S, AH-64, and LHX family rotorcraft are comparatively discussed. L.T.

A85-31971#

TECHNOLOGY IMPACT ON HELICOPTER, TILT ROTOR, AND TILT FOLD ROTOR CONCEPTS

C. G. MATTHYS and E. E. SCROGGS, JR. (Bell Helicopter Textron, Fort Worth, TX) IN: American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 229-236. refs

This paper initially presents historical weight trends of the major subsystems of helicopters that also apply to tilt rotor and tilt fold rotor aircraft. These data reveal that the helicopter industry is responding to customer requirements for a faster, smoother rotorcraft and is building a lighter weight, lower cost aircraft with higher productivity. Implementation of emerging technology in the major subsystems of the helicopter indicates that this trend will continue into the next decade. The impact of this technology on total aircraft productivity is then presented. In addition, it is shown that advanced rotorcraft concepts like the tilt rotor and the tilt fold rotor will benefit even more from emerging technology than the conventional helicopter. Author

A85-31972#

INTEGRATING NEW TECHNOLOGY INTO WEIGHT METHODOLOGY

R. H. SWAN and A. H. SCHMIDT (Boeing Vertol Co., Philadelphia, PA) IN: American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 237-240. refs

An ever present problem is to introduce advanced technology into methods to predict the weight of a new design. Two methods to determine the effects of new technology on rotorcraft weights are given: one for structural boxes, and one for drive system modification. The structural box approach has applications to wings and tails and is unique since only one equation includes the effects of simultaneous bending and torsion loads, rib spacing, and loading intensity. The drive system method uses a detailed but simple weight estimation for each main mesh plus effects of shaft material and number of couplings. These methods are used to modify existing trends to include the effects of new technology. Author

A85-31973#

ADVANCE TECHNOLOGY IMPACTS ON ROTORCRAFT WEIGHT

E. VEGA (Hughes Helicopters, Inc., Technology Dept., Culver City, CA) IN: American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 241-251.

The design of the LHX, the Army's rotorcraft of the future, has provided the helicopter industry with an opportunity to integrate recently developed and newly emerging technologies in a single vehicle. The present investigation is concerned with advances which have been considered by an American aerospace company to achieve reductions in helicopter weight. Attention is given to a revision of weight trending equations in the areas of rotors, structures, propulsion systems, and flight control to accommodate the changes. An example is discussed to illustrate the extensive effect of the considered technological advances on the weight of the AH-64A Advance Helicopter, if it were designed today. This study provides the basis for an evaluation of the impact of the improvements on the LHX helicopter. G.R.

A85-31974#

AN ASSESSMENT OF THE IMPACT OF TECHNOLOGY ON VTOL WEIGHT PREDICTION

D. K. UNSWORTH and J. G. SUTTON (United Technologies Corp., Sikorsky Aircraft Div., Stratford, CT) IN: American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 253-261.

A summary of weight trending methods and methods of accurate prediction of the effects of technological advances on weight for the LHX-family aircraft is presented. Emphasis is placed on the importance of accurately assessing the technological improvements in rotors, control systems, airframe, and propulsion, and on the weight impact of attribute enhancement in such areas as nuclear, biological, and chemical protection. The significance of the concept selection from among high-speed compound helicopters, ABCs, or tilt rotors is also acknowledged, together with the lack of statistical weight data base for any of these. The existing methods of weight prediction are updated and improved, and semianalytical sizing methods and a detailed subsystem weight evaluation method are developed. L.T.

A85-31975#

SOME WEIGHT ASPECTS OF SOVIET HELICOPTERS

W. Z. STEPNIIEWSKI (International Technical Associates, Upper Darby, PA) IN: American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 263-272. refs

In order to provide the necessary background for a better understanding of the weight aspects of Soviet helicopters, some important events in the development of the Soviet school of rotary-wing design are outlined, with appropriate emphasis on the overall weight characteristics of their designs. This is followed by a comparison of relative-weight trends of major components of Western vs. Soviet traditional and hypothetical helicopters. As a corollary to the above, the general philosophy of a Soviet weight-prediction method for major helicopter components is discussed and compared with some Western approaches, while the use of these methods as tools in the structural weight minimization of a transport helicopter is briefly examined. A rudimentary assessment of Soviet efforts to close the productivity gap in their new-generation helicopters, and examination of the role of weight aspects in that process, concludes this presentation. Author

A85-31985#

IMPACT OF MAIN ROTOR TIP GEOMETRY ON MAIN ROTOR/TAIL ROTOR INTERACTION IN HOVER

D. T. BALCH (United Technologies Corp., Sikorsky Aircraft Div., Stratford, CT) IN: American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 349-358. refs

Balch and Saccullo (1983) have presented the results of a study involving the interactions between the main rotor, tail rotor, and fuselage. It was found that the influence of the fuselage on the rotor was a function of the rotor blade twist. The present investigation includes the study of 93 different rotor/tip/tail rotor configurations, taking into account cases in which the fuselage influence was present. Two advanced geometry main rotors were tested with a total of eight tip configurations at three tip Mach numbers, 0.55, 0.6, and 0.65 when operating out of ground effect, and one tip Mach number of 0.6 when operating in ground effect. A number of graphs showing the test data are presented, and the obtained conclusions are discussed. G.R.

A85-31987#

EVALUATION OF A TEN-FOOT DIAMETER X-WING ROTOR

K. R. READER (David W. Taylor Naval Ship Research and Development Center, Bethesda, MD) and W. J. DIXON, JR. (Boeing Vertol Co., Philadelphia, PA) IN: American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 377-387. DARPA-supported research. refs

A 10-ft diameter, Mach-scaled model of a potential full-scale demonstrator aircraft was built and tested to obtain data at tip speed and disk loadings considered to be representative of those required for an operational X-Wing aircraft. A higher harmonic control capability was considered necessary and was a primary factor in the model design. The test program covered most flight regimes including hover, transition, forward flight to conversion speeds, and high advance ratios representing conversion. The paper presents a brief discussion of the circulation control concept, a description of the model, and a discussion of the major aerodynamic test results. Hover shaft power data is presented and compared with the results from a previous model. The low speed transitional flight regime is discussed, and data demonstrating the trim requirement and critical airspeed is presented. A simple algorithm for applying higher harmonic control is included that resulted in flapwise bending moment reductions of nearly eighty percent. Finally, a comparison between test data and analytical predictions is made, and generally good agreement demonstrated. Author

A85-31990#

ANALYTIC AND EXPERIMENTAL VERIFICATION OF THE NOTAR CIRCULATION CONTROL TAIL BOOM

K. M. MORGER (Hughes Helicopters, Inc., Research and Development Div., Culver City, CA) and D. R. CLARK (Analytical Methods, Inc., Bellevue, WA) IN: American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 419-428. refs

This paper addresses the recent analytical modeling and whirl stand testing performed on the NOTAR (No Tail Rotor) demonstrator helicopter's circulation control tail boom. In initial flight tests, the demonstrator aircraft required flow control fences on the tail boom to achieve the desired circulation control performance. This work was performed to find a more fundamental solution than the fences. An initial analytical model describing the demonstrator's flow field was used to develop design solutions to the fences. After testing revealed the full extent of the flow interactions, the model was modified to provide a more complete representation of the flow field. The whirl stand tests showed that the flow coming off the fuselage interfered with the tail boom's efficiency and that the demonstrator's single, uniform slot was not optimum for all configurations tested. These results imply the solution to NOTAR demonstrator's tail boom inefficiency will be from design changes that eliminate fuselage/tail boom interference and that distribute blowing along the slot(s) to minimize longitudinal pressure gradients. Author

A85-31994*# Cincinnati Univ., Ohio.

ON-LINE DETERMINATION OF OPTIMAL FLIGHT PATHS FOR HELICOPTERS

G. L. SLATER (Cincinnati, University, Cincinnati, OH) and M. STOUGHTON IN: American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 461-470. refs (Contract NAG2-175)

A procedure for computing fuel optimal fixed range trajectories is developed for helicopters. The algorithm uses a simplified dynamic model and a climb-cruise-descent assumption which simplifies the variational problem to an algebraic minimization. Development of the performance model is discussed extensively and representative results for the S-61 and S-76 helicopters are presented. The results show that the model and optimization algorithm are small enough and simple enough to be incorporated into an on-line optimization algorithm. Author

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A85-31996#

A DESIGN METHODOLOGY FOR A COMPLIANT MATRIX COMPOSITE BEARINGLESS MAIN ROTOR

C. J. SADDLER and D. L. HAWKINGS (Westland Helicopters, Ltd., Yeovil, Somerset, England) IN: American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 481-488.

A design methodology is described which performs the preliminary design of a compliant matrix composite bearingless main rotor flexure. For a given set of material elastic properties and rotor geometry constraints the methodology generates a flexure design that satisfies prescribed dynamic characteristics. Overall stresses are computed for supplied design load cases and compared with predicted material strength properties. The methodology is illustrated by application to an example problem.

Author

A85-31997#

ARE TWO ALWAYS BETTER THAN ONE?

S. A. HANVEY and C. A. PARLIER (Hughes Helicopters, Inc., Mesa, AZ) IN: American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 489-494.

The tradeoffs associated with the number of engines and pilots and the type of survivability for the U.S. Army's Light Helicopter (LHX) program are examined. The main variables involved in the design of the rotorcraft, which is intended for both scout/light attack and utility purposes, are: 1 vs 2 pilots, 1 vs 2 engines (single T700X at 2000 SHP or twin PLT-34B1 at 1000 SHP each), extraction system, and the associated changes in the weight, drag, and cost of the aircraft. An analysis of the operational desirability of various combinations points to the optimal combination being that of a single engine with an extraction system.

L.T.

A85-31998#

ADVANCED TECHNOLOGY IMPACT ON LHX HELICOPTER PRELIMINARY DESIGN

J. P. ROGERS, R. A. SHINN, and R. L. SMITH (U.S. Army, Directorate for Advanced Systems, St. Louis, MO) IN: American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 495-505. refs

The impact of advanced technology on LHX size and weight was investigated by conducting preliminary design studies for conventional helicopter configurations with 1970's technology and with technology levels planned for LHX. Advanced technologies considered include composite structures, the ATE engine, digital/optical flight controls, advanced mission equipment package, integrated/automated cockpit, and the ITR rotor. The predicted effect of individual advanced technologies on LHX weight and performance is presented. Then the integrated effect of across-the-board application of advanced technology on LHX helicopter preliminary design sizing is presented. The results demonstrate that the successful incorporation into LHX of all aspects of advanced rotorcraft technology is vital to the achievement of its stringent weight and cost goals.

Author

A85-31999#

JVX DESIGN UPDATE

S. MARTIN, JR. (Bell Helicopter Textron, Fort Worth, TX) and W. B. PECK (Boeing Vertol Co., Philadelphia, PA) IN: American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 507-517.

The JVX vertical lift tiltrotor is a multiservice, multimission aircraft suitable for both military missions and commercial roles. Currently in the Preliminary Design phase, it uses the advanced but mature technologies of composite structures, digital fly-by-wire flight controls, and digital multiplexed avionics to make a highly capable and efficient aircraft. The on-going effort combines wind tunnel tests, flight simulation, structural tests, mockups, trade studies, and a strong Systems Engineering and Logistics Analysis effort. Results of these tasks are becoming available and are confirming

the capabilities of the JVX. The Full-Scale Development phase is scheduled to commence in 1985, and first production deliveries will take place in 1991.

Author

A85-32002*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

AEROMECHANICAL STABILITY OF A FULL-SCALE HINGELESS ROTOR IN HOVER

R. L. PETERSON, W. WARMBRODT (NASA, Ames Research Center, Moffett Field, CA), and J. HOOVER (Boeing Vertol Co., Philadelphia, PA) IN: American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 559-571. refs

The aeroelastic stability in hover of a 9.8-m-diam, hingeless helicopter rotor system is evaluated. Rotor inplane damping data were obtained for rotor operation between 350 and 425 rpm for thrust coefficients between 0.0 and 0.12. At constant rotor rotational speed, a minimum inplane damping level was obtained at a thrust coefficient of approximately 0.02. At constant rotor thrust, a minimum in rotor inplane damping was measured at 400 rpm. Correlation with a comprehensive aeroelastic stability program is found to be good. The influence of different aerodynamic inflow models on predicted damping levels is shown. Best correlation with experimental data is obtained using a dynamic inflow model rather than static or quasi-static inflow models. Comparison with other full-scale, hingeless rotor stability data in hover is presented. Also, direct comparisons are made with data from a full-scale bearingless main rotor test performed on the same general-purpose test apparatus. Although the bearingless rotor is more highly damped at design tip speed and 1-g thrust operation, greater sensitivity to operating conditions is shown.

Author

A85-32003#

PITCH-FLAP-LAG INSTABILITY OF ELASTIC MODES OF AN ARTICULATED ROTOR BLADE

J. R. NEFF (Hughes Helicopters, Inc., Culver City, CA) IN: American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 573-579. refs

Details of a main rotor blade instability encountered during flight test of an instrumented experimental helicopter are presented in this paper. The unstable mode was observed to be the first elastic chordwise mode coupled with the second elastic flapwise mode and with the first reactionless torsion mode. An analytical simulation using the DART structural analysis program gave good correlation with the observed frequency and damping, and was therefore used to define a modified blade configuration that eliminated the instability throughout the flight envelope of the helicopter. Flight tests confirmed the stability of the modified blade design. Details of the analytical investigation, including the effects of significant design factors such as weight, stiffness, and chordwise c.g., and of rotor trim, are presented. Particular attention is given to inter-relations between chordwise bending, flapwise bending, and torsional frequencies and chordwise c.g. distribution. The analytical procedures developed during the investigation discussed above were subsequently applied to the design of a new rotor for a similar helicopter. Flight tests confirmed that the design was aeroelastically stable over the entire flight envelope. Details of this program are also presented.

Author

A85-32004*# United Technologies Research Center, East Hartford, Conn.

DEVELOPMENT AND EVALUATION OF A GENERIC ACTIVE HELICOPTER VIBRATION CONTROLLER

M. W. DAVIS (United Technologies Research Center, East Hartford, CT) IN: American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 581-595. refs (Contract NAS2-11260)

A computerized generic active controller is developed, which alleviates helicopter vibration by closed-loop implementation of higher harmonic control (HHC). In the system, the higher harmonic blade pitch is input through a standard helicopter swashplate; for

a four-blade helicopter rotor the 4/rev vibration in the rotorcraft is minimized by inducing cyclic pitch motions at 3, 4, and 5/rev in the rotating system. The controller employs the deterministic, cautious, and dual control approaches and two linear system models (local and global), as well as several methods of limiting control. Based on model testing, performed at moderate to high values of forward velocity and rotor thrust, reductions in the rotor test apparatus vibration from 75 to 95 percent are predicted, with HHC pitch amplitudes of less than one degree. Good performance is also noted for short-duration maneuvers. L.T.

A85-32011**A MISSION ORIENTED APPROACH TO COCKPIT DESIGN AS APPLIED TO OBSERVATION AND ATTACK HELICOPTERS**

R. R. TAYLOR and E. R. POOLE (Bell Helicopter Textron, Fort Worth, TX) American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Paper. 11 p.

A description is provided of a mission and task analysis methodology which has been developed and refined over a number of years. The methodology is built on human engineering techniques specified in MIL-H-56855. Analytical techniques are combined from Operational Research, Systems Engineering, and Human Engineering to provide the requisite capability for analyzing a total mission environment. It is pointed out that the results of these analyses, when applied to a design problem in a timely manner, can help the designers to produce a helicopter cockpit and systems suite which will optimize human and helicopter systems performance. G.R.

A85-32016* Systems Technology, Inc., Mountain View, Calif.

SIMULATION VALIDATION OF THE XV-15 TILT-ROTOR RESEARCH AIRCRAFT

S. W. FERGUSON, G. D. HANSON (Systems Technology, Inc., Mountain View, CA), and G. B. CHURCHILL (NASA, Ames Research Center, Moffett Field, CA) American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Paper. 23 p. refs

The results of a simulation validation program of the XV-15 tilt-rotor research aircraft are detailed, covering such simulation aspects as the mathematical model, visual system, motion system, cab aural system, cab control loader system, pilot perceptual fidelity, and generic tilt rotor applications. Simulation validation was performed for the hover, low-speed, and sideward flight modes, with consideration of the in-ground rotor effect. Several deficiencies of the mathematical model and the simulation systems were identified in the course of the simulation validation project, and some were corrected. It is noted that NASA's Vertical Motion Simulator used in the program is an excellent tool for tilt-rotor and rotorcraft design, development, and pilot training. L.T.

A85-32110**REMOTELY PILOTED AIRCRAFT FOR SMALL FORMAT AERIAL PHOTOGRAPHY**

G. F. TOMLINS and M. J. MANORE (B.C. Research, Vancouver, Canada) IN: Canadian Symposium on Remote Sensing, 8th, and Association Quebecoise de Teledetection, Congress, 4th, Montreal, Canada, May 3-6, 1983, Proceedings. Sainte-Foy, Quebec, Canada, Association Quebecoise de Teledetection, 1984, p. 127-136. Research supported by the Ministry of Universities, Science and Communications of British Columbia. refs

The use of Remotely Piloted Aircraft (RPA) to acquire small-format aerial photography is discussed. Project AERIE (Airborne Equipment for Remote Imaging of the Environment), a research and development program which examines the feasibility, advantages, and limitations of using RPA systems in civil remote-sensing applications is described. A 2.7-m span fixed-wing model aircraft which carries a remotely operated 35-mm camera system is used as a platform for small-format aerial photography. The RPA is used in a variety of applications including forestry, pollution detection, wildlife-habitat monitoring, real estate and publicity, and shoreline mapping. The results obtained during demonstration studies undertaken in 1982 are reported. Some advantages of RPA include low-noise levels, and low-speed and

low-altitude capabilities. The development of a new airframe and command system which provides a solution to the most severe operational limitations is considered. M.D.

A85-32344**ACTIVE VIBRATION SUPPRESSION OF A CANTILEVER WING**

L. MEIROVITCH (Virginia Polytechnic Institute and State University, Blacksburg, VA) and L. M. SILVERBERG (TRW, Inc., TRW Space and Technology Group, Redondo Beach, CA; Virginia Polytechnic Institute and State University, Blacksburg, VA) Journal of Sound and Vibration (ISSN 0022-460X), vol. 97, Dec. 8, 1984, p. 489-498. refs

A method for the active vibration suppression of a cantilever wing is presented. The approach is based on modal control, in which a modal feedback control law relating the motion of the control surfaces to the controlled modes is implemented. Modal displacements and velocities required for feedback are extracted from sensor measurements by means of modal filters. A numerical example is presented. Author

A85-32584*# National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.

DESIGN OF A FLUTTER SUPPRESSION SYSTEM FOR AN EXPERIMENTAL DRONE AIRCRAFT

J. R. NEWSOM, I. ABEL (NASA, Langley Research Center, Hampton, VA), and A. S. POTOTZKY (Kentron International, Inc., Hampton, VA) (Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 2, p. 564-576) Journal of Aircraft (ISSN 0021-8669), vol. 22, May 1985, p. 380-386. Previously cited in issue 12, p. 1702, Accession no. A83-29868. refs

A85-32588#**FLIGHT-TEST EVALUATION OF ENGINE POWER EFFECTS ON LIFT AND DRAG**

T. R. YECHOUT (U.S. Air Force Academy, Colorado Springs, CO), W. G. SCHWEIKHARD (Kanasa, University, Lawrence, KS), and K. B. BRAMAN Journal of Aircraft (ISSN 0021-8669), vol. 22, May 1985, p. 409-414. Previously cited in issue 06, p. 720, Accession no. A84-18166. refs

A85-32780*# Integrated Systems, Inc., Palo Alto, Calif.

OPTIMAL SYMMETRIC FLIGHT WITH AN INTERMEDIATE VEHICLE MODEL

P. K. A. MENON (Integrated Systems, Inc., Palo Alto, CA; Virginia Polytechnic Institute and State University, Blacksburg, VA), H. J. KELLEY, and E. M. CLIFF (Virginia Polytechnic Institute and State University, Blacksburg, VA) (Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, Collection of Technical Papers, p. 548-558) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 8, May-June 1985, p. 312-319. Previously cited in issue 19, p. 2798, Accession no. A83-41715. refs (Contract NAG1-203)

A85-32781*# Air Force Rocket Propulsion Lab., Edwards AFB, Calif.

ONBOARD NEAR-OPTIMAL CLIMB-DASH ENERGY MANAGEMENT

A. WESTON (USAF, Rocket Propulsion Laboratory, Edwards AFB, CA; Virginia Polytechnic Institute and State University, Blacksburg, VA), G. CLIFF, and H. KELLEY (Virginia Polytechnic Institute and State University, Blacksburg, VA) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 8, May-June 1985, p. 320-324. refs (Contract NAG1-203)

This paper studies optimal and near-optimal trajectories of high-performance aircraft in symmetric flight. Onboard, real-time, near-optimal guidance is considered for the climb-dash mission, using some of the boundary-layer structure and hierarchical ideas from singular perturbations. In the case of symmetric flight, this resembles neighborhood-optimal guidance using energy-to-go as the running variable. However, extension to three-dimensional flight is proposed, using families of nominal paths with heading-to-go

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as the additional running variable. Some computational results are presented for the symmetric case. Author

A85-32800 **RADIAL TIRES UNDERGO OPERATIONAL TESTS ON MILITARY, CIVIL AIRCRAFT**

K. F. MORDOFF Aviation Week and Space Technology (ISSN 0005-2175), vol. 122, April 29, 1985, p. 177-179.

Positive features and trial results with radial tires on the landing gear of military A10 and several commercial aircraft are described. It is expected that radials will provide increased life, reduced weight and high load-carrying capability. The handling characteristics have seemed equivalent to those of conventional tires to pilots of 40 A10 aircraft. Projected costs savings of \$13,000 on fuel have been projected for the A300 due to a weight savings of 640 lb total for eight tires. The test tires aren't pulled off for inspection until 500 landings, compared to 350-400 landings before wear out for conventional tires. The FAA will require certification tests of radials on all aircraft types on which they are mounted to expose any detrimental effects on landing gear systems. M.S.K.

A85-32842 **AN ADVANCED SHORT RANGE AIRLINER DESIGN PROJECT**

J. FIELDING (Cranfield Institute of Technology, Cranfield, Beds., England) Aerospace (UK) (ISSN 0305-0831), vol. 12, April 1985, p. 11-16.

The results of a student project to produce a workable design of an advanced short range transport aircraft which satisfies noise pollution abatement, operating cost and fuel consumption requirements of current new designs are presented. The goal was to replace the 727 in the 150 passenger class. The students were required to consider space and weight for amenities and cargo, a 1000 mi range, Mach 0.83 flight, 39,000 ft cruise, and a 6000 ft maximum runway length. Advanced composites were designated wherever possible, and a high aspect ratio was chosen to improve flight performance and efficiency. The overall design was judged a good demonstration that the students had developed practicable design skills. M.S.K.

A85-32847 **AEROELASTIC STABILITY ANALYSIS OF A COMPOSITE ROTOR BLADE**

I. CHOPRA (Maryland, University, College Park, MD) and C.-H. HONG American Helicopter Society, Journal (ISSN 0002-8711), vol. 30, April 1985, p. 57-67. refs (Contract DAAG29-83-K-0002)

The aeroelastic stability of flap bending, lead-lag bending and torsion of a composite rotor blade in hover is shown to be strongly influenced by structural coupling terms which depend on fibers orientation. This effect is investigated using a finite element theory based on Hamilton's principle. Stiffness coupling terms caused by bending-torsion and extension-torsion couplings are identified. Quasi-steady strip theory is used to obtain aerodynamic forces. The flutter solution is calculated assuming blade motions to be small perturbations about the steady solution, and the normal mode approach based on coupled vibration modes is used. Numerical results are calculated for selected structural configurations, categorized as symmetric and antisymmetric according to the lay-up of laminae on opposing flanges. A systematic study is made to identify the importances of the stiffness coupling terms on blade dynamic stability with changing fiber orientation and for different configurations. Author

A85-32947 **STRUCTURES FOR 21ST CENTURY AIRCRAFT EXAMINED**

J. H. BRAHNEY Aerospace Engineering (ISSN 0736-2536), vol. 5, May 1985, p. 8-13.

Several aircraft passive and active structural design features are being studied to identify those offering enhanced control, maneuverability, flight efficiency and thermal damage resistance. Laminar flow control devices governed by computers processing gust probe data deflect leading and trailing edge control surfaces to alleviate gust forces and eliminate the boundary layer which

directs turbulence onto aircraft surfaces. NASA has been examining flutter suppression by outboard ailerons and a flying stabilizer on a L1011, and also employs a Firebee drone to investigate various flight configurations. The HIMAT (Highly Maneuverable Aircraft Technology) aircraft, a close coupled canard aircraft with advanced airfoil design and aeroelastic tailoring is composed one-third by weight of composites and has wings which change shape in response to aerodynamic loads. Critical research areas to accommodate projected aircraft performance and speed capabilities are high temperature polyimides, carbon/carbon composites and metallic alloys for the external skins and engine parts for Mach 2, 3 over 3.5 and hypersonic aircraft. M.S.K.

N85-22351*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

SPACE SHUTTLE PILOT-INDUCED-OSCILLATION RESEARCH TESTING

B. G. POWERS *In* AGARD Ground and Flight Testing for Aircraft Guidance and Control 7 p Dec. 1984 refs Original language document was announced as N84-20566
Avail: NTIS HC A09/MF A01 CSCL 01C

The simulation requirements for investigation of pilot-induced-oscillation (PIO) characteristics during the landing phase are discussed. Orbiters simulations and F-8 digital fly-by-wire aircraft tests are addressed. Author

N85-22356*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

A FLIGHT MANAGEMENT ALGORITHM AND GUIDANCE FOR FUEL-CONSERVATIVE DESCENTS IN A TIME-BASED METERED AIR TRAFFIC ENVIRONMENT: DEVELOPMENT AND FLIGHT TEST RESULTS

C. E. KNOX *In* AGARD Ground and Flight Testing for Aircraft Guidance and Control 17 p Dec. 1984 refs
Avail: NTIS HC A09/MF A01 CSCL 01C

A simple airborne flight management descent algorithm designed to define a flight profile subject to the constraints of using idle thrust, a clean airplane configuration (landing gear up, flaps zero, and speed brakes retracted), and fixed-time end conditions was developed and flight tested in the NASA TSRV B-737 research airplane. The research test flights, conducted in the Denver ARTCC automated time-based metering LFM/PD ATC environment, demonstrated that time guidance and control in the cockpit was acceptable to the pilots and ATC controllers and resulted in arrival of the airplane over the metering fix with standard deviations in airspeed error of 6.5 knots, in altitude error of 23.7 m (77.8 ft), and in arrival time accuracy of 12 sec. These accuracies indicated a good representation of airplane performance and wind modeling. Fuel savings will be obtained on a fleet-wide basis through a reduction of the time error dispersions at the metering fix and on a single-airplane basis by presenting the pilot with guidance for a fuel-efficient descent. Author

N85-22359# Industrieanlagen-Betriebsgesellschaft m.b.H., Otobrunn (West Germany).

AIR COMBAT SIMULATION: METHODS, MODELS, TRENDS

G. WUNDERLICH and H. P. FEHRENTZ *In* AGARD Ground and Flight Testing for Aircraft Guidance and Control 17 p Dec. 1984 refs

Avail: NTIS HC A09/MF A01

Various methods are described briefly to evaluate weapon system parameters needed during air combat. The influences and connections between unmanned and manned combat simulation are derived as well as the main differences between 1 vs 1 and m vs n combat including relevant pilot behavior. Finally unmanned and manned m/n air combat simulations are described and it is shown how both methods support each other thus broadening the validity of application and results. Author

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N85-22360# Societe Nationale Industrielle Aerospatiale, Marignane (France.) Avionics and Systems Group.
GROUND EVALUATION OF HELICOPTER AIR-TO-AIR WARFARE

G. CATANI *In* AGARD Ground and Flight Testing for Aircraft Guidance and Control 13 p Dec. 1984

Avail: NTIS HC A09/MF A01

Air to air capability has become a necessity for armed helicopters. The simulation models allow theoretical evaluation of given air to air fire controls through a large area of air to air scenarios. During definition phases, they represent a powerful means of building and ground testing every fire control. On the other hand increased efficiency during development phases makes it possible to avoid expensive in-flight tests of non-optimized systems. Simple gun pilot fire control systems and definition and evaluation of complex gun/missile fire control systems were described. B.G.

N85-22362*# National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.

AIRLAB: A LABORATORY FOR FLIGHT-CRUCIAL-ELECTRONICS SYSTEM RESEARCH

H. M. HOLT, D. G. HOLDEN, and A. O. LUPTON *In* AGARD Ground and Flight Testing for Aircraft Guidance and Control 12 p Dec. 1984 refs

Avail: NTIS HC A09/MF A01 CSCL 01C

A new laboratory, AIRLAB, recently completed at the NASA Langley Research Center was developed as a focus for conducting research on fault-tolerant electronic systems for flight-critical applications. The laboratory was conceived and implemented to enhance the utilization of aeronautical research for improving the performance of future aerospace vehicles. Advanced vehicles will require highly reliable digital electronic systems to perform flight-critical functions which if lost, would cause total failure of the vehicle. Techniques to form the basis for a validation methodology that can be used to determine the performance and reliability of advanced digital systems are being developed. Included are the development of analytical models, emulation techniques, and experimental procedures. The techniques and methods are verified using these specimens of fault-tolerant computers and systems and the capabilities of AIRLAB. Author

N85-22377 Mississippi State Univ., Mississippi State.
DETERMINATION OF AERODYNAMIC AND PROPULSION PARAMETERS OF GENERAL AVIATION AIRCRAFT USING STEADY STATE FLIGHT TEST DATA Ph.D. Thesis

M. SABZEHBARVAR 1984 70 p

Avail: Univ. Microfilms Order No. DA8428151

The feasibility of identifying concurrently an aircraft's propulsive efficiency and aerodynamic drag parameters using the Gradient Search technique along with the application of Lock's propeller model was studied. The primary task was to perform a curve fitting process to represent the propeller blade lift and drag coefficients calculated by the extensive work that Lock conducted during the 1930's and 1940's. It was found that an iterative analysis was useful to reduce all the propeller chart interpolation into a numerical interpolation. The Gradient Search method was used to estimate the performance parameters because of stable convergence and its ability to handle the poor initial value guesses. For the present investigation, initial parameter guesses up to fifty percent off the actual values were tried and convergence was obtained within an accuracy of 2.0 percent in about fifty iterations. This parameter identification technique requires only steady state measurement of propeller blade angle and RPM, aircraft weight, speed, rate of climb, and atmospheric density. Dissert. Abstr.

N85-22378*# Lockheed-California Co., Burbank.

STUDY FOR THE OPTIMIZATION OF A TRANSPORT AIRCRAFT WING FOR MAXIMUM FUEL EFFICIENCY. VOLUME 1: METHODOLOGY, CRITERIA, AEROELASTIC MODEL DEFINITION AND RESULTS Final Report

N. A. RADOVICICH, D. DREIM, D. A. OKEEFE, L. LINNEN, S. K. PATHAK, J. S. REASER, D. RICHARDSON, J. SWEERS, and F. CONNER Jan. 1985 356 p refs

(Contract NAS1-16794)

(NASA-CR-172551; NAS 1.26:172551) Avail: NTIS HC A16/MF A01 CSCL 01C

Work performed in the design of a transport aircraft wing for maximum fuel efficiency is documented with emphasis on design criteria, design methodology, and three design configurations. The design database includes complete finite element model description, sizing data, geometry data, loads data, and inertial data. A design process which satisfies the economics and practical aspects of a real design is illustrated. The cooperative study relationship between the contractor and NASA during the course of the contract is also discussed. A.R.H.

N85-22380*# National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.

A DESCRIPTION OF THE LANGLEY WIREFRAME GEOMETRY STANDARD (LAWGS) FORMAT

C. B. CRAIDON Feb. 1985 45 p refs

(NASA-TM-85767; Z-2; NAS 1.15:85767) Avail: NTIS HC A03/MF A01 CSCL 01A

The background leading to the adoption of a Langley Research Center wireframe geometry format standard, a detailed description of the standard, and recommendations for use of the standard is given. The standard chosen is flexible enough to describe almost any complex shape. Author

N85-22381*# National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.

APPROACH FOR SERVICE LIFE EXTENSION OF EXPLOSIVE DEVICES FOR AIRCRAFT ESCAPE SYSTEMS

L. J. BEMENT and M. L. SCHIMMEL (McDonnell Aircraft Co., St. Louis, Mo.) Feb. 1985 23 p refs

(NASA-TM-86323; NAS 1.15:86323) Avail: NTIS HC A02/MF A01 CSCL 01C

The service life evaluation of explosive devices used in a wide variety of aircraft escape systems is described. The purpose was to develop a service extension approach, supported by tests on candidate devices, to evaluate the effects of service, age, and degradation, and allow responsible, conservative, service life determinations. An overview is given on the recommended approach and experimental procedures for accurate service evaluations with test results on rigid and flexible explosive transfer lines, one-way transfers, and flexible linear shaped charges. Author

N85-22382*# Georgia Inst. of Tech., Atlanta. Center for Rotary Wing Aircraft Technology.

SIMPLE THEORETICAL MODELS FOR COMPOSITE ROTOR BLADES Final Report

R. R. VALISETTY and L. W. REHFELD Nov. 1984 35 p refs

(Contract NAG1-398)

(NASA-CR-175620; NAS 1.26:175620) Avail: NTIS HC A03/MF A01 CSCL 01C

The development of theoretical rotor blade structural models for designs based upon composite construction is discussed. Care was exercised to include a member of nonclassical effects that previous experience indicated would be potentially important to account for. A model, representative of the size of a main rotor blade, is analyzed in order to assess the importance of various influences. The findings of this model study suggest that for the slenderness and closed cell construction considered, the refinements are of little importance and a classical type theory is adequate. The potential of elastic tailoring is dramatically demonstrated, so the generality of arbitrary ply layup in the cell wall is needed to exploit this opportunity. Author

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N85-22383# Nielsen Engineering and Research, Inc., Mountain View, Calif.

PRELIMINARY DEVELOPMENT OF AN APPROXIMATION PROCEDURE FOR SUPERCRITICAL WING DESIGN OPTIMIZATION APPLICATIONS Final Report, 1 Jul. 1981 - 1 Nov. 1984

S. S. STAHARA 28 Dec. 1984 47 p

(Contract N00014-81-C-0557)

(AD-A150177; NEAR-TR-337) Avail: NTIS HC A03/MF A01 CSCL 20D

An investigation was carried out involving the preliminary development of an approximation procedure and associated computational codes for rapidly determining approximations to nonlinear, three-dimensional flow solutions, with the purpose of establishing a method for minimizing the computational work requirements associated with design optimization studies of supercritical wings. The results here concern the extension of a previously-developed successful approximation method for determining accurate approximations to two-dimensional nonlinear transonic flows involving the simultaneous change of multiple geometric and/or aerodynamic parameters. The specific development involves combination of the nonlinear approximation procedure with the FLO22 three-dimensional wing transonic flow solver together with the CONMIN optimization program in a configuration suitable for supercritical wing design/optimization studies. GRA

N85-22384# Joint Publications Research Service, Arlington, Va. **CHINA REPORT: SCIENCE AND TECHNOLOGY**

26 Mar. 1984 37 p refs Transl. into ENGLISH from various Chinese articles

(JPRS-CST-84-008) Avail: NTIS HC A03/MF A01

An improved general purpose transport aircraft is described. Other areas of discussion are: Optimal design projects of various sizes in Shanghai; Research in microcirculation; Hemorrhagic fever research; Need for develop research on eugenics; and Organ transplants.

N85-22385# Joint Publications Research Service, Arlington, Va. **IMPROVED Y-11 GENERAL-PURPOSE TRANSPORT DESIGNATED Y-12**

X. WENJIE *In its* China Rept.: Sci. and Technol. (JPRS-CST-84-008) p 3-8 26 Mar. 1984 refs Transl. into ENGLISH from Guoji Hangkong (Beijing, China), no. 12, 5 Dec. 1983 p 2-4

Avail: NTIS HC A03/MF A01

After extensive market research and analysis, certain improvements to the 'Y-11' so its performance can meet a wider range of additional requirements were made. This improved model is the 'Y-12' general purpose aircraft. The development plan of the 'Y-12' was finalized, actual design, and manufacturing and assembly of three prototypes began. The first successful flight of the 'Y-12' took place and at the present time, two of the aircraft are being used in full scale flight tests, and small scale production has begun. The improved specifications are given and discussed. E.R.

