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A Continuing Bibliography with Indexes

NASA SP-7037(181)
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National Aeronautics and Space Administration

Aeronautical Engineering Aeronautical Engineering Aeronautical Engineering Aeronautical Engineering Aeronautical Engineering Aeronautical Engineering Aeronautical Engineering Aeronautical Engineering Aeronautical Engineering Aeronautical Engineering Aeronautical Engineering Aeronautical Engineering

ACCESSION NUMBER RANGES

Accession numbers cited in this Supplement fall within the following ranges.

STAR (N-10000 Series)	N84-31085 - N84-33365
IAA (A-10000 Series)	A84-42708 - A84-46525

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NASA SP-7037(181)

AERONAUTICAL ENGINEERING

A CONTINUING BIBLIOGRAPHY WITH INDEXES

(Supplement 181)

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 November 1984 in

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

NASA Scientific and Technical Information Branch 1984
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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 823 reports, journal articles, and other documents originally announced in November 1984 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.

Six indexes -- subject, personal author, corporate source, 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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N84-10017*# Kansas Univ., Lawrence. Flight Research Lab.
A LIFTING SURFACE THEORY IN ROTATIONAL FLOW Topical Report, Jun. 1981 - Dec. 1982
M. J. SHIAU and C. E. LAN Oct. 1983 74 p refs
(Contract NAG1-75)
(NASA-CR-172233; NAS 1.26:172233; CRINC-FRL-467-2) Avail: NTIS HC A04/MF A01 CSCL 01A

The partial differential equation for small disturbance steady rotational flow in three dimensions is solved through an integral equation approach. The solution is obtained by using the method of weighted residuals. Specific applications are directed to wings in nonuniform subsonic parallel streams with velocity varying in vertical and spanwise directions and to airfoils in nonuniform freestream. Comparison with limited known results indicates that the present method is reasonably accurate. Numerical results for the lifting pressure of airfoil, lift, induced drag, and pitching moments of airfoil, lift, induced drag, and pitching moments of elliptic, rectangular, and delta wings in a jet, wake, or monotonic sheared stream are presented. It is shown that, in addition to the effect of local dynamic pressures, a positive velocity gradient tends to enhance the lift. Author

TYPICAL CITATION AND ABSTRACT FROM *IAA*

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A84-10131#
EXPERIMENTAL INVESTIGATION OF CURVATURE EFFECTS ON VENTILATED WALL JETS
R. M. EL-TAHER (King Abdulaziz University, Jeddah, Saudi Arabia) AIAA Journal (ISSN 0001-1452), vol. 21, Nov. 1983, p. 1505-1511. refs

The results of an experimental study for a ventilated plane jet attaching to an offset plane surface or to an offset convex surface of circular cross section are presented. The results demonstrate the dependence of the rate of entrainment through the gap, the location of the attachment point, the growth of the length scale, and the decay of the maximum velocity on the wall curvature. Moreover, the effect of wall curvature on the mean velocity, the turbulence velocity components, and the Reynolds shear stress in the different zones of the jet are investigated. Author

AERONAUTICAL ENGINEERING

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AERONAUTICS (GENERAL)

A84-42864
LARGE AREA AEROSPACE COMPOSITE STRUCTURE FABRICATION TECHNOLOGY
K. H. W. FOULSTON (British Aerospace, PLC, Weybridge, Surrey, England) IN: Fibre-resin composites - New applications and developments; Proceedings of the Seminar and Workshop, Manchester, England, June 22, 1982 . London, Mechanical Engineering Publications, Ltd., 1983, p. 25-30. Research supported by the Ministry of Defence (Procurement Executive).