N85-22784# Joint Publications Research Service, Arlington, Va. **REDESIGN OF FUSELAGE COMPARTMENTS BY METHOD OF SPECIAL CONTOURS** Abstract Only

F. K. CHISTYAKOV, V. V. NAYKHANOV, and A. A. DUBANOV *In its* USSR Rept.: Eng. and Equipment (JPRS-UEQ-85-003) p 1-2 12 Mar. 1985 Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved.: Aviats. Tekhn. (Kazan, USSR), no. 1, Jan. - Mar. 1984 p 106-108

Avail: NTIS HC A06

The method of a special contour, useful in computer-aided aircraft design, is also applicable to iterative redesign of fuselage compartments with correction and adjustment of aerodynamic surfaces. On the basis of relevant geometrical relations, such a redesign of an already laid out fuselage compartment is shown to be possible by a purely mathematical procedure without introduction of any new method. This is demonstrated on a typical fuselage

compartment which occupies the sector between ribs 3 and 7, thus spanning three intermediate ribs, bounded by the plane of maximum width and a meridional plane. Author

N85-22817# Joint Publications Research Service, Arlington, Va. **NORMAL MODE CALCULATIONS FOR FUSELAGE TYPE INTRICATE STRUCTURES BY REGARDING THEM AS SYSTEMS WITH SUPERPOSED CONSTRAINTS** Abstract Only

V. BORISOV *In its* USSR Rept.: Eng. and Equipment (JPRS-UEQ-85-003) p 43 12 Mar. 1985 Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved.: Aviats. Tekhn. (Kazan, USSR), no. 1, Jan. - Mar. 1984 p 102-105

Avail: NTIS HC A06

Calculations of the normal modes of intricate structures in the fuselage class are considered, these structures are systems with superposed constraints. Two groups of constraints are imposed, one limiting vibrations in all solid body modes and one limiting vibrations in k fundamental elastic modes. The corresponding two independent systems of equations are solved by iteration of matrices or by iteration of the subspace, the algorithm of the first method looping once for each matrix and the algorithm of the second method having a single loop. The latter is superior because it includes simultaneous refinement of the fundamental modes and frequencies, but its effectiveness is limited by capabilities of the computer and standard programs. A preferable hybrid two-loop algorithm is proposed, the first loop dealing with all solid body modes and the second loop dealing with only the k fundamental elastic modes. E.A.K.

N85-23691# Joint Publications Research Service, Arlington, Va. **DEPUTY MINISTER ON CIVIL AVIATION FUEL CONSERVATION EFFORTS**

I. MASHKIVSKIY *In its* USSR Rept.: Transportation (JPRS-UTR-85-005) p 10-14 25 Mar. 1985 Transl. into ENGLISH from Vozdushnyy Transport (Moscow), 22 Jan. 1985 p 2

Avail: NTIS HC A05/MF A01

The final year of the 11th Five-Year Plan is 1985. The major and vital tasks which civil aviation workers have to resolve were taken up in detail. The most important feature of the 1985 plan is the high rate of production intensification. The entire increase in the volume of operations must be ensured by increasing flight productivity and by reducing the proportionate consumption of aviation fuel. Author

N85-23750*# National Aeronautics and Space Administration, Washington, D. C.

THE DESIGN OF HIGH-PERFORMANCE GLIDERS

B. MUELLER and V. HEUERMANN Mar. 1985 24 p Transl. into ENGLISH from "Auslegung von Hochleistungssegelflugzeugen" rept. DGLR-T-83-01 DGLR, Bonn, 1983 presented at Symp. on Probl. and Develop. Trends in Gen. Aviation, 1983 p 41-61 Symp. held in Friedrichshafen, West Germany, 24-25 Mar. 1983 Original language document was announced in IAA as A84-15408 Transl. by Scientific Translation Service, Santa Barbara, Calif.

(NASA-TM-77772; NAS 1.15:77772; DGLR-T-83-01) Avail: NTIS HC A02/MF A01 CSCL 01C

A high-performance glider is defined as a glider which has been designed to carry the pilot in a minimum of time a given distance, taking into account conditions which are as conveniently as possible. The present investigation has the objective to show approaches for enhancing the cross-country flight cruising speed, giving attention to the difficulties which the design engineer will have to overcome. The characteristics of the cross-country flight and their relation to the cruising speed are discussed, and a description is provided of mathematical expressions concerning the cruising speed, the sinking speed, and the optimum gliding speed. The effect of aspect ratio and wing loading on the cruising speed is illustrated with the aid of a graph. Trends in glider development are explored, taking into consideration the design of laminar profiles, the reduction of profile-related drag by plain flaps, and the variation of wing loading during the flight. A number of

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suggestions are made for obtaining gliders with improved performance. G.R.(IAA)

N85-23751*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
DESIGN CONSIDERATIONS FOR HIGH-ALTITUDE, LONG-ENDURANCE, MICROWAVE-POWERED AIRCRAFT M.S. Thesis - George Washington Univ., Washington, D.C.
H. Q. NGUYEN (George Washington Univ., Washington, D.C.) Apr. 1985 136 p refs
(NASA-TM-86403; NAS 1.15:86403) Avail: NTIS HC A07/MF A01 CSCL 01C

The sizing and performance analyses have been conducted in the design of long-endurance, high-altitude airplanes. These airplanes receive power either continuously beamed from a phased array transmitter or intermittently beamed from a dish transmitter. Results are presented for the cases of flight in zero wind speed and nonzero wind speed. Sensitivity studies indicate that the vehicle size is relatively insensitive to changes in the transmitter size. Cost estimates were made using models that excluded the airplane cost. Using a reference payload, results obtained from array and dish configurations were compared. Comparisons showed savings in cost as well as smaller vehicle sizes when an array transmitter was used. Author

N85-23752*# George Washington Univ., Washington, D.C. School of Engineering and Applied Science.
A RESEARCH PROGRAM IN ACTIVE CONTROL/AEROELASTICITY Semiannual Status Report, Oct. 1984 - Apr. 1985
Sep. 1984 9 p
(Contract NAG1-199)
(NASA-CR-175674; NAS 1.26:175674) Avail: NTIS HC A02/MF A01 CSCL 01C

Research activities concerning active control aeroelasticity are discussed. In aeroservoelastic system design of a flexible aircraft, it is often necessary to obtain specified steady state structural dynamic response and to maintain stability margins at both the plant (aircraft) input and output. The research during the present period is discussed. Steady state structural dynamic response constraints and gradients were formulated. Incorporation of the design software as an update to the PADLOCS synthesis software was examined. The stability margin improvement technique at both the plant input and output using singular value properties and constrained optimization method was validated. B.W.

N85-23753*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
RELATIVE CONTROL EFFECTIVENESS TECHNIQUE WITH APPLICATION TO AIRPLANE CONTROL COORDINATION
F. J. LALLMAN Apr. 1985 18 p refs
(NASA-TP-2416; L-15864; NAS 1.60:2416) Avail: NTIS HC A02/MF A01 CSCL 01C

A method to select optimal combinations of the control variables of a linear system is reported. The combinations are chosen so that the control channels have their principal influences on selected fundamental modes of the system. A series of algebraic maximization problems is used to maximize the effects of the control channels on selected modes while simultaneously minimizing the effects on the remaining modes. The method is applied to the lateral and directional control of a linearized airplane model having ailerons, a rudder, and differential tail surfaces. Integration of these control eliminates oscillations present in the roll rate for a step lateral-control input and improves the sideslip response with reduced rolling motions for a step directional-control input. Inclusion of thrust-vectoring engine nozzles improves the roll rate capability of the airplane. E.A.K.

N85-23754*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SIMULATION OF AIRCRAFT BEHAVIOUR ON AND CLOSE TO THE GROUND

A. G. BARNES (British Aerospace Plc, Preston, England) and T. J. YAGER Loughton, England AGARD Jan. 1985 66 p refs
(NASA-TM-87460; NAS 1.15:87460; AGARD-AG-285; ISBN-92-835-1490-4; AD-A153320) Avail: NTIS HC A04/MF A01 CSCL 01C

A guide to the current state of the technology of simulating fixed-wing aircraft handling qualities and performance on or close to the ground is presented and pitfalls which may prevent an adequate implementation are indicated. The scope of possible applications in both aircraft design work and pilot training is considered and the requirements for mathematical model definitions and implementations are discussed. The current requirements for visual and motion systems, cockpit cueing, and software modelling are also reviewed, and illustrated with specific examples in areas of aircraft research and development studies and pilot training uses. Needs for further improvements and additional data acquisition are identified. Author

N85-23757*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
IMPACT STUDIES OF A 1/3-SCALE MODEL OF AN AIR CUSHION VEHICLE

R. H. DAUGHERTY Apr. 1985 24 p refs
(NASA-TM-86360; L-15916; NAS 1.15:86360) Avail: NTIS HC A02/MF A01 CSCL 01C

An experimental investigation was conducted to determine the effects of various parameters of the impact performance of a 1/3-scale dynamic model of an air cushion vehicle. Impact response was determined by measuring the maximum values of variables, including sidelobe, front lobe, and cavity pressures, normal acceleration, pitch and roll angles, and vertical displacement during impact, for various combinations of drop height, initial pitch and roll angles, and forward speed. Increasing initial pitch angle increased the maximum values of the front lobe pressure, normal acceleration, nose down pitch angle, and to some extent, vertical displacement, but it inversely affected the maximum cavity pressure. Increasing the drop height of the model increased the potential energy of the system and generally produced larger responses over the entire range of variables measured, except for the roll angle after impact, which remained constant. Forward speed had no effect on the impact performance of the model, except for essentially doubling the maximum nose down pitch angle after impact at the maximum speed tested. Author

N85-23758# Federal Aviation Administration, Washington, D.C. Office of Environment and Energy.
NOISE MEASUREMENT FLIGHT TEST: DATA/ANALYSES, HUGHES 500 D/E HELICOPTER
J. S. NEWMAN, E. J. RICKLEY, T. L. BLAND, and K. R. BEATTIE May 1984 78 p
(AD-A148110; FAA/EE-84-3) Avail: NTIS HC A05/MF A01 CSCL 01C

The report contains documentary sections describing the acoustical characteristics of the subject helicopter and provides analyses and discussions addressing topics ranging from acoustical propagation to environmental impact of helicopter noise. This report is the third in a series of seven documenting the FAA helicopter noise measurement program conducted at Dulles International Airport during the summer of 1983. The Hughes 500D/E test program involved the acquisition of detailed acoustical, position and meteorological data. This test program was designed to address a series of objectives including: (1) acquisition of acoustical data for use in assessing heliport environmental impact, (2) documentation of directivity characteristics for static operation of helicopters, (3) establishment of ground-to-ground and air-to-ground acoustical propagation relationships for helicopters, (4) determination of noise event duration influences on energy dose acoustical metrics, (5) examination of the differences between noise

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measured by a surface mounted microphone and a microphone mounted at a height of four feet (1.2 meters), and (6) documentation of noise levels acquired using international helicopter noise certification test procedures. GRA

N85-23759# Naval Ship Research and Development Center, Bethesda, Md. Aviation and Surface Effects Dept.

BASIC CONSIDERATION OF THE LIFTING CAPABILITY OF STOPPABLE ROTORS Final Report

A. W. SCHWARTZ Dec. 1984 20 p

(Contract ARPA ORDER 4238)

(AD-A150850; DTNSRDC/ASED-84/10) Avail: NTIS HC

A02/MF A01 CSCL 20D

Stoppable rotor designs involve the operation of the rotor through very high advance ratios and, thus, large regions of reverse flow as the rotor is slowed. Dual-slot, circulation control airfoils, such as those on an X-Wing rotor, produce useable lift in the reverse flow region. A simple method is developed to determine the critical flight condition where the capability of the rotor to produce lift is minimized. Expressions are derived relating the rotor retreating side mean dynamic pressure (indicative of lifting capability) and the lateral offset of the centroid of that dynamic pressure (indicate of roll moment capability) to the rotor geometry and flight conditions. The critical advance ratios predicted by these expressions are compared with the results from a more sophisticated rotor performance analysis. GRA

N85-23760# Lockheed-Georgia Co., Marietta.

ADVANCED LIFE ANALYSIS METHODS. VOLUME 4:

TABULATED TEST DATA FOR ATTACHMENT LUGS Final Report, 3 Sep. 1980 - 30 Sep. 1984

K. KATHIRESAN and T. R. BRUSSAT Wright-Patterson AFB, Ohio AFWAL Sep. 1984 310 p

(Contract F33615-80-C-3211)

(AD-A151016; LG82ER0117-4; AFWAL-TR-84-3080-VOL-4)

Avail: NTIS HC A14/MF A01 CSCL 13E

This report is Vol. 4 of a 6-part final report. Extensive experiments were conducted as a part of the assessment of damage tolerance of aircraft attachment lugs. Experimental results and the correlations with analytical predictions using the analysis methods developed under this contract were reported in Vol. 3 of the final report. In this volume, all the experimental test data generated are tabulated. The experiments were divided into two groups: Group 1 and Group 2. Group 1 consists of only simple straight shank male lugs and Group II consists of lug configuration commonly used in design practices such as tapered, dogbone, clevis and real aircraft lugs. This volume contains the tabulation of raw residual strength and fatigue crack growth data for both groups of tests. This volume also contains the baseline material property data, crack initiation test results and details of different loading spectra used in testing. GRA

N85-23761# Lockheed-Georgia Co., Marietta.

ADVANCED LIFE ANALYSIS METHODS. VOLUME 5:

EXECUTIVE SUMMARY AND DAMAGE TOLERANCE CRITERIA RECOMMENDATIONS FOR ATTACHMENT LUGS Final Report, 3 Sep. 1980 - 30 Sep. 1984

K. KATHIRESAN and T. R. BRUSSAT Wright-Patterson AFB, Ohio AFWAL Sep. 1984 72 p 5 Vol.

(Contract F33615-80-C-3211)

(AD-A151017; LG82ER0117-5; AFWAL-TR-84-3080-VOL-5)

Avail: NTIS HC A04/MF A01 CSCL 01C

This is the 5th volume of a 6 part report on a program to develop the design criteria and analytical methods necessary to ensure the damage tolerance of aircraft attachment lugs. This program consisted of seven tasks proceeding from and extensive cracking data survey and assessment of nondestructive inspection capabilities (NDI), through analysis methods development and evaluation, to the recommending of the damage tolerance design criteria for aircraft attachment lugs. Volume 1 to 4 provide: Results of the cracking data survey and nondestructive inspection capabilities assessment (Tasks 1 and 2); The developed analytical methods for predicting residual strength and crack growth behavior

in attachment lugs; The results of analytical predictions (Task 4), experimental testing (Task 5) and analytical-experimental correlations (Task 6); and The tabulation of raw experimental data generated under Task 5. The volume summarizes results for the first six tasks and recommends the initial flaw requirements for damage tolerance design criteria for aircraft attachment lugs, which were developed in Task 7. Vol 6 is the user's manual for the computer program LUGRO for the prediction of crack growth behavior in attachment lugs. GRA

N85-23763# Centre d'Essais en Vol, Istres (France).

GLIDER NIMBUS 3-24.5. PARTIAL CERTIFICATION TEST RESULTS FOR IMPORTATION IN THE U CATEGORY [PLANEUR NIMBUS 3-24.5. RESULTATS D'EREUVES RESTREINTES DE CERTIFICATION POUR IMPORT EN CATEGORIE U]

13 Nov. 1984 30 p In FRENCH

(REPT-CEV/IS/SE/AV/84) Avail: NTIS HC A03/MF A01

Flight tests of a high performance glider built in glass carbon epoxy with 24.5 m wing spread are described. Tests include longitudinal control, lateral maneuverability, compensation, static longitudinal stability and high velocity controls. Corrections necessary to allow a certification recommendation are summarized. Author (ESA)

N85-23764# National Bureau of Standards, Gaithersburg, Md. Center for Fire Research.

THERMAL RESPONSE OF AIRCRAFT CABIN CEILING MATERIALS DURING A POST-CRASH, EXTERNAL FUEL-SPILL, FIRE SCENARIO

L. Y. COOPER Oct. 1984 53 p refs Sponsored in part by FAA

(PB85-145647; NBSIR-84/2912) Avail: NTIS HC A04/MF A01 CSCL 01B

An algorithm was developed to predict the thermal response of aircraft ceiling materials during a post-crash fire scenario. The scenario involves an aircraft's emergency exit doorway which opens directly onto the flames of an external, fuel-spill fire which engulf a large portion of the fuselage. Data of near-ceiling temperatures acquired during a series of eight, full-scale, wide-body aircraft cabin, post-crash test simulations provide indirect validation of the algorithm. These tests involved cabins outfitted with single, mockup seats. Two other full-scale cabin tests involving fire spread through twenty-one seat arrays with different types of seat construction provide the input data required to exercise the algorithm in evaluations of fully outfitted cabins. GRA

N85-23765# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).

GEARS AND POWER TRANSMISSION SYSTEMS FOR HELICOPTERS AND TURBOPROPS

Loughton, England Jan. 1985 385 p refs In ENGLISH and FRENCH Conf. held in Lisbon, 8-12 Oct. 1984

(AGARD-CP-369; ISBN-92-835-0372-4) Avail: NTIS HC A17/MF A01

The Symposium was arranged in seven sessions: Review of Current Transmission Technology (4); Helicopter and Turboprop Transmission Technology Needs and Design (4); Component Design Technology and Manufacturing Considerations (8); Tribological Aspects of Transmission Components (6); Diagnostics, Measurements, and Noise (5); Problems and Failures in Gearing Applications (3); and Qualification Standards and Specifications (2). The purpose of the Symposium was to exchange and disseminate information on research and development conducted on gears and transmission systems in order to introduce new technologies for improvements in weight, performance, and life-cycle costs.

N85-23774# Westland Helicopters Ltd., Yeovil (England). Tribology Research.

FINE FILTRATION: AN ATTRACTIVE ROUTE TOWARDS LOWER HELICOPTER OPERATING COSTS

P. B. MACPHERSON *In* AGARD Gears and Power Transmission Systems for Helicopters and Turboprops 10 p Jan. 1985 refs Avail: NTIS HC A17/MF A01

Helicopter transmission mechanical reliability and longevity are considered and discussed in terms of filtration of the gearbox lubricating media. The background research and trials experience that led to the adoption of fine (3 micron) filtration are discussed. It is pointed out that in order to increase longevity, and therefore lower costs, the transmission unit must begin its life in the cleanest possible state. To achieve this end, standard production methods must be revised. G.L.C.

N85-23795# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany). Helicopter and Military Aircraft Group.
DO NEW AIRCRAFT NEED NEW TECHNOLOGIES AND CERTIFICATION RULES?

J. HARMANN and W. JONDA *In* AGARD Gears and Power Transmission Systems for Helicopters and Turboprops 7 p Jan. 1985

Avail: NTIS HC A17/MF A01

Using the example of development steps, a transmission usable for a 2 ton dual engine multipurpose helicopter demonstrates that technologies could drastically improve this product within approximately 15 years. Technologies which will influence the design are: improved manufacturing; use of computer calculation methods; testing procedure knowledge; diagnosis systems; and materials. The overall layout for the available engine power will change. To avoid unnecessary disadvantages the certification rules should be updated. The optimum benefits will be achieved when the certification rules are standardized for all countries in the Western World. B.G.

N85-23796# Federal Aviation Administration, Des Plaines, Ill. Propulsion Branch.

ESTABLISHMENT AND MAINTENANCE OF CERTIFICATION STANDARDS FOR HELICOPTER AND TURBOPROP POWER TRANSMISSION SYSTEMS

H. W. FERRIS *In* AGARD Gears and Power Transmission Systems for Helicopters and Turboprops 7 p Jan. 1985 refs Avail: NTIS HC A17/MF A01

The procedures used by the Federal Aviation Administration (FAA) to develop qualification/certification safety standards for helicopter and engine turboprop drive systems are discussed. The rules are always generated in coordination with industry for a minimum of economic impact, and are worded to promote design innovation while maintaining adequate safety. The rules are periodically updated to account for service experience and advancements in the state-of-the-art. A survey of the applicable Federal Aviation Regulations (FAR's) explains how all safety aspects of a new drive system are covered during the initial certification program. The FAR's also provide for continued airworthiness, as service experience is accumulated, such that inspection intervals may be increased to on condition, or decreased, if service difficulties indicate that an area of redesign is required. As further testing continues, initial limitations on component replacement times are relaxed until operating costs decrease to a minimum as the design reaches maturity. The FAA role is to assist industry in the promotion of aviation without compromising safety. Author

N85-24104# Joint Publications Research Service, Arlington, Va. **SOME OPTIMIZATION PROBLEMS IN STATIC AEROELASTICITY FOR WINGS MADE OF COMPOSITE MATERIALS Abstract Only**

N. V. BANICHUK and S. Y. IVANOVA *In its* USSR Rept.: Eng. and Equipment (JPRS-UEQ-84-001) p 69-70 9 Feb. 1984 Transl. into ENGLISH from *Izv. Akad. Nauk Arm. SSR: Mekhan.* (Yerevan), v. 36, no. 3, Mar. 1983 p 21-30
Avail: NTIS HC A06

Two optimization problems are considered which arise in design and construction of straight wings with composite materials. The wing is to be made of an elastic isotropic composite material containing randomly oriented reinforcement fibers, the range of fiber concentration being limited by other considerations to $0 \leq \zeta \leq 1$. The equation of aerodynamic equilibrium and the boundary conditions for an elastic wing in a gas stream are used as basis for establishing the optimality criterion and minimizing the weight functional, with the wing treated as a beam. The first problem is to minimize the weight through optimum distribution $\zeta(x)$ of reinforcing fibers over the wing span for a given critical wing divergence rate. This problem is solved numerically by the Newton method, and the weight advantage is referred to a wing of the same dimensions with a uniform distribution of reinforcing fibers. The second problem is to minimize the weight through optimum distribution $\zeta(x)$ of reinforcing fibers over the wing span for a given critical aileron reversal speed. This problem is solved numerically according to the algorithm of successive optimizations. B.W.

N85-24158# Joint Publications Research Service, Arlington, Va. **SELECTION OF EFFECTIVE ARRANGEMENT OF HEAVY UNDERCARRIAGE SYSTEMS FOR USE WITH CONCRETE RUNWAYS Abstract Only**

T. M. AVDYUKHINA *In its* USSR Rept.: Eng. and Equipment (JPRS-UED-84-005) p 1 19 Jul. 1984 Transl. into ENGLISH from *Izv. Vyssh. Ucheb. Zaved.: Aviat. Tekh.* (Kazan), no. 2, Mar. - May 1983 p 83-85
Avail: NTIS HC A04

Various arrangements of heavy aircraft landing gear for use on concrete runways was studied. Running gear mass is used as the optimization criterion. It is found that as the number of wheels increases there is no stable tendency toward decreasing landing gear mass. In the 200-250 t takeoff weight range as the number of wheels varies from 8 to 24 for 4-truck landing gear, 12 to 36 for 6-truck landing gear, landing gear mass does not decrease smoothly. The optimal number of wheels on aircraft with a takeoff weight of 200 t is found to be 12 for both 4 and 6 truck landing gear. Author

N85-24159# Joint Publications Research Service, Arlington, Va. **DURABILITY CALCULATION OF WING PANEL ELEMENT Abstract Only**

A. V. KIRILLOV and A. S. MOSTOVOY *In its* USSR Rept.: Eng. and Equipment (JPRS-UED-84-005) p 1-2 19 Jul. 1984 Transl. into ENGLISH from *Probl. Proch.* (Kiev), no. 12, Dec. 1983 p 32-26
Avail: NTIS HC A04

About 85% of all fatigue fractures in aircraft structural components occur in joinings. Thus it is important to be able to predict durability of these components. A method of determining the durability of the joint of a wing panel element was considered using stringer loaded by cyclic asymmetric tension. The stringer is demountable, and has on central and two lateral fish plates at the connection points. All components of the joint were made of D16T alloy. The proposed method of determining durability is based on the linear-discrete hypothesis of accumulation of fatigue damage. A flowchart is given of a program for simulation of the process of fatigue on the M4030 computer. The results of calculation show satisfactory agreement with experimental data from a plant of the Ministry of the Aviation Industry. Author

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

N85-24176# Joint Publications Research Service, Arlington, Va. **AUTOMATING THE STUDY OF ERROR IN DISCRETE AERODYNAMIC FAIRING DESIGN Abstract Only**

I. I. ITSKOVICH *In its* USSR Rept.: Eng. and Equipment (JPRS-UED-84-005) p 41-42 19 Jul. 1984 Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved.: Aviats. Tekh. (Kazan), no. 2, Mar. - May 1983 p 28-33
Avail: NTIS HC A04

The assignment of a set of coordinates for numerical control of a machine tool to generate an aerodynamic shape was studied. The possibility is studied of automated monitoring of the coordinate error of a gas dynamic fairing by the use of a computer. The mathematical method for estimating the error is based on the theory of linear digital signal filtration. The effectiveness of linear digital filtration was performed during calculation for the production of turbine compressor blades. The error of each internal point on the profile was estimated and coordinate noise characteristics computed. The estimates were used to determine serious errors in coordinates, beyond the statistical distribution. These points were then discarded. The resolution of the digital filter was found to be 0.0001 mm. At least 10 points should be used to get local and statistical estimates of coordinate errors. About 100 points per minute can be computed on a YeS-1022 computer. Author

N85-24425# Joint Publications Research Service, Arlington, Va. **MI-8 HELICOPTER CARGO LOADING EXPERIMENT FOR ARCTIC SHIPPING Abstract Only**

S. OMELCHENKO *In its* USSR Rept.: Earth Sci. (JPRS-UES-85-004) p 3 13 Mar. 1985 Transl. into ENGLISH from Vozdushnyy Transport (USSR), 18 Oct. 1984 p 4
Avail: NTIS HC A05/MF A01

A cargo handling experiment in which the ocean-going ship Lakhta was loaded and unloaded with the aid of an MI-8 helicopter is described. The ship was located in the Tatar Strait near Malaya Kema at the time. These operations were carried out by civilian helicopter pilots of Vladivostok, with the participation of specialists of the Far East Marine Shipping Line and the Maritime Territory Timber Procurement Association. The experiment was performed in connection with work which specialists of the shipping line are doing on the problem of loading and unloading vessels at shore points without cargo handling equipment and in conditions of drifting ice in the Arctic, and in areas without convenient sea inlets, ports and mooring places. The experiment consisted of two parts: helicopter-aided unloading of fuel and lubricants, and loading of timber. A number of proposals are made for correcting shortcomings of cargo-handling devices that were used in these operations. B.G.

06

AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

A85-31271 **FAULT TOLERANT COMPUTER SYSTEM FOR THE A129 HELICOPTER**

B. W. JOHNSON (Virginia, University, Charlottesville, VA) and P. M. JULICH (Harris Corp., Government Aerospace Systems Div., Melbourne, FL) IEEE Transactions on Aerospace and Electronic Systems (ISSN 0018-9251), vol. AES-21, March 1985, p. 220-229. refs

The A129 integrated multiplex system (IMS) is a highly reliable computer system designed to implement automatic flight control, navigation, system monitoring, and other flight-critical and mission-related tasks. The reliability of the IMS has been achieved through the development of hardware-implemented and software-implemented fault-tolerance techniques which exploit several unique architectural and hardware characteristics. This paper describes the fault-tolerance design philosophy, the IMS

architecture, the fault detection and fault recovery techniques, and the hardware and software structures. Also presented is a Markov reliability analysis which was used to quantify the reliability of the system. Author

A85-31779# **TACHISTOSCOPIC STUDIES OF POWERPLANT INSTRUMENTS [BADANIA TACHISTOSKOPOWE PRZYRZADOW KONTROLI PRACY ZESPOLU NAPADOWEGO DWUSILNIKOWEGO]**

Z. KAZIMIERSKA Instytut Lotnictwa, Prace (ISSN 0509-6669), no. 97, 1984, p. 53-60. In Polish. refs

The functions and tasks performed by the pilot in flight are examined in relation to the types and functions of the control instruments of the powerplant. Details and results of tachistoscopic studies conducted during the development of a torque meter for a two-engine helicopter are discussed. V.L.

A85-31965# **DEVELOPMENT OF AN ON-BOARD COMPUTER FOR FLIGHT TEST DATA ANALYSIS**

C. HUTCHINSON and A. MILLER (Boeing Vertol Co., Philadelphia, PA) IN: American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Proceedings. Alexandria, VA, American Helicopter Society, 1984, p. 181-187.

An account is given of the development history of the commercial Chinook helicopter variant's onboard computer data analysis system, which was first used in its helicopter's certification program in conjunction with a real-time data system and has subsequently been used in the certification program for a fiberglass-reinforced composite rotor blade and an icing phenomena study. Attention is given to system architecture and to the helicopter performance, peak-to-peak detector, and inoperative cruise guide indicator logics. Benefits are noted in flight safety, aircraft maintainability and reliability, and reduced pilot workload. O.C.

A85-32488 **NEW PERFORMANCE MANAGEMENT SYSTEM BEING TESTED ON AN A300**

J.-P. LEDOIT, J.-L. LEBRUN (Societe Francaise d'Equipements pour la Navigation Aeriennne, Velizy-Villacoublay, Yvelines, France), and M. TAMBIDORE (Direction Generale de l'Aviation Civile, Service Technique de la Navigation Aeriennne, Paris, France) ICAO Bulletin, vol. 40, March 1985, p. 24-27.

The equipment, functions and effects of performance management systems (PMS) under development for transport aircraft are reviewed. The PMS is designed to reduce fuel burn and flight time. Meteorological and flight plan data are fed into the PMS before takeoff, followed by flight status and course change requests in-flight. The autopilot consults the PMS for preferred modes of operation, i.e., those closest to an optimized flight plan. The algorithms have been shown by NASA to be effective when the flight is treated in terms of a whole process, rather than in segments. The PMS constantly updates the flight distance remaining and enunciates turning points during descent. Early data from flight tests on an A300 support a positive trend in fuel savings. Further research is required for ATC to issue directions compatible with optimized flight plans. M.S.K.

N85-22354# Royal Aircraft Establishment, Bedford (England). Operational Systems Div.

CIVIL AVIONICS FLIGHT TESTING WITH THE RAE(B) BAC1-11

R. R. NEWBERY and P. ENGLAND *In* AGARD Ground and Flight Testing for Aircraft Guidance and Control 22 p Dec. 1984 refs Original contains color illustrations
Avail: NTIS HC A09/MF A01

The BAC 1-11 research aircraft and test flight facility are described. Significant results were achieved in the fields of automatic control, improved accuracy of navigation, the use of CRT flight deck displays, the development of time control maneuvers, and the use of direct voice input. The role of avionics systems in the total air traffic management system is addressed.

The development of flight path and time control algorithms will be extended to deal with multiple constraints. Further attention will be paid to the interfaces between the aircraft systems, crew, and air traffic control. B.G.

N85-22357# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugfuehrung.

AVIONICS FLIGHT EVALUATION SYSTEM (AFES)

K. HURRASS *In* AGARD Ground and Flight Testing for Aircraft Guidance and Control 9 p Dec. 1984 refs

Avail: NTIS HC A09/MF A01

New avionic systems require thorough testing. Particularly as far as navigation systems are concerned, very accurate reference trajectories have to be established. For this purpose, DFVLR has developed an Avionics Flight Evaluation System (AFES). A tracking radar, a laser tracker, and an inertial navigation system (INS) on board the test aircraft are used in order to measure flight trajectories. The data of all these sensors are combined by optimal filters. In order to be able to evaluate in real time, computers are used at different locations. All elements of this measurement system are linked together by an efficient data transfer system. Besides the reference system, AFES contains subsystems for artificial traffic loading and measuring multipath effects. Author

N85-22387*# Analytical Mechanics Associates, Inc., Mountain View, Calif.

ANALYSIS OF ESTIMATION ALGORITHMS FOR CDTI AND CAS APPLICATIONS Final Report

T. GOKA Apr. 1985 216 p refs

(Contract NAS1-16135)

(NASA-CR-172444; NASA 1.26:172444) Avail: NTIS HC A10/MF A01 CSCL 01D

Estimation algorithms for Cockpit Display of Traffic Information (CDTI) and Collision Avoidance System (CAS) applications were analyzed and/or developed. The algorithms are based on actual or projected operational and performance characteristics of an Enhanced TCAS II traffic sensor developed by Bendix and the Federal Aviation Administration. Three algorithm areas are examined and discussed. These are horizontal x and y, range and altitude estimation algorithms. Raw estimation errors are quantified using Monte Carlo simulations developed for each application; the raw errors are then used to infer impacts on the CDTI and CAS applications. Applications of smoothing algorithms to CDTI problems are also discussed briefly. Technical conclusions are summarized based on the analysis of simulation results.

Author

N85-22388# Royal Signals and Radar Establishment, Malvern (England). Reliability and Environmental Engineering Section.

RELIABILITY PREDICTIONS FOR MILITARY AVIONICS. ROYAL SIGNALS AND RADAR ESTABLISHMENT RELIABILITY PREDICTION METHOD NO. 250

Sep. 1977 18 p

(BR69221) Avail: NTIS HC A02/MF A01

A prediction model for military avionics applications, 18 months after an equipment is first introduced, is presented. Base component failure rates, with maximum stress levels are presented. Factors influencing avionics reliability are outlined. Author (ESA)

N85-23798# Advisory Group for Aerospace Research and Development, Paris (France). Avionics Panel.

DESIGN FOR TACTICAL AVIONICS MAINTAINABILITY, TECHNICAL EVALUATION REPORT

B. L. DOVE, ed. and J. B. CLARY, ed. Oct. 1984 13 p

(AGARD-AR-204; AD-A150576) Avail: NTIS HC A02/MF A01

The inherent logical makeup of digital systems presents the opportunity for improving the maintainability of complex avionic systems. While there was limited success in the early use of Built-In-Self-Test and Built-In-Test (BIST/BIT), higher levels of circuit integration now offer even greater opportunities and challenges to avionic systems designers. However, while past and current digital systems designs have BIST/BIT as an add-on

feature, future avionic system designs must be designed for maintainability. Recently, improved techniques and tools to support design for maintainability have become available to avionics systems designers. If used appropriately, these new approaches can lead to dramatic improvements in avionic systems maintainability. Advanced methods and tools to support design for avionic maintainability are discussed. Since modern avionic systems consist of programmable processors, both hardware and software design for maintainability issues and approaches were discussed. B.W.

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.

A85-30331#

A NEW APPROACH TO DURABILITY PREDICTION FOR FUEL TANK SKINS

M. A. FERMAN, W. H. UNGER, C. R. SAFF (McDonnell Aircraft Co., St. Louis, MO), and M. D. RICHARDSON (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) *In*: Structures, Structural Dynamics, and Materials Conference, 26th, Orlando, FL, April 15-17, 1985, Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, 1985, p. 102-109. refs

(AIAA PAPER 85-0602)

A possible source of aircraft fuel tank leaks exists in premature fatigue cracking initiated by dynamic loading, which compounds the nominal spectrum fatigue loading. The new loading source arises from fluid-structure interaction dynamics between tank skins and fuel mass. The pertinence of this model to premature fuel tank skin fatigue and leakage problems that were not previously predicted by maneuver spectrum fatigue methods is considered. An improved design approach for the minimization of fuel leakage from fatigue cracks is projected. O.C.

A85-30377#

EFFECTS OF MISTUNING ON THE FORCED VIBRATION OF BLADED DISKS IN SUBSONIC FLOW

P. W. WHALEY (Nebraska, University, Lincoln, NE) and J. C. MACBAIN (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) *In*: Structures, Structural Dynamics, and Materials Conference, 26th, Orlando, FL, April 15-17, 1985, Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, 1985, p. 490-499. refs

(AIAA PAPER 85-0760)

Mistuning in bladed disk assemblies is known to have a beneficial effect on flutter and an adverse effect on the forced response. In previous studies of the forced vibration amplitude of mistuned bladed disks, mistuning has been demonstrated to increase the forced vibration amplitude by twenty percent in the absence of aeroelastic coupling. In this paper the forced vibration as a function of mistuning is investigated for aeroelastic coupling and subsonic flow. Under certain aerodynamic conditions and for certain engine orders and mistuning, the forced vibration has been demonstrated to increase by more than an order of magnitude.

Author

07 AIRCRAFT PROPULSION AND POWER

A85-30378*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

THE EFFECT OF AERODYNAMIC AND STRUCTURAL DETUNING ON TURBOMACHINE SUPERSONIC UNSTALLED TORSIONAL FLUTTER

D. HOYNIK (NASA, Lewis Research Center, Cleveland, OH) and S. FLEETER (Purdue University, West Lafayette, IN) IN: Structures, Structural Dynamics, and Materials Conference, 26th, Orlando, FL, April 15-17, 1985, Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, 1985, p. 500-514. refs (AIAA PAPER 85-0761)

The effects of alternate-blade structural detuning and adjacent-blade alternate-circumferential-spacing aerodynamic detuning on the supersonic unstalled torsional flutter stability of a turbomachine rotor are investigated analytically. An unsteady aerodynamic model employing influence coefficients is constructed for the case of a flat-plate-airfoil cascade in torsion-mode harmonic oscillation in a supersonic inviscid isentropic adiabatic irrotational perfect-gas inlet flow with a subsonic leading-edge locus. The influence coefficients and equations of motion are derived; the model is verified by applying it to the 12-blade cascade-B flow geometry studied by Verdon and McCune (1975); and the results are presented graphically. It is found that the rotor can be stabilized over the entire reduced frequency range by applying a combination of structural and aerodynamic detuning as the passive flutter-control mechanism. T.K.

A85-31458

A GENERALIZED ALGORITHM FOR THE TOPOLOGICAL OPTIMIZATION OF THE SECONDARY ELECTRIC POWER DISTRIBUTION SYSTEMS OF AIRCRAFT [OBOBSHCHENNYI ALGORITM TOPOLOGICHESKOI OPTIMIZATSII SAMOLETNYKH VTORICHNYKH SISTEM RASPREDELENIYA ELEKTRICHESKOI ENERGII]

V. N. KUSHNIRENKO and V. S. TERESHCHUK Aviationsnnaia Tekhnika (ISSN 0579-2975), no. 4, 1984, p. 36-41. In Russian.

An algorithm for the synthesis of the secondary electric power distribution network of aircraft is developed which is based on the dynamic programming approach. The algorithm makes it possible to determine the required amount of power distribution hardware and its optimum layout within the electrical fitting space of the aircraft. The algorithm proposed here is a part of the software being developed for a computer-aided design system and can be used at the initial stage of design. V.L.

A85-31966#

DEVELOPMENT FLIGHT TEST OF THE FULL AUTHORITY DIGITAL FUEL CONTROL IN THE HH-65A HELICOPTER

S. L. CHISOM (Aerospatiale Helicopter Corp., Grand Prairie, TX) IN: American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Proceedings. Alexandria, VA, American Helicopter Society, 1984, p. 189-192.

Advances in microprocessor-based electronic control systems offer substantial weight savings, size reductions, and reliability and accuracy improvements in aircraft applications. Attention is presently given to such an application in the case of the U.S. Coast Guard's HH-65A Short Range Recovery helicopter, which takes the form of a full authority digital electronic fuel control system for the LTS-101 engine. Flight test results are evaluated. O.C.

A85-32005*# General Electric Co., Lynn, Mass.

CONTINGENCY POWER CONCEPTS FOR HELICOPTER TURBOSHAFT ENGINE

R. HIRSCHKRON, R. H. DAVIS, D. N. GOLDSTEIN, J. F. HAYNES (General Electric Co., Lynn, MA), and J. W. GAUNTNER (NASA, Lewis Research Center, Cleveland, OH) IN: American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Proceedings. Alexandria, VA, American Helicopter Society, 1984, p. 597-608. Previously announced in STAR as N84-23648. (Contract NAS3-23705)

Twin helicopter engines are often sized by power requirement of safe mission completion after the failure of one of the two

engines. This study was undertaken for NASA Lewis by General Electric Co. to evaluate the merits of special design features to provide a 2-1/2 minute Contingency Power rating, permitting an engine size reduction. The merits of water injection, cooling flow modulation, throttle push and an auxiliary power plant were evaluated using military life cycle cost (LCC) and commercial helicopter direct operating cost (DOC) merit factors in a rubber engine/rubber aircraft scenario. Author

A85-32006*# General Electric Co., Lynn, Mass.

TF34 CONVERTIBLE ENGINE CONTROL SYSTEM DESIGN
D. R. GILMORE, JR. (General Electric Co., Aircraft Engine Business Group, Lynn, MA) IN: American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Proceedings. Alexandria, VA, American Helicopter Society, 1984, p. 609-620. refs (Contract NAS3-22752)

The characteristics of the TF34 convertible engine, capable of producing shaft power, thrust, or a combination of both, is investigated with respect to the control system design, development, bench testing, and the anticipated transient response during engine testing at NASA. The modifications to the prototype standard TF34-GE-400 turbofan, made primarily in the fan section, consist of the variable inlet guide vanes and variable exit guide vanes. The control system was designed using classical frequency domain techniques and was based on the anticipated convertible/VTOL airframe requirements. The engine has been run in the fan mode and in the shaft mode, exhibiting a response of 0.14 second to a 5-percent thrust change. L.T.

A85-32007#

DESIGNING RELIABILITY INTO DERIVATIVE ENGINES

J. A. BYRD (General Motors Corp., Detroit Diesel Allison Div., Indianapolis, IN) IN: American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Proceedings. Alexandria, VA, American Helicopter Society, 1984, p. 621-629.

Allison is actively developing two new engine additions to the Model 250 product line, the C34 and C24 engines. The C34 engine is a growth version of the Model 250-C30 and, with a 10 percent increase in power, will replace the C30 as the largest engine in the Model 250 family. The C24 engine features reduced fuel consumption and substantial increases in hot-day performance compared to its predecessor, the Model 250-C20B. Both engines incorporate similar design features but emphasize increased reliability and durability and reduced complexity and part count. The development programs for the two new engines build on the programs for their predecessors, emphasizing changes in testing philosophies that result in increased test hours at critical milestones, increased severity in test profiles, and the addition of special abusive tests. Reliability tracking of production engines and reliability projections for the derivative engines with the potential for unforeseen failure modes is discussed. Author

A85-32008#

DEFINITION OF REQUIREMENTS FOR 5000 HORSEPOWER CLASS DEMONSTRATOR ENGINE

E. T. JOHNSON (U.S. Army, Applied Technology Laboratory, Fort Eustis, VA) IN: American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Proceedings. Alexandria, VA, American Helicopter Society, 1984, p. 631-635. refs

The formulation of a demonstration engine program is a long drawn out process requiring numerous analyses and continued coordination between the developer and user as well as coordination with the other services. Existing and newly defined aircraft are used in the analysis to determine aircraft performance (payload, range, mission fuel consumption) using both existing and advanced technology engines. Many refinements are made to the advanced technology engine requirements as a result of the analyses and the coordination with other agencies. The final engine never looks like the initial concept; however, it more nearly represents an engine that can meet the requirements for all its intended applications. Author

A85-32012
INTERNAL AERODYNAMICS OF INFRARED SUPPRESSORS FOR HELICOPTER ENGINES

F. TOULMAY (Aerospatiale, Division Helicopteres, Marignane, Bouches-du-Rhone, France) American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Paper. 16 p. refs

Three analytical methods suited for performance prediction and dimensioning of exhaust ejectors are reviewed: first, a global one-dimensional approach which clarifies basic trends; second, a momentum integral method which takes into account the mixing duct length and primary nozzle shape; third, a two-dimensional finite difference scheme of the parabolic kind which adequately models compressibility, heat transfer, and wall friction. The correlation with various experimental results points to a shortcoming common to the last two, namely, their inability to cope with separated flow configurations that are found to be most usual. A demonstration program for the IR protection of rear-powered twin-engine helicopters offers an illustration where it appears that some additional factors such as inlet distortion, duct curvature, and turbine exhaust swirl, may adversely affect the ejector suction capability and that the final performance cannot be easily predicted. Ground testing is recognized as a major step in the iterative design process. Author

A85-32589#
FATIGUE RELIABILITY OF GAS TURBINE ENGINE COMPONENTS UNDER SCHEDULED INSPECTION MAINTENANCE

J. N. YANG and S. CHEN (George Washington University, Washington, DC) (Structures, Structural Dynamics and Materials Conference, 25th, Palm Springs, CA, May 14-16, 1984, Technical Papers, Part 1, p. 410-420) Journal of Aircraft (ISSN 0021-8669), vol. 22, May 1985, p. 415-422. Previously cited in issue 13, p. 1836, Accession no. A84-31670. refs
 (Contract F33615-81-C-5015)

A85-32601#
NUMERICAL SIMULATION OF COLD FLOW IN AN AXISYMMETRIC CENTERBODY COMBUSTOR

J. N. SCOTT (Dayton, University, Dayton, OH) and W. L. HANKEY, JR. (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) AIAA Journal (ISSN 0001-1452), vol. 23, May 1985, p. 641-649. Previously cited in issue 17, p. 2467, Accession no. A83-37219. refs
 (Contract F33615-82-K-2252)

A85-32945
IS THE UNDUCTED FAN TOMORROW'S SUBSONIC ENGINE?
 J. H. BRAHNEY Aerospace Engineering (ISSN 0736-2536), vol. 5, Feb. 1985, p. 7-10.

The design features and prospects for specific fuel consumption reduction of the 'unducted fan' (UDF) aircraft propulsion turbine engine configuration are discussed. The essential feature of this novel configuration is the driving of two contrarotating turbine stages, to which high disk loading/high tip speed fan blades are affixed, directly by the engine core's exhaust gases; thereby yielding the fan rotational speeds desirable in high subsonic speed transport aircraft without resort to a weight-increasing and mechanical efficiency-compromising gearbox. The UDF is projected to yield a specific fuel consumption that is 25 percent better than that of a conventional, shrouded turbofan engine configuration of comparable technological sophistication. O.C.

A85-32946
WILL PROPFANS REQUIRE GEARBOXES?

D. J. HOLT Aerospace Engineering (ISSN 0736-2536), vol. 5, Feb. 1985, p. 12-17.

An evaluation is made of the emerging design alternatives in advanced gearboxes for propfan engine-powered aircraft. Such gearboxes are made necessary by the large rotational speed difference between the core engine turbomachinery and propfan rotor. No suitable gearbox exists for the 10,000-15,000 shp range typical of the airliners to which propfan propulsion would be applied.

The thoroughgoing design task that must accordingly be undertaken has prompted consideration of novel gear and bearing configurations and alloys, modular disposition of accessories, and contrarotation. Emphasis is being given to the simplification of gearbox mechanisms. O.C.

N85-22389 Defence Research Information Centre, Orpington (England).
OXIDATION RESISTANT MATERIALS FOR HOT GAS TURBINES AND JET ENGINES

K. HAUFFE Oct. 1984 58 p refs Transl. into ENGLISH from Metall (West Germany), v. 36, no. 8, 1982 p 882-888 and v. 36, no. 10, 1982 p 1082-1087
 (AD-B087399L; DRIC-T-7145; BR93288) Avail: NTIS HC A04/MF A01 CSCL 21E

The use of highly alloyed chromium and chromium-nickel steels in gas turbines operating at high temperatures and jet engines with isothermic and cyclic temperature guidance is discussed. Aluminum-containing nickel-chromium alloys are superior in their oxidation behavior to cobalt-chromium alloys. The presence of small amounts of halides and sulfur compounds in the combustion gases requires addition of compounds to the alloys to protect high-grade alloys against corrosion at high temperatures. To limit the expense of the alloys it is necessary to focus development on oxidation resistant layers coated on the basic alloy. Heat-resistant fiber reinforced composite material combined with oxidation resistant layers is of particular technical importance. The development of nonmetallic materials for high temperature use, particularly silicon nitride, silicon carbide and carbon or graphite, gives interesting results. Author (ESA)

N85-22391*# Massachusetts Inst. of Tech., Cambridge. Gas Turbine Lab.

STRUCTURAL RESPONSE OF A ROTATING BLADED DISK TO ROTOR WHIRL Final Report
 E. F. CRAWLEY Apr. 1985 140 p refs
 (Contract NAG3-200)
 (NASA-CR-175605; NAS 1.26:175605) Avail: NTIS HC A07/MF A01 CSCL 21E

A set of high speed rotating whirl experiments were performed in the vacuum of the MIT Blowdown Compressor Facility on the MIT Aeroelastic Rotor, which is structurally typical of a modern high bypass ratio turbofan stage. These tests identified the natural frequencies of whirl of the rotor system by forcing its response using an electromagnetic shaker whirl excitation system. The excitation was slowly swept in frequency at constant amplitude for several constant rotor speeds in both a forward and backward whirl direction. The natural frequencies of whirl determined by these experiments were compared to those predicted by an analytical 6 DOF model of a flexible blade-rigid disk-flexible shaft rotor. The model is also presented in terms of nondimensional parameters in order to assess the importance of the interaction between the bladed disk dynamics and the shaft-disk dynamics. The correlation between the experimental and predicted natural frequencies is reasonable, given the uncertainty involved in determining the stiffness parameters of the system. Author

N85-22393*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

LARGE AMPLITUDE FORCING OF A HIGH SPEED 2-DIMENSIONAL JET Interim Report, Jan. 1982 - Dec. 1983
 L. BERNAL and V. SAROHA 15 Dec. 1984 48 p refs
 Sponsored in part by Navy
 (Contract NAS7-918)
 (NASA-CR-175646; JPL-PUB-84-91; NAS 1.26:175646) Avail: NTIS HC A03/MF A01 CSCL 21E

The effect of large amplitude forcing on the growth of a high speed two dimensional jet was investigated experimentally. Two forcing techniques were utilized: mass flow oscillations and a mechanical system. The mass flow oscillation tests were conducted at Strouhal numbers from 0.00052 to 0.045, and peak to peak amplitudes up to 50 percent of the mean exit velocity. The exit Mach number was varied in the range 0.15 to 0.8. The

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corresponding Reynolds numbers were 8,400 and 45,000. The results indicate no significant change of the jet growth rate or centerline velocity decay compared to the undisturbed free jet. The mechanical forcing system consists of two counter rotating hexagonal cylinders located parallel to the span of the nozzle. Forcing frequencies up to 1,500 Hz were tested. Both symmetric and antisymmetric forcing can be implemented. The results for antisymmetric forcing showed a significant (75 percent) increase of the jet growth rate at an exit Mach number of 0.25 and a Strouhal number of 0.019. At higher rotational speeds, the jet deflected laterally. A deflection angle of 39 deg with respect to the centerline was measured at the maximum rotational speed.

M.G.

N85-22394*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

EFFECTS OF INLET DISTORTION ON A STATIC PRESSURE PROBE MOUNTED ON THE ENGINE HUB IN AN F-15 AIRPLANE

D. L. HUGHES, L. P. MYERS, and K. G. MACKALL 1985 23 p refs

(NASA-TP-2411; H-1182; NAS 1.60:2411) Avail: NTIS HC A02/MF A01 CSCL 21E

An inlet static pressure (PS2) probe was mounted on the hub of an F100 engine in an F-15 airplane. Flight test results showed that for low distortion conditions, the ratio of engine-face total pressure to static pressure agreed well with previous altitude facility data. Off-schedule operation of the inlet third ramp angle caused increased distortion of the inlet airflow during steady-state flight conditions. Data are shown for inlet third ramp excursions leading to engine stall. The relationships of inlet face total to static pressure ratio as a function of several distortion descriptors are also described.

Author

N85-22396# Shell Research Ltd., Chester (England). Continuous Combustion Fuels Div.

THE INFLUENCE OF FUEL QUALITY UPON FLAME-TUBE TEMPERATURE AND FLAME RADIATION IN A MODEL GAS-TURBINE PRIMARY ZONE

T. T. BOWDEN and J. H. PEARSON Feb. 1984 27 p refs

(Contract MIN-DEF-A45A/578)

(K233; BR91055) Avail: NTIS HC A03/MF A01

Fuels with hydrogen contents varying from 8.66% to 15.16% weight were burned under conditions simulating those occurring in aviation gas turbine engines. Flame-tube temperature and flame radiation were correlated against the inspection properties of hydrogen content, aromatics content and smoke point. All three criteria give good correlation, with hydrogen content providing the best. Results indicate that aromatic content may be an inappropriate specification requirement for fuels containing condensed bicyclic saturated hydrocarbons.

Author (ESA)

N85-22397# Massachusetts Inst. of Tech., Cambridge. Gas Turbine Lab.

CURRENT PROBLEMS IN TURBOMACHINERY FLUID DYNAMICS Final Report, 1 Oct. 1981 - 30 Sep. 1984

E. M. GREITZER, J. L. KERREBROCK, W. T. THOMPSON, J. E. MCCUNE, and A. H. EPSTEIN 3 Dec. 1984 55 p

(Contract F49620-82-K-0002)

(AD-A150533; AFOSR-85-0016TR) Avail: NTIS HC A04/MF

A01 CSCL 21E

A multiinvestigator program on problems of current interest in turbomachinery fluid dynamics is being conducted at the MIT Gas Turbine Laboratory. Within the scope of this effort, four different tasks, encompassing both design and off design programs, have been identified. These are: (1) Investigation of fan and compressor design point fluid dynamics (including formation of design procedures using current 3-D transonic codes and development of advanced measurement techniques for use in transonic fans); (2) Studies of basic mechanisms of compressor stability enhancement using compressor casing/hub treatment; (3) Fluid mechanisms of inlet vortex flow distortions in the gas turbine engines; (4) Investigations of 3-D analytical and numerical

computations of flows in highly loaded turbomachinery blading.

GRA

N85-22823# Joint Publications Research Service, Arlington, Va. **EFFICIENCY OF ALGORITHMS FOR GAS-AIR CHANNEL DIAGNOSTICS IN GAS TURBINE ENGINES BASED ON GAS THERMODYNAMIC PARAMETERS Abstract Only**

A. M. AKHMEDZYANOV and K. F. GALIULLIN *In its* USSR Rept.: Eng. and Equipment (JPRS-UEQ-85-003) p 80 12 Mar. 1985 Transl. into ENGLISH from *Izv. Vyssh. Ucheb. Zaved.: Aviats. Tekhn.* (Kazan, USSR), no. 1, Jan. - Mar. 1984 p 7-13
Avail: NTIS HC A06

Five algorithms of diagnosing the flow of gas and air through the main channel of a gas turbine engine are evaluated comparatively for efficiency: (1) identification of mathematical model by the method of least squares, (2) sifting various combinations of square series-parallel matrices based on adequate linear models; (3) nonlinear optimization by the method of steepest descent; (4) nonlinear optimization with first three terms of the Taylor series by the method of conjugate gradients; (5) solving an indeterminate system of linear algebraic equations. One of the efficiency criteria is the difference between real and diagnosed values of a defective state parameter, the other one is the difference between the value of a defective state parameter and the value of a nearly state parameter. Analytical calculations and computer experiments based on mathematical models of various engine configurations have revealed that the algorithm of matrix sifting is most efficient for diagnosis, but the algorithm of least squares becomes most efficient at higher levels of noise resulting from inaccuracy of state parameter determination and from inadequacy of the mathematical model.

Author

N85-22825# Joint Publications Research Service, Arlington, Va. **EXERGETICAL ANALYSIS OF TURBOJET ENGINE CYCLE Abstract Only**

K. A. MALINOVSKIY *In its* USSR Rept.: Eng. and Equipment (JPRS-UEQ-85-003) p 81-82 12 Mar. 1985 Transl. into ENGLISH from *Izv. Vyssh. Ucheb. Zaved.: Aviats. Tekhn.* (Kazan, USSR), no. 1, Jan. - Mar. 1984 p 32-37
Avail: NTIS HC A06

The turbojet engine cycle is analyzed in terms of exergy rather than energy, the former being defined as the maximum useful external work done by a body during transition from a given state to the state of equilibrium with the ambient medium. The exergy function $e = i - i_0 - T_0 (s - s_0)$ (i - enthalpies, s - entropies, T_0 - ambient temperature) is evaluated directly for an air-turbojet engine burning kerosene, without special graphs and tables (which are not available). The exergy balance behind injector, behind compressor, behind combustion chamber, behind turbine, and in nozzle throat is calculated accordingly. On the basis of these, cycle balances and other relevant thermodynamic relations are then determined for the specific thrust and the energy efficiency of such an altitude $H = 0$.

Author

N85-22826# Joint Publications Research Service, Arlington, Va. **ENERGY LOSSES AT LEADING EDGE OF TURBINE BLADE DURING MULTIROW JET COOLING Abstract Only**

V. V. RUMYANTSEV and I. P. MAKOV *In its* USSR Rept.: Eng. and Equipment (JPRS-UEQ-85-003) p 82 12 Mar. 1985 Transl. into ENGLISH from *Izv. Vyssh. Ucheb. Zaved.: Aviats. Tekhn.* (Kazan, USSR), no. 1, Jan. - Mar. 1984 p 37-40
Avail: NTIS HC A06

Multirow jet cooling of turbine blades is evaluated relative to single-row jet cooling. The hydraulic drag coefficient and the discharge coefficient at the leading edge were measured, to indicate the energy losses at that edge, with the Reynolds number referred to the jet diameter d varied over the (1-8), 10 to the 4th power range and the distance H from deflector spout to inner housing wall varied over the $H/d = 0.5-2$ range. In the case of two symmetric rows of cooling jets both coefficients were found to increase linearly with the Reynolds number and to remain independent of the H/d ratio, both being somewhat larger than in the case of single-row jet cooling. In the case of three symmetric

rows of cooling jets both coefficients were found first to increase sublinearly with increasing H/d ratio and then, after becoming independent of the latter in the H/d 1.5 range, to increase almost linearly with the Reynolds number. In this case the conditions are similar to those at a plane shield struck by a circular jet and, with increasing of the H/d ratio, become more favorable for eddying.

Author

N85-22828# Joint Publications Research Service, Arlington, Va. **SOME UNIQUE FEATURES IN OPERATION OF TWO-STAGE TURBOJET ENGINE WITH AFTERBURNER Abstract Only**

B. D. FISHBEYN *In its* USSR Rept.: Eng. and Equipment (JPRS-UEQ-85-003) p 83-84 12 Mar. 1985 Transl. into ENGLISH from *Izv. Vyssh. Ucheb. Zaved.: Aviats. Tekhn. (Kazan, USSR)*, no. 1, Jan. - Mar. 1984 p 45-49

Avail: NTIS HC A06

The performance of a two-stage turbojet engine during cut-in of the afterburner pump with attendant increase of power drain from the turbocompressor is evaluated, for the purpose of programming the turbocompressor and engine regulation. On the basis of power and fuel-air thermodynamics, the increment of power drain during climb and during flight at speed $M = 2.8$ is calculated as a linear function of the two-staging factor over its $m = 0.4$ range. Calculations for 1.0 excess air and for 2.5 excess air, with the ratio of pressure rise in the afterburner pump to effective drop of specific enthalpy varied from 5 to 60, yield the corresponding displacements of compressor and afterburner operating lines as well as of their intersection points representing concurrent operation of compressor and afterburner. These results indicate how the regulation of engine and compressor must be programmed for optimum performance during and following cut-in of the afterburner pump.

Author

N85-22829# Joint Publications Research Service, Arlington, Va. **HYDRODYNAMIC SIMULATION OF TRANSIENT PROCESSES IN INJECTION SYSTEM OF AIRCRAFT ENGINES DURING PUMP UNSWIRLING Abstract Only**

V. V. CHERVAKOV, N. S. YERSHOV, and B. V. OVSYANNIKOV *In its* USSR Rept.: Eng. and Equipment (JPRS-UEQ-85-003) p 84 12 Mar. 1985 Transl. into ENGLISH from *Izv. Vyssh. Ucheb. Zaved.: Aviats. Tekhn. (Kazan, USSR)*, no. 1, Jan. - Mar. 1984 p 49-54 Original language document previously announced as A84-47561

Avail: NTIS HC A06

The operation of the pump of an aircraft engine during startup is studied, and a mathematical model describing the feed system of the engine is developed. Sets of criteria and boundary conditions are obtained for the hydrodynamic modeling of transient processes that occur in the feed system of the engine as the pump accelerates to its normal speed.

V.L. (IAA)

N85-22830# Joint Publications Research Service, Arlington, Va. **EFFECT OF WATER INJECTION INTO AIR FOR TURBINE COOLING ON ECONOMY OF OPERATION OF GAS TURBINE ENGINE WITH AFTERBURNING Abstract Only**

G. M. GORELOV, V. P. DANILCHENKO, and V. Y. REZNIK *In its* USSR Rept.: Eng. and Equipment (JPRS-UEQ-85-003) p 85 12 Mar. 1985 Transl. into ENGLISH from *Izv. Vyssh. Ucheb. Zaved.: Aviats. Tekhn. (Kazan, USSR)*, no. 1, Jan. - Mar. 1984 p 81-83

Avail: NTIS HC A06

Formulas are presented for calculating fuel savings resulting from the injection of water into the air that cools turbine blades and nozzle guide vanes. It is shown that the fuel economy achieved depends to a large degree on the maximum gas temperature at the turbine inlet. It is calculated that the fuel saved during one hour of operation with the afterburner on can be sufficient for a 1.5 to 2-hr flight at an altitude of 11 km and Mach 0.8.

V.L. (IAA)

N85-22832# Joint Publications Research Service, Arlington, Va. **ANNULAR GROOVE IN COMPRESSOR CASING AS DEVICE FOR CONTROL OF AIR STREAM Abstract Only**

V. N. YERSHOV, A. P. YEFIMENKO, and V. Y. NEZYM *In its* USSR Rept.: Eng. and Equipment (JPRS-UEQ-85-003) p 86 12 Mar. 1985 Transl. into ENGLISH from *Izv. Vyssh. Ucheb. Zaved.: Aviats. Tekhn. (Kazan, USSR)*, no. 1, Jan. - Mar. 1984 p 85-86

Avail: NTIS HC A06

As a result of extensive experimental and theoretical studies at the Kharkov Institute of Aviation concerning the incipience of rotatory separation low in axial compressors, there has been developed a device for controlling the air stream so as to extend the range of nonseparation flow. It is an annular groove cut in the compressor casing around the runner. Two basic configurations have been evaluated comparatively and relative to a uniform radial gap between smooth casing and straight smooth runner blade edge: (1) axially tapered radial gap between slanted groove bottom in the casing and straight smooth runner blade edge; (2) uniform radial gap between slanted groove bottom in the casing and parallel axially slanted runner blade edge dovetailing into the groove. Both width and height of the dovetailing blade edge segment were varied, and tests performed with an S-17 compressor stage (outside diameter 0.46 m, relative hub diameter 0.84) at average referred circumferential velocities of 83-193 m/s have yielded satisfactory results.

Author

N85-22838# Joint Publications Research Service, Arlington, Va. **ESTIMATION OF GAS TURBINE ENGINE BOOST PROVIDED BY INJECTING WATER BEHIND COMPRESSOR Abstract Only**

A. N. PROKOFYEV *In its* USSR Rept.: Eng. and Equipment (JPRS-UEQ-85-003) p 90 12 Mar. 1985 Transl. into ENGLISH from *Izv. Vyssh. Ucheb. Zaved.: Mashinostr. (Moscow)*, no. 4, Apr. 1984 p 80-82

Avail: NTIS HC A06

The injection of water into the duct of gas turbine engines in order to boost output is examined. The maximum amount of water injected is determined as a function of the required increase in compression pressure, the compressor efficiency, the water temperature and the temperature and moisture content of the atmospheric air. The influence of the parameters of the compressor and the initial content of the air on the maximum amount of water injected is investigated. The use of the method for making a thermodynamic analysis of the heat-regenerating gas turbine engine employed for transportation is presented. It is found that injecting the maximum amount of water behind the compressor increases the nominal engine power by 27% while reducing relative fuel consumption by 7%.

Author

N85-23766# Army Research and Technology Labs., Cleveland, Ohio. Propulsion Lab.

SUMMARY OF DRIVE-TRAIN COMPONENT TECHNOLOGY IN HELICOPTERS

G. J. WEDEN and J. J. COY *In* AGARD Gears and Power Transmission Systems for Helicopters and Turboprops 17 p Jan. 1985 refs

Avail: NTIS HC A17/MF A01

A review of current helicopters was conducted to determine the technology in the drive train systems. The design features including reliability, maintainability and survivability characteristics, in transmission systems for the OH-58, UH-1, CH-47 and UH-60 helicopters are highlighted. In addition, trade offs involving cost, reliability and life are discussed.

B.W.

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N85-23767# Societe Nationale Industrielle Aerospatiale, Marignane (France.) Service D'Etude des Transmissions.

CURRENT TRANSMISSION SYSTEMS [SYSTEMES DE TRANSMISSION ACTUELS]

R. FRANCOIS *In* AGARD Gears and Power Transmission Systems for Helicopters and Turboprops 12 p Jan. 1985 *In* FRENCH

Avail: NTIS HC A17/MF A01

Transmissions on the new generation Ecureuil, Dauphin, and Super-Puma helicopters, produced in series by the National Industrial Aerospace Society, are described. The most significant technical options are comparatively analyzed showing progress made in the areas of safety, reliability, and the noise of reduction gears and gear boxes. The effective demonstration of safety margins is recalled as well as redundant systems for lubricating the main gear box. Simplicity of design, the use of steels, and heat treatments enhance the performance of gears and ball bearings. Consideration of the noise criteria when choosing the geometry of the gear teeth is discussed. A.R.H.

N85-23769# Boeing Vertol Co., Philadelphia, Pa.

SPECIAL POWER TRAIN REQUIREMENTS FOR THE NEXT GENERATION OF ROTARY-WING AIRCRAFT

R. J. DRAGO and J. W. LENSKI, JR. *In* AGARD Gears and Power Transmission Systems for Helicopters and Turboprops 14 p Jan. 1985 refs

Avail: NTIS HC A17/MF A01

The omnipresent rotary wing drive system requirements for minimum weight with maximum reliability will be compounded in the future by additional restrictions on size, damage tolerance, cost, and ease of assembly and maintenance. Possible approaches designed to improve the performance of rotary wing drive systems are discussed. Specific examples of extensions of current technology are given. B.W.

N85-23770# General Electric Co., Lynn, Mass. Gear Systems. **A STATE OF THE ART ASSESSMENT OF TURBOPROP TRANSMISSION TECHNOLOGY AND PROJECTED NEEDS FOR THE NEXT GENERATION**

R. J. WILLIS, JR. *In* AGARD Gears and Power Transmission Systems for Helicopters and Turboprops 11 p Jan. 1985 refs

Avail: NTIS HC A17/MF A01

The major share of power transmission research and development during the past twenty years has been expended on the improvement of helicopter main rotor drives. Fortunately, most of the advanced technology features resulting from these efforts are directly applicable to turboprop transmission. The technology base is made up of a number of interacting disciplines whose application is tempered by economics as well as the engineering state of the art at any given time. Modern computers are playing an ever increasing role in the design process and promise to be the means of removing gear design from its empirical background. The utilization of state of the art technology as the framework for turboprop transmission design is discussed. B.W.

N85-23771# Pratt and Whitney Aircraft of Canada Ltd., Mississauga (Ontario).

ADVANCED GEARBOX TECHNOLOGY IN SMALL TURBO PROPELLER ENGINES

C. BROWNRIDGE and D. HOLLINGWORTH *In* AGARD Gears and Power Transmission Systems for Helicopters and Turboprops 14 p Jan. 1985 refs

Avail: NTIS HC A17/MF A01

Gearbox component analysis traditionally deals with the calculation of Hertzian stresses at gear contacting surfaces and the fillet stresses at the tooth bases caused by the meshing loads. Major assumptions are often made regarding the dynamic loads and the variation of loads across teeth due to misalignment. Little attention is paid to gear weight optimization, or stresses generated at complex interactions such as splines or fretting surfaces between flanges. Current 3D fe methods used to examine some of the more complex surface to surface interactions are discussed. The loading experienced between dynamically active teeth meshing at

high speed is addressed. To successfully design a light weight and durable gearbox for aircraft applications complex computer modelling is necessary and new theories of failure are needed to deal with such aspects as fretting fatigue. B.W.

N85-23772# Bell Helicopter Co., Fort Worth, Tex. Transmission Design.

THE HELICOPTER TRANSMISSION DESIGN PROCESS

R. BATTLES *In* AGARD Gears and Power Transmission Systems for Helicopters and Turboprops 8 p Jan. 1985

Avail: NTIS HC A17/MF A01

An overview of helicopter transmission design and development is presented. Aspects from conceptualization to working production equipment are presented. They include the following six phases: (1) pre-design; (2) design; (3) manufacturing coordination; (4) bench testing; (5) aircraft testing; and (6) field service support. G.L.C.

N85-23779# Fiat Aviazione S.p.A., Turin (Italy). Transmission Engineering Dept.

POSSIBLE TECHNOLOGICAL ANSWERS TO NEW DESIGN REQUIREMENTS FOR POWER TRANSMISSION SYSTEMS

L. BATTEZZATO and S. TURRA *In* AGARD Gears and Power Transmission Systems for Helicopters and Turboprops 13 p Jan. 1985 refs

Avail: NTIS HC A17/MF A01

In the new projects of gearboxes for aeronautical application, the specified requirements have become more and more severe asking for continuous technology advance. The most important points put out by these specs, such as fail safety, reliability, low vibration and low noise, high working temperature, invulnerability and maintainability, of course combined with a low weight characteristic are discussed. A detailed analysis is carried out to identify the guidelines for obtaining the best compromise among the above listed requirements, by applying a proven philosophy. The advantage of a reliable system capable of detecting failures in progress within the gearbox is also underlined as it can be a key point in defining the final design resulting from the optimization procedure. G.L.C.

N85-23789# Fiat Aviazione S.p.A., Turin (Italy). Direzione Progettazione.

EVOLUTION OF THE DESIGN TECHNIQUES FOR HELICOPTER MAIN TRANSMISSION GEARBOXES

G. BENSI and L. TARRICONE *In* AGARD Gears and Power Transmission Systems for Helicopters and Turboprops 14 p Jan. 1985

Avail: NTIS HC A17/MF A01

The evolution of the design techniques are shown which were adopted in FIAT AVIAZIONE for the helicopters main transmission gearboxes by means of the description of the mechanical units designed for the AEROSPATIALE helicopters: SA 321, SA 330, SA 360, SA 365. The technical solutions have followed a development strictly related to the customer required specifications. Considering the past and present evolution we can foresee the future development trend. As an explanatory example, an advanced main transmission gearbox for a medium twin engined helicopter is considered and some design solutions are shown. Evaluations of four gearbox configurations were carried out by assigning the right importance coefficient to three appreciation functions: reliability, cost and weight. Author

N85-23790# Naval Aircraft Materials Lab., Fleetlands (England). **CONDITION MONITORING OF HELICOPTER GEARBOXES USING AUTOMATIC VIBRATION ANALYSIS TECHNIQUES**

P. GADD and P. J. MITHCELL (MOD Navy) *In* AGARD Gears and Power Transmission Systems for Helicopters and Turboprops 10 p Jan. 1985

Avail: NTIS HC A17/MF A01

Methods using enhanced signal averaging techniques were developed to give early warning of the onset of a variety of gearbox failures. Prototype analysis equipment was developed and tested which will permit the condition of components within helicopter dynamic systems (rotors, gearboxes, and powerplants) to be

established. Arrangements for data collection in flight and during ground runs are described. The signal processing methods, including the automatic techniques for secondary analysis which enable defined features to be extracted from the basic signatures, are discussed. Examples are given of the extent to which damage or malfunction of various internal components can be discerned by the techniques employed. The question of application to the widely dispersed fleet of naval aircraft is considered, and the prospects for achieving full on-condition maintenance of in-service gearboxes is assessed. Author

N85-23799*# National Aeronautics and Space Administration, Washington, D. C.

WELCOME TO THE SACLAY PROPELLER TESTING CENTER
Apr. 1985 22 p Transl. into ENGLISH of the book "Bienvenue au Centre d'Essais des Propulseurs de Saclay" Saclay, France, Saclay Propeller Testing Center, 1977 p 1-15 Transl. by The Corporate Word, Inc., Pittsburgh
(Contract NASW-4006)
(NASA-TM-77648; NAS 1.15:77648) Avail: NTIS HC A02/MF A01 CSCL 01C

The history, organization, purpose, and activities of the Saclay Propeller Testing Center is described. A list is provided of all facilities, current and planned, and the types of tests done in each facility are summarized. E.A.K.

08

AIRCRAFT STABILITY AND CONTROL

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

A85-30373#
COMPUTER-AIDED FREQUENCY DOMAIN SYNTHESIS OF A ROBUST ACTIVE FLUTTER SUPPRESSION CONTROL LAW

D. K. SCHMIDT (Purdue University, West Lafayette, IN) and T. K. CHEN (Lear Siegler, Inc., Flight Systems Technology Dept., Dayton, OH) IN: Structures, Structural Dynamics, and Materials Conference, 26th, Orlando, FL, April 15-17, 1985, Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, 1985, p. 459-467. refs
(AIAA PAPER 85-0754)

Computer-aided, graphical, conventional synthesis techniques are employed to obtain a robust active-flutter-suppression control law. The relatively high dynamic order of such problems are dealt with effectively with a computer-aided approach, while interactive computer graphics allows conventional graphical techniques to be utilized. Key design information is displayed for variations in flight conditions such that a simple control law is obtained that is robust over the variation in the flight condition. Through visualization of the pole and zero migration with dynamic pressure, for example, control synthesis, evaluation of effects of unsteady aerodynamics, and model reduction were performed almost by inspection. A candidate control law is analytically shown to compare very favorably to several others taken from the literature. Author

A85-30374#
EFFECT OF ACTIVE CONTROL SYSTEM NONLINEARITIES ON THE L-1011-3(ACS) DESIGN GUST LOADS

J. D. GOULD (Lockheed California Co., Burbank, CA) IN: Structures, Structural Dynamics, and Materials Conference, 26th, Orlando, FL, April 15-17, 1985, Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, 1985, p. 468-476.
(AIAA PAPER 85-0755)

An active control system has been developed for a derivative of the L-1011 which allows an increase in wing span with little increase in design wing loads. Utilization of an active control system to control loads at the design limit level requires that these loads

include the effects of any significant nonlinearities present in the active control system while operating in the severe turbulence levels which produce limit loads on the aircraft. An allowance for load increases produced by active control system nonlinear effects has been included in the design loads, and the adequacy of this allowance has been substantiated by a nonlinear simulation of the aircraft and active control system encountering these severe turbulence levels. Author

A85-31342#
THE APPLICATION OF THE OPTIMAL MODEL-FOLLOWING METHOD TO THE DESIGN OF ELEVATOR CONTROLLERS

X. SHEN Northwestern Polytechnical University, Journal, vol. 3, Jan. 1985, p. 83-95. In Chinese, with abstract in English.

Quadratic optimal control theory, supplemented by classical control theory, is applied to the design of the pitch channel of aircraft Command Augmentation Systems. An optimal model-following system for the design of elevator controllers is chosen with adequate adaptability using the C-star criterion, whose structure and parameters are chosen. The designed C-star elevator controller satisfies the Mil-F-8785B level 1 handling quality requirements. An appropriate cost function is set up in order to ensure the quality of the model-following system, reduce the dimension of weighting matrices, and reduce the computing time. Derivations of fundamental formulas are presented in both continuous and discrete forms. The results of digital simulation are quite satisfactory. C.D.