A carbon fiber-reinforced epoxy composite wing torsion box has been designed and manufactured for the Jaguar attack aircraft and will be subjected to both static and flight testing. This wing box is of multispar design and employs the minimum number of ribs, with a skin reinforcement configuration consisting of + or - 45 deg plies with four additional 90-deg plies (and plies of other orientations at local pickups). The spanwise spars are of sine wave configuration. The prepreg system used in these laminates encompasses high tensile strength carbon fibers, unidirectionally arrayed and impregnated with a modified epoxy resin suitable for operations over a -55 to +170 C temperature range. Attention is given to the tooling, skin layup, curing, bonding, and machining procedures used. A 13 percent weight saving over the metallic Jaguar wing is noted. O.C.

A84-43892*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
NASA'S ROLE IN AERONAUTICAL RESEARCH
M. PARKER (NASA, Langley Research Center, Office of Public Affairs, Hampton, VA) AIAA Student Journal (ISSN 0001-1460), vol. 21, Winter 1983, p. 2-4.

Past and current research in the aeronautical field conducted by NASA is reviewed. The first national center for aeronautical research, the Langley Memorial Aeronautical Laboratory, was established in 1917 by the then formed National Advisory Committee for Aeronautics (NACA). Two other research centers established later by NACA (Lewis and Ames) were staffed with research cadres from Langley. These three research centers formed the nucleus of NASA when it was established in 1958. Studies conducted today by NASA's research centers include: a concept for commuter-style aircraft, turbofan engines for military supersonic fighter aircraft, strength and durability of man-made fiber materials, and maneuverability problems in high speed aircraft. In addition, at Ames, research is being conducted on short-haul aviation, and short and vertical takeoff while at Lewis studies concentrate on propulsion system and engines. At Langley the emphasis is on basic research, stressing aircraft structure improvements, stall avoidance and noise abatement. Finally, the importance of NASA's educational program is discussed. I.R.

A84-44451
FLIGHT TESTING TECHNOLOGY: A STATE-OF-THE-ART REVIEW; PROCEEDINGS OF THE THIRTEENTH ANNUAL SYMPOSIUM, NEW YORK, NY, SEPTEMBER 19-22, 1982
Symposium sponsored by the Society of Flight Test Engineers. Lancaster, CA, Society of Flight Test Engineers, 1982, 302 p. For individual items see A84-44452 to A84-44481.

The present conference discusses the 757/767 and DC-10-10 airliners' flight test programs, the flight testing of the AV-8B VTOL fighter, the effect of gun gas ingestion on engine performance, direct measurement of in-flight engine thrust, evaluations of F-101 DFE engine performance in F-14 and F-16 airframes, the calibration of F-15 in-flight wing loads, automated flight test maneuvers, engineering aspects of F/A-18A high angle-of-attack/spin testing, and flight fidelity evaluation of the T-44A flight trainer. Also covered are flight test considerations for an integrated flight/fire-control program, a test range tracking concept employing the Global Positioning Satellite, density digital encoding, transmission and decoding in standard video signals, KC-10 aerial refueling qualification, testing and evaluation, and perspectives on spin-recovery systems. O.C.

A84-44750
FACSKED - A FACILITY FOR SCHEDULING
C. LEWIS (Sanders Associates, Inc., Nashua, NH) IN: Air Traffic Control Association, Annual Fall Conference, 27th, Atlantic City, NJ, October 18-21, 1982, Proceedings . Arlington, VA, Air Traffic Control Association, 1982, p. 289-294. Navy-supported research.

The distinctive features of the U.S. Navy's FACSKED system for scheduling and coordinating the use of offshore operating areas are described. FACSKED accepts requests for area use, identifies conflicts among the requests and retains usage data for later analysis. Several of the problems resolved by FACSKED are described in detail, and the advantages of the system over conventional manual scheduling systems are discussed. The hardware and software requirements of the system are also described, and a series of simulated schedules are provided in the form of photographic representations of a computer screen which is operating with the program. I.H.

A84-44926
INTERNATIONAL COUNCIL OF THE AERONAUTICAL SCIENCES, CONGRESS, 14TH, TOULOUSE, FRANCE, SEPTEMBER 9-14, 1984, PROCEEDINGS. VOLUMES 1 & 2
B. LASCHKA, ED. and R. STAUFENBIEL, ED. New York, American Institute of Aeronautics and Astronautics, 1984, Vol. 1, 619 p.; vol. 2, 697 p. In English and French. For individual items see A84-44927 to A84-45069.

Current research in aeronautics is presented in reviews and reports and illustrated with diagrams, drawings, graphs, micrographs, and photographs. Subjects examined include computational aerodynamics, wind-tunnel techniques, composite materials and structures, theoretical methods in flight mechanics, flight-test validation, design integration, the Euler code, flow separation, structural dynamics and testing, airworthiness, subsystem development, and drag reduction and measurement. Consideration is given to stability and control, airbreathing engines, unsteady aerodynamics (including flutter), civil transport aircraft, electrical and digital control systems, CAD, delta-wing and canard aerodynamics, fracture mechanics, noise problems, computer-aided flight management, engine-airframe interference, terminal-area control, and airport environmental effects. T.K.

A84-44927#
ENGINEERING ASPECTS OF INTERNATIONAL COOPERATION IN AERONAUTICS
R. H. BETEILLE (Airbus Industrie, Blagnac, Haute-Garonne, France) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 1-6.

International cooperation, and the joining of complex engineering functions for the benefit of aerospace programs, are discussed. Consideration is given to organizational approaches to compensate differences in national characteristics and language, and suggestions concerning the coordination of technology, when various government and industrial partners are involved, are presented. The assignment of responsibility within such a consortium is stressed, and a suggestion is made on how it might work. Companies such as Airbus and Ariane have shown favorable results through international cooperation despite increased complexity. The pursuit of such forms of activity by the aerospace community is recommended. J.P.

A84-44975#
CERTIFICATION PROBLEMS FOR COMPOSITE AIRPLANE STRUCTURES
D. CHAUMETTE (Avions Marcel Dassault-Breguet Aviation, Saint-Cloud, Hauts-de-Seine, France) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 421-426.

The development of international airworthiness regulations for aircraft composite structures is traced. The goal of the criteria has been to assure at least the same overall safety levels now available from metallic structures, with specifications tailored separately for civil and military aircraft. The acceptable impact damage is now limited to any that does not reduce the load carrying capability below ultimate loads, thus avoiding the danger of allowing load-handling to approach limit loads and catastrophic failure. Account has also been taken of the differences in scatter of measurements of strengths of composites and metallic components. M.S.K.

A84-44989#
FLYING THE MIRAGE 2000 BY WIRE
J. COUREAU IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 551-556.

Features and capabilities of the Mirage 2000 electrical flight control system (EFCS), which has no mechanical back-up, are described. The EFCS permits flying in otherwise unacceptable unstable modes, and has triple- or quadruple-redundancy of control signal pathways and interfaces with a redundant hydraulic system. A computerized flight management system receives control surface position sensor inputs and pilot inputs and adapts the aircraft to match internal control laws. The spring-loaded controller in the pilot's hands gives an artificial feel to the controls and provides a governor range against which greater force must be applied to input commands. The design philosophy has been to permit the pilot to fly the aircraft continuously at the outer reaches of the flight envelope without worrying about mechanical difficulties. M.S.K.

A84-45613*# Stanford Univ., Calif.
COMPUTATION OF OPTIMAL FEEDBACK STRATEGIES FOR INTERCEPTION IN A HORIZONTAL PLANE
N. RAJAN (Stanford University, Stanford, CA) and M. D. ARDEMA (NASA, Ames Research Center, Moffett Field, CA) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 7, Sept.-Oct. 1984, p. 627-629. Previously cited in issue 05, p. 577, Accession no. A83-16626. refs

A84-46197
AIRLINER OFFICE EQUIPMENT
Flight International (ISSN 0015-3710), vol. 126, Aug. 18, 1984, p. 128-130, 132-135.