A85-31955#
A PILOTED SIMULATOR INVESTIGATION OF DECOUPLING HELICOPTERS BY USING A MODEL FOLLOWING CONTROL SYSTEM

G. BOUWER (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Institut fuer Flugmechanik, Brunswick, West Germany) and K. B. HILBERT (U.S. Army, Aeromechanics Laboratory, Moffett Field, CA) IN: American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Proceedings. Alexandria, VA, American Helicopter Society, 1984, p. 49-65. refs

A U.S. and German piloted simulation experiment conducted to evaluate the performance of a model following control system by applying it to hingeless-rotor and teetering-rotor helicopters is reported. The explicit model was a linear, decoupled model such that the pilot commanded pitch attitude with the longitudinal cyclic, roll attitude with the lateral cyclic, yaw rate with the pedals, and earth-fixed downward velocity with the collective. The results of the simulation indicate that the performance of the model following control system is primarily dependent on the limitations of the actuating system. Satisfactory handling qualities were achieved for both augmented helicopters flying two specified evaluation tasks: dolphin and slalom maneuvers. The significant improvements in task performance and handling qualities achieved for these two radically different helicopters, augmented with the designed model following control system, indicates the flexibility and versatility of this control technique. Author

A85-31964#
FLIGHT TEST OF THE 4-VALVE FLY-BY-WIRE/FLY-BY-OPTICS CONTROL SYSTEM

M. R. MURPHY (Bell Helicopter Textron, Fort Worth, TX) IN: American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Proceedings. Alexandria, VA, American Helicopter Society, 1984, p. 171-180. Army-supported research.
(Contract N62269-82-C-0715)

The 4-valve fly-by-wire (FBW) control system was flight-tested in the collective channel of the Model 249 Cobra in January 1984. In addition to the basic quad-redundant FBW mode, an auxiliary simplex fly-by-optics (FBO) mode was also tested. A backup mechanical mode was installed to enhance safety during the development phase. The quad-electrical control paths were dual-fail/operate; only one monitoring plane was required. The FBW mode was flown from takeoff to touchdown and included simulated first and second failures during maneuvers. The simplex

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FBO mode was flown at altitude only. While establishing significant advances in the state of the art, this program accomplished its two objectives: (1) to flight-validate the 4-valve FBW control concept, and (2) to develop engineering flight data on the operation of optical transducers in a helicopter flight environment. Author

A85-32000#

THE AH-64 BACK-UP CONTROL SYSTEM

R. W. PROUTY (Hughes Helicopters, Inc., Culver City, CA) IN: American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Proceedings. Alexandria, VA, American Helicopter Society, 1984, p. 519-523.

The Back-Up Control System (BUCS) designed for the Army/Hughes AH-64 Apache is a fly-by-wire system which would take over from the mechanical system if that system were to suffer combat damage involving either a component severance or a jam. The key components are Linear Variable Differential Transformer position transducers, shear pins, and suitable interfaces between the digital computer and the electro-hydraulic control actuators. Many tests have been performed on the ground with an 'Iron Bird' and verification flight tests have been performed on an AH-64 prototype. This Back-Up Control System is believed to be the first fly-by-wire system in a production U.S. helicopter.

Author

A85-32013* Army Research and Technology Labs., Moffett Field, Calif.

ADVANCED AFCS DEVELOPMENTS ON THE XV-15 TILT ROTOR RESEARCH AIRCRAFT

G. B. CHURCHILL (U.S. Army, Aeromechanics Laboratory, Moffett Field, CA) and R. M. GERDES (NASA, Ames Research Center, Moffett Field, CA) American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Paper. 26 p. refs

The design criteria and control and handling qualities of the Automatic Flight Control System (AFCS), developed in the framework of the XV-15 tilt-rotor research aircraft, are evaluated, differentiating between the stability and control criteria. A technically aggressive SCAS control law was implemented, demonstrating that significant benefits accrue when stability criteria are separated from design criteria; the design analyses for application of the control law are presented, and the limit bandwidth for stabilization in hovering flight is shown to be defined by rotor or control lag functions. Flight tests of the aircraft resulted in a rating of 3 on the Cooper-Harper scale; a possibility of achieving a rating of 2 is expected if the system is applied to the yaw and heave control modes.

L.T.

A85-32015

DEVELOPMENT OF PILOTING TECHNIQUES TO REDUCE HELICOPTER APPROACH NOISE

C. R. COX (Bell Helicopter Textron, Fort Worth, TX) American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Paper. 7 p. refs

This paper discusses the development of piloting techniques which mitigate main rotor blade/wake interaction noise and documents the resulting noise reductions measured by a ground-based microphone array. Noise levels and acoustic time histories are presented for variations in approach speeds, descent rates, and combinations thereof. Changes in landing speed and descent rate for fixed glideslope approaches are shown to vary noise levels by 2 to 5 dBA. The impulsive characteristic of main rotor noise can be dramatically reduced in these cases. Similar reductions are shown to be possible using an approach procedure in which airspeed is slowly bled off while maintaining moderately low rotor collective pitch. A description of the piloting technique is given. It is shown to be practical for normal approach operations and be acceptable and comfortable to passengers on board.

Author

A85-32487

FLIGHT MANAGEMENT SYSTEMS - THEIR ROLE IS STEADILY INCREASING

M. K. DEJONGE (Lear Siegler, Inc., Instrument Div., Grand Rapids, MI) ICAO Bulletin, vol. 40, March 1985, p. 20-23.

The progressively greater influence and complexity of function in Flight Management Systems (FMS) are traced from their introduction as advisory systems in the mid-1970s. The FMS became active with an interface with the throttle and the pitch control, mainly for the vertical flight path. Hub and spoke airlines, i.e., feeder routes converging for accurate timetable connections, utilize the FMS to calculate optimum cost, speed and thrust as functions of fuel and time costs. Only new aircraft integrate navigational capabilities into the FMS, which then also generates displays and controls lateral flight. The installation of 1250 MLS systems by the FAA will permit tight flight routes to be flown close to airports. A four-dimensional navigation system is being developed to include wind forecasts at different altitudes and provide flight times of arrival accurate to within 5 sec. M.S.K.

A85-32586*# National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.

TRANSONIC TIME RESPONSES OF THE MBB A-3 SUPERCRITICAL AIRFOIL INCLUDING ACTIVE CONTROLS

J. T. BATINA (NASA, Langley Research Center, Loads and Aeroelasticity Div., Hampton, VA; Purdue University, West Lafayette, IN) and T. Y. YANG (Purdue University, West Lafayette, IN) (Structures, Structural Dynamics and Materials Conference, 25th, Palm Springs, CA, May 14-16, 1984, and AIAA Dynamics Specialists Conference, Palm Springs, CA, May 17, 18, 1984, Technical Papers. Part 2, p. 578-588) Journal of Aircraft (ISSN 0021-8669), vol. 22, May 1985, p. 393-400. Previously cited in issue 13, p. 1836, Accession no. A84-31748. refs

A85-32593#

A POSSIBLE CAUSATIVE FLOW MECHANISM FOR BODY ROCK

L. E. ERICSSON (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA) Journal of Aircraft (ISSN 0021-8669), vol. 22, May 1985, p. 441-443. refs

Published experimental results for nonlinear pitch-yaw-roll coupling phenomena in high performance aircraft are analyzed in order to deepen understanding of the basic fluid mechanic phenomenon responsible for body rock. In view of the fact that all the nonlinear aerodynamic phenomena in question are generated by separated flow, questions are raised as to the applicability of subscale test data to full scale flight conditions.

O.C.

A85-32777#

DEVELOPMENT OF THE F/A-18A AUTOMATIC CARRIER LANDING SYSTEM

J. M. URNES and R. K. HESS (McDonnell Aircraft Co., St. Louis, MO) (Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, Collection of Technical Papers, p. 920-930) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 8, May-June 1985, p. 289-295. Previously cited in issue 19, p. 2804, Accession no. A83-41765.

A85-32779*# Minnesota Univ., Minneapolis.

ACTIVE FLUTTER SUPPRESSION USING EIGENSPACE AND LINEAR QUADRATIC DESIGN TECHNIQUES

W. L. GARRARD and B. S. LIEBST (Minnesota, University, Minneapolis, MN) (Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, Collection of Technical Papers, p. 423-431) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 8, May-June 1985, p. 304-311. Previously cited in issue 19, p. 2803, Accession no. A83-41702. refs (Contract NAG1-217)

A85-32783#

A NONLINEAR PILOT MODEL FOR HOVER

D. ANDRISANI, II (Purdue University, West Lafayette, IN) and C.-F. GAU (Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, Collection of Technical Papers, p. 499-508) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 8, May-June 1985, p. 332-339. Previously cited in issue 19, p. 2803, Accession no. A83-41710. refs
(Contract N62269-81-C-0729)

A85-32846

STABILITY AND CONTROL OF THE TWIN LIFT HELICOPTER SYSTEM

H. C. CURTISS, JR. (Princeton University, Princeton, NJ) and F. W. WARBURTON (United Technologies Corp., Sikorsky Aircraft Div., Stratford, CT) American Helicopter Society, Journal (ISSN 0002-8711), vol. 30, April 1985, p. 14-23.

As a step towards a better understanding of the dynamics of helicopter twin lift systems utilizing a spreader bar (the configuration previously demonstrated by two CH-54's), a linear seven-degree-of-freedom hover model was developed and a real-time interactive simulation study conducted. The inherent vertical stability provided by the spreader bar configuration, the effect of bar and cable geometry, and various control strategies for minimizing the pilot workload involved in maintaining separation were investigated. Pilot assessments of this simulation has led to the conclusion that manual control with only a conventional autopilot may be more feasible than originally thought, that vertical separation can be used safely to reduce horizontal separation (and hence spreader bar weight), and that workload decreases as the payload is increased. Author

A85-33282

AN OPTIMAL, PROPORTIONAL-PLUS-INTEGRAL/TRACKING CONTROL LAW FOR AIRCRAFT APPLICATIONS

T. SADEGHI (Fairchild Republic Co., Farmingdale, NY) and M. WOZNY (Rensselaer Polytechnic Institute, Troy, NY) IN: Conference on Decision and Control, 22nd, San Antonio, TX, December 14-16, 1983, Proceedings. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, p. 562-564. Research supported by the Rensselaer Polytechnic Institute and Fairchild Republic Co. refs
(Contract NSF ISP-79-2040)

An Optimal Proportional-plus-Integral/Tracking control law is formulated. The control law has a Command Augmentation System configuration suitable for implementation on a digital computer on-board an aircraft. The proposed configuration offers the flexibility for choosing a feedforward matrix incorporating a set of additional control elements and for shaping the transient response without affecting the steady state tracking property. Assuming the system is open loop stable, then in the presence of a 'Jam' the disengaged system will maintain the steady state tracking property which is desirable for aircraft continuing their mission. Author

A85-33283

SENSITIVITY REDUCTION AND ROBUST TRACKING WITH APPLICATION TO AIRCRAFT CONTROL

J. D. DE MELO and S. N. SINGH (Santa Catarina, Universidade Federal, Florianopolis, Brazil) IN: Conference on Decision and Control, 22nd, San Antonio, TX, December 14-16, 1983, Proceedings. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, p. 567-572. refs

An approach for reducing trajectory sensitivity in robust asymptotic tracking for linear feedback systems when there are parameter perturbations and disturbance inputs, is presented. The controller consists of a servocompensator containing the modes of the reference signals and disturbance inputs, a stabilizing feedback loop, and a feed-forward element. Application of the method to the design of a VTOL aircraft flight control system is presented. The use of precompensator allows to perform maneuvers so that the aircraft tracks desired trajectories and the feed-forward signal aids in reducing the trajectory sensitivity to variations of parameters due to change in airspeed, and to wind

gust. Simulation results are presented to show the robust tracking, disturbance rejection, and sensitivity reduction capabilities of the flight control system. Author

A85-33294

NONLINEAR STATE FEEDBACK CONTROL OF UNCERTAIN LINEAR SYSTEMS AND APPLICATION TO CONTROL OF AIRCRAFT

S. N. SINGH (Santa Catarina, Universidade Federal, Florianopolis, Brazil) and A. A. R. COELHO (Para, Universidade Federal, Belem, Brazil) IN: Conference on Decision and Control, 22nd, San Antonio, TX, December 14-16, 1983, Proceedings. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, p. 883-888. refs

An approach to the control of nonzero set points of uncertain linear systems based on the theory of ultimate boundedness is described. A nonlinear control which guarantees that every system response is ultimately bounded within a certain neighborhood of the desired nonzero set point is derived. Analytical expressions for the bounds on variations in parameters for ultimate boundedness are obtained. These results are applied to control of a VTOL aircraft whose time-varying parameters are uncertain. Unlike previous works, arbitrary and fast variations in aircraft parameters are allowed. It is shown that the nonlinear controller is effective for larger variation in parameters than the reduced linear controller. Digital simulation results show that the aircraft can be precisely maneuvered in spite of uncertain parameter variations. M.D.

A85-33300

SHORTCOMINGS OF MODERN CONTROL AS APPLIED TO FIGHTER FLIGHT CONTROL DESIGN

P. R. CHANDLER and W. POTTS (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, OH) IN: Conference on Decision and Control, 22nd, San Antonio, TX, December 14-16, 1983, Proceedings. Volume 3. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, p. 1068-1073. refs

The road to applying modern control theory to fighter control design has been a very rocky one. LQR in its purest form has repeatedly been found unsuccessful. When it has worked, it has been so modified as to be unrecognizable. This paper presents the basic requirements for a flight control synthesis theory, plus reasons and examples are given revealing modern control theory to be highly deficient - in particular LQR, LQG, singular value theory, and eigenvalue/eigenstructure assignment. In contrast, alternative techniques and theories are presented that address the real problems in flight control synthesis-coping with uncertainty and achieving specs. Frequency response has been found to be better suited to flight control design. Author

A85-33304

A ROBUST PITCH POINTING CONTROL LAW

K. M. SOBEL and E. Y. SHAPIRO (Lockheed-California Co., Burbank, CA) IN: Conference on Decision and Control, 22nd, San Antonio, TX, December 14-16, 1983, Proceedings. Volume 3. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, p. 1088-1093. refs

Eigenstructure assignment and command generator tracking are applied to the design of a pitch pointing control law for the AFTI F-16 aircraft. The eigenvalues are chosen to obtain desired damping and rise time and the eigenvectors are chosen to decouple the pitch attitude and flight path angle. Then the design is modified to improve the multivariable phase and gain margins. Finally, a proportional and integral and delay model of a pilot is utilized to illustrate the interaction between the pilot and the aircraft. This output feedback and feedforward gain design differs from previous designs in that only proportional control is required. Author

08 AIRCRAFT STABILITY AND CONTROL

N85-22352# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugmechanik.

DYNAMIC WIND TUNNEL TESTING FOR ACTIVE CONTROL RESEARCH

K. WILHELM and B. GMELIN /in AGARD Ground and Flight Testing for Aircraft Guidance and Control 26 p Dec. 1984 refs

Avail: NTIS HC A09/MF A01

For the investigation of problems associated with the application of active control systems a technique was developed, which allows a comprehensive treatment of flight mechanics problems including the effects of aerodynamics, aeroelastics and control systems. Since this technique, the dynamic wind tunnel test technique, is a synthesis of both computer simulation and wind tunnel test a variety of information on specific flight mechanical phenomena can be obtained. At DFVLR two experimental devices were developed: the installation for dynamic simulation in wind tunnels for investigation in the field of fixed-wing aircraft; and the rotor test stand for investigation in the field of rotary-wing aircraft. At first a brief description of the test facilities is given, further advantages and special problems associated with the application of this test technique are shown. In addition, test results of completed test programs are presented. Author

N85-22353*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

DYNAMIC WIND-TUNNEL TESTING OF ACTIVE CONTROLS BY THE NASA LANGLEY RESEARCH CENTER

I. ABEL, R. V. DOGGETT, J. R. NEWSOM, and M. SANDFORD /in AGARD Ground and Flight Testing for Aircraft Guidance and Control 23 p Dec. 1984 refs

Avail: NTIS HC A09/MF A01 CSCL 01C

Dynamic wind-tunnel testing of active controls by the NASA Langley Research Center is presented. Seven experimental studies that were accomplished to date are described. Six of the studies focus on active flutter suppression. The other focuses on active load alleviation. In addition to presenting basic results for these experimental studies, topics including model design and construction, control law synthesis, active control system implementation, and wind-tunnel test techniques are discussed. Author

N85-22355# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany).

GUIDANCE AND CONTROL RESEARCH FLIGHT TESTING WITH HFB 320 TEST AIRCRAFT

V. ADAM and W. LECHNER /in AGARD Ground and Flight Testing for Aircraft Guidance and Control 13 p Dec. 1984 refs

Avail: NTIS HC A09/MF A01

Flight testing is the last and decisive phase in the development process of new aircraft guidance and control methods, procedures and equipment to give evidence of the expected functional performance. No highly elaborated ground-based simulation can replace this phase unless there is complete knowledge of the aircraft system characteristics and no restriction on expenditure. On the other hand there is no doubt that simulation including most of the real system hardware is a necessary phase to pass before flight testing can be started. This is the means for step by step system validation on the ground under reproducible conditions. In-flight simulation, direct lift control, side stick control, fly-by-wire and integrated navigation tests on the German aircraft HFB 320 are reported. Ground-based experimental systems and flight test equipment are also described. B.G.

N85-22361# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany). Military Aircraft Div.

TESTING OF THE DIGITAL FLIGHT CONTROL SYSTEM OF THE GERMAN CCV FIGHTER EXPERIMENTAL AIRCRAFT

U. KORTE /in AGARD Ground and Flight Testing for Aircraft Guidance and Control 12 p Dec. 1984 refs Original language document was announced as N83-22110

Avail: NTIS HC A09/MF A01

A quad redundant digital FBW Control System for a highly unstable fighter aircraft has been developed and flight tested by MBB in a single seater F-104 G which had been modified as a CCV demonstrator. The CCV program was funded by the German MOD. From Dec. 1977 to Nov. 1981 a total of 118 flights has been conducted. During these flights the quadruplex system was successfully tested for five different configurations starting with the highly stable basic aircraft and ending up with the highly unstable canard configuration with a static instability up to 22% mean aerodynamic chord (MAC). Some of the results obtained regarding control system design, handling evaluation and redundancy management with the digital system will be presented. Author

N85-22398*# Stanford Univ., Calif. Electronics Labs. **MODEL REDUCTION FOR CONTROL SYSTEM DESIGN Final Report**

D. ENNS Mar. 1985 305 p refs

(Contract NAG2-223)

(NASA-CR-170417; NAS 1.26:170417) Avail: NTIS HC A14/MF A01 CSCL 01C

An approach and a technique for effectively obtaining reduced order mathematical models of a given large order model for the purposes of synthesis, analysis and implementation of control systems is developed. This approach involves the use of an error criterion which is the H-infinity norm of a frequency weighted error between the full and reduced order models. The weightings are chosen to take into account the purpose for which the reduced order model is intended. A previously unknown error bound in the H-infinity norm for reduced order models obtained from internally balanced realizations was obtained. This motivated further development of the balancing technique to include the frequency dependent weightings. This resulted in the frequency weighted balanced realization and a new model reduction technique. Two approaches to designing reduced order controllers were developed. The first involves reducing the order of a high order controller with an appropriate weighting. The second involves linear quadratic Gaussian synthesis based on a reduced order model obtained with an appropriate weighting. Author

N85-23800*# Old Dominion Univ., Norfolk, Va. Dept. of Electrical Engineering.

DESIGN OF MULTIVARIABLE FEEDBACK CONTROL SYSTEMS VIA SPECTRAL ASSIGNMENT USING REDUCED-ORDER MODELS AND REDUCED-ORDER OBSERVERS Final Report, Oct. 1982 - Apr. 1984

R. R. MIELKE, L. J. TUNG, and P. I. CARRAWAY, III Washington NASA Apr. 1985 147 p refs

(Contract NSG-1650)

(NASA-CR-3889; NAS 1.26:3889) Avail: NTIS HC A07/MF A01

The feasibility of using reduced order models and reduced order observers with eigenvalue/eigenvector assignment procedures is investigated. A review of spectral assignment synthesis procedures is presented. Then, a reduced order model which retains essential system characteristics is formulated. A constant state feedback matrix which assigns desired closed loop eigenvalues and approximates specified closed loop eigenvectors is calculated for the reduced order model. It is shown that the eigenvalue and eigenvector assignments made in the reduced order system are retained when the feedback matrix is implemented about the full order system. In addition, those modes and associated eigenvectors which are not included in the reduced order model remain unchanged in the closed loop full order system. The full state feedback design is then implemented by using a reduced order observer. It is shown that the eigenvalue and eigenvector

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assignments of the closed loop full order system remain unchanged when a reduced order observer is used. The design procedure is illustrated by an actual design problem. Author

N85-23801*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
TOTAL ENERGY-RATE FEEDBACK FOR AUTOMATIC GLIDE-SLOPE TRACKING DURING WIND-SHEAR PENETRATION
C. M. BELCASTRO and A. J. OSTROFF May 1984 73 p refs (NASA-TP-2412; L-15845; NAS 1.60:2412) Avail: NTIS HC A04/MF A01 CSCL 01C

Low-altitude wind shear is recognized as an infrequent but significant hazard to all aircraft during the take-off and landing phases of flight. A total energy-rate sensor was developed for measuring the specific total energy rate of an airplane with respect to the air mass. Control-system designs, both with and without energy-rate feedback, for the approach to landing of a transport airplane through a severe-wind-shear and gust environment are presented in order to evaluate this application of the sensor. A system model incorporates wind-shear-dynamics equations with the airplane equations of motion to permit analysis of the control systems under various wind-shear conditions. The control systems are designed using optimal-output feedback and are analyzed using frequency-domain control-theory techniques. Control-system performance is evaluated using a complete nonlinear simulation of the airplane combined with a severe-wind-shear and gust data package. This evaluation is concerned with control system stability and regulation capability only. A.R.H.

N85-23802# Boston Univ., Mass. Center for Computational and Applied Dynamics.
FLUTTER TAMING: A NEW TOOL FOR THE AEROELASTIC DESIGNER Final Report, 1 Apr. 1983 - 30 Apr. 1984
L. MORINO Jun. 1984 77 p (Contract AF-AFOSR-0163-83) (AD-A150834; CCAD-TR-84-01; AFOSR-85-0140TR) Avail: NTIS HC A05/MF A01 CSCL 20D

A new concept for the design of aeroservoelastic systems is introduced: flutter taming by nonlinear control, i.e., use of nonlinear terms in the equation to ensure that the behavior of the system beyond the flutter speed is of benign rather than destructive nature. This is accomplished by using a very simple nonlinear control law. It is shown (using a singular perturbation analysis about the stability boundary) that flutter taming is always possible for an aeroservoelastic system that can be represented by a system of nonlinear differential equations with analytical nonlinearities. It is important to emphasize that the control system for flutter taming is fully nonlinear, and therefore it does not affect the linear behavior (in particular the stability characteristics) of the system. Hence, flutter taming can be used in conjunction with flutter suppression by active control to increase the flutter speed). Applications of the theory to the case of an airfoil in supersonic flow are presented. In addition to an active control modification (use of control surface with nonlinear feedback), passive modifications (e.g., a nonlinear damper) are also investigated. GRA

N85-23803# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany).
ACTIVITIES IN FLIGHT MECHANICS AND FLIGHT CONTROL Annual Report, 1984 [FORSCHUNGSBEREICH FLUGMECHANIK/FLUGFUEHRUNG. WISSENSCHAFTLICHER BERICHT STAND 1984]
1984 104 p refs In GERMAN Original contains color illustrations (ISSN-0720-7808) Avail: NTIS HC A06/MF A01

Flight mechanics; real time and in flight simulation techniques; mathematical methods and data techniques; flight test instrumentation; flight control human engineering and simulation; automatic guidance and control systems; gyroscopic techniques and inertial navigation; communication processing and radio navigation; flight path tracking; aircraft radio and flight data

techniques; flight medicine; and pilotless vehicles are discussed. Author (ESA)

N85-24186# Joint Publications Research Service, Arlington, Va.
A 320 TO HAVE COMBINED AUTOMATIC PILOT, FLIGHT CONTROL SYSTEM
H. PRANDENC *In its* West Europe Rept.: Sci. and Technol. (JPRS-WST-85-013) p 51-52 26 Apr. 1985 refs Avail: NTIS HC A06/MF A01

An innovative machine in more ways than one, the A 320 will be the first airliner equipped with a combined automatic pilot and flight control system FMGS. G.L.C.

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RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tube facilities; and engine test blocks.

A85-30369*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
EXPLORATORY FLUTTER TEST IN A CRYOGENIC WIND TUNNEL
S. R. COLE (NASA, Langley Research Center, Configuration Aeroelasticity Branch, Hampton, VA) IN: Structures, Structural Dynamics, and Materials Conference, 26th, Orlando, FL, April 15-17, 1985, Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, 1985, p. 426-434. refs (AIAA PAPER 85-0736)

The feasibility of flutter testing in cryogenic wind tunnels is investigated experimentally in tests on a rigid solid-metal rectangular-planform aspect-ratio-1.5 NACA 64A010 wing model with an integral flexible beam support, cantilever mounted to the wall of the 0.3-m transonic cryogenic tunnel at NASA Langley, at Mach numbers $M = 0.5$ and 0.8 and Reynolds numbers $Re = (4.09-18.16) \times 10^6$. Best results are obtained when the onset of flutter (predicted by the peak-hold subcritical-response technique of Sandford et al., 1975) is approached by adjusting stagnation pressure while keeping M and the stagnation temperature constant. The data are presented in graphs and tables and discussed. It is found that Re effects on flutter cannot be separated from mass-ratio and temperature effects for a single test model and must be interpreted from analytical trends, and that the effects detected by this procedure are so small (4.0-6.5 percent) as to fall within the scatter band of the subcritical-response predictions. T.K.

A85-31782#
THE USE OF MINICOMPUTERS FOR AUTOMATING DESIGN TASKS DURING THE STATIC TESTING OF AIRCRAFT STRUCTURES [ZASTOSOWANIE MINIKOMPUTERA DO AUTOMATYZACJI PRAC PROJEKTOWYCH W PROBACH STATYCZNYCH KONSTRUKCJI LOTNICZYCH]
A. SZOT and J. ZBOROWSKI Instytut Lotnictwa, Prace (ISSN 0509-6669), no. 98, 1984, p. 47-56. In Polish.

The use of minicomputers for automating engineering tasks at the design and development stage is illustrated by an example involving determination of the geometry and strength characteristics of a three-dimensional linkage system and development of technical documentation. The system discussed is designed for applying loads during the static testing of aircraft structures. V.L.

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A85-32014

THE DEVELOPMENT OF ACOUSTICAL GUIDELINES FOR NEW HELIPORTS

J. W. LEVERTON (Westland, Inc., Arlington, VA) American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Paper. 8 p. refs

The basic concepts adopted by the Helicopter Association International (HAI) in developing acoustical guidelines for heliports are outlined, together with the concepts used by FAA in a recent advisory circular. The various aspects of HAI and FAA documents discussed include the planning and environmental issues, helicopter noise rating, and community criteria. The procedures described are aimed at establishing a reference level, dependent on the type of the area, for the sound exposure level associated with the helicopter operations. L.T.

A85-32625*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

REFINEMENT OF AN 'ALTERNATE' METHOD FOR MEASURING HEATING RATES IN HYPERSONIC WIND TUNNELS

C. G. MILLER (NASA, Langley Research Center, Space Systems Div., Hampton, VA) AIAA Journal (ISSN 0001-1452), vol. 23, May 1985, p. 810-812. refs

Recently obtained hypersonic wind tunnel results are presented which resolve the principal uncertainty associated with the use of thin film gages on substrates of the glass ceramic substance designated MACOR. The uncertainty is with respect to both MACOR's thermal properties and the variation of these properties with temperature. The relatively large influence of shock strength on stagnation point heating at low Reynolds numbers is illustrated. O.C.

A85-33353#

DEVELOPMENT OF AUTOMATIC DATA ACQUISITION SYSTEM FOR RJ 500 ENGINE

Ishikawajima-Harima Engineering Review (ISSN 0578-7904), vol. 24, Nov. 1984, p. 451-455. In Japanese, with abstract in English.

The Anglo-Japanese collaborative engine RJ500 is a new turbofan engine designed and manufactured by means of high technology of the aero-engine industries in both countries. This engine requires precise performance analysis, so very severe requirements for data acquisition are needed during the engine operation. Having been a responsible company in charge of the engine operation and data acquisition, IHI has completed the new automatic data acquisition system for the engine. This system was developed based on over 10 years' experience in the field of jet engine automatic data acquisition in IHI, and the latest hardware devices and software techniques were adopted to satisfy the special requirements. By using this system multichannel, high-speed, high-accuracy measurement can be performed. It has been used since the first test in February 1982 and has greatly contributed to the development of the RJ500 engine. Author

N85-22399 Oklahoma State Univ., Stillwater.

CALIBRATION OF WIND TUNNEL FLOW QUALITY Ph.D. Thesis

A. S. ABU-MOSTAFA 1984 128 p
Avail: Univ. Microfilms Order No. DA8427638

Preston-tube measurements on a transition cone were corrected and used to derive a calibration procedure for the 11-ft TWT flow quality. This procedure was applied to the corrected laminar data, and an effective freestream unit Reynolds number was defined by requiring a matching of the average Preston-tube pressure in flight and in the 11-TWT. Results show the operating Reynolds number is below the effective value. The distribution of this effective Reynolds number correlates well with the tunnel noise. Analyses of transitional and turbulent data, however, did not result in effective Reynolds numbers that can be correlated with noise since vorticity fluctuations present in transitional and turbulent boundary layers dominate and mask the effects of tunnel noise on Preston-tube measurements. So, in order to calibrate the effects of noise on transonic wind tunnel tests, only laminar data should be used. To calibrate the effects of transonic wind-tunnel noise on drag

measurements, the Preston-tube data must be supplemented with direct measurements of skin friction. Such data could be used in the subject procedure to define equivalent flight unit Reynolds numbers which would result in a matching of the average, laminar skin friction. Dissert. Abstr.

N85-22400*# Mechanical Technology, Inc., Latham, N. Y. DEVELOPMENT OF A MULTIPLANE MULTISPEED BALANCING SYSTEM FOR TURBINE SYSTEMS

M. R. MARTIN 19 Jul. 1984 114 p refs
(Contract NAS3-20609)

(NASA-CR-174750; NAS 1.26:174750; MTI-84TR39) Avail: NTIS HC A06/MF A01 CSCL 14B

A prototype high speed balancing system was developed for assembled gas turbine engine modules. The system permits fully assembled gas turbine modules to be operated and balanced at selected speeds up to full turbine speed. The balancing system is a complete stand-alone system providing all necessary lubrication and support hardware for full speed operation. A variable speed motor provides the drive power. A drive belt and gearbox provide rotational speeds up to 21,000 rpm inside a vacuum chamber. The heart of the system is a dedicated minicomputer with attendant data acquisition, storage and I/O devices. The computer is programmed to be completely interactive with the operator. The system was installed at CCAD and evaluated by testing 20 T55 power turbines and 20 T53 power turbines. Engine test results verified the performance of the high speed balanced turbines. B.W.

N85-22401*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

CRYOGENIC WIND TUNNELS: A SELECTED ANNOTATED BIBLIOGRAPHY

M. H. TUTTLE (Vigyan Research Associates, Inc., Hampton, Va.), R. A. KILGORE, and P. D. MCGUIRE Apr. 1985 71 p
(NASA-TM-86346; L-15915; NAS 1.15:86346) Avail: NTIS HC A04/MF A01 CSCL 14B

This selected, annotated bibliography supersedes three previous bibliographies--NASA TM-80168 (Oct. 1979), Supplement to NASA TM-80168 (May 1980), and NASA TM-84474 (Sept. 1982). There are 376 entries, 109 of which have been added in this updated version. Selection for inclusion was made with consideration of usefulness of the document to persons interested in building or using a cryogenic wind tunnel. A cryogenic wind tunnel is defined as one which operates with test gas stagnation temperature below 150 K. Publications of historical interest are included that are directly related to key events in the evolution of the cryogenic wind tunnel. The arrangement is chronological by date of publication in the case of reports and by presentation in the case of papers. B.W.

N85-22849# Joint Publications Research Service, Arlington, Va.

CARD'S LOW-SPEED WIND TUNNEL DESCRIBED

W. MAOXUN and P. RUIKANG In *its* Chinese Rept: Sci. and Technol. (JPRS-CST-85-005) p 160-166 20 Feb. 1985 refs
Transl. into ENGLISH from Guoji Hangkong (Beijing, China), no. 10, 5 Oct. 1984 p 2-4

Avail: NTIS HC A10/MF A01

A low speed wind tunnel is described. The 8 m x 6 m wind tunnel is a large-scale, low-speed open-type wind tunnel with dual in-line closed test sections. Overall length is 237 m, maximum width is 40 m, maximum height is 20.5 m, and it is made up of the intake apparatus, stabilizing section, first construction section, first test section, second construction section, second test section, first diffusion section, fan section, second diffusion section, and air exit. The ceiling of each test section has movable gates, in the center of the floor there is a turntable that can rotate 360 deg, and in the sidewalls and ceiling there are many observation windows. The important performance parameters of the two test sections are given. The first test section is primarily for low-speed tests of helicopters and V/STOL aircraft, and research on testing industrial aerodynamic surfaces. For this reason, when the wind tunnel was designed, the demands for quality of flow field were

low, they just had to be able to satisfy test demands. The second test section is the main work section of this wind tunnel; the quality of its flow field achieved design norms and the unified stipulated norms for low-speed wind tunnels nationwide. R.J.F.

N85-23692# Joint Publications Research Service, Arlington, Va.
DEPUTY MINISTER ON CIVIL AVIATION CONSTRUCTION PROJECTS

V. BELIKOV *In its* USSR Rept.: Transportation (JPRS-UTR-85-005) p 15-16 25 Mar. 1985 Transl. into ENGLISH from Izv. (Moscow), 23 Jan. 1985 p 2
Avail: NTIS HC A05/MF A01

Aeroflot's objectives in the final year of the five-year plan were discussed at an expanded meeting of the Ministry of Civil Aviation collegium and the presidium of the Aviation Workers Union central committee. Together with many other aspects of air transport, considerable attention was devoted to the development of ground structures and services and the construction of airports and air terminals. Author

N85-23808*# Southeast Basin Inter-Agency Committee, Atlanta, Ga. Dept. of Aeronautics and Astronautics.

A PRELIMINARY INVESTIGATION OF THE DYNAMIC FORCE-CALIBRATION OF A MAGNETIC SUSPENSION AND BALANCE SYSTEM Contractor Report, Jun. 1983 - Jan. 1984

M. J. GOODYER May 1985 14 p
(Contract NSG-7523)
(NASA-CR-172580; NAS 1.26:172580) Avail: NTIS HC A02/MF A01 CSCL 14B

The aerodynamic forces and moments acting upon a magnetically suspended wind tunnel model are derived from calibrations of suspension electro magnet currents against known forces. As an alternative to the conventional calibration method of applying steady forces to the model, early experiences with dynamic calibration are outlined, that is a calibration obtained by oscillating a model in suspension and deriving a force/current relationship from its inertia force and the unsteady components of currents. Advantages of dynamic calibration are speed and simplicity. The two methods of calibration applied to one force component show good agreement. Author

N85-23810# Canyon Research Group, Inc., Westlake Village, Calif.

VISUAL SIMULATION REQUIREMENTS FOR AIRCRAFT ASPECT RECOGNITION AT REAL WORLD DISTANCES Final Interim Report, 1 Sep. 1981 - 31 Aug. 1984

R. S. KENNEDY, K. S. BERBAUM, S. C. COLLYER, J. G. MAY, and W. P. DUNLAP Dec. 1984 73 p
(Contract N61339-81-C-0105)
(AD-A151040; NAVTRAEQUIPC-81-C-0105-5) Avail: NTIS HC A04/MF A01 CSCL 06P

A research program is underway whose goal is to provide engineering guidelines on target image sufficiency for training tactics and maneuvering skills in ground-based flight simulators. The experiment examined aspect recognition sensitivity, i.e., the distance at which subjects could determine the orientation of another aircraft. The aspect recognition task was simplified in the following ways: (1) only 16 stationary targets orientations of a TA4J aircraft were presented; (2) targets had essentially the same length/width ratio; (3) subjects made binary up/down judgements; and (4) a staircase method provided percent detection thresholds for aspect recognition range. In Phase 1, four different target luminances and three background luminances were combined with four different levels of projector resolution in a partial parametric study to access the relative effects of contrast, resolution, and brightness on aspect recognition. In Phase 2, motion and direction of view were varied. Phase 3 replicated Phase 1 to determine whether sequence effects occurred in this repeated measures study. Through a series of ministudies, Phase 4 examined subsidiary effects (viz., different aircraft, different perceptual judgements, difficulty level of the silhouette stimuli, and poorer resolution). GRA

N85-24143# Joint Publications Research Service, Arlington, Va.
HARBIN'S SUBSONIC, TRANSONIC WIND TUNNEL DETAILED
W. RUIFU and F. JIECHUAN *In its* China Rept.: Sci. and Technol. (JPRS-CST-84-012) p 36-40 23 Apr. 1985 Transl. into ENGLISH from Guoji Hangkong (Peking), no. 8, 5 Aug. 1983 p 6-7

Avail: NTIS HC A04/MF A01

Technical modifications on a 0.52m x 0.64m subsonic and transonic wind tunnel is discussed. The wind tunnel has been in operation since July 1982, during which time several thousand wind tunnel tests have been performed with satisfactory results. The technical modifications include the following: for the first time the wind tunnel uses a test section made of a single point support, semiflexible wall nozzle and slanted hole walls with variable open-shut ratio or low noise slanted hole plates; a DJS-622 computer is used to control the wind tunnel operation and to perform automatic collection and real time processing of test data; the test Mach Number can be varied continuously from 0.3 to 1.5 to provide an extended range for conducting low supersonic tests, and an advanced test procedure for studying the wall characteristics of a transonic wind tunnel. E.R.