The market in airliner avionics is reviewed, with emphasis on cockpit cathode ray tubes, flight-management systems, and color weather radars. The airliner avionics market, which is estimated at about 800 million dollars per year, is dominated by large US avionics companies. Attention is given to the main US and European manufacturers of avionics and their products, the influence of current sales of new airliners (such as the B757, B767, A310, and A320) on the avionics market, and upgrading of avionics in existing airliners. The features of electronic flight instruments and management systems and the characteristics of a new generation of color weather radars are discussed and illustrated with photographs. I.R.

A84-46326
AMERICAN HELICOPTER SOCIETY, ANNUAL FORUM, 39TH, ST. LOUIS, MO, MAY 9-11, 1983, PROCEEDINGS
Alexandria, VA, American Helicopter Society, 1984, 744 p. For individual items see A84-46327 to A84-46382.

Various papers on subjects related to helicopters are presented. The general topics addressed include: aerodynamics, product support, structures and materials, dynamics, manufacturing and product assurance, avionics and systems, propulsion, test and evaluation, acoustics, handling qualities, aircraft design, and optimal design. C.D.

A84-46332#
HELICOPTER PRODUCT LIABILITY - A CUSTOMER SUPPORT VIEW
H. B. EPSTEIN and J. D. KNICKERBOCKER (Aerospatiale Helicopter Corp., Grand Prairie, TX) IN: American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 81-88. refs

The actions a manufacturer takes to monitor the serviceability of a helicopter following delivery and to keep the product safe and operational are discussed. Typical customer technical support functions are described, including service engineering, accident investigation, field service, training, and technical publications. The procurement and warehousing of materials and spare materials are addressed along with the role of service stations. C.D.

A84-46333#
AVIATION PRODUCT ASSESSMENT AS VIEWED BY THE AVIATION R&D COMMAND
E. J. HOLLMAN (U.S. Army, Aviation Research and Development Command, St. Louis, MO) IN: American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 89-94.

The product support challenge of both military and commercial helicopter operation is to assure that aircraft delivered to the user remain fully mission capable. This paper will address the impacts of complexity, multi-mission capability, modular design, built-in diagnostics, redundancy, reliability centered maintenance, and current achievements and shortfalls in obtaining full mission readiness within the current maintenance/logistical support system. Author

A84-46335#
LOGISTICS CHALLENGES OF THE APACHE ATE
V. M. VEERAGOUDAR (Hughes Helicopters, Inc., Culver City, CA). IN: American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 108-111.

The Apache Automatic Test Equipment (ATE) was developed under direction of the AAH-PMO, by Hughes Helicopters, Inc. (HHI) and RCA. The ATE for Apache was built around the AN/USM-410. While the Apache was in its development cycle, changing requirements and design approaches made it necessary to remain flexible during ATE hardware and software design, thus causing serious but surmountable problems. Author

A84-46336#
BLACK HAWK - A LOGISTICS SUCCESS STORY
T. M. DONAHUE (Sikorsky Aircraft, Stratford, CT) IN: American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 112-118.

Since 1979, over 350 UH-60A Black Hawk helicopters have been delivered to the U.S. Army. The UH-60A helicopter was developed by an American aerospace company to satisfy the requirements for the Utility Tactical Transport Aircraft System (UTTAS). The UTTAS mission needed a helicopter which could provide an airmobile means for moving troops and equipment into combat. In addition, these troops had to be resupplied. Other functions for the aircraft included aeromedical evacuation, crash rescue, repositioning of reserves, resupply of units not in contact, and other combat support and combat service support. Attention is given to requirements regarding design reliability and maintainability, logistics engineering, supply support, the technical manuals which support the Black Hawk helicopter, and a training program. G.R.