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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.

A85-31574

ALGORITHMS FOR DIAGNOSING THERMAL LOADS OF FLIGHT VEHICLES [ALGORITMY DIAGNOSTIKI TEPLOVYKH NAGRUZOK LETATEL'NYKH APPARATOV]

O. M. ALIFANOV, V. K. ZANTSEV, B. M. PANKRATOV, E. A. ARTIUKHIN, V. P. MISHIN, V. I. ZHUK, and A. S. GOLOSOV Moscow, Izdatel'stvo Mashinostroenie, 1983, 168 p. In Russian. refs

The general principles of the thermal design of flight vehicles and experimental investigations of the thermal parameters of their operation are examined. The boundary value inverse heat conduction problem is formulated in several different ways, and the use of the methods based on the inverse heat conduction problem in the thermal design of flight vehicles is reviewed. The discussion also covers preliminary processing of thermal data, calculation of boundary conditions, direct methods for solving boundary value inverse problems, and the inverse problem as a regularized nonlinear programming problem. V.L.

A85-32192* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

TOPEX GROUND DATA SYSTEM

S. N. ROSELL and C. A. YAMARONE, JR. (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) IN: NTC '83; Proceedings of the National Telesystems Conference, San Francisco, CA, November 14-16, 1983. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, p. 112-117. refs

The TOPEX Project is a proposed oceanographic mission to measure the topography of the sea surface for a period of three years. This mission is sponsored by the National Aeronautics and Space Administration and managed by the Jet Propulsion Laboratory. Measurements of topography are used to study ocean currents, tides, bathymetry and the oceanic geoid. Several of the primary goals of this mission are to process and verify the altimetric data, and distribute them within days to the science investigators. This paper describes the TOPEX end-to-end ground data system. In addition to controlling the TOPEX satellite, the ground data system has been designed to minimize the time from data

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acquisition to science processing and data distribution. A centralized design supports the favorable response time of the system and also allows for operational efficiencies. Networking of real time and non-real time elements of the data system provides for more effective data processing. Author

N85-23841*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ON-ORBIT SYSTEMS IDENTIFICATION OF FLEXIBLE SPACECRAFT TECHNOLOGY, 1984, PT. 2 P 465-481
L. TAYLOR and L. D. PINSON *In its Large Space Antenna Systems Technol.*, 1984, Pt. 2 p 465-481 Apr. 1985 refs
Avail: NTIS HC A21/MF A01 CSCL 22B

Future spacecraft include configurations which are too flexible to be adequately tested prior to flight and which will require on-orbit systems identification to ensure safe operation of the flight control system. The structural dynamics model will evolve and its accuracy will improve in stages as ground tests of full-scale components and replica-scale models are performed. State Space Modeling and Conditional Maximum Likelihood Parameter Estimation methodology can provide the formal probability-based framework for the process of upgrading a model as additional test results are obtained. Although the number of unknown parameters can be reduced by the use of canonical forms for the stability matrix, the number of unknown model parameters quickly becomes unmanageable unless advantage is taken of the relationship of a much fewer number of global model parameters. Distributed parameter systems or partial differential equation models are one way to take advantage of such global parameters to reduce the number of unknown model parameters. B.G.

N85-23845*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
LARGE ANTENNA CONTROL METHODS: CURRENT STATUS AND FUTURE TRENDS

G. RODRIGUEZ, Y. H. LIN, and M. H. MILMAN *In NASA. Langley Research Center Large Space Antenna Systems Technol.*, 1984, Pt. 2 p 547-568 Apr. 1985 refs
Avail: NTIS HC A21/MF A01 CSCL 22B

Current methods for control of large antennas, as well as future trends required for improved performance are addressed. Some of the target missions in which these methods would be used are: the Land Mobile Satellite System (LMSS) for communications; the Satellite Surveillance (SSS) for aircraft traffic control; the orbiting Very Long Baseline Interferometer (VLBI), or QUASAT, for radio astronomy; and the Large Deployable Reflector (LDR) for IR and submillimeter astronomy. G.L.C.

N85-23926*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FABRICATION OF CERAMIC SUBSTRATE-REINFORCED AND FREE FORMS

R. J. QUENTMEYER, G. MCDONALD, and R. C. HENDRICKS
19 Apr. 1985 26 p refs Presented at 12th Intern. Conf. on Met. Coatings, Los Angeles, 15-19 Apr. 1985; sponsored by American Vacuum Society
(NASA-TM-86994; E-2540; NAS 1.15:86994) Avail: NTIS HC A03/MF A01 CSCL 21H

Components fabricated of, or coated with, ceramics have lower parasitic cooling requirements. Techniques are discussed for fabricating thin-shell ceramic components and ceramic coatings for applications in rocket or jet engine environments. Thin ceramic shells with complex geometric forms involving convolutions and reentrant surfaces were fabricated by mandrel removal. Mandrel removal was combined with electroplating or plasma spraying and isostatic pressing to form a metal support for the ceramic. Rocket engine thrust chambers coated with 0.08 mm (3 mil) of ZrO₂-8Y₂O₃ had no failures and a tenfold increase in engine life. Some measured mechanical properties of the plasma-sprayed ceramic are presented. B.G.

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CHEMISTRY AND MATERIALS

Includes chemistry and materials (general); composite materials; inorganic and physical chemistry; metallic materials; nonmetallic materials; and propellants and fuels.

A85-30259#
EXPERIMENTAL INVESTIGATION ON ADVANCED COMPOSITE STIFFENED STRUCTURES UNDER UNIAXIAL COMPRESSION AND BENDING

G. ROMEO (Torino, Politecnico, Turin, Italy) IN: Structures, Structural Dynamics, and Materials Conference, 26th, Orlando, FL, April 15-17, 1985, Technical Papers. Part 1. New York, American Institute of Aeronautics and Astronautics, 1985, p. 283-292. refs (AIAA PAPER 85-0674)

Several tests were conducted on graphite/epoxy hat and blade-stiffened panels under uniaxial compression and wing box beams under pure bending in order to verify the correlation between theoretical analysis and experimental results. Compression panels theoretical analysis is based on a wide column theory to predict overall buckling, on the orthotropic buckling equations to predict local buckling and on the torsional instability theory for the blade-stiffened panels. Adequate correlations with experimental results were obtained for uniaxial compression. Single compression tests cannot represent the load conditions of a wing box compression panel properly; in particular, the bending curvature causes a lateral pressure that can reduce the longitudinal load at which buckling occurs. Author

A85-31487
THE USE OF HIGH-TEMPERATURE CERAMICS IN DIESEL AND GAS-TURBINE ENGINES (REVIEW) [PRIMENENIE VYSOKOTEMPERATURNOI KERAMIKI V DIZEL'NYKH I GAZOTURBINNYKH DVIGATELIYKH /OBZOR/]

E. T. DENISENKO, T. V. EREMINA, D. F. KALINOVICH, and L. T. KUZNETSOVA (Akademiiia Nauk Ukrainskoi SSR, Institut Problem Materialovedeniia, Kiev, Ukrainian SSR) Poroshkovaia Metallurgiiia (ISSN 0032-4795), March 1985, p. 97-106. In Russian. refs

The use of silicon nitride, silicon-carbide, Si₃N₄-AlN-Al₂O₃, and other high-temperature ceramic systems in diesel and gas-turbine automotive engines is reviewed. Ceramic engine parts are generally manufactured by reaction bonding, reaction sintering, or hot isostatic pressing; often, the ceramic matrix is combined with reinforcing fibers. The properties of ceramic materials produced by the above methods and their modifications are discussed, and test results are presented. V.L.

A85-31572
ESTIMATION OF STRUCTURAL TRANSFORMATIONS IN JET FUELS FROM ELECTRICAL CONDUCTIVITY AND VISCOSITY [OTSENKA STRUKTURNYKH PREVRASHCHENII V REAKTIVNYKH TOPLIVAKH PO ELEKTROPROVODIMOSTI I VIAZKOSTI]

A. I. BELOUSOV and E. M. BUSHUEVA (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Meftianoi Promyshlennosti, Moscow, USSR) Khimiia i Tekhnologiiia Topliv i Masel (ISSN 0023-1169), no. 3, 1985, p. 20, 21. In Russian. refs

The temperature dependences of the electrical conductivity and viscosity of jet fuels with a crystallization temperature below -60 C (T-1, RT, TS-1, and T-6) have been investigated with the objective of detecting structural transformations. An analysis of test results indicates the presence of structural transformations in the jet fuels at temperatures well above the crystallization point. The data obtained can be used for estimating the contribution of structural transformations to an increase in the viscosity of the fuels. V.I.

A85-31688* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

CHEMICAL REACTIONS INVOLVED IN THE INITIATION OF HOT CORROSION OF IN-738

G. C. FRYBURG, F. J. KOHL, and C. A. STEARNS (NASA, Lewis Research Center, Cleveland, OH) Electrochemical Society, Journal (ISSN 0013-4651), vol. 131, Dec. 1984, p. 2985-2997. Previously announced in STAR as N84-28958. refs

Sodium-sulfate-induced hot corrosion of preoxidized IN-738 was studied at 975 C with special emphasis placed on the processes occurring during the long induction period. Thermogravimetric tests were run for predetermined periods of time, and then one set of specimens was washed with water. Chemical analysis of the wash solutions yielded information about water soluble metal salts and residual sulfate. A second set of samples was cross sectioned dry and polished in a nonaqueous medium. Element distributions within the oxide scale were obtained from electron microprobe X-ray micrographs. Evolution of SO was monitored throughout the thermogravimetric tests. Kinetic rate studies were performed for several pertinent processes; appropriate rate constants were obtained from the following chemical reactions; $\text{Cr}_2\text{O}_3 + 2 \text{Na}_2\text{SO}_4(1) + 3/2 \text{O}_2$ yields $2 \text{Na}_2\text{CrO}_4(1) + 2 \text{SO}_3(\text{g})$; $\text{TiO}_2 + \text{Na}_2\text{SO}_4(1)$ yields $\text{Na}_2\text{O}(\text{T}102)\text{n} + 503(\text{g})\text{n} \text{T}102 + \text{Na}_2\text{CrO}_4(1)$ yields $\text{Na}_2(\text{T}102)\text{n} + \text{CrO}_3(\text{g})$. Author

A85-31962#

DELAMINATION CONTROL OF COMPOSITE ROTOR HUBS

W. S. CHAN, C. ROGERS, J. D. CRONKHITE, and J. MARTIN (Bell Helicopter Textron, Fort Worth, TX) IN: American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Proceedings. Alexandria, VA, American Helicopter Society, 1984, p. 141-154. Research supported by the Bell Helicopter Textron Independent Research and Development Program. refs

Methods for controlling free-edge delamination considered in this study include changing the ply stacking sequence, minimizing Poisson's ratio mismatch, and adding an adhesive layer to the laminates. S2 glass laminates were used to investigate the effect of these parameters on delamination strength. The finite element method was employed to evaluate the interlaminar stress and strain energy release rate. From analytical and experimental results, it is concluded that, with a reduction in the Poisson's ratio mismatch between plies, the interlaminar stress can be reduced and the delamination strength can be significantly increased. Also, proper placement of an adhesive layer in glass laminates, as in graphite/epoxy laminates, can significantly increase the delamination strength. However, unlike graphite laminates, glass laminates with an adhesive layer delaminate before final failure. Finally, a method to predict the onset of free-edge delamination strain, which accounts for the ratio $G(\text{II})/G(\text{I})$ on interlaminar fracture toughness $G(\text{C-prime})$ is proposed. Author

A85-32023

THE USES OF TITANIUM

J. R. B. GILBERT (IMI Titanium, Ltd., Birmingham, England) Materials Science and Technology (ISSN 0267-0836), vol. 1, April 1985, p. 257-262.

The range of applications of titanium and its alloys has broadened considerably in recent years as advances in the users' technologies have brought appropriate responses from the titanium industry. Alloy development to match improvements in aircraft gas-turbine engines is the prime example; useful alloys must strike a balance between creep strength, fatigue strength, and fracture toughness. Dramatic changes in manufacturing techniques are currently widening the range of uses for titanium in airframes, where the metal now accounts for about 7 percent of the structural weight for commercial aircraft and 20-25 percent for military aircraft. Other major areas of use are in general and marine engineering, heat exchangers and steam condensers, chemical and electrochemical plant, and surgical implants. Titanium is now an everyday engineering material with a price per unit volume in between stainless steels and nickel-base alloys. Author

A85-32380

POLYCRYSTALLINE GRAIN CONTROLLED CASTINGS FOR ROTATING COMPRESSOR AND TURBINE COMPONENTS

B. A. EWING and K. A. GREEN (General Motors Corp., Indianapolis, IN) IN: Superalloys 1984; Proceedings of the Fifth International Symposium, Champion, PA, October 7-11, 1984. Warrendale, PA, Metallurgical Society of AIME, 1984, p. 33-42.

Allison evaluations of integrally cast superalloy components have shown that the Grainex and Microcast X processes developed by the Howmet Turbine Components Corporation offer substantially refined macrostructures and improved microstructural uniformity over conventional castings. Both processes offer improved tensile properties and the potential for reduced data scatter. Of the two processes, the Microcast X castings showed grain sizes that were on the order of ASTM 3 to 5, compared with ASTM 0 for the Grainex product. It was determined that the Microcast X process offered the best potential for achieving maximum tensile property response and that Microcast X IN-792 + Hf, Inconel 718, and AF 95 alloys offer attractive mechanical properties for moderate temperature/stress applications. With additional work it may be possible to selectively utilize near-net-shape Microcast X castings in static and rotating turbine applications as substitutes for forgings. Author

A85-32409

A HISTORY OF SUPERALLOY METALLURGY FOR SUPERALLOY METALLURGISTS

C. T. SIMS (General Electric Co., Schenectady, NY) IN: Superalloys 1984; Proceedings of the Fifth International Symposium, Champion, PA, October 7-11, 1984. Warrendale, PA, Metallurgical Society of AIME, 1984, p. 399-419. refs

Superalloys are utilized at a higher fraction of their actual melting point than any other class of broadly commercial metallurgical materials. Superalloys are the materials which have made much of very-high-temperature engineering technology possible. They are the materials leading edge of jet engines. This 'history' is an attempt to tell their story. However, it is not intended to be simply a logical recording of the events that have transpired to create them, but is intended to be a technically and scientifically useful analysis through chronological treatment, based upon consideration of the development of their significant property factors, the human factors, and other external forces which have generated these unusual, and now essential, materials. Author

A85-32433

DEVELOPMENT OF COATINGS FOR THE PROTECTION OF GAS TURBINE BLADES AGAINST HIGH TEMPERATURE OXIDATION AND CORROSION

J. E. RESTALL (Royal Aircraft Establishment, Farnborough, Hants., England) IN: Superalloys 1984; Proceedings of the Fifth International Symposium, Champion, PA, October 7-11, 1984. Warrendale, PA, Metallurgical Society of AIME, 1984, p. 721-730. refs

An account is given of three techniques that are currently under development for the deposition of overlay-type coatings suitable for protecting superalloy turbine blades and vanes in service engines. These are (1) a combination of plasma spraying with subsequent chemical vapour deposition of aluminum or other elements, (2) sputter ion plating, and (3) occluded electroplating. Results are presented and discussed of various laboratory tests and high velocity corrosion rig tests carried out on superalloy components and test pieces coated by these techniques. Author

A85-32850

IONIC RADII AND ELECTRONEGATIVITIES OF EFFECTIVE SINTERING AIDS FOR Si3N4 CERAMICS

K. NEGITA (Nissan Motor Co., Ltd., Material Research Laboratory, Yokosuka, Japan) Journal of Materials Science Letters (ISSN 0261-8028), vol. 4, April 1985, p. 417, 418. refs

Chemical bond and geometrical effects of sintering aids for densifying Si3N4 are discussed. The study is limited to electronegativities (EN) and ionic radii (IR). The grain boundaries of Si3N4 ceramics comprise metal oxides and/or oxynitride glasses,

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the former producing an ionic bond during sintering. Small IR (below 0.1 nm) permit the acceptance of metal ions. However, a true understanding of densification will also depend on the development of a data base on the relaxation of surface and grain boundary energies, the alpha-beta phase transition, and techniques for initiating solid solution high-temperature reactions. M.S.K.

A85-33241

THE LAMINATED EPOXY FRENCH GLIDER PEGASUS [LE PLANEUR FRANCAIS PEGASE EN STRATIFIE EPOXY]

Materiaux et Techniques (ISSN 0032-6985), no. 1, 2, Jan.-Feb. 1984, p. 52, 53. In French.

The Pegasus glider has a glass fiber/epoxy composite laminated skin. The fuselage panels are cast in molds 7 m long and are cured at temperatures sufficiently high to drive out bubbles. Aileron molds 3 m long are prepared in the same manner to produce panels 0.5 mm thick which are laminated to five or six thicknesses of varying masses. The layers are bonded with a polymer and are fitted with nylon fixtures for attachment to the metal chassis. Similar techniques are employed for the wings, which require only three layers. The glider is constructed from two half-shells and has a surface area comprising about 300 sq mm of material, considering the total of all laminates. M.S.K.

A85-33242

THE USE OF CARBON WEAVES AND TAPES - TECHNICAL AND ECONOMIC SURVEYS [EMPLOI DES NAPPES ET DES TISSUS CARBONE - BILAN TECHNIQUE ET ECONOMIQUE]

G. BRIENS (Societe Nationale Industrielle Aerospaciale, Paris, France) *Materiaux et Techniques* (ISSN 0032-6985), no. 1, 2, Jan.-Feb. 1984, p. 55-61. In French.

The advantages and shortcomings of carbon fiber woven fabrics and tapes in diverse aerospace applications are explored. Polymerized plies of woven fabrics can be prepared in thicknesses ranging from 0.05-0.250 mm, offering ultralight, compression resistant thermally stable construction for, e.g., satellite walls. The complexity of the shapes that can be constructed in one piece is limited because of the difficulty of working with thin sheets and the brittleness of perpendicularly impregnated fibers. The properties of carbon fiber tapes depend on the number of filaments, the presence or absence of twist, and the carbon mass of the tape. Tape can be used for complex forms, simplifies the manufacturing process due to built-in multidirectional fibers, has a low porosity, and is suitable for acoustic liners and satellite solar panel supports. The mechanical weakness of tapes requires compensation with extra layers in areas of high stress, thereby incurring a weight penalty. The fabrics therefore have a better overall performance and offer a greater ease of dimensional optimization, except where delicate manipulations to achieve a particular finished form are required. M.S.K.

N85-22562# University of Southern California, Los Angeles. Dept. of Mechanical Engineering.

EFFECTS OF TEMPERATURE VARIATION AMONG DROPLETS IN AN EVAPORATING FUEL SPRAY

P. R. CHOUDHURY and M. GERSTEIN in *APL 21st JANNAF Combust. Meeting*, Vol. 1 p 455-463 Oct. 1984 refs
Avail: NTIS HC A21/MF A01 CSCL 21D

It is well known that the boiling point of a typical fuel blend is different from those of the pure components. For an ideal mixture of liquids at a given state the new boiling point can be calculated either theoretically or can be obtained from experimental data (e.g., ASTM distillation curve). The ASTM distillation data for JP-4, for example, show that the boiling point can change by about 250 C depending upon the degree of evaporation. Droplets of different diameters in a spray undergo different degrees of evaporation and hence have different boiling temperatures. The purpose is to investigate the effect of temperature distribution in the spray on the local overall fuel-air ratio. Sprays of both JP-8 and JP-4 (ASTM distillation data) are used as examples in a flowing, one-dimensional stream at 20 atm and 680 K. The droplets undergo an initial phase of unsteady heating and finally steady evaporation follows when the wet-bulb temperature is reached. The results show that

under most operating conditions the temperature distribution in a fuel spray can have a significant effect on the local fuel-air mixture and hence on the performance of an airbreathing propulsion system. The use of a constant mean boiling temperature rather than the variable boiling temperature will result in significant errors. R.J.F.

N85-22646# Shell Research Ltd., Chester (England). Continuous Combustion Fuels Div.

THE INFLUENCE OF FUEL MOLECULAR COMPOSITION UPON FLAME-TUBE TEMPERATURE AND FLAME RADIATION IN A MODEL GAS-TURBINE PRIMARY ZONE

T. T. BOWDEN and J. H. PEARSON Feb. 1984 44 p refs
(Contract MIN-DEF-A45A/578)

(K234; BR93796) Avail: NTIS HC A03/MF A01

Fuels containing known concentrations of well-defined hydrocarbon types were burned under conditions simulating those occurring in aviation gas turbine engines. The values of flame tube temperature and flame radiation were compared to predicted values. Results indicate that aromatic content is inappropriate as an inspection property for fuels containing fused bicyclic saturated hydrocarbons; that hydrogen content is a satisfactory inspection property for fuels containing simple aromatics and fused bicyclic saturated hydrocarbons; and that only smoke point is a satisfactory inspection property for fuels containing high concentrations of tetralins and naphthalenes. A kinetic explanation for the observed results is proposed. Author (ESA)

N85-22698# Joint Publications Research Service, Arlington, Va. **USES OF COMPOSITE MATERIALS**

V. DOVIDENAS *In its USSR Rept.: Mater. Sci. and Met.* (JPRS-UMS-85-002) p 7-10 6 Feb. 1985 Transl. into ENGLISH from *Komsomolskaya Pravda* (USSR), no. 93, 12 May 1984 p 3
Avail: NTIS HC A05/MF A01

The use of composite materials in the design of automobiles, ships, aircraft, and spacecraft is described. Weight reduction and durability are two advantages of composite materials. Also discussed were the advantages of glass fiber reinforced plastics and carbon fiber reinforced plastics. B.G.

N85-22768# Ohio State Univ., Columbus. Dept. of Physics.

A STANDARD AIRCRAFT DIFFUSION FLAME: SPECTRAL CHARACTERISTICS AND A FEASIBILITY STUDY FOR DEVELOPING AN ALTERNATE CALIBRATION SOURCE FOR AIRCRAFT OPTICAL FIRE DETECTION SYSTEMS Final Report, 31 Mar. 1983 - 30 Sep. 1984

R. L. HAWKINS and K. N. RAO Wright-Patterson AFB, Ohio Air Force Wright Aeronautical Labs. 30 Dec. 1984 29 p
(Contract F33615-83-K-2308)

(AD-A150231; AFWAL-TR-84-2080) Avail: NTIS HC A03/MF A01 CSCL 21D

The standard aircraft diffusion flame source presents practical difficulties due to its lack of controllability and its production of large amounts of smoke and soot. A source which is more convenient to handle, but which emulates the spectral and power characteristics of the standard flame, might prove useful. The requirements of such a flame were evaluated by measuring the spectral and power characteristics of a standard aircraft diffusion flame over the spectral range 2.5 micrometers to 20 micrometers. The total power output in this range was on the order of 1000 watts. About one-fourth of this was from the 4.4 micrometers carbon dioxide emission and; a small amount was due to weaker emissions of water vapor and carbon dioxide; and the remainder was due to thermal emission from soot particles. GRA

N85-23768# Imperial Coll. of Science and Technology, London (England). Tribology Section.

HELICOPTER TRANSMISSION LUBRICANTS

H. A. SPIKES *In AGARD Gears and Power Transmission Systems for Helicopters and Turboprops* 10 p Jan. 1985 refs
Avail: NTIS HC A17/MF A01

The problems associated with the lubrication of helicopter transmissions are outlined. Changes likely to occur over the next

decade involving helicopter lubricants are discussed. For many years, helicopter reliability has suffered both in the UK and the USA from the requirement that the oil be common to both the transmission and the gas turbine. In practice, certainly in the UK, most helicopters do not, in fact, use a common oil. The UK helicopter industry is in sympathy with the logistic advantages of minimizing the number of oils stocked but feels that this could be more successfully achieved by adopting a single transmission oil for all NATO helicopters. It now appears that this is now being considered as a practical alternative on both sides of the Atlantic. In the UK, the MOD has funded the successful development of a helicopter transmission oil in anticipation of such a move. The USA after many years of being antagonistic towards separate gearbox and engine lubricants is about to embark on a relevant oil development program. B.W.

N85-23781*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TRANSMISSION EFFICIENCY MEASUREMENTS AND CORRELATIONS WITH PHYSICAL CHARACTERISTICS OF THE LUBRICANT

J. J. COY, A. M. MITCHELL, and B. J. HAMROCK *In* AGARD Gears and Power Transmission Systems for Helicopters and Turboprops 15 p Jan. 1985 refs Previously announced as N84-30293 Prepared in cooperation with Army Research and Technology Labs.

Avail: NTIS HC A17/MF A01 CSCL 11G

Data from helicopter transmission efficiency tests were compared to physical properties of the eleven lubricants used in those tests. The tests were conducted with the OH-58 helicopter main rotor transmission. Efficiencies ranged from 98.3 to 98.8 percent. The data was examined for correlation of physical properties with efficiency. There was a reasonable correlation of efficiency with absolute viscosity if the viscosity was first corrected for temperature and pressure in the lubricated contact. Between lubricants, efficiency did not correlate well with viscosity at atmospheric pressure. Between lubricants, efficiency did not correlate well with calculated lubricant film forming capacity. Bench type sliding friction and wear measurements could not be correlated to transmission efficiency and component wear. Author

N85-23784# Pisa Univ. (Italy).
PROBLEMS OF ELASTIC HYDRODYNAMIC LUBRICATION OF HELICOPTER TRANSMISSION GEARS

D. DINI *In* AGARD Gears and Power Transmission Systems for Helicopters and Turboprops 9 p Jan. 1985 refs

Avail: NTIS HC A17/MF A01

The reduction gear box and its components, from the engine to the main and tail rotors, contain epicyclic and bevel reduction gears, as taper thrust and cylindrical roller bearing, subjected to elasto-hydro-dynamic lubrication whose operation needs a better understanding in order to improve present efficiency. Since the lubrication efficiency is depending upon the elastic deformation of the contact surfaces, a theory for a better physical interpretation of the mechanism is discussed as a design means to alleviate adverse stress conditions during operations. An attempt to solve the problem of computing the pressure distribution in the contact is made and, at the same time, of allowing for the effects that this pressure has on the properties of the fluid and on the geometry of the elastic solids. The solution also provides the shape of the lubricant film, particularly the minimum clearance between the solids. An experimental high performance equipment capable to simulate the behaviour of Hertzian contacts in elasto-hydro-dynamic lubrication is proposed. Author

N85-23941*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

APPLICATIONS OF HIGH PRESSURE DIFFERENTIAL SCANNING CALORIMETRY TO AVIATION FUEL THERMAL STABILITY RESEARCH Final Report

M. C. NEVEU (State Univ. of New York, Fredonia) and D. P. STOCKER Apr. 1985 25 p refs (NASA-TM-87002; E-2547; NAS 1.15:87002) Avail: NTIS HC A02/MF A01 CSCL 21D

High pressure differential scanning calorimetry (DSC) was studied as an alternate method for performing high temperature fuel thermal stability research. The DSC was used to measure the heat of reaction versus temperature of a fuel sample heated at a programmed rate in an oxygen pressurized cell. Pure hydrocarbons and model fuels were studied using typical DSC operating conditions of 600 psig of oxygen and a temperature range from ambient to 500 C. The DSC oxidation onset temperature was determined and was used to rate the fuels on thermal stability. Kinetic rate constants were determined for the global initial oxidation reaction. Fuel deposit formation is measured, and the high temperature volatility of some tetralin deposits is studied by thermogravimetric analysis. Gas chromatography and mass spectrometry are used to study the chemical composition of some DSC stressed fuels. E.A.K.

N85-23970# Battelle Columbus Labs., Ohio.

AN OVERVIEW OF THE MIL-HDBK-5 PROGRAM Final Report, 9 Jun. 1980 - 2 Jul. 1984

P. E. RUFF Wright-Patterson AFB, Ohio AFWAL Sep. 1984 55 p

(Contract F33615-80-C-5037)

(AD-A147788; AFWAL-TR-84-1423) Avail: NTIS HC A04/MF A01 CSCL 05B

An overview of the MIL-HDBK-5 program is presented. The intent of the overview is to provide information which will be helpful to those who are not familiar with the MIL-HDBK-5 program. In addition, the history of the MIL-HDBK-5 Handbook and its predecessor, ANC-5 Bulletin, has been chronicled for the first time. MIL-HDBK-5, Metallic Materials and Elements for Aerospace Structures, contains standardized mechanical property design values and other related design information for metallic materials, fasteners and joints, as well as other structural elements used in aircraft, missiles, and space vehicles. The mechanical property design allowables are presented on a statistical or specification basis. The products included in the document are standardized with regard to composition and processing methods and are described by industry or government specifications. In addition, the Handbook contains some of the more commonly used methods and formulas by which the strength of various structural elements are calculated. The last chapter of the document contains guidelines for the analysis and presentation of data for MIL-HDBK-5. Department of Defense agencies, Federal Aviation Administration (FAA) and National Aeronautics and Space Administration require the use of data in this Handbook in the design of aerospace vehicles which are purchased or controlled by them. GRA

N85-24022# Southwest Research Inst., San Antonio, Tex.

JP-8 AND JP-5 AS COMPRESSION IGNITION ENGINE FUEL Interim Report, Jul. - Dec. 1984

J. N. BOWDEN, E. C. OWENS, and M. E. LEPERA 15 Jan. 1985 35 p

(Contract DAAK70-85-C-0007; DA PROJ. 1L1-62733-AH-20)

(AD-A150796; AFHRL-192) Avail: NTIS HC A03/MF A01 CSCL 21D

For many years, aircraft turbine fuel JP-5 was used in diesel engines as an alternate fuel for DF-2, and is listed as such in Army Regulation 703-1. Since 1965, diesel engine endurance tests have been conducted in a variety of compression-ignition engines using JP-5 or JP-8 as the fuel and comparing performances with DF-2. None of these tests showed engine failures or excessive wear attributable to the use of kerosene-type aircraft turbine fuels, although slightly reduced fuel injection delivery volumes and lower power output were experienced in most engines, due to lower

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viscosity and lower heat content of JP-5 and JP-8 compared to DF-2. These results not withstanding, periodically, concerns are raised about the use of JP-5 and JP-8 in diesel engines over long periods in the 500 to 1000-hour time frame, especially in new engine designs. This report is primarily an annotated bibliography of 23 references consisting of technical notes, letters, letter reports, and interim reports, on the subject of using aircraft turbine fuels JP-5 and JP-8 in diesel engines. GRA

N85-24023# Department of Energy, Bartlesville, Okla. National Inst. for Petroleum and Energy Research.

TRENDS OF PETROLEUM FUELS

E. M. SHELTON and P. W. WOODWARD Feb. 1985 34 p refs

(Contract DE-FC01-83FE-60149)

(DE85-000116; NIPER-22) Avail: NTIS HC A03/MF A01

Trends in properties of motor gasolines for the years 1942 through 1984; diesel fuels for the years 1950 through 1983; aviation fuels for the years 1947 through 1983; and heating oils for the years 1955 through 1984 were evaluated. Various companies throughout the country obtain samples of motor gasolines from retail outlets and refinery samples for the other surveys, and analyze the samples using American Society for Testing and Materials (ASTM) procedures. A summary was assembled from data in 83 semiannual surveys for motor gasolines that shows trends throughout the entire era from winter 1942 through 1943 to the present. Trends of properties including octane numbers, antiknock ratings, distillation temperatures, Reid vapor pressure, sulfur and lead content are shown. DOE qr

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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.

A85-30226

STRUCTURES, STRUCTURAL DYNAMICS, AND MATERIALS CONFERENCE, 26TH, ORLANDO, FL, APRIL 15-17, 1985, TECHNICAL PAPERS. PARTS 1 & 2

Conference sponsored by AIAA, ASME, ASCE, and AHS. New York, American Institute of Aeronautics and Astronautics, 1985, Pt. 1, 859 p.; pt. 2, 762 p. For individual items see A85-30227 to A85-30405.

Among the topics discussed are sandwich core composite panels, graphite/epoxy composite plates, composite material crack growth behavior, damage tolerance analyses, computer-based structural system design and analysis methods, thermomechanical response prediction, laser irradiation of structures, the buckling behavior of structures, hybrid reinforcing fiber composite characteristics, large space structure antenna design and structural dynamics, multilevel structural optimizations, the fracture behavior of filament-wound structures, and finite element analysis methods. Also covered are metal matrix composite materials, the superplastic forming of high strength aluminum alloys, woven fabric-reinforced composite properties, structural shape optimization, thermal stresses in sandwich panels, airfoil stability and response determination, deployable space structures, space structure control actuators, the stability of flexible structures, structure-borne noise, damping synthesis for large space structures, and optimal vibration control. O.C.

A85-30251#

STOCHASTIC CRACK PROPAGATION IN FASTENER HOLES

J. N. YANG (George Washington University, Washington, DC), S. D. MANNING (General Dynamics Corp., Fort Worth, TX), J. L. RUDD (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, OH), and W. H. HSI IN: Structures, Structural Dynamics, and Materials Conference, 26th, Orlando, FL, April 15-17, 1985, Technical Papers. Part 1. New York, American Institute of Aeronautics and Astronautics, 1985, p. 225-233. refs (Contract F33615-83-K-3226) (AIAA PAPER 85-0666)

A simple crack growth rate-based stochastic model for fatigue crack propagation in fastener holes under spectrum loadings is investigated. With available fractographic data in the very small crack size region, i.e., 0.004 to 0.07 inches, the model was demonstrated previously to be very good. Further, laboratory tests were conducted using wide fastener hole specimens to obtain fractographic data covering the small and large crack size regions in both laboratory air and a corrosive environment. The correlations between the stochastic model and the fractographic results in either the corrosive or noncorrosive environment are demonstrated to be very good. The model is shown to be valid for crack growth damage accumulation from the very small crack up to the critical crack size. Such a simple model is ideal for practical applications, such as in durability and damage tolerance analyses. Factors affecting the stochastic crack growth analysis and prediction are also investigated. Author

A85-30260#

FABRICATION AND TESTING OF A BRAZED MULTIPIECE BERYLLIUM SUPPORT STRUCTURE FOR TACTICAL SENSORS

R. H. ANDERSON, JR. (McDonnell Douglas Astronautics Co., Huntington Beach, CA) IN: Structures, Structural Dynamics, and Materials Conference, 26th, Orlando, FL, April 15-17, 1985, Technical Papers. Part 1. New York, American Institute of Aeronautics and Astronautics, 1985, p. 293-298. (AIAA PAPER 85-0679)

A multielement brazed structure has been developed for the beryllium sensor support structure currently used in the military helicopter Mast Mounted Sight (MSS) which, through the use of a less expensive grade of beryllium and near net shape billets with simplified geometry, reduces costs and machining risks without compromising structural performance. The present use of the hot isostatic pressing process for near-shape billet consolidation is unique for beryllium structures subjected to high cycle fatigue environments. The incorporation of this brazed support into future MSSs will reduce production costs by \$25,000/sensor support structure. O.C.

A85-30291*# Army Structures Lab., Hampton, Va.

A NONLINEAR ANALYSIS OF INFINITELY LONG GRAPHITE-EPOXY CYLINDRICAL PANELS LOADED WITH INTERNAL PRESSURE

R. L. BOITNOTT (U.S. Army, Structures Laboratory, Hampton, VA), E. R. JOHNSON (Virginia Polytechnic Institute and State University, Blacksburg, VA), and J. H. STARNES, JR. (NASA, Langley Research Center, Structures and Dynamics Div., Hampton, VA) IN: Structures, Structural Dynamics, and Materials Conference, 26th, Orlando, FL, April 15-17, 1985, Technical Papers. Part 1. New York, American Institute of Aeronautics and Astronautics, 1985, p. 593-604. refs (Contract NCC1-15) (AIAA PAPER 85-0770)

The structural response of internally pressurized composite cylindrical panels, representative of a transport aircraft's fuselage skins, is predicted by means of a one-dimensional, geometrically nonlinear analysis. An analytical study is conducted for the response of 4-, 8-, and 16-ply graphite/epoxy skins. The results obtained indicate that the response is geometrically nonlinear, and that a boundary layer with a severe bending gradient exists at the panel edges. The importance of through-the-thickness shearing deformations in the bending boundary layer is illustrated through

comparison of analyses based on Kirchhoff-Love and shear deformation theories. Numerical results for the bending boundary layer lengths of the different panels are presented, and two bending boundary layers are predicted with the shear deformation theory.

O.C.

A85-30298#**TENSION ANALYSIS OF STIFFENED AIRCRAFT STRUCTURES**

M. MOHAGHEGH (Boeing Commercial Airplane Co., Seattle, WA) IN: Structures, Structural Dynamics, and Materials Conference, 26th, Orlando, FL, April 15-17, 1985, Technical Papers. Part 1. New York, American Institute of Aeronautics and Astronautics, 1985, p. 665-672.

(AIAA PAPER 85-0795)

Failure criteria and analysis methods have been developed for mechanically fastened built-up structure under tension load. Failure occurs when the maximum local strain in the structure reaches the strain capability of the material. The tension strength is related to the material stress-strain curve and the geometry of the structure; and it is concluded that the most significant property affecting the tensile strength of built-up structure is the material tensile strength just beyond yield. A simple fastener specimen is used to evaluate the relative static strength and strain concentration of various materials and fastener systems. It is noted that the use of interference fasteners, or fasteners in cold-worked holes, reduces the elongation and strength of the structure. A method of reducing panel test data to standard properties is recommended. Author

A85-30319#**A SYNTHESIZING PROCEDURE FOR TRANSIENT TEMPERATURES IN COMPOSED STRUCTURES**

X. ZHANG (Northwestern Polytechnical University, Xian, Shaanxi, People's Republic of China) IN: Structures, Structural Dynamics, and Materials Conference, 26th, Orlando, FL, April 15-17, 1985, Technical Papers. Part 1. New York, American Institute of Aeronautics and Astronautics, 1985, p. 847-852. refs

(AIAA PAPER 85-0830)

A synthesizing procedure is proposed for the determination of transient temperatures in composed structures. In the procedure a structure is first separated into simple components, then the transient temperature of each component is found out under the condition of supposed temperature functions at the junctures of components. These unknown functions are therefore determined via the heat flux continuity requirement for the junctures. The procedure has the advantage in making full use of simple solutions to solve much involved problems of complicated structures. Several examples of practical significance are presented to show how the procedure can be carried out to obtain transient temperatures in composed structures. Author

A85-30355#**AN ITERATIVE PROCEDURE FOR NONLINEAR FLUTTER ANALYSIS**

C. L. LEE (Texas Instruments, Inc., Aeromechanics Section, Lewisville, TX) IN: Structures, Structural Dynamics, and Materials Conference, 26th, Orlando, FL, April 15-17, 1985, Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, 1985, p. 290-297. refs

(AIAA PAPER 85-0688)

The flutter analysis of large dynamic systems with multiple structural nonlinearities is presently undertaken by means of an iterative procedure whose major components are (1) the 'describing function' approach to system linearization, (2) a structural dynamics modification method for the shifting of system mode shapes and frequencies, and (3) a complex eigenvalue algorithm for the solution of the flutter equation. The purpose of the procedure is to achieve alignment of the oscillatory amplitude in each nonlinear spring by means of the describing function prediction of stiffness, prior to the computation of final stability characteristics. The system obtained is tuned to the flutter frequency at the time of instability. The iterative method's validation is achieved through examples involving dynamic systems of increasing complexity, coupled with

various representations of the unsteady aerodynamic forces.

O.C.

A85-30357#**FLUTTER AND DIVERGENCE BOUNDARY PREDICTION FROM NONSTATIONARY RANDOM RESPONSES AT INCREASING FLOW SPEEDS**

Y. MATSUZAKI (Nagoya University, Nagoya, Japan) and Y. ANDO (National Aerospace Laboratory, Chofu, Tokyo, Japan) IN: Structures, Structural Dynamics, and Materials Conference, 26th, Orlando, FL, April 15-17, 1985, Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, 1985, p. 313-320. refs

(AIAA PAPER 85-0691)

The present locally stationary process-type method for flutter and divergence boundary prediction is applied to response signals obtained from wing models that were subjected to flow turbulence in subcritical flutter and divergence tests, in which dynamic pressure was increased at constant speed while Mach number remained fixed. The estimated values of Jury's (1964) stability parameters in each of the intervals into which the nonstationary response record was divided exhibit considerable scatter. It is nevertheless shown that stability boundaries can be predicted by drawing a straight line to form an envelope for the stability parameters' estimated scattering values. Author

O.C.

A85-30370#**MULTIMODE INSTABILITY PREDICTION METHOD**

K. E. KADRKA (Rockwell International Corp., El Segundo, CA) IN: Structures, Structural Dynamics, and Materials Conference, 26th, Orlando, FL, April 15-17, 1985, Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, 1985, p. 435-442. refs

(AIAA PAPER 85-0737)

A technique for analyzing the stability of multimode aeroelastodynamic systems and estimating the point of instability from test data is developed and demonstrated. The stability criteria of Mikhailov (Popov, 1962) and Routh and Hurwitz are employed to extend the subcritical-response flutter-speed-prediction method of Zimmerman and Weissenburg (1964) to systems with up to five modes. Numerical results are presented graphically for a three-mode model corresponding to one stabilizer surface and for the first five modes of a finite-element wing structure, both based on simulated p-k flutter frequencies and damping decay rates. It is predicted that the method can be extended to modes higher than five if certain inherent difficulties can be overcome. Author

T.K.

A85-30390*# Old Dominion Univ., Norfolk, Va.**THE EFFECT OF SOURCE LOCATION ON THE STRUCTURAL-ACOUSTIC INTERACTION OF AN INFINITE ELASTIC SHELL**

J. J. KELLY (Old Dominion University, Norfolk, VA) and C. R. FULLER (Virginia Polytechnic Institute and State University, Blacksburg, VA) IN: Structures, Structural Dynamics, and Materials Conference, 26th, Orlando, FL, April 15-17, 1985, Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, 1985, p. 609-616. refs

(Contract NAG1-390)

(AIAA PAPER 85-0788)

This paper deals with the response of an infinite elastic shell to simple acoustic sources (monopole and dipole). This simplified model is considered in order to gain insight into the characteristics of aircraft interior noise. The shell represents the aircraft fuselage and the sources are due to the propeller. Specifically, in this study the location of the source with respect to the cylinder is the major concern. How this affects acoustic line power, intensity flow into the shell and internal sound pressure is analyzed. Author

A85-30775

CONFERENCE ON FLUID MACHINERY, 7TH, BUDAPEST, HUNGARY, SEPTEMBER 13-16, 1983, PROCEEDINGS. VOLUMES 1 & 2

A. SZABO, ED. (Budapesti Muszaki Egyetem, Budapest, Hungary) and L. KISBOCSKOI, ED. Budapest, Akademiai Kiado, 1983, Vol. 1, 489 p., vol. 2, 491 p. No individual items are abstracted in these volumes.

The design, testing, and operation of various classes of fluid machines are discussed in reviews and reports and illustrated with diagrams, graphs, drawings, and photographs. Topics examined include ideal and real channel flows, boundary-layer flows, flows around bodies, cascade flows, two-phase flows and mixing, cavitation and erosion, noise and surge, and positive-displacement pumps. Consideration is given to water turbines; axial fans and compressors; centrifugal fans, pumps, and compressors; seals; branching networks and distribution systems; turbocompressors; nozzles and jet pumps; flow measurements and orifice flows; fluid couplings; and stresses in rotors. T.K.

A85-31007

EXPERIMENTAL INVESTIGATION OF LOSSES AND SECONDARY FLOW IN AN AXIAL COMPRESSOR STAGE

V. CYRUS (Statni Vyzkumny Ustav Stavby Stroju, Bechovice, Czechoslovakia) Forschung im Ingenieurwesen (ISSN 0015-7899), vol. 51, no. 2, 1985, p. 33-40. refs

A detailed investigation of a three-dimensional flow using both stationary and rotating pressure probes has been carried out in a low speed axial compressor stage. At the casing of a rotor row there is secondary flow produced by the relative motion of the annular wall to rotor blade tip and the tip clearance flow. At the hub a channel vortex can be observed. The value of the loss coefficient of both rotor and stator rows determined from conventional pressure probe data is affected by flow unsteadiness. This effect has been considered in detail. As a result, the probes should be dynamically calibrated. The rotor and stator blade elements loss at mid-span approximately equals two-dimensional cascade loss, when the data of probes exposed to strong flow unsteadiness have been corrected. Author

A85-31185

GRID GENERATION FOR FLUID MECHANICS COMPUTATIONS

P. R. EISEMAN (Columbia University, New York, NY) IN: Annual review of fluid mechanics. Volume 17. Palo Alto, CA, Annual Reviews, Inc., 1985, p. 487-522. refs (Contract AF-AFOSR-82-0176A)

Algebraic and partial differential equation techniques for coordinate generation of grids for fluid mechanics analysis flowfields are explored. Grids are used because the connectives between coordinates permit limitation of the necessary flow region to be described, thus simplifying the equations, and tracking the motions of flow variations that would otherwise generate singularities which would appear in a cartesian grid boundary. The grid topology is selected to match the surface a flow passes. The shearing, Hermit transformations and multisurface methods germane to algebraic transformations are reviewed. Elliptic partial differential equations offer less accuracy, but allow consideration of flows of higher complexity and three dimensions. The extent of control exerted numerically on the grid and its adaptations is the cornerstone of the precision of the calculations. M.S.K.

A85-31455

AN IMPLEMENTATION OF THE MODULAR APPROACH IN SOLVING ELASTICITY PROBLEMS [OB ODNOI REALIZATSII MODUL'NOGO PODKHODA PRI RESHENII ZADACH TEORII UPRUGOSTI]

A. G. GORSHKOV and I. IU. KOLESNIKOV Aviatsonnaia Tekhnika (ISSN 0579-2975), no. 4, 1984, p. 22-26. In Russian.

The superelement version of the finite element method, which involves numerical synthesis of superelement influence matrices, is one of the most versatile approaches to the strength analysis of aircraft structures. Here, a procedure is presented for the

approximate analytical synthesis of influence matrices in the context of elasticity problems. The procedure, which is based on a modular approach, is demonstrated for a problem concerning the torsion of a prismatic beam of arbitrary cross section. V.L.

A85-31459

USING THE FORCE METHOD FOR JOINING SUBSTRUCTURES WITH VARIOUS KINEMATIC HYPOTHESES [PRIMENENIE METODA SIL DLIYA SOCHLENIENIIA PODKONSTRUKTSII S RAZLICHNYMI KINEMATICHESKIMI GIPOTEZAMI]

P. D. LEVASHOV Aviatsonnaia Tekhnika (ISSN 0579-2975), no. 4, 1984, p. 41-47. In Russian. refs

The paper is concerned with the synthesis of systems of resolvent equations by the displacement method in the case where substructures are joined using the force method. For different substructures, different sets of kinematic hypotheses are assumed. It is shown that the joining method presented here is equivalent to the method of indeterminate Lagrangian multipliers. The introduction of joint matrices makes it possible to obtain systems of resolvent equations in compact form for arbitrary structures. V.L.

A85-31473

THE DISCRETE NATURE OF THE MOTION OF A SYSTEM DURING SURFACE WORKING [DISKRETNOST' DVIZHENIIA SISTEMY PRI POVERKHNOSTNOM DEFORMIROVANII]

P. G. BALIUKA Aviatsonnaia Tekhnika (ISSN 0579-2975), no. 4, 1984, p. 99-101. In Russian.

In mechanical surface working, the rate of surface working is often limited by relaxation self-oscillations having a negative effect on the quality of the surface being treated. Here, a mathematical model is developed which describes a surface working system with two degrees of freedom operating in the relaxation self-oscillatory mode. The model makes it possible to analyze the factors affecting the discrete motion of systems used for grinding, honing, burnishing, and other types of finish treatments. V.L.

A85-31954#

ACOUSTIC VIBRATION CHARACTERISTICS OF HIGH CONTACT RATIO PLANETARY GEARS

C. A. YOERKIE and A. G. CHORY (United Technologies Corp., Sikorsky Aircraft Div., Stratford, CT) IN: American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Proceedings. Alexandria, VA, American Helicopter Society, 1984, p. 19-32. refs

Contrary to expectations, the high contact ratio butress (HCRB) planetary gearset whose effects on the high frequency vibration emitted by the Black Hawk helicopter's transmission were investigated in the laboratory is noted to have increased vibrations at the ring gear clash frequency and its associated sidebands. It is suggested that the potential vibration reduction benefits associated with increased contact ratio in HCRB gearing were compromised by the reduction of planetary face widths, which was incorporated in order to take full advantage of the HCRB's increased strength. O.C.

A85-31959#

A BALANCED APPROACH TO THE ESTABLISHMENT OF STRUCTURAL COMPONENT LIVES

R. W. ARDEN (U.S. Army Aviation Systems Command, St. Louis, MO) IN: American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Proceedings. Alexandria, VA, American Helicopter Society, 1984, p. 113-122. refs

Driven by the competing forces of safety, readiness and cost, the Army has established a new maintenance program called Reliability Centered Maintenance (RCM). This paper explores the application of this concept to life limited structural components and describes its interface with the existing safe life and damage tolerance methods. RCM program objectives, general criteria and detailed methodology are provided along with examples of RCM logic applied to specific helicopter components. Based on the potential impact of RCM on component airworthiness qualification

and in-service maintenance procedures, recommendations are provided for further government and industry action. Author

A85-31967#
TECHNIQUES FOR THE EARLY DETECTION OF GEAR AND BEARING FAILURES IN HELICOPTER DRIVE TRAINS

D. GORE and G. EDGAR (RCA, Burlington, MA) IN: American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Proceedings. Alexandria, VA, American Helicopter Society, 1984, p. 193-201.

(Contract DAAK51-82-C-0052)

The high costs associated with the failure of bearings and gears in helicopter drive lines has led to programs for the development of reliable early fault detection techniques. The present investigation is concerned with a technique for determining the condition of an individual gearbox which has never been tested, taking into account a family of similar gearboxes for which some prior data exists. The study takes into consideration the presence of spalls on the contacting surfaces of rolling element bearings and on gears. Such spalls produce transient ringing pulses that are directly related to the presence of the fault in the component. Attention is given to the physical phenomena of bearing failure, fault signature waveforms, detection and signal processing techniques, data base and limit development, and system performance. G.R.

A85-31976#
ADVANCED METHODOLOGY FOR QUALITY CONTROL OF COMPOSITE ROTOR BLADES AT BELL HELICOPTER TEXTRON

B. RUPE and B. J. HUNTER (Bell Helicopter Textron, Fort Worth, TX) IN: American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Proceedings. Alexandria, VA, American Helicopter Society, 1984, p. 273-284.

Quality assurance testing and inspection methods were used almost as a standard routine in the case of metal rotor blades. These older methods are no longer sufficient for an adequate inspection of the newer composite materials. The use of composite materials in the manufacture of rotor blades has, therefore, required a variety of new equipment. The advantages of composites are considered along with the quality assurance functions, laboratory testing, and postmachining operations. Attention is given to surface preparation, filament winding and compaction, fabrication and assembly, weight control, postbond cleanup and inspection, ultrasonic inspection, fluoroscope/radiographic inspection, destructive testing, the automated coordinate measuring machine, blade machining, and the balancing of rotor blades. G.R.

A85-31977#
EVALUATION OF AUTOMATED EDDY CURRENT SYSTEM RELIABILITY

A. THOMPSON (General Electric Co., Aircraft Engine Business Group, Cincinnati, OH) IN: American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Proceedings. Alexandria, VA, American Helicopter Society, 1984, p. 291-294.

The use of eddy current inspection techniques for the detection of flaws in critical areas of jet engine rotating hardware has involved predominantly an employment of manual or semiautomatic processes. Disadvantages of such processes are related to time requirements, labor intensiveness, and a potential for operator error. Recognizing these disadvantages, the Manufacturing Technology Division of the U.S. Air Force has sponsored contracts to establish an automated eddy current inspection system which can be used to inspect critical areas of jet engine rotating components in either an overhaul or new manufacture environment. Two automated systems of the considered type have been designed, fabricated, checked out, and installed at two Air Force locations. The systems have been evaluated for a period of four months. A system description is provided, taking into account automated motion control, the host computer, digital eddy current instrumentation, and details of automated operation. G.R.

A85-31978#
AUTOMATIC INSPECTION AND PRECISION GRINDING OF SPIRAL BEVEL GEARS

A. J. LEMANSKI and H. K. FRINT (United Technologies Corp., Sikorsky Aircraft Div., Stratford, CT) IN: American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Proceedings. Alexandria, VA, American Helicopter Society, 1984, p. 295-303.

An advanced automatic inspection and precision grinding method, utilizing a computer controlled universal measuring machine, is currently being developed. It is expected that this method will substantially improve the producibility of aircraft spiral bevel gearing. The state of the art of spiral bevel gear manufacture is examined, taking into account the inspection of spiral bevel gears on a specially designed Gleason test machine. It is found that the quality control process described has certain inherent disadvantages. There is, therefore, a definite need for a more definitive and objective way of determining whether a bevel gear profile is acceptable. A method to provide such a way is based on the use of a universal coordinate measuring machine. Attention is given to an improved method of tooth measurement and numerical representation of tooth errors at each specified probe point, and the demonstration of an improved final inspection method for spiral bevel gears. G.R.

A85-32031
SIMULATION OF INITIALLY FORCED MIXING LAYERS

O. INOUE (Tokyo, University, Tokyo, Japan) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 54, Jan: 1985, p. 121-133. refs

Two-dimensional turbulent mixing layers with initial periodic forcing are simulated by a vortex-blob method. The motions of up to 2600 vortices and 3000 marker particles are followed by the use of the direct-summation method. The first-order-accurate Euler scheme is employed as a time-integral scheme. Forcing frequencies higher than the first subharmonic of the predominant frequency of an unforced mixing layer are applied. It is shown that the development of a turbulent mixing layer depends much on forced disturbances, and that turbulence suppression or amplification occurs depending on forcing frequencies. The results are consistent with experiments. Author

A85-32345
CONTRIBUTION TO THE LINEAR DYNAMIC ANALYSIS OF SLENDER BODIES IN LOW AND MEDIUM FREQUENCY RANGES

P. GIBERT (ONERA, Chatillon-sous-Bagneux, Hauts-de-Seine, France) Journal of Sound and Vibration (ISSN 0022-460X), vol. 97, Dec. 8, 1984, p. 499-511. refs

New methods of analysis of slender bodies in the low-frequency and medium-frequency ranges are introduced. In the medium-frequency range, the modes can be expected to be very oscillatory along the axis of the body. For this reason, the use of standard numerical calculation methods, such as the finite element method, is accompanied by severe practical difficulties. The alternative technique proposed here is of W.K.B.J. type, well-known in quantum mechanics. It is shown in particular that in the medium-frequency range, there are two types of modes: global modes and spatially localized modes. Author

A85-32503#
COMPUTATION OF HYDRAULIC LOSSES IN A PLANE PROFILE CASCADE

I. ANTON, D. IONESCU, and G. CALIN (Timisoara, Institutul Politehnic, Timisoara, Rumania) Studii si Cercetari de Mecanica Aplicata (ISSN 0039-4017), vol. 43, Sept-Dec. 1984, p. 439-450. In Romanian. refs

12 ENGINEERING

A85-32582#

AN ASSESSMENT OF NUMERICAL SOLUTIONS OF THE COMPRESSIBLE NAVIER-STOKES EQUATIONS

J. S. SHANG (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) *Journal of Aircraft* (ISSN 0021-8669), vol. 22, May 1985, p. 353-370. Previously cited in issue 17, p. 2477, Accession no. A84-37966. refs

A85-32711

PRECISION POINTING USING A DUAL-WEDGE SCANNER

C. T. AMIRALTY and C. A. DIMARZIO (Raytheon Electro-Optics Systems Laboratory, Sudbury, MA) *Applied Optics* (ISSN 0003-6935), vol. 24, May 1, 1985, p. 1302-1308.

The calibration and precise pointing of the germanium dual-wedge scanner that is used by an airborne CO₂ Doppler lidar is undertaken by a system whose iterative calibration program combines the available data with estimated parameters of the scanner's orientation (relative to the aircraft's inertial navigation system axes). Attention is given to the effects of specific error conditions on program performance, and to the results of the program's application to 1981 flight test data. O.C.

A85-32759

PROBABILISTIC CHARACTERISTICS OF THE FREQUENCY SPECTRUM OF THE NATURAL VIBRATIONS OF TURBOCOMPRESSOR BLADES [VEROJATNOSTNYE KHARAKTERISTIKI SPEKTRA CHASTOT SOBSTVENNYKH KOLEBANII LOPATOK TURBOKOMPRESSORA]

E. A. IGUMENTSEV *Problemy Prochnosti* (ISSN 0556-171X), April 1985, p. 92-97. In Russian. refs

The laws governing the probability distributions of the natural vibration frequencies of turbocompressor blades are determined from any analysis of a physical model and previously collected data. It is found that the observed scatter of natural frequencies is largely determined by manufacturing imprecision, inhomogeneity of material properties, varying tension of the blade roots, and varying accuracy of blade fitting. The probability distribution density of the natural frequencies is described by a normal law or by a Weibull distribution. V.L.

A85-32962*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

FLUTTER OF SWEEP FAN BLADES

R. E. KIELB and K. R. V. KAZA (NASA, Lewis Research Center, Cleveland, OH) *ASME, Transactions, Journal of Engineering for Gas Turbines and Power* (ISSN 0022-0825), vol. 107, April 1985, p. 394-398. Previously announced in STAR as N84-16587. refs (ASME PAPER 84-GT-138)

The effect of sweep on fan blade flutter is studied by applying the analytical methods developed for aeroelastic analysis of advance turboprops. Two methods are used. The first method utilizes an approximate structural model in which the blade is represented by a swept, nonuniform beam. The second method utilizes a finite element technique to conduct modal flutter analysis. For both methods the unsteady aerodynamic loads are calculated using two dimensional cascade theories which are modified to account for sweep. An advanced fan stage is analyzed with 0, 15 and 30 degrees of sweep. It is shown that sweep has a beneficial effect on predominantly torsional flutter and a detrimental effect on predominantly bending flutter. This detrimental effect is shown to be significantly destabilizing for 30 degrees of sweep. M.G.

A85-33007

FACTORY AUTOMATION FOR COMPOSITE STRUCTURES MANUFACTURING

R. A. POSTIER (GGT Inc., Aerospace Div., South Windsor, CT) *SAMPE Quarterly* (ISSN 0036-0821), vol. 16, April 1985, p. 45-49. refs

A review of automation approaches in the storing, cutting, and processing of composite aircraft parts is presented. The automation of refrigerated storage includes the implementation of the Automated Inventory Control System and an Automated Guided Vehicle for the purposes of eliminating human error. Furthermore,

an integrated cutting center is described, which involves the use of state-of-the-art CAD/CAM technology to nest, identify, and cut composite shapes. Among the processing aspects considered are laser and water-jet cutting, filament winding and tape laying, broadgoods lay-up techniques, curing, and inspection. L.T.

A85-33220

OBSERVATIONS OF TIP VORTEX CAVITATION INCEPTION FROM A MODEL MARINE PROPELLER

R. K. LODHA and V. H. ARAKERY (Indian Institute of Science, Bangalore, India) *Indian Institute of Science, Journal, Section A - Engineering and Technology* (ISSN 0019-4964), vol. 65, Jan. 1984, p. 11-20. Research supported by the Electronics Commission and Ministry of Defence. refs

Cavitation inception characteristics of a model marine propeller having three blades, developed area ratio of 0.34 and at three different pitch to diameter ratios of 0.62, 0.83 and 1.0 are reported. The dominant type of cavitation observed at inception was the tip vortex type. The measured magnitude of inception index is found to agree well with a proposed correlation due to Strasberg. Performance calculations of the propeller based on combined vortex and blade element theory are also presented. Author

A85-33245

STUDIES IN FIN-LINE ANTENNA DESIGN FOR IMAGING ARRAY APPLICATIONS

E. FARR, K. WEBB, and R. MITTRA (Illinois, University, Urbana, IL) *Archiv fuer Elektronik und Uebertragungstechnik* (ISSN 0001-1096), vol. 39, Mar.-Apr. 1985, p. 87-89. refs (Contract DAAG29-82-K-0084; N00014-79-C-0424)

An experimental study was conducted concerning the development of an endfire fin-line antenna, suitable for imaging array applications at 220 GHz. Experimental models of several designs were built and tested at 80 GHz. The most successful design used a fin-line to dielectric rod transition followed by a dielectric rod antenna. Author

N85-22563# McDonnell-Douglas Research Labs., St. Louis, Mo. **THE ROLE OF CONVECTIVE PERTURBATIONS IN SUPERCRITICAL INLET OSCILLATIONS**

T. J. BOGAR and M. SAJBEN *In APL JANNAF Combust. Meeting*, Vol. 1 p 465-479 Oct. 1984 refs
Avail: NTIS HC A21/MF A01 CSCL 20D

Available experimental evidence on supersonic diffuser flow oscillations is reviewed, focusing on features that conflict with quasi-one-dimensional, linear acoustic theory. A model is proposed in which convective, transverse perturbations initiated by the shock and carried by the boundary layers are the dominant downstream-moving disturbances. These disturbances in turn combine with upstream-moving acoustic waves to form the total oscillatory pattern. The boundary conditions at the two ends of the channel applicable to such flows are discussed. The reflection coefficients for pressure and velocity perturbations are related but not equal; some estimates of their values are given. The model offers a qualitative explanation for most non-acoustic features of the oscillations and suggests a possible mechanism for inlet/compressor coupling. Author

N85-22782# Joint Publications Research Service, Arlington, Va.

USSR REPORT: ENGINEERING AND EQUIPMENT

12 Mar. 1985 106 p refs Transl. into ENGLISH from various Russian articles (JPRS-UEQ-85-003) Avail: NTIS HC A06

News items, abstracts, and scientific reports on aspects of engineering and equipment including turbine and engine design; testing and materials; non-nuclear energy; navigation and guidance systems; nuclear energy; mechanics of solids; high energy devices, optics, and photography; industrial technology; aeronautics and space; and fluid mechanics.

N85-22785# Joint Publications Research Service, Arlington, Va.
PROPAGATION OF THREE-DIMENSIONAL TURBULENT JET FROM LOBAR NOZZLE THROUGH SURROUNDING STREAM
Abstract Only

V. I. VASILYEV, S. Y. KRASHENINNIKOV, and Y. A. RUDI *In its* USSR Rept.: Eng. and Equipment (JPRS-UEQ-85-003) p 3-4 12 Mar. 1985 Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved.: Aviats. Tekhn. (Kazan, USSR), No. 1, Jan. - Mar. 1984 p 18-22

Avail: NTIS HC A06

Propagation of the jet through the surrounding stream, after discharge from a lobar nozzle in a two-flow turbojet engine, is analyzed on the basis of an approximate mathematical model which describes mixing of two substances and facilities numerical calculations. The static pressure in the cylindrical mixing chamber is assumed to remain constant, with negligible molecular and thermal diffusion in the direction of flow so that the two equations of the boundary layer become parabolic. The one-parametric equation of turbulence is also parabolic. Mixing is assumed to occur at a low Mach number and the equation of state reduces to that for a perfect gas. The system is closed by an equation of continuity which, upon inclusion of the transverse velocity of secondary potential flow, becomes an elliptic Poisson equation. The initial conditions are characterized by the ratio of velocities and the ratio of densities at the nozzle throat as well as by the geometry of the boundary layer and the distribution of eddy viscosity. The corresponding boundary value problem, formulated in dimensionless variables, is solved by numerical integration according to the method of false positions. Author

N85-22831# Joint Publications Research Service, Arlington, Va.
PRESSURE DROP AND COEFFICIENTS OF INTERNAL HEAT TRANSFER NECESSARY FOR TRANSPIRATION COOLING
Abstract Only

S. G. DEZIDERYEV, A. G. KARIMOVA, and P. P. MAKAROV *In its* USSR Rept.: Eng. and Equipment (JPRS-UEQ-85-003) p 85 12 Mar. 1985 Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved.: Aviats. Tekhn. (Kazan, USSR), no. 1, Jan. - Mar. 1984 p 83-85

Avail: NTIS HC A06

The pressure drop and the coefficients of internal heat transfer necessary for transpiration cooling of high-temperature turbine nozzles and blades with the use of porous materials are calculated semi-empirically. Equating the empirical hydraulic drag coefficient in pores $\zeta = 420/Re_{sub d}$ ($Re_{sub d}$ - Reynolds number for air in pores) to the theoretical hydraulic drag coefficient in pores $\zeta = \Delta P / (1/2 \rho V^2)$ yields the pressure drop $\Delta P = 1/2 \rho V^2 \zeta / d = 210 G \mu \Delta P / (\rho d^2)$ (ρ , μ - density and dynamic viscosity of air at mean temperature and mean pressure, V - velocity of air in pores, ΔP - thickness of porous layer, d - diameter of pores, G - flow rate of air per unit surface area, 2 - porosity factor). B.W.

N85-22836# Joint Publications Research Service, Arlington, Va.
EFFECT OF GAS STREAM SWEEPING PAST THE EFFLUENT OF A PERFORATED PLATE ON HEAT TRANSFER INSIDE THE PERFORATIONS
Abstract Only

V. A. TRUSHIN, K. M. ISKAKOV, and Z. S. ISKHAKOV *In its* USSR Rept.: Eng. and Equipment (JPRS-UEQ-85-003) p 88 12 Mar. 1985 Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved.: Aviats. Tekhn. (Kazan, USSR), no. 1, Jan. - Mar. 1984 p 101-103 Original language document previously announced as A84-47578

Avail: NTIS HC A06

An analysis of heat transfer inside the perforations of air-cooled turbine blades suggests that transverse gas flow at the outlet of the perforations may be one of the factors affecting the heat transfer process. To investigate the effect of transverse flow, experiments have been carried out on perforated plates 1, 2, 3, and 4 mm thick with 0.6-1.4-mm-diameter perforations. It is found that in the Reynolds number range 2,000-50,000, transverse gas flow at the outlet of the perforations (injection ratio, 0.6-2.8) has no effect on heat transfer inside the perforations. V.L. (IAA)

N85-22837# Joint Publications Research Service, Arlington, Va.
SELECTION OF AIR INTAKE PARAMETERS FOR SUPERSONIC-FLOW OPERATION
Abstract Only

V. I. BAZHANOV and A. A. STEPCHKOV *In its* USSR Rept.: Eng. and Equipment (JPRS-UEQ-85-003) p 89-90 12 Mar. 1985 Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved.: Aviats. Tekhn. (Kazan, USSR), no. 1, Jan. - Mar. 1984 p 69-71 Original language document previously announced as A84-47565

Avail: NTIS HC A06

An optimum system of skewed shock waves is selected for supersonic flight velocities (Mach 4-6) under the condition that the total stream rotation angle behind the skewed shock waves do not exceed a certain critical value corresponding to the onset of sonic flow. The approach proposed here is illustrated by an example in which systems of skewed shock waves are calculated for Mach 6. V.L. (IAA)

N85-22851 Clemson Univ., S.C.
DATA COMPRESSION FOR NOISELESS CHANNELS
Ph.D. Thesis

S. G. CATHEY 1984 137 p

Avail: Univ. Microfilms Order No. DA-8426762

A data compression method to compress strings of digital data and to encode the compressed data for transmission over a noiseless channel is presented. Several aspects of information theory and lattice theory are combined to produce a method by which an optimum way of reorganizing and combining source words can be found. The source considered here has identification bits and data bits intermingled. Source words that are related in some fashion, either sequentially or by position in a group of words, are stacked and new subsources formed by taking source words vertically rather than horizontally. A partition lattice is then formed with the partition being over source combination. A minimal length chain can be found which connects the minimum-entropy partition for each level. By using the truncated lattice method, this chain may be calculated directly with a significant reduction in work to find the optimum partition for the given constraints on a system. Several examples are given and a practical application to the on-board F-15 radar system is discussed. Dissert. Abstr.

N85-22897# Clarkson Coll. of Technology, Potsdam, N.Y. Dept. of Electrical and Computer Engineering.

CONTROL OF CASCADED INDUCTION GENERATOR SYSTEMS
Final Technical Report, 1 Sep. 1983 - 30 Aug. 1984

T. H. ORTMEYER 13 Dec. 1984 63 p

(Contract AF-AFOSR-0268-83)

(AD-A150429; AFOSR-84-1259TR) Avail: NTIS HC A04/MF

A01 CSCL 10B

This report documents an investigation of the stability and control of cascaded doubly fed machines (CDFM). These machines are brushless variable speed constant frequency electric power generators with potential for application in aircraft. A previous analytical study indicated the CDFM system would be controllable in the subsynchronous operating mode with a passive RL load. The present study contains two steps. First is an investigation of the machine operation in the supersynchronous mode. The second step is an investigation of machine operation with output capacitors providing excitation VARs for the machine and load. Step 1 results show that the machines exhibit stability characteristics in the supersynchronous mode similar to those observed in the subsynchronous mode. Step 2 results show that output capacitors degrade the system performance, particularly at light loads. The results show that output current feedback can be employed to improve the system performance. GRA

12 ENGINEERING

N85-22919# Joint Publications Research Service, Arlington, Va.
COORDINATE DETERMINATION ERRORS IN MEASURING CHARACTERISTICS OF RADIATION FIELD OF AIRBORNE ANTENNAS Abstract Only

E. D. GAZAZYAN and V. G. PANCHENKO *In its* USSR Rept.: Electron. and Elec. Eng. (JPRS-UEE-85-002) p 7 23 Jan. 1985 Transl. into ENGLISH from Izmeritel. Tekhn. (Moscow), no. 9, Sep. 1984 p 54-56
Avail: NTIS HC A05/MF A01

Expressions are derived for estimating the coordinate errors in measuring the characteristics of the radiation field of airborne antennas. Errors in six coordinates must be taken into account at any given moment: the azimuth, elevation, slant range, heading, pitch and roll of the aircraft. It is recommended that straight-line flights be employed. Maneuvers should be used only in extreme cases, such as for measurements in the upper hemisphere. Conditions are specified under which it is possible to measure the characteristics of airborne antennas not equipped with maneuvering sensors, recording means or telemetry. Author

N85-23089# General Electric Co., Lynn, Mass. Aircraft Engine Business Group.

T700 CUTTER LIFE IMPROVEMENT PROGRAM Final Report, Sep. 1981 - Mar. 1984

D. M. DOMBROWSKI Mar. 1984 124 p
(Contract DAAK50-81-C-0029)
(AD-A150450; R84AEB010) Avail: NTIS HC A06/MF A01
CSCL 131

The purpose of the T700 Cutter Life Improvement Program was to reduce the number of cutters used for the blisk and impeller airfoil milling operations from 134 to less than 90 cutters per engine set, thereby reducing T700 engine cost. The objective was achieved by stiffening toolholders, improving cutter designs, and changing cutter material. Other parameters investigated include cutting speeds, cutting fluids, surface coating, and surface treatment of the cutters. Phase 1 of the program was mainly analytical, phase 2 involved more extensive laboratory testing of cutter designs, materials, cutting fluids machining parameters, and production verification of the laboratory results. A computer simulation program was used to study effect of spindle and tool compliance and eccentricity, cutter geometry, and cutting parameters on cutting forces and tool deflections. This is the first computer simulation program to accurately predict milling forces and tool breakage when tool deflection is significant. Cutter failure investigation was conducted to understand modes/causes of tool failure. As a result, adjustments to NC program were made, deficiencies in the cutter geometry were corrected to improve cutter life. GRA

N85-23103# Shock and Vibration Information Center (Defense), Washington, D. C.

APPLICATIONS OF THE CONFORMAL MAPPING METHOD TO THE SOLUTION OF MECHANICAL VIBRATIONS PROBLEMS

P. A. A. LAURA (Inst. of Applied Mech., Puerto Belgrano Naval Base, Argentina) *In its* The Shock and Vibration Digest, Volume 16, No. 12 p 3-7 Dec. 1984 refs
Avail.: SVIC, Code 5804, Naval Research Lab., Washington, D.C. 20375 CSCL 20K

Traditional applications of the method of conformal mapping are governed by the Laplace equation. The equation has also been used to solve wave propagation problems and those involving membrane and plate vibrations. In many instances it has been possible to obtain elegant approximate analytical solutions and algorithmic procedures; they have been implemented on desk computers and programmable pocket calculators. Author

N85-23108# Lockheed-Georgia Co., Marietta.
ADVANCED LIFE ANALYSIS METHODS. VOLUME 1: CRACKING DATA SURVEY AND NDI (NONDESTRUCTIVE INSPECTION) ASSESSMENT FOR ATTACHMENT LUGS Final Report, 3 Sep. 1980 - 30 Sep. 1984

T. R. BRUSSAT, K. KATHIRESAN, and T. M. HSU
Wright-Patterson AFB, Ohio Air Force Wright Aeronautical Labs. Sep. 1984 64 p
(Contract F33615-80-C-3211)
(AD-A150419; LG82ER0117-1; AFWAL-TR-84-3080-VOL-1)
Avail: NTIS HC A04/MF A01 CSCL 13E

Results of a survey of cracking data and an evaluation of NDI capability for aircraft attachment lugs are presented. This survey and evaluation are part of an overall effort involving fatigue testing and analyses to develop the design criteria and analytical methods necessary to ensure the damage tolerance of pin-loaded lugs. Cracking data from coupon and full scale fatigue tests and from service failures are summarized in terms of causes of initial cracking and final failure; initial crack type, shape, location and multiplicity; and final critical crack size. Existing NDI capability is reviewed, and an inspectable initial flaw size criterion for lugs is proposed, subject to experimental verification. GRA

N85-23739*# Spectron Development Labs., Inc., Costa Mesa, Calif.

ADVANCE PARTICLE AND DOPPLER MEASUREMENT METHODS

C. BUSCH *In* NASA. Marshall Space Flight Center Proc.: 7th Ann. Workshop on Meteorol. and Environ. Inputs to Aviation Systems p 54-55 Apr. 1984
Avail: NTIS HC A07/MF A01 CSCL 14B

The use of imaging and scattering methods to measure rain, ice, and snow particles in the natural environments in which aircraft fly and in simulation environments that are encountered in ground-test facilities is examined. The extraction of data from photographs using a computerized image analyzer and from holograms is considered. Advantages and disadvantages of single particle and ensemble approaches are reviewed. A.R.H.

N85-23780# Watteeuw (M. C.) N.V., Bruges (Belgium).
CASE DEPTH ON FLANKS OF GEARS FOR HELICOPTER GEARBOXES

A. WATTEEUW *In* AGARD Gears and Power Transmission Systems for Helicopters and Turboprops 12 p Jan. 1985 refs
Avail: NTIS HC A17/MF A01

One of the most difficult and delicate operations during the manufacturing process of gears for helicopter gearboxes and aircraft gears is the heat treatment. Case hardened alloy steel of high quality are mainly used for aircraft gears. not only a good structure in the case hardened tooth but also the surface hardness, the core hardness and case depth are very important for the load capacity of these gears. On the drawing and in the specifications belonging to it, values and tolerances have been provided for the above mentioned hardnesses. These, however, are not always adequate to guarantee a good manufacture. These and other factors such as load capacity, tensile stress and pitting of gears are treated. Author

N85-23787# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).

ROOT STRESSES IN CONFORMAL GEARS-STRAIN GAUGE AND PHOTOELASTIC INVESTIGATIONS

D. G. ASTRIDGE, B. R. REASON, and D. BATHE *In its* Gears and Power Transmission Systems for Helicopters and Turboprops 15 p Jan. 1985 refs
Avail: NTIS HC A17/MF A01

The significant amount of analytical work on strong gear tooth forms carried out since the classical papers of Shotton et al are reviewed, and the results of a project which addresses a problem common to all three-dimensional photoelastic studies of root stresses in gears are presented an accurate delineation of the contact conjunction geometry throughout the stress freezing cycle is the common problem. Photoelastic model results are compared

with those measured by strain gauge methods on the definitive gears. Author

N85-23794# Cambridge Univ. (England). Dept. of Engineering. **TRANSMISSION ERROR MEASUREMENTS IN GEARBOX DEVELOPMENT**

J. D. SMITH *In* AGARD Gears and Power Transmission Systems for Helicopters and Turboprops 5 p Jan. 1985 refs
 Avail: NTIS HC A17/MF A01

There is a requirement to test gears for initial development, for production monitoring and for condition monitoring in service. Traditionally the first two were carried out by a combination of profile, helix, pitch and bedding checks and the third by measuring vibration at bearing housings. Gear drives in aircraft applications present difficulties in checking due to high distortions in the light weight gear cases. The use of transmission error (single flank) checking can give useful information on accuracy of alignment in gearboxes as well as fundamental noise generation information. Problems arise with attempts to use grating systems in turboprops but helicopters have tooth frequencies in a suitable range.

Author

N85-24064# Joint Publications Research Service, Arlington, Va. **MODAL SYNTHESIS OF MULTIDIMENSIONAL PI-REGULATORS FOR OBJECTS WITH INERTIAL SECTIONS Abstract Only**

A. A. VOYEVODA and S. A. STAVROPOLTSEV *In its* USSR Rept.: Eng. and Equipment (JPRS-UEQ-84-001) p 33-34 9 Feb. 1984 Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedeniy: Priborostr. (Leningrad), v. 26, no. 8, Aug. 1983 p 42-46
 Avail: NTIS HC A06

The synthesis of regulators for objects, which are described by matrix transfer functions with inertial sections, or which can be approximated accurately enough by such matrices were studied. These objects include flight vehicles, technological processes, motors, etc. The problem of choosing the parameters of a multidimensional PI regulator such that the poles of the system consisting of the regulator and the object are in the required region is studied. The example of synthesizing a PI regulator with y vector feedback for an aircraft turbine is provided. Author

N85-24067# Joint Publications Research Service, Arlington, Va. **OPTIMIZATION OF COMBINED CONVECTIVE AND FILM COOLING OF PERFORATED BAFFLE BLADES IN GAS TURBINES Abstract Only**

Y. N. BOGOMOLOV and V. I. ORLOVA *In its* USSR Rept.: Eng. and Equipment (JPRS-UEQ-84-001) p 36 9 Feb. 1984 Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedeniy: Energet. (Minsk), no. 10, Oct. 1983 p 90-96
 Avail: NTIS HC A06

Combination convective and film cooling of baffle blades with several rows of performance in gas turbines is evaluated on the basis of the thermal efficiency of each mode individually and the Kutateladze-Leont'yev relation for the efficiency of a gas shield before an array of perforations. The resultant film effect on a perforated surface is calculated according to the Sellers relation and, for calculating the heat transfer by internal convection, the thermal resistance of the blade wall is assumed to be negligible. The differential equation of coolant flow with continuous transverse jet injection is solved by the numerical method of finite elements. The results indicate ways to optimize the cooling system parameters for given operating conditions. Author

N85-24068# Joint Publications Research Service, Arlington, Va. **EXPERIMENTAL STUDY OF HEAT TRANSFER FROM SHAFT IN COOLED RADIAL BEARING OF GNT-25 GAS TURBINE Abstract Only**

V. V. RUKHLINSKIY, I. D. USAYEV, and A. V. YERMOLENKO *In its* USSR Rept.: Eng. and Equipment (JPRS-UEQ-84-001) p 36-37 9 Feb. 1984 Transl. into ENGLISH from Teploenerg. (Moscow), no. 4, Apr. 1983 p 64-66
 Avail: NTIS HC A06

The heat transfer from the shaft in a cooled radial bearing design was studied experimentally in a GTN-25 gas turbine. The basic dimensions of the bearing were 315 mm inside diameter and 140 mm width. This split bearing had two oil feed orifices in the plane of separation and its housing was cooled with oil fed through an annular chamber. Heating of the shaft neck and the bearing housing under operating conditions was simulated. The experimental data have been processed according to methods of similarity and dimensional analysis, the results yielding semiempirical relations for the temperature and the thermal flux at the rubbing surface during laminar and transitional flow. Relations have also been obtained from these data for the hot spot temperature and the friction coefficient at the rubbing surface. The former characterizes the cooling system design and performance, the latter characterizes the bearing efficiency and economy. The results confirm that the effect of energy dissipation in the lubricant on the intensity of heat transfer from the shaft depends largely on the size and the shape of the shaft bearing clearance. G.L.C.

N85-24073# Joint Publications Research Service, Arlington, Va. **DESIGN OF PIPING FOR OIL DRAIN FROM TURBINE BEARINGS Abstract Only**

I. Y. TOKAR, Y. I. ZARETSKIY, I. I. MELNIKOV, and S. M. POLISHCHUK *In its* USSR Rept.: Eng. and Equipment (JPRS-UEQ-84-001) p 40-41 9 Feb. 1984 Transl. into ENGLISH from Energomashinostroyeniye (Moscow), no. 6, Jun. 1983 p 15-17
 Avail: NTIS HC A06

The performance of the piping system for oil drain from turbine bearings is analyzed on the basis of the two dimensional Laplace equation for flow of a viscous incompressible fluid through a rectangular channel and the Poisson equation for flow of such a fluid into the collector pan. The flow is assumed to be two dimensional and laminar, stable throughout its path, with negligible inertia forces and negligible pressure variations at the oil air interface. The solution to this system of equations for the appropriate boundary conditions and experimental data on the oil level along a model drain channel are correlated with the Chezy equation, its coefficient being most accurately (within 30%) described by the A.D. Al'tshul' relation $c=2.66Re$ to the 0.47th power. An empirical design equation is subsequently derived for the discharge coefficient as function of the Reynolds number in the μ ($N \text{ sub } r$) = $a-bRe + c(Re)^2$ cubed form which approximates the results of measurements within 5% accuracy. Author

N85-24075# Joint Publications Research Service, Arlington, Va. **CONSTRUCTION OF PROFILES OF INTERMEDIATE BLADE SECTIONS FROM MASTER PROFILES GIVEN ON CONICAL SURFACES Abstract Only**

M. P. KAPLAN and N. N. KOVALENKO *In its* USSR Rept.: Eng. and Equipment (JPRS-UEQ-84-001) p 42 9 Feb. 1984 Transl. into ENGLISH from Energomashinostroyeniye (Moscow), no. 4, Apr. 1983 p 6-7
 Avail: NTIS HC A06

An expedient way to produce highly economical turbine stages with wide opening angles is to design them with conical surfaces bounding the flow channel. A method is proposed for drawing the profiles of intermediate blade sections on a blueprint from master profiles given on conical surfaces approximating the surfaces of meridional traces of stream lines, after these surfaces have been developed onto a plane. The algorithm of this construction was programmed for an M-222 digital computer. High design precision

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requires at least 50 points each on the convex part and on the concave part of the blade contour, and an array of section profiles so dense that the distance between adjacent sections to be drawn does not exceed 30 to 40% of the chord length. Author

N85-24077# Joint Publications Research Service, Arlington, Va. **OSCILLATIONS OF GAS TURBINE INSTALLATION ROTORS UNDER OPERATING CONDITIONS Abstract Only**

Y. A. IGUMENTSEV *In its* USSR Rept.: Eng. and Equipment (JPRS-UEQ-84-001) p 43 9 Feb. 1984 Transl. into ENGLISH from *Energomashinostroyeniye* (Moscow), no. 7, Jul. 1983 p 7-10 Avail: NTIS HC A06

Experimental studies to determine the frequencies and amplitudes of oscillations of rotor bodies when oil vortexes are present indicated that the frequency of the vortex may differ significantly from half the rotating frequency of the rotor, the amplitude exceeding the levels of oscillations at the nominal rotor speed by many times. Problems of rotor-bearing-body dynamics under operating conditions are thus extremely important. A gas turbine rotor can be looked upon as an elastic beam in compliant supports. A mathematical analysis of the problem is presented. The algorithm used allows the vibration status of a gas turbine to be computed under operating conditions for a GT-750-6 turbine, used in major compressor stations along main gas pipelines. Author

N85-24140# Joint Publications Research Service, Arlington, Va. **CHINA REPORT: SCIENCE AND TECHNOLOGY**

23 Apr. 1984 56 p Transl. into ENGLISH from various Chinese articles (JPRS-CST-84-012) Avail: NTIS HC A04/MF A01

Developments in applied science and technology are reported. Some topics of discussion are: remote sensing and geology, using geological research to promote prospecting, testing in transonic and subsonic wind tunnels, applications of ultrasonic technology and advances in study of cold injuries.

N85-24157# Joint Publications Research Service, Arlington, Va. **USSR REPORT: ENGINEERING AND EQUIPMENT**

19 Jul. 1984 58 p refs Transl. into ENGLISH from various Russian articles (JPRS-UEQ-84-005) Avail: NTIS HC A04

Activities are reported in aeronautical engineering; surface transportation; nuclear energy; industrial technology; turbines; navigation and guidance systems; and mechanics of fluids and solids; and in testing and materials.

N85-24160# Joint Publications Research Service, Arlington, Va. **PLANNING OF AIR CUSHION TRANSPORT VEHICLES Abstract Only**

A. A. BADIYAGIN, A. I. BAYDIN, and B. S. SHCHERBAKOV *In its* USSR Rept.: Eng. and Equipment (JPRS-UEQ-84-005) p 3 19 Jul. 1984 Transl. into ENGLISH from *Izv. Vyssh. Ucheb. Zaved.: Aviats. Tekh.* (Kazan), no. 2, Mar. - May 1983 p 85-88 Avail: NTIS HC A04

The design of an air cushion vehicle in which bypass engines are used to provide the air for the air cushion and the reaction force to move the vehicle was studied. When the engines are first started, all of the air from the outer path is used to create the air cushion. As the vehicle accelerates, less of the air from this path is used to support the cushion, and finally at full speed all of the air is used to move the vehicle, with aerodynamic forces maintaining the cushion. It is concluded that there is an optimal ratio of air flow through the two paths in the engine. The optimal length of the acceleration run increases with increasing mass of the vehicle. Author

N85-24169# Joint Publications Research Service, Arlington, Va. **ESTIMATE OF FATIGUE STABILITY OF GAS-TURBINE ENGINE COMPRESSOR VANES IN PROBABILISTIC ASPECT Abstract Only**

A. V. PROKOPENKO and M. F. BAUMSHTEYN *In its* USSR Rept.: Eng. and Equipment (JPRS-UEQ-84-005) p 31 19 Jul. 1984 Transl. into ENGLISH from *Probl. Proch.* (Kiev), no. 11, Nov. 1983 p 74-76 Avail: NTIS HC A04

A method of determining the tolerance limits of durability of structural components based on correct statistical procedures is described. The method is illustrated by calculation from the results of tests of standard prismatic specimens with a crack, and gas turbine engine compressor vanes made of 14Kh17N2 steel tested under the same conditions of vibration loading by bending. The experimentally determined durability of the vanes was within the tolerance range determined from calculations done with respect to results of tests of the specimens. Author

N85-24170# Joint Publications Research Service, Arlington, Va. **INVESTIGATION OF GAS-TURBINE ENGINE BLOWER IMPELLER VIBRATIONS WITH CHANGE IN ENGINE INTAKE CONDITIONS Abstract Only**

D. S. YELENEVSKIY and V. V. MALYGIN *In its* USSR Rept.: Eng. and Equipment (JPRS-UEQ-84-005) p 31-32 19 Jul. 1984 Transl. into ENGLISH from *Probl. Proch.* (Kiev), no. 10, Oct. 1983 p 81-85

Avail: NTIS HC A04

Vibrations of low pressure compression impellers in multiple shaft gas turbine engines were studied in stand tests with different intake conditions. The working vanes of the investigated blowers had relatively large linear dimensions compared with the disks, and were equipped with antivibration shroud tips. The test results show that different designs of the engine intake device have a strong influence on the structure of nonuniformity of gasdynamic flow at the engine intake, and also determine the vibration behavior of the blower impellers. Resonant vibrations of the working vanes occur at maximum symmetry of airflow into the engine. Distortions of intake conditions introduced by segmental interceptors increase turbulence in the flow section of the blower, resulting in stochastic vibration response of the blower vanes. The results of studies of the vibration state of the blower in engines of various classes were qualitatively identical, which shows that the patterns observed in this research are general in nature. G.L.C.

N85-24205# Illinois Univ., Urbana. Engineering-Psychology Research Lab.

MULTIPLE RESOURCES AND DISPLAY FORMATTING: THE IMPLICATIONS OF TASK INTEGRATION IN A SIMULATED AIR TRAFFIC CONTROL TASK

C. D. WICKENS, B. GOETTL, and D. BOLES Dec. 1984 18 p (Contract N00014-79-C-0658) (AD-A150713; EPL-84-5/ONR-84-4) Avail: NTIS HC A02/MF A01 CSDL 17B

Two experiments are reported which test the hypothesis that multiple sources of displayed information should be presented to common rather than separate resources when those sources must be integrated with a single mental model of the task. One experiment requires subjects to integrate horizontal and vertical information in a spatially presented air traffic control task. In support of the hypothesis, performance was best when both sources were presented visually, rather than bimodally. In a control experiment when the altitude and horizontal information did not need to be integrated, the performance advantage to intramodal display disappears. In a separate experiment using a digital display of the aircraft position information, no evidence for better processing of the information to be integrated within the visual modality was obtained. Author (GRA)

N85-24253# Institut Franco-Allemand de Recherches, St. Louis (France).

APPLICATION OF LASER ANEMOMETRY TO JETS IN COMBUSTION CHAMBERS [ANWENDUNG DER LASERANEMOMETRIE AUF BRENNKAMMERSTRAHLEN]

H. J. SCHAEFER 25 Apr. 1983 29 p refs In GERMAN Presented at Seminar on Anemometrie Laser en Combust., Saint Denis, France, 20 Apr. 1983; sponsored by Combustion Inst. (ISL-CO-210/83) Avail: NTIS HC A03/MF A01

An experimental investigation was conducted on a hot free jet to assess measuring problems in the application of laser-double-beam-anemometry to hot, high velocity flows. The free jet with a diameter of 80 mm and an exhaust velocity of 400 m/sec was produced in a model combustion chamber which simulates the conditions in a jet engine. The effects of environmental conditions and fluctuating temperature gradients; the injection of scattering particles; and the signal processing are discussed. Experimental results showing the presence of large coherent structures on the axis of the hot free jet demonstrate the efficiency of the anemometers. Author (ESA)

N85-24270*# National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.

MEASUREMENTS IN THE FLOW FIELD OF A CYLINDER WITH A LASER TRANSIT ANEMOMETER AND A DRAG RAKE IN THE LANGLEY 0.3 M TRANSONIC CRYOGENIC TUNNEL

W. C. HONAKER and P. L. LAWING Apr. 1985 25 p refs (NASA-TM-86399; NAS 1.15:86399) Avail: NTIS HC A02/MF A01 CSCL 14B

An experiment was conducted at the 0.3 m Transonic Cryogenic Tunnel using a Laser Transit Anemometer (LTA) to probe the flow field around a 3.05 centimeter-diameter circular cylinder. Measurements were made along the stagnation line and determination of particle size was evaluated by their ability to follow the flow field. The LTA system was also used to scan into the boundary layer near the 45 degree point on the model. Results of these scans are presented in graphic and tabular form. Flow field particle seeding was accomplished by inbleeding dry service air. The residual moisture (5-10 ppm) condensed and formed ice particles which served as Mie scattering centers for the LTA detection system. Comparison of data taken along the stagnation streamline with theory indicated that these particles tracked the velocity gradient of the flow. Tunnel operating conditions for the tests were a Mach number of 0.3, a pressure of 1.93×100000 n/m squared, and a temperature of 225 degrees K. Free stream Mach number and pressure were varied for the particle size determination. Author

N85-24290 Welding Inst., Cambridge (England).

LASER DRILLING OF AEROENGINE COMPONENTS

D. F. TOLLER *In its* Laser Welding, Cutting and Surface Treat. p 48-51 1984 refs

Avail: Issuing Activity

The solid state YAG laser has proved itself to be a useful tool for drilling, cutting, and welding aeroengine materials. It has advantages both as a production process, where its lower consumable costs and faster floor to floor times over other techniques make it the first choice for many applications, and also as a development tool where its ease of programming and absence of major tooling and fixturing enable it to respond rapidly to design changes. These factors, together with the high quality holes now being produced by the trepanning technique, mean that this process has developed into a reliable cost effective production technique. G.L.C.

N85-24302# Air Products and Chemicals, Inc., Allentown, Pa.

SOLID STATE COMPRESSOR Research and Development Status Report, 1 Sep. - 31 Dec. 1984

W. A. STEYERT 25 Jan. 1985 41 p

(Contract N00014-83-C-0394)

(AD-A150790; SR-6) Avail: NTIS HC A03/MF A01 CSCL 13G

Pennsylvania State University has continued their basic ceramic material studies but has been unable to fabricate complete high

performance drivers. APCI continued testing and modifying the one cell simulator. Work was also done on fabricating elastomers and designing a one cell prototype compressor. CeramPhysics analyzed the drive characteristics of the three cell simulator and achieved a 2:1 compression ratio with the peristaltic compression mechanism. We believe that the single cell prototype compressor which is being designed will demonstrate the feasibility of building a closed cycle J-T compressor which incorporates the solid state compressor concepts. GRA

N85-24319# Lockheed-Georgia Co., Marietta.

ADVANCED LIFE ANALYSIS METHODS. VOLUME 3: EXPERIMENTAL EVALUATION OF CRACK GROWTH ANALYSIS METHODS FOR ATTACHMENT LUGS Final Report, 3 Sep. 1980 - 30 Sep. 1984

K. KATHIRESAN and T. R. BRUSSAT 17 Sep. 1984 384 p (Contract F33615-80-C-3211)

(AD-A151058; LG82ER0117-3; AFWAL-TR-84-3080-VOL-3)

Avail: NTIS HC A17/MF A01 CSCL 20K

This volume covers the results of experimental evaluation of crack growth analysis methods for attachment lugs which were reported in Vol. 2 of the final report. These experiments were conducted to assess the damage tolerance of aircraft attachment lugs. The experimental test program included baseline material characterization, crack initiation, residual strength and crack propagation tests. Several loading and geometric complexities were considered in the test program. The types of loading complexities included were constant-amplitude, block spectrum and flight-by-flight spectrum, symmetric and off-axis loadings. Peak stress levels in the lug which were below and above the yield strength of the materials were also included in the test program. The types of geometric complexities considered were straight, tapered, dogbone, clevis and real aircraft lug configurations. Additional geometric complexities considered include lugs with lower thickness and lugs with interference-fit bushings. The experimental results were correlated with the analytical predictions made using methods described in Vol. 2 of the final report and are presented in this volume. Excellent correlation results were obtained for most of the test cases. In some cases, the developed analytical methods needed some improvements or some new solutions had to be generated. Such efforts were conducted and the refined correlation results are also included in the present volume. GRA

N85-24320*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

RECENT DEVELOPMENTS IN THE DYNAMICS OF ADVANCED ROTOR SYSTEMS

W. JOHNSON Mar. 1985 117 p refs

(NASA-TM-86669; A-85089; NAS 1.15:86669) Avail: NTIS HC A06/MF A01 CSCL 20K

The problems that were encountered in the dynamics of advanced rotor systems are described. The methods for analyzing these problems are discussed, as are past solutions of the problems. To begin, the basic dynamic problems of rotors are discussed: aeroelastic stability, rotor and airframe loads, and aircraft vibration. Next, advanced topics that are the subject of current research are described: vibration control, dynamic upflow, finite element analyses, and composite materials. Finally, the dynamics of various rotorcraft configurations are considered: hingeless rotors, bearingless rotors, rotors with circulation control, coupled rotor/engine dynamics, articulated rotors, and tilting prop rotor aircraft. Author

N85-24321# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).

FATIGUE CRACK TOPOGRAPHY

Loughton, England Nov. 1984 238 p refs Conf. held in Sienna, Italy, 1-6 Apr. 1984

(AGARD-CP-376; ISBN-92-835-1480-7; AD-A152368) Avail:

NTIS HC A11/MF A01

Available methods for determining the growth rate of cracks from their topography are reviewed and any shortcomings in these

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methods are noted. Further research and development is recommended. Phenomenological aspects of fatigue fractures; methods and means of crack front marking and fracture surface analysis techniques are emphasized.

N85-24325# Aeronautical Systems Div., Wright-Patterson AFB, Ohio.

TWO RECENT CASES OF MARKER LOAD APPLICATIONS ON CARGO/FIGHTER AIRCRAFT FATIGUE TESTS

D. R. ERSKINE and J. L. HOPKINS *In* AGARD Fatigue Crack Topography 20 p Nov. 1984 refs

Avail: NTIS HC A11/MF]en1] A01

Two applications of marker cycles under distinctly different loading spectra are discussed. The first spectrum represents a cargo aircraft load environment, with a maximum load case of 60% limit. The other spectrum represents a fighter usage with the usually high frequency of near limit load cycles. Examples are presented of the crack growth, the marking and the engineering approaches. The effects of the marker cycles on the natural growth are shown to be insignificant. Good fractographic correlation was found in both component and full scale tests. E.A.K.

N85-24328# Industrieranlagen-Betriebsgesellschaft m.b.H., Ottobrunn (West Germany).

GENERATION OF MARKER LINES ON FATIGUE FRACTURE SURFACES

M. KALWEIT *In* AGARD Fatigue Crack Topography 5 p Nov. 1984 refs

Avail: NTIS HC A11/MF A01

A flight by flight loading program for a predominantly maneuver loaded military aircraft structure it was proposed, with respect to the generation of marker lines, to alter the more or less arbitrary arrangement of the loading sequence which is representative for normal service operation. The 45 most severe load cycles in each particle sequence comprising of 250 flights were interspersed into the first 45 flights of each of the partial sequences. Fatigue tests with simple test specimens were run to investigate if, with the proposed loading arrangement, easily visible, clearly identifiable marker lines could be operated. It was investigated if the concentration of the high load cycles in the first flights of a partial load sequence would create any misleading test results with respect to crack propagation and fatigue life. Flight by flight fatigue tests with a total of nine notched AL specimens, loaded uniaxially in tension and compression, were performed. From these nine specimens, five were used to generate marker lines and the remaining four were used to determine fatigue life. The tests were conducted with two loading programs which differed only in the selected sequence of load cycles. E.A.K.

N85-24329# Lockheed-California Co., Burbank.

PERIODIC LOADING SEQUENCES FOR THE SYSTEMATIC MARKING OF FATIGUE CRACK FRACTURE SURFACES

J. C. EKVALL, L. BAKOW, and T. R. BRUSSAT *In* AGARD Fatigue Crack Topography 9 p Nov. 1984 refs

Avail: NTIS HC A11/MF A01

Periodic loading sequences which leave characteristic markings on the fracture surface are used for evaluating the results of crack growth tests. These markings aid in the evaluation of crack growth rates and prediction formulations, and define the shape of cracks at specific times during the test. To illustrate how loading sequences are used to produce regularly spaced fracture surface markings in crack growth tests, three examples are presented. These include a fighter spectrum, a transport spectrum, and constant amplitude loading sequences. The composition of each of the loading sequences is discussed, and photographs of some of their resultant fracture surfaces are shown. The fracture surface markings produced by the three loading sequences are visible to the naked eye and photographed without magnification. Author

N85-24330# National Aerospace Lab., Amsterdam (Netherlands).

MODIFICATIONS OF FLIGHT BY FLIGHT LOAD SEQUENCES TO PROVIDE FOR GOOD FRACTURE SURFACE READABILITY

H. H. VANDERLINDEN *In* AGARD Fatigue Crack Topography 22 p Nov. 1984 refs

Avail: NTIS HC A11/MF A01

In order to establish an inspection schedule for fatigue, critical fastener holes in the wing lower skin of a fighter aircraft, crack growth data under realistic loading was required. Experimental determination of these data was a logical choice since a representative specimen was available. However, the spectrum and load sequence, representative for the Dutch usage of the aircraft, do not mark the fracture surface well enough. Methods to identify markers were evaluated: scanning electron microscopy gives the best results. Goals, means of accomplishment and detailed results are described of a pilot program in which modifications of the load sequences were investigated. Simple center notched and complex representative specimens were used. A marker version of the original sequence was validated. Author

N85-24334# National Research Council of Canada, Ottawa (Ontario).

APPLICATION OF OPTICAL AND ELECTRON MICROSCOPIC TECHNIQUES IN THE FRACTOGRAPHIC DETERMINATION OF FATIGUE CRACK GROWTH RATES

R. V. DAINY *In* AGARD Fatigue Crack Topography 26 p Nov. 1984 refs

Avail: NTIS HC A11/MF A01

The fractographic derivation of fatigue crack growth information is entirely dependent on the fractographer's ability to correlate accurately the striated fracture surface topography with the applied test or service loads. Some techniques developed to acquire this type of quantitative information through the application of optical and electron microscopy are reviewed. Fractographic analyses of fatigue specimens and components that failed during laboratory and full-scale aircraft fatigue tests are presented. These analyses show how the identification and correlation of various fatigue load application formats, i.e., constant amplitude, programmed block, flight-by-flight and random loading, can be utilized to derive this type of experimental crack growth data. Author

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GEOSCIENCES

Includes geosciences (general); earth resources; energy production and conversion; environment pollution; geophysics; meteorology and climatology; and oceanography.

A85-30600

AUTOMATIC MONITORING OF AVIATION TERMINAL FORECASTS

D. J. VERCELLI (NOAA, Techniques Development Laboratory, Silver Spring, MD) *American Meteorological Society, Bulletin* (ISSN 0003-0007), vol. 66, March 1985, p. 292-296. refs

The design, testing, and current status of, as well as future plans for, the computer program that automatically monitors aviation terminal forecasts at National Weather Service forecast offices are detailed. The program, written in FORTRAN, comprises four primary segments: decoding the surface airway observations (SAO); decoding the terminal forecasts (FT); comparing the SAO and FT values with the official FT amendment criteria and a set of alert criteria; and alerting the forecaster that the output product is ready for display. In addition, the program serves as a quality control on the SAOs and FTs that have been incorrectly entered into the computer. It is noted that the monitoring program made it possible to amend FTs up to 20 to 30 min earlier, as compared to the manual monitoring and to provide more time for the forecaster to

concentrate on solutions to forecast problems identified by the computer. L.T.

N85-30961

STEREO MODELS FROM SYNTHETIC APERTURE RADAR

E. S. LEONARDO (Goodyear Aerospace Corp., Litchfield Park, AZ) IN: Extraction of information from remotely sensed images; Proceedings of the Conference on Techniques for Extraction of Information from Remotely Sensed Images, Rochester, NY, August 16-19, 1983. Falls Church, VA, American Society of Photogrammetry, 1984, p. 105-114. refs

For a long time, image interpreters and geoscientists have been intrigued by the possibility of using conventional stereoscopes and stereo plotters to obtain measurable three-dimensional models of synthetic aperture side-looking radar (SAR) imagery. On the basis of studies, it has now been verified that a visual stereo radar model is not only theoretically possible, but that measurements compatible with the sensor's resolution and the terrain can be made using conventional stereo mensuration equipment. Because of SAR's unique geometries and characteristics, the flight parameters required for stereo collection flights are much more stringent than for aerial photography. Flightpath configurations are discussed, taking into account preferred configuration, and alternate configurations. Attention is given to radar stereo measurements, steep depression angle effects, and edge guidance and flightpath effects. G.R.

N85-23256# Battelle Columbus Labs., Ohio.

COMPOSITION AND PHOTOCHEMICAL REACTIVITY OF TURBINE ENGINE EXHAUST Final Report, Jan. 1982 - Mar. 1984

C. W. SPICER, M. W. HOLDREN, T. F. LYON, and R. M. RIGGIN Tyndall AFB, Fla. AFESC Sep. 1984 196 p (Contract F08635-82-C-0131)

(AD-A150559; AFESC/ESL-TR-84-28) Avail: NTIS HC A09/MF A01 CSCL 07C

The environmental impact of organic compounds emitted from jet aircraft turbine engines has not been firmly established due to the lack of data regarding the emission rates and identities of the compounds. The objectives of this project were to identify and quantify the organic compounds present in gaseous emissions from jet engines and to study a photochemical reactivity of these compounds. These objectives were met through a five-task approach. Tasks 1 and 2 involved sampling and analysis methods development and validation. This report reviews the Task 1 and 2 studies, and describes Tasks 3-5 in detail. Task 3 involved detailed exhaust organic composition studies with two full-scale turbine engines utilizing three fuels. Task 4 investigated the photochemical reactivity of the exhausts, and Task 5 involved analysis and interpretation of results. GRA

N85-23732*# Newton (Dennis W.), Reno, Nev.

GENERAL AVIATION'S METEOROLOGICAL REQUIREMENTS

D. NEWTON /in NASA. Marshall Space Flight Center Proc.: 7th Ann. Workshop on Meteorol. and Environ. Inputs to Aviation Systems p 19-27 Apr. 1984

Avail: NTIS HC A07/MF A01 CSCL 04B

An overview of the meteorological information requirements of general aviation is presented preceded by an outline defining the characteristics of general aviation and noncommercial pilot training. Thunderstorm and icing products, weather charts, and information dissemination are discussed. M.G.

N85-23733*# Business and Commercial Aviation, White Plains, N.Y.

CORPORATE/COMMUTER AIRLINES METEOROLOGICAL REQUIREMENTS

J. W. OLCOTT /in NASA. Marshall Space Flight Center Proc.: 7th Ann. Workshop on Meteorol. and Environ. Inputs to Aviation Systems p 23-25 Apr. 1984

Avail: NTIS HC A07/MF A01 CSCL 04B

The incidence of inadequate preflight planning and weather as causal factors in civil aircraft accidents is examined and the

meteorological information needs of corporate/commuter airlines are discussed. The requirements of such operations center principally on facilitating the communications of actual weather data, particularly data that influence schedule predictability, ride comfort, operating efficiency, and on using existing non-Flight Service Station communication facilities to input flight plan information. M.G.

N85-23737*# Naval Research Lab., Washington, D. C. Experimental Cloud Physics Section.

A NEW CHARACTERIZATION OF THE ICING ENVIRONMENT BELOW 10,000 FEET AGL FROM 7,000 MILES OF MEASUREMENTS IN SUPERCOOLED CLOUDS

R. K. JECK /in NASA. Marshall Space Flight Center Proc.: 7th Ann. Workshop on Meteorol. and Environ. Inputs to Aviation Systems p 44-47 Apr. 1984 refs

Avail: NTIS HC A07/MF A01 CSCL 04B

About 7,000 nautical miles (NM) of airborne measurements in supercooled clouds at altitudes up to 10,000 feet (3 km) were computerized to form a data base for low-altitude, aircraft icing applications. Half of the data is from the National Advisory Committee for Aeronautics (NACA) aircraft icing studies of 1946-50 where ice accretion on rotating multicylinders was the primary measurement technique for liquid water content (LWC) and droplet size. The other half is from recent research flights using optical, cloud droplet size spectrometers. These measure droplet sizes, with LWC recorded droplet size distribution. The NACA and modern data generally agree in most aspects, indicating that the NACA data are accurate and reliable except possibly for indicated droplet diameters larger than 35 microns. The intermittent maximum and continuous maximum graphs (envelopes) in FAR-25, Appendix C, do not correctly describe the icing environment in the altitude range from 0 to 10,000 feet AGL. Differences in maximum values of LWC, upper and lower limit to the median volume diameter of cloud droplets, and temperature dependences of medium volume diameters are evident. A.R.H.

N85-23740*# Flying Tigers-Retired, San Pedro, Calif.

DEVELOPMENT OF A WIND SHEAR PERFORMANCE ENVELOPE

J. H. BLISS /in NASA. Marshall Space Flight Center Proc.: 7th Ann. Workshop on Meteorol. and Environ. Inputs to Aviation Systems p 55-57 Apr. 1984

Avail: NTIS HC A07/MF A01 CSCL 04B

Airplane performance during a continuing headwind loss is examined. Safe flight path control in a new airmass can only be assured by using a safe actual speed relative to the new airmass before entering. The safe speed cannot be resolved by using airspeed alone, which disregards the environment ahead. The best defense for take-off is examined and the airspeed/ground speed method for landing approach is assessed. A.R.H.

N85-23742*# Toronto Univ., Downsview (Ontario). Inst. for Aerospace Studies.

A MODEL OF A DOWNBURST; A WIND TUNNEL PROGRAM ON PLANETARY BOUNDARY LAYER; AND AIRSHIP IN TURBULENCE

B. ETKIN /in NASA. Marshall Space Flight Center Proc.: 7th Ann. Workshop on Meteorol. and Environ. Inputs to Aviation Systems p 61-66 Apr. 1984

Avail: NTIS HC A07/MF A01 CSCL 04B

Engineering models of turbulence at high altitude, of the planetary boundary layer, and of microbursts, must reflect reasonably well the reality physics and have parameters in them that can be varied to adjust the models to suit various circumstances. A typical microburst generated by a doublet sheet is illustrated and a 3-D model is compared for different strength distributions. A wind tunnel for simulating shear and turbulence is described for studying landing or takeoff through the planetary boundary layer. The feasibility of applying the slender-body/strip theory to determine the turbulence-induced forces on an airship was assessed. Transfer functions for the bare hull and the hull with fins are shown. A.R.H.

13 GEOSCIENCES

N85-24537*# National Aeronautics and Space Administration, Washington, D. C.

DISTURBANCE TO THE POPULATION DUE TO FLIGHT OPERATIONS AT LANDING FIELDS. QUESTIONNAIRE ON COMMUNITY REACTION TO NON-COMMERCIAL AND SPORTING AVIATION

B. ROHRMANN Feb. 1981 118 p refs Transl. into ENGLISH of the book "Die Gestoertheit des Bevoelkerung durch den Flugbetrieb auf Landeplaetzen. Eine Sozialpsychologische Feldstudie Durchgefuehrt im Auftrag des Bundesministeriums des Innern" Hamburg, Jul. 1975 p 1-108 Transl. by Kanner (Leo) Associates, Redwood City, Calif. (Contract NASW-3199) (NASA-TM-76531; NAS 1.15:76531) Avail: NTIS HC A06/MF A01 CSCL 13B

A field study was undertaken to determine the Sociopsychological effects of air traffic noise experienced by residents of areas near small sporting aviation fields. A questionnaire was prepared which includes questions on flight restriction measures, on attitudes which moderate annoyance and on comparisons with other noise sources, etc. B.W.

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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.

A85-30227*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
MULTIDISCIPLINARY ANALYSIS AND SYNTHESIS - NEEDS AND OPPORTUNITIES

R. H. TOLSON and J. SOBIESZCZANSKI-SOBIESKI (NASA, Langley Research Center, Hampton, VA) IN: Structures, Structural Dynamics, and Materials Conference, 26th, Orlando, FL, April 15-17, 1985, Technical Papers. Part 1. New York, American Institute of Aeronautics and Astronautics, 1985, p. 1-12. refs (AIAA PAPER 85-0584)

A comprehensive evaluation is conducted of structural analysis and synthesis opportunities which emerge through a multidisciplinary design program approach that simultaneously and interactively encompasses, in its determination of a given aircraft design, aerodynamics, structure, structural dynamics, materials, controls, and propulsion. In this way, it becomes possible to rapidly exploit technological advances in order to yield synergistic effects among configurational subsystems. The aircraft type presently considered as recipients of this treatment are commercial transports, high performance military aircraft, rotorcraft, and large space antennas, giving attention to common features among the multidisciplinary design tasks represented. O.C.

A85-30267#

A ROBOTIC QUICK DISCONNECT WRIST FOR AIRCRAFT BULKHEAD INSPECTION

C. M. GOEKE (Eastman Kodak Research Laboratories, Rochester, NY), M. S. DARLOW, and J. F. MEAGHER (Rensselaer Polytechnic Institute, Troy, NY) IN: Structures, Structural Dynamics, and Materials Conference, 26th, Orlando, FL, April 15-17, 1985, Technical Papers. Part 1. New York, American Institute of Aeronautics and Astronautics, 1985, p. 373-380. DARPA-USAF-supported research. (AIAA PAPER 85-0700)

A lightweight robotic quick disconnect (QD) prototype wrist was designed for a small industrial robot. The QD wrist allows a robot to pick up any one of a number of waiting tools. The specific application of the tools is to perform dimensional inspection tasks on an aircraft bulkhead. The tools are stored in a rack at the

edge of the robot's envelope. The QD wrist also allows for electrical connections to be made to each tool. The mating of QD wrist is repeatable and reliable to + or - 0.001 inches along and + or - 5 milliradians about the wrist centerline and + or - 0.020 inches at a point on the unit centerline 15 inches out from the wrist. This mating specification was met with a 5-pound tool attached to the wrist. Commercially available components comprise a substantial part of the wrist, resulting in a readily available proven technology. Author

A85-31453

MULTISTEP TERMINAL GUIDANCE OF LINEAR SYSTEMS UNDER CONDITIONS OF PARAMETRIC AND CONSTANT PERTURBATIONS [MNOGOSHAGOVOE TERMINAL'NOE UPRAVLENIE LINEINNYMI SISTEMAMI PRI PARAMETRICHESKIKH I POSTOIANNO DEISTVUIUSHCHIKH VOZMUSHCHENIIAKH]

V. A. AFANASEV, A. S. MESHCHANOV, and T. K. SIRAZETDINOV Aviatsonnaia Tekhnika (ISSN 0579-2975), no. 4, 1984, p. 11-18. In Russian.

The possibility of applying multistep vector terminal guidance based on a simplified model to flight vehicles exposed to various perturbations is demonstrated theoretically. In particular, the theorem of the existence of a set of piecewise continuous vector controls for a completely guided system is proved, and the accuracy of guidance is estimated. A procedure for developing a multistep terminal guidance system is presented. V.L.

A85-31463

OPTIMIZATION OF QUEUING DISCIPLINES IN MULTIPHASE CLOSED QUEUING SYSTEMS [K OPTIMIZATSII DISTSIPLIN OBSLUZHIVANIIA V MNOGOFAZNYKH ZAMKNUTYKH SISTEMAKH MASSOVOGO OBSLUZHIVANIIA]

I. KH. SADYKOV Aviatsonnaia Tekhnika (ISSN 0579-2975), no. 4, 1984, p. 63-67. In Russian.

The paper is concerned with the problem of determining optimal queuing disciplines with dynamic and statistical priorities in multiphase closed queuing systems. In particular, an approximate algorithm for determining an optimal queuing discipline with statistical priorities is presented which consists in finding the best possible transition (i.e., with a minimum loss in the quality functional) from optimal dynamic to statistical priorities. V.L.

A85-31464

EVALUATION OF STOCHASTIC SIMILARITY CRITERIA FOR A LIMITED VOLUME OF AVIATION EQUIPMENT TESTS [OTSENKA KRITERIEV STOKHASTICHESKOGO PODOBIIA PRI OGRANICHENNOM OB'EME ISPYTANII IZDELII AVIATSIONNOI TEKHNIKI]

N. A. SEVERTSEV, P. N. POPOV, S. N. PROKUDIN, and G. A. IARYGIN Aviatsonnaia Tekhnika (ISSN 0579-2975), no. 4, 1984, p. 68-72. In Russian.

A method is proposed for developing and using stochastic similarity criteria for processing and analyzing results of a small volume of multifactorial tests on aviation equipment. The method employs a recurrence procedure where the number of parameters included in the criteria gradually increases. The method also provides for an evaluation of the accuracy of the criteria. V.L.

A85-31466

THE USE OF FUNCTIONAL SPLINES FOR CONSTRUCTING AIRCRAFT SURFACES [PRIMENENIE FUNKTSIONAL'NYKH SPLAINOVO DLIA POSTROENIIA POVERKHNOSTEI LETATEL'NYKH APPARATOV]

V. F. SNIGIREV Aviatsonnaia Tekhnika (ISSN 0579-2975), no. 4, 1984, p. 77-80. In Russian. refs

The use of two-dimensional splines for constructing shell surfaces of complex geometry during the strength analysis of the structural elements of aircraft is discussed. The splines proposed here can be also used in computer-aided design systems for developing aircraft surfaces and rigging. The approach proposed here is illustrated by an example. V.L.

A85-31475

OPTIMAL CONTROL SYNTHESIS FOR STOCHASTIC SYSTEMS WITH ALLOWANCE FOR A DELAY IN THE CONTROL CIRCUIT IN THE CASE OF INCOMPLETE AND INACCURATE INFORMATION ON THE SYSTEM STATE [SINTEZ OPTIMAL'NOGO UPRAVLENIIA STOKHASTICHESKIMI SISTEMAMI S UCHETOM ZAPAZDYVANIIA V KONTURE UPRAVLENIIA V USLOVIAKH NEPOLNOI I NETOCHNOI INFORMATSII O SOSTOIANII SISTEMY]

A. G. DEGTIAREV *Aviatsionnaia Tekhnika* (ISSN 0579-2975), no. 4, 1984, p. 105-108. In Russian. refs

A85-31991#

DEVELOPMENT OF A GENERIC ARCHITECTURE

C. BERGGREN (IBM Corp., Owego, NY) IN: *American Helicopter Society, Annual Forum, 40th, Arlington, VA, May 16-18, 1984, Proceedings*. Alexandria, VA, American Helicopter Society, 1984, p. 429-437.

Concepts of the next generation avionic systems utilize developments in technologies such as Very-High-Speed Integrated Circuits (VHSIC), fiber optics, image processing, and artificial intelligence. For the development and integration of a next generation system with the required capabilities, it is necessary to construct a test vehicle or a system which can model expected data of a correctly functioning system. The cost of developing integration laboratories is mainly determined by expenditures for the design of the system architecture and software. The present investigation is concerned with the design of a facility to address the total development cycle of military systems from initial analytical studies through design, integration, test, and training. The conducted studies focus on generic system capabilities, capabilities such as reusability, flexibility, and extendibility. Attention is given to a configuration description, a basic functional module, module interconnection strategy, and module software considerations.

G.R.

A85-32782#

ECCENTRIC TWO-TARGET MODEL FOR QUALITATIVE AIR COMBAT GAME ANALYSIS

J. SHINAR (Technion - Israel Institute of Technology, Haifa, Israel) and A. DAVIDOVITZ *Journal of Guidance, Control, and Dynamics* (ISSN 0731-5090), vol. 8, May-June 1985, p. 325-331. refs (AIAA PAPER 83-2122)

An air combat duel with 'all-aspect' guided missiles between a Harrier type and a faster conventional fighter aircraft is modeled as a two-target game between a 'homicidal chauffeur' and an 'aggressive pedestrian'. The firing envelopes of the missiles are approximated by eccentric circles in the faster airplane's coordinate system. The qualitative two-target game analysis is a nontrivial combination of two zero-sum pursuit-evasion games with eccentric circular target sets. The analysis confirms the need for large 'off-boresight' angle missiles for the less maneuverable aircraft and the great sensitivity of the solution to firing envelope parameters.

Author

A85-33018#

MULTI-DIMENSIONAL CASE OF AN ENTROPIC VARIATIONAL FORMULATION OF CONSERVATIVE HYPERBOLIC SYSTEMS

F. A. MAZET and F. BOURDEL (ONERA, Centre d'Etudes et de Recherches de Toulouse, Toulouse, France) *La Recherche Aeronautique (English Edition)* (ISSN 0379-380X), no. 5, 1984, p. 67-76. refs

The mathematics of solving conservative hyperbolic systems is briefly reviewed. The entropic variational formulation of Mazet (1983) for a class of physical systems is generalized to the two-dimensional case and substantiated. The finite-element approximation and the new algorithm described are tested with different external flows.

Author

A85-33287

A REALISTIC AERIAL COMBAT DUEL AS A DIFFERENTIAL GAME STUDY

B. JARMARK (Saab-Scania AB, Linkoping, Sweden) IN: *Conference on Decision and Control, 22nd, San Antonio, TX, December 14-16, 1983, Proceedings. Volume 2*. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, p. 682-687. refs

Optimal control theory is applied to a realistic missile duel between two aircraft on nonshort range. The duel is formulated as a two person, zero-sum differential game with perfect information and free final times. The longitudinal acceleration of each vehicle is modelled in accordance with realistic aircraft and long range missiles, including practical constraints like maximum load factor due to stall or structural limit. Accordingly the differential game will be very nonlinear and an effective numerical optimization method is needed. By a modified differential dynamic programming method combined with an expedient convergence control technique the problem has successfully been solved. However, the duel problem has a particular property by the launch mechanism, which the ordinary control theory does not include. Therefore the algorithm used is extended to a new type of transversality condition. A discussion of applying differential game theory in practice is made. This is demonstrated in two examples, one having four stationary solutions.

Author

A85-33299

ITERATIVE QUEUEING NETWORK TECHNIQUES FOR THE ANALYSIS OF LARGE MAINTENANCE FACILITIES

K. R. PATTIPATI and M. P. KASTNER (Alphatech, Inc., Burlington, MA) IN: *Conference on Decision and Control, 22nd, San Antonio, TX, December 14-16, 1983, Proceedings. Volume 3*. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, p. 1045-1055. Research supported by the Sperry Corp. refs

This paper presents an iterative queueing network model for the steady state performance analysis of a large avionics maintenance facility. The maintenance process involves hundreds of avionics equipment (customer classes), each requiring multiple maintenance operations and an overlapping set of resources (queues) for each operation. A three-level iterative algorithm is used to solve the resulting nonstandard queueing network model. One of the levels employs the well-known mean value analysis (MVA) technique to achieve computational efficiency. The model is currently in use, as part of a larger optimization-based design model, in the analysis and synthesis of maintenance facilities for avionics equipment.

Author

A85-33301

A STATE-SPACE MODEL FOR AN AEROELASTIC SYSTEM

J. A. BURNS (Virginia Polytechnic Institute and State University, Blacksburg, VA; USAF, Office of Scientific Research, Bolling AFB, Washington, DC), E. M. CLIFF, and T. L. HERDMAN (Virginia Polytechnic Institute and State University, Blacksburg, VA) IN: *Conference on Decision and Control, 22nd, San Antonio, TX, December 14-16, 1983, Proceedings. Volume 3*. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, p. 1074-1077. refs

(Contract NSF ECS-81-09245; F49620-82-C-0035)

A complete dynamic model is formulated for a system in which the elastic motions of a structure are coupled with the motions of the surrounding fluid. While certain aspects of the problem are well-studied, the emphasis here is on development of a well-posed state-space formulation. Such models have proven conceptual and computational value in problems of optimal control and parameter identification.

Author

15 MATHEMATICAL AND COMPUTER SCIENCES

A85-33303

OUTPUT FEEDBACK DESIGN FOR AIRCRAFT WITH ILL-CONDITIONED DYNAMICS

D. D. MOERDER and A. J. CALISE (Drexel University, Philadelphia, PA) IN: Conference on Decision and Control, 22nd, San Antonio, TX, December 14-16, 1983, Proceedings. Volume 3. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, p. 1084-1087. refs

Singular perturbation concepts are exploited to develop a procedure for designing a dynamic output feedback controller. It is assumed that the original system is ill-conditioned in the sense that the plant contains widely separated dynamics requiring stabilization, and that the measurements are composed of a linear combination of slow and fast variables. A two time scale design approach results which depends on two-way control spillover suppression. An application to active control of aircraft wing flutter modes is used to illustrate the design method. Author

N85-23308# Royal Aircraft Establishment, Farnborough (England).

OPERATIONAL LOADS MEASUREMENT: A PHILOSOPHY AND ITS IMPLEMENTATION

D. M. HOLFORD and J. R. STURGEON Mar. 1984 37 p refs (AD-A149445; RAE-TR-84031; RAE-MATER/STRUCT-76; BR93043) Avail: NTIS HC A03/MF A01

A philosophy of operational data acquisition, for structural objectives for in-flight load measurement is reviewed, highlighting the constraints such activities place on the data acquisition system. A system which can be tailored to perform tasks ranging from the collection of time histories of flight parameters or strain gages to complex fatigue load analyses throughout the airframe is described. The system comprises a digital cassette recorder and a data acquisition unit within which a microprocessor is used for control of data acquisition and in-flight data analysis. System requirements in terms of accuracy, bandwidth and sampling rates are discussed for a range of aircraft types and operating conditions. Operation modes are illustrated, showing the value of studying operational data in terms of fatigue life management, fatigue life monitoring, operational practices and design procedures. Author (ESA)

N85-24813*# Research Triangle Inst., Research Triangle Park, N.C.

AN EXPERIMENT IN SOFTWARE RELIABILITY Final Report

J. R. DUNHAM and J. L. PIERCE Mar. 1985 63 p refs (Contract NAS1-16489) (NASA-CR-172553; NAS 1.26:172553; REPT-412U-2094-12/14) Avail: NTIS HC A04/MF A01 CSCL 09B

The results of a software reliability experiment conducted in a controlled laboratory setting are documented. The experiment was undertaken to gather data on software failures and is one in a series of experiments being pursued by the Fault Tolerant Systems Branch of NASA - Langley Research Center, to find a means of credibly performing reliability evaluations of flight control software. The experiment tests a small sample of implementations of radar tracking software having ultra reliability requirements and uses a version programming for error detection, and repetitive run modelling for failure and fault rate estimation. The experiment results agree with those of Nagel and Skrivan in that the program error rates suggest an approximate log linear pattern and the individual faults occurred with significantly different error rates. Additional analysis of the experimental data raises new questions concerning the phenomenon of interacting faults. This phenomenon may provide one explanation for software reliability decay. M.G.

N85-24848# Mississippi State Univ., Mississippi State. Dept. of Aeronautics and Aerospace Engineering.

THE GENERATION OF THREE-DIMENSIONAL BODY-FITTED COORDINATE SYSTEMS FOR VISCOUS FLOW PROBLEMS Final Report, 1 Oct. 1983 - 30 Sep. 1984

Z. U. A. WARSI Oct. 1984 63 p (Contract AF-AFOSR-0185-80) (AD-A150861; AFOSR-85-0146TR) Avail: NTIS HC A04/MF A01 CSCL 12A

The problem of numerical generation in surfaces and in three-dimensional configurations through elliptic Partial Differential Equations has been pursued under this grant. The developed mathematical model has been programed on CRAY-1 and has been tested for single and two-body configurations enclosed in a single boundary and for generation of coordinates in a single surface. The main aim of this research has been to develop and implement a technique for the generation of spatial coordinates in 3D regions enclosed by arbitrary smooth surfaces for ultimate use in the numerical solution of the Navier-Stokes equations. In this regard, a mathematical model based on a set of elliptic PDE's has been developed, which has been used to generate smooth coordinates in the region formed by arbitrary inner and outer surfaces of known shapes, around multibodies, particularly around a wing-body combination. These equations have also been used to generate surface coordinates in arbitrary surfaces and are also capable of coordinate redistribution in any desired manner both in 3D regions and in 2D surface regions. GRA

N85-24863# National Inst. for Aeronautics and Systems Technology, Pretoria (South Africa).

FINITE ELEMENT METHODS IN SOUTH AFRICA 1983

1984 702 p refs Conf. held in Pretoria, 17-20 Jan. 1984 Sponsored in part by South Africa Inst. for Aeronautical Engineers (S-332; ISBN-0-7988-2692-4) Avail: NTIS HC A99/MF A01

Twenty-eight papers discussing various applications of the finite element method are compiled. Particular emphasis is given to problems in structural analysis; engineering problems in hydrodynamics, aerodynamics and microwave techniques are also addressed. M.G.

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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.

A85-30388*# Columbia Univ., New York.

REVIEW OF RESEARCH ON STRUCTUREBORNE NOISE

R. VAICAITIS (Columbia University, New York, NY) and J. S. MIXSON (NASA, Langley Research Center, Hampton, VA) IN: Structures, Structural Dynamics, and Materials Conference, 26th, Orlando, FL, April 15-17, 1985, Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, 1985, p. 587-601. refs (Contract NSG-1450) (AIAA PAPER 85-0786)

Publications on the topic of structureborne noise are reviewed. Recent accomplishments, including representative results, are presented for aircraft, rotorcraft, space structures, automotive vehicles, ship and building technology. Special attention is given to propeller-driven aircraft. This review demonstrates that substantial progress has been made in understanding the characteristics of structureborne noise. Possible future research efforts and development of technology for control of structureborne noise are discussed. Author

A85-30389* Virginia Polytechnic Inst. and State Univ., Blacksburg.

AN IMPROVED SOURCE MODEL FOR AIRCRAFT INTERIOR NOISE STUDIES

J. R. MAHAN and C. R. FULLER (Virginia Polytechnic Institute and State University, Blacksburg, VA) IN: Structures, Structural Dynamics, and Materials Conference, 26th, Orlando, FL, April 15-17, 1985, Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, 1985, p. 602-608. Previously announced in STAR as N85-17668. refs (Contract NAG1-493)

(AIAA PAPER 85-0787)

There is concern that advanced turboprop engines currently being developed may produce excessive aircraft cabin noise level. This concern has stimulated renewed interest in developing aircraft interior noise reduction methods that do not significantly increase take off weight. An existing analytical model for noise transmission into aircraft cabins was utilized to investigate the behavior of an improved propeller source model for use in aircraft interior noise studies. The new source model, a virtually rotating dipole, is shown to adequately match measured fuselage sound pressure distributions, including the correct phase relationships, for published data. The virtually rotating dipole is used to study the sensitivity of synchrophasing effectiveness to the fuselage sound pressure trace velocity distribution. Results of calculations are presented which reveal the importance of correctly modeling the surface pressure phase relations in synchrophasing and other aircraft interior noise studies. Author

A85-30669* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

FAR-FIELD NOISE OF A SUBSONIC JET UNDER CONTROLLED EXCITATION

K. B. M. Q. ZAMAN (NASA, Langley Research Center, Hampton, VA) Journal of Fluid Mechanics (ISSN 0022-1120), vol. 152, March 1985, p. 83-112. refs

The role of large-scale coherent structures in broadband jet noise suppression and amplification under controlled excitation are studied experimentally. It is found that suppression occurs only at low Reynolds and Mach numbers, when the boundary layer at the jet exit is laminar; the optimum $St(\Theta)$ (St , based on the initial shear-layer momentum thickness) value is 0.017, at which the excitation results in a quick roll-up and transition of the laminar shear-layer vortices, yielding coherent structures similar to those existing at high speeds. At the asymptotic level the broadband jet noise can only be amplified by the excitation. The amplification is inferred to be maximum for excitation in the $St(D)$ (St based on the jet diameter) range of 0.65-0.85. Finally, it is noted that the pairing process induced by the excitation is at the origin of the broadband noise amplification. L.T.

A85-31195* Cambridge Acoustical Associates, Inc., Mass.

THE SOUND FIELD IN A FINITE CYLINDRICAL SHELL

M. C. JUNGER (Cambridge Acoustical Associates, Inc., Cambridge, MA) Acoustical Society of America, Journal (ISSN 0001-4966), vol. 77, April 1985, p. 1610-1612. NASA-sponsored research. refs

The sound field excited by vibrating boundaries in a finite cylindrical space, e.g., in a cylindrical shell, differs from the pressure distribution in an infinite cylindrical shell of comparable structural wavelength by the pressure diffracted by the end caps. The latter pressure component is comparable in magnitude to the pressure generated by the vibrating cylindrical boundary, but does not introduce additional resonances or antiresonances. Finally, a third pressure component associated with end cap vibrations is formulated. Author

A85-32592* Bionetics Corp., Hampton, Va.

NOISE TRANSMISSION THROUGH AN ACOUSTICALLY TREATED AND HONEYCOMB-STIFFENED AIRCRAFT SIDEWALL

F. W. GROSVELD (Bionetics Corp., Hampton, VA) and J. S. MIXSON (NASA, Langley Research Center, Hampton, VA) Journal of Aircraft (ISSN 0021-8669), vol. 22, May 1985, p. 434-440. Previously cited in 01, p. 74, Accession no. A85-10873. refs (Contract NAS1-16978)

A85-32594#

A COMPOSITE MODEL OF AIRCRAFT NOISE

R. G. MELTON (Pennsylvania State University, University Park, Pa) Journal of Aircraft (ISSN 0021-8669), vol. 22, May 1985, p. 443, 444.

In the present method for reducing the amount of computation needed to determine the aircraft noise levels affecting communities, it is assumed that each aircraft can be assigned to one of several known flight paths. The invoked concept of 'energy addition' raises the possibility, for the purposes of simulation, of replacing a number of aircraft moving along a specified trajectory with a single 'equivalent source' that delivers the same weighted average power distribution to points on the ground. O.C.

A85-32605* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

ANALYSIS OF TURBULENT UNDEREXPANDED JETS. II - SHOCK NOISE FEATURES USING SCIPVIS

J. M. SEINER (NASA, Langley Research Center, Aeroacoustics Branch, Hampton, VA), S. M. DASH, and D. E. WOLF (Science Applications, Inc., Propulsion Gas Dynamics Div., Princeton, NJ) AIAA Journal (ISSN 0001-1452), vol. 23, May 1985, p. 669-677. refs

SCIPVIS, the computational model discussed by Dash et al. (1985), is assessed in predicting the complicated flow structure associated with shock-containing plumes. In addition, the analysis in this study examines this code's applicability as a basic part of a program for estimating broadband shock noise radiation. The results of this study show that excellent agreement exists between predicted and measured static pressure distributions for both underexpanded and overexpanded flow cases considered. Of the three turbulence closure models incorporated in the SCIPVIS code, the kW model of Spalding produces the most uniform agreement with measurement. The k-epsilon-2 model of Launder consistently overestimates plume spreading for supersonic jets with exit Mach numbers in the 1-2 range. Dash's (1983) k-epsilon-2-cc, compressibility-corrected version of Launder's model underestimates plume spreading. Good qualitative agreement was also obtained between the measured longitudinal turbulence intensity and that predicted by the code for the same trial case. Comparison of measured and predicted broadband shock noise spectrum peak values were found to be in excellent agreement. This utilized a variant of the Harper-Bourne and Fisher (1973) phase-array model: the effective shock spacing was reinterpreted as the value of the end of the plume potential core, determined herein by the SCIPVIS code. Author

A85-32954* Missouri Univ., Rolla.

CONTRIBUTIONS TO THE FINITE ELEMENT SOLUTION OF THE FAN NOISE RADIATION PROBLEM

W. EVERSMAN, A. V. PARRETT (Missouri-Rolla, University, Rolla, MO), J. S. PREISSER, and R. J. SILCOX (NASA, Langley Research Center, Hampton, VA) ASME, Transactions, Journal of Vibration, Acoustics, Stress, and Reliability in Design (ISSN 0739-3717), vol. 107, April 1985, p. 216-223. Research supported by the Boeing Military Airplane Co. refs (Contract NAG1-198) (ASME PAPER 84-WA/NCA-1)

The radiation of fan generated noise to the far field from a nacelle of realistic geometry is investigated using the finite element method. Several innovations have been introduced to minimize the computational requirements and create a highly efficient numerical scheme. The innovations include: (1) formulation of the

problem in terms of velocity potential and density in such a way that no inlet mean flow velocity derivatives are required in the field equations, (2) the use of 'wave envelope' elements in an outer region permitting a grid much coarser than would be used for conventional finite elements, (3) the use of a mesh which deforms with an increase of forward flight speed so that mesh lines are always lines of constant phase and rays for a point source, permitting the use of wave envelope elements and simple boundary conditions for any case of forward velocity, (4) an efficient scheme for introducing the noise source via modal amplitude coefficients, and (5) the use of a frontal solution technique which for physically realistic problems drastically reduces the active storage requirements. The finite element scheme is outlined, as are the specific details of the innovations. Results are given for cases where comparable experimental data are available.

Author

A85-32955*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A NEW LOOK AT SOUND GENERATION BY BLADE/VORTEX INTERACTION

J. C. HARDIN and J. P. MASON (NASA, Langley Research Center, Hampton, VA) ASME, Transactions, Journal of Vibration, Acoustics, Stress, and Reliability in Design (ISSN 0739-3717), vol. 107, April 1985, p. 224-228. refs
 (ASME PAPER 84-WA/NCA-2)

As a preliminary attempt to understand the dynamics of blade/vortex interaction, the two-dimensional problem of a rectilinear vortex filament interacting with a Joukowski airfoil is analyzed in both the lifting and nonlifting cases. The vortex velocity components could be obtained analytically and integrated to determine the vortex trajectory. With this information, the aeroacoustic low-frequency Green's function approach could then be employed to calculate the sound produced during the encounter. The results indicate that the vortex path deviates considerably from simple convection due to the presence of the airfoil and that a reasonably sharp sound pulse is radiated during the interaction whose fundamental frequency is critically dependent upon whether the vortex passes above or below the airfoil. Determination of this gross parameter of the interaction is shown to be highly nonlinearly dependent upon airfoil circulation, vortex circulation, and initial position.

Author

N85-23374*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A COMMUNITY SURVEY OF HELICOPTER NOISE ANNOYANCE CONDUCTED UNDER CONTROLLED NOISE EXPOSURE CONDITIONS

J. M. FIELDS (Bionetics Corp., Hampton, Va.) and C. A. POWELL
 Mar. 1985 188 p refs
 (Contract NAS1-16978)
 (NASA-TM-86400; NAS 1.15:86400) Avail: NTIS HC A09/MF A01 CSCL 20A

Reactions to low numbers of helicopter noise events (less than 50 per day) were studied in a community setting. Community residents were repeatedly interviewed about daily noise annoyance reactions on days when helicopter noise exposures were, without the residents' knowledge, controlled. The effects of maximum noise level and number of noise events on helicopter noise annoyance are consistent with the principles contained in LEQ-based noise indices. The effect of the duration of noise events is also consistent with LEQ-based indices. After removing the effect of differences in noise levels (LEQ) there is not an important difference between reactions to impulsive and nonimpulsive types of helicopters. EPNL, where corrected for number of overflights, and LEQ are approximately equally successful in representing the characteristics of noise which are related to human response. The new type of design provided estimates of the parameters in a noise reaction model which would not be obtained with a similar degree of precision from conventional study designs.

Author

N85-23375*# Bionetics Corp., Hampton, Va.
RESEARCH ON THE EFFECT OF NOISE AT DIFFERENT TIMES OF DAY: MODELS, METHODS AND FINDINGS
 J. M. FIELDS Apr. 1985 83 p refs
 (Contract NAS1-16978)
 (NASA-CR-3888; NAS 1.26:3888) Avail: NTIS HC A05/MF A01 CSCL 20A

Social surveys of residents' responses to noise at different times of day are reviewed. Some of the discrepancies in published reports about the importance of noise at different times of day are reduced when the research findings are classified according to the type of time of day reaction model, the type of time of day weight calculated and the method which is used to estimate the weight. When the estimates of nighttime weights from 12 studies are normalized, it is found that they still disagree, but do not support stronger nighttime weights than those used in existing noise indices. Challenges to common assumptions in nighttime response models are evaluated. Two of these challenges receive enough support to warrant further investigation: the impact of changes in numbers of noise events may be less at night than in the day and nighttime annoyance may be affected by noise levels in other periods. All existing social survey results in which averages of nighttime responses were plotted by nighttime noise levels are reproduced.

Author

N85-23376*# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
AN EXPERIMENTAL INVESTIGATION OF THE CHOPPING OF HELICOPTER MAIN ROTOR TIP VORTICES BY THE TAIL ROTOR

A. R. AHMADI Sep. 1984 111 p refs
 (Contract NAS2-11313)
 (NASA-CR-177338; NAS 1.26:177338; BBN-5756) Avail: NTIS HC A06/MF A01 CSCL 20A

The chopping of helicopter main rotor tip vortices by the tail rotor was experimentally investigated. This is a problem of blade vortex interaction (BVI) at normal incidence where the vortex is generally parallel to the rotor axis. The experiment used a model rotor and an isolated vortex and was designed to isolate BVI noise from other types of rotor noise. Tip Mach number, radical BVI station, and free stream velocity were varied. Fluctuating blade pressures, farfield sound pressure level and directivity, velocity field of the incident vortex, and blade vortex interaction angles were measured. Blade vortex interaction was found to produce impulsive noise which radiates primarily ahead of the blade. For interaction away from the blade tip, the results demonstrate the dipole character of BVI radiation. For BVI close to the tip, three dimensional relief effect reduces the intensity of the interaction, despite larger BVI angle and higher local Mach number. Furthermore, in this case, the radiation pattern is more complex due to diffraction and pressure communication around the tip.

Author

N85-23377*# Bolt, Beranek, and Newman, Inc., Canoga Park, Calif.
WIND TUNNEL ACOUSTIC STUDY OF A PROPELLER INSTALLED BEHIND AN AIRPLANE EMPENNAGE: DATA REPORT

J. F. WILBY and E. G. WILBY Jan. 1985 267 p refs
 (Contract NAS2-11085)
 (NASA-CR-177335; NAS 1.26:177335; BBN-5658) Avail: NTIS HC A12/MF A01 CSCL 20A

The open test section of the NASA-Ames 7- by 10- ft wind tunnel was used for an acoustic test of a propeller mounted behind an airplane empennage. The empennage was attached to a model fuselage and the propeller with its electric motor drive was mounted separately so that the relative positions of empennage and propeller could be varied. A single vertical fin, and a V-tail with, and without, a dorsal fin configurations were used the model propeller had four blades (SR-1). Data were recorded at several locations for two tunnel flow speeds (45.7 and 62.5 m/s) and propeller speeds in the range 4000 to 8200 rpm. Data reduction was performed in narrowband and one-third octave band spectra, with emphasis on

harmonics of the passage frequency blade. The influence of flow speed, propeller rpm, empennage configuration, axial and vertical separation between propeller axis and empennage centerline, and empennage angle of incidence on propeller harmonic levels and acoustic field directivity are studied. A.R.H.

N85-23788# Kaman Aerospace Corp., Bloomfield, Conn.
TRANSMISSION OF GEAR NOISE TO AIRCRAFT INTERIORS
PREDICTION METHODS

A. BERMAN *In* GARD Gears and Power Transmission Systems for Helicopters and Turboprops 7 p Jan. 1985 refs
 Avail: NTIS HC A17/MF A01

Prediction of interior noise of helicopters due to drive train vibration ideally requires an analytical model of the entire dynamic system including airframe, transmission, and all attachments. The development of such a model is beset with numerous difficulties. The need for such model is addressed, as is certain of the critical issues involved: the inadequacy of finite element modeling in the acoustic frequency range; the costs associated with assessment of parametric variations; the difficulty of incorporating new technology into existing computer programs. Potential solutions to these problems are discussed: use of combined test and analysis (system identification) to obtain better models; component synthesis using frequency domain reduced models; a computer program known as DYSCO. This program has a general capability to modify and couple components in the time or frequency domain and can act as a repository for the latest analytical developments.

Author

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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.

A85-30999
ATTEMPT TO REGULATE RESTRICTIVE COMMERCIAL PRACTICES IN THE FIELD OF AIR TRANSPORTATION WITHIN A TRANSNATIONAL ANTITRUST LEGAL AND INSTITUTIONAL FRAMEWORK

J. K. BENTIL (La Trobe University, Melbourne, Australia) *Journal of Air Law and Commerce* (ISSN 0021-8642), vol. 50, no. 1, 1984, p. 69-120. refs

The legal and economic consequences of applying international antitrust law to the air-transport industry are examined, with a focus on the measures proposed to the EEC by the EC Commission in 1981. The range of anticompetitive or protectionist practices allowed under the current rule of national sovereignty and bilateral agreements is surveyed; the substantial and procedural provisions of EEC general antitrust law are summarized; and the strategies adopted by the EC Commission to overcome difficulties in applying them to air transportation are discussed. The scope of the proposed secondary legislation (applying to private commercial carriers but not national-government-controlled carriers) is found to limit its effectiveness, but its implementation and strict enforcement are recommended as first steps. T.K.

N85-25000# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.

FISCAL YEAR 1986 TECHNICAL OBJECTIVE DOCUMENT
Annual Report

Wright-Patterson AFB, Ohio AFWAL Feb. 1985 91 p
 Supersedes AFWAL-TR-84-2000, AD-A140581
 (Contract AF PROJ. 9991)
 (AD-A151039; AFWAL-TR-85-2000; AFWAL-TR-84-2000) Avail:
 NTIS HC A05/MF A01 CSCL 21E

This Technical Objective Document (TOD) has been prepared by the Aero Propulsion Laboratory to provide science and industry with specific technical objectives which the Air Force feels are critical to maintain aerospace superiority in the future. The TOD contains three functional areas (Aircraft, Missile and Space) which provide planning objectives covering the technical disciplines and airbreathing propulsion, aerospace vehicle power, fire protection, and aircraft and missile fuels and lubrication. Author (GRA)

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GENERAL

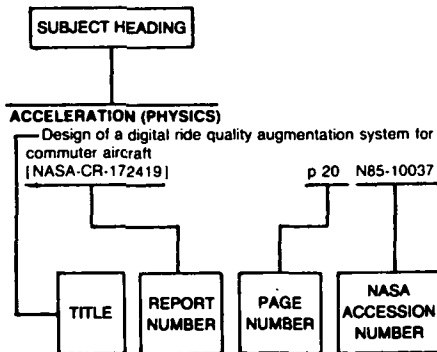
N85-25166*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

RESEARCH AND TECHNOLOGY

1984 92 p
 (NASA-TM-86662; A-85045; NAS 1.15:86662) Avail: NTIS HC A05/MF A01 CSCL 05A

Various research and technology activities at Ames Moffett and Ames Dryden are described. Highlights of these accomplishments indicate the Center's varied and highly productive research efforts for 1984. The research is divided into three subject areas, which are: Aeronautics, Life Science and Space Science and Applications. E.R.

Typical Subject Index Listing



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 the document content, the 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.

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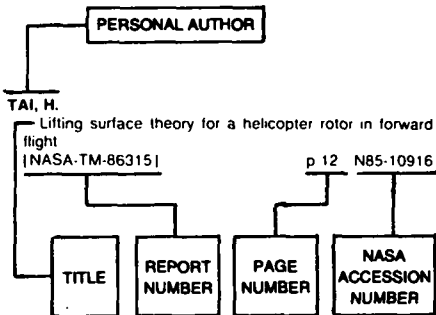
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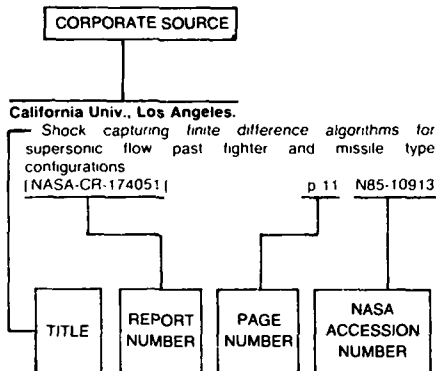
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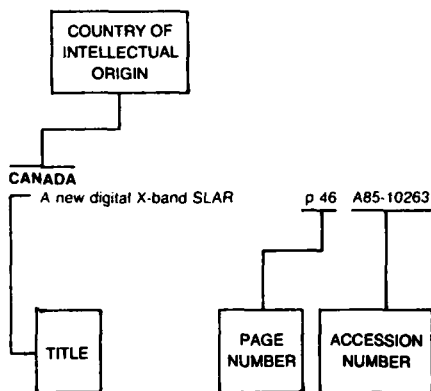
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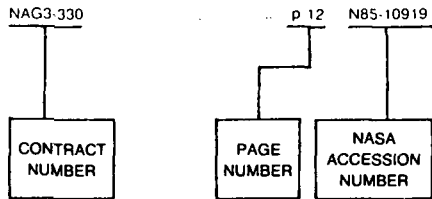
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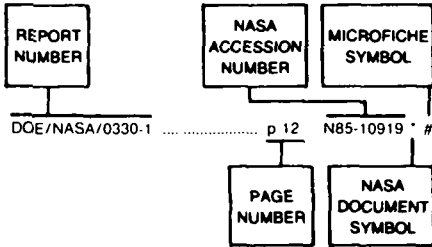


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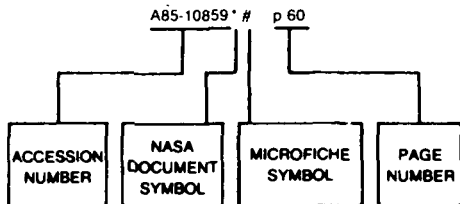
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