A84-46369*# San Jose State Univ., Calif.
A PRACTICAL APPROACH TO ROTORCRAFT SYSTEMS IDENTIFICATION
R. W. DU VAL (Advanced Rotorcraft Technology, Inc., Los Altos, CA), J. C. WANG, and M. Y. DEMIROZ (San Jose State University, San Jose, CA) IN: American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 483-492.
(Contract NCC2-083)

A standard for rotorcraft system identification is proposed to facilitate the exchange of data and technology within the industry. This integrated approach utilizes simulations to validate methodology and flight data to validate simulations. A new technique allowing results obtained from separate maneuvers to be systematically combined is also presented and shown to be a fundamental tool in providing a practical approach to rotorcraft identification. The proposed methodology is evaluated using data generated by nonlinear blade-element simulation of the Rotor Systems Research Aircraft. Author

A84-46520
AGUSTA - FULFILLING DA VINCI'S DREAMS
S. WARTENBERG Vertiflite (ISSN 0042-4455), vol. 30, Sept.-Oct. 1984, p. 14-20.

The helicopter division of Agusta S.p.A. produces a variety of helicopters under license to the U.S. manufacturers Bell, Boeing, and Sikorsky; in addition, it manufactures the A 109 helicopter (of its own design). Within the last year, Agusta has initiated new programs that involve the flight testing of its A 129 'Mongoose' light attack/scout helicopter, and the development of the EH-101 ASW helicopter. In addition to several other military applications, the EH-101 will have a commercial version for the offshore oil platform support market. Another oil platform support helicopter manufactured by Agusta under license (from Sikorsky) is the AS-61N 'Silver'. O.C.

A84-46521
MESSERSCHMITT-BOLKOW-BLOHM - A COMMITMENT TO THE FUTURE
S. WARTENBERG Vertiflite (ISSN 0042-4455), vol. 30, Sept.-Oct. 1984, p. 21-27.

Messerschmitt-Bolkow-Blohm (MBB) will in conjunction with two non-German manufacturers develop two new helicopters in the next few years. The first of these, a single-engined trainer designated BN 109, is in the 1.2-1.25 metric ton class and will be developed in association with PT Nurtanio of Indonesia. The second, an advanced light helicopter in the 4-4.5 metric ton class, will be developed with Hindustan Aeronautical Limited of India. The most important MBB development program, however, is that for the German/French PAH-2 antitank helicopter, which will enter service in 1992. Also noted among continuing development programs are those for hingeless and bearingless main rotors, composite rotor blades and primary structure components, and the BO 105 CB military helicopter. O.C.

A84-46522
THE NEW WESTLAND ON THE MOVE
S. WARTENBERG Vertiflite (ISSN 0042-4455), vol. 30, Sept.-Oct. 1984, p. 30-36.

The Westland 30-100 helicopter uses the dynamic systems of the Lynx military helicopter, together with Gem 40 engines, to yield a commuter helicopter able to seat 20 passengers. The army-developed Lynx 3 helicopter can be used for a wide range of missions, including antitank, reconnaisance, transport, and utility. In the antitank role, it can carry TOW, HOT, or HELLFIRE missiles, a variety of 68- and 81-mm rockets, and 20or 25-mm cannons. A navy-deployed Lynx 3 version has also been developed. The British Experimental Rotor Program will soon produce a novel composite main rotor blade that will be used on the Lynx 3. Other technologies under development at Westland are helicopter turboshaft transmissions, advanced cockpit designs, bearingless titanium rotor hubs, and a higher harmonic control system. O.C.

A84-46523
AEROSPATIALE - SUCCESSFULLY BRANCHING OUT
S. WARTENBERG Vertiflite (ISSN 0042-4455), vol. 30, Sept.-Oct. 1984, p. 37-44.

Attention is given to the helicopters and helicopter component technologies under development at Aerospatiale of France. Composite rotor hubs produced by a robotic laser system include the AStar/Twin Star, Starflex design; an advanced Sphereflex rotor hub is currently undergoing flight tests on the Super Puma helicopter. The Integrated Anti-Resonant System with Bars is a gearbox antivibration system that is being tested on the AStar helicopter. All-composite 'fenestron' tail rotors for helicopters of up to 6 tons have been developed. Much effort has been expended in the development of advanced production technology, which includes the forming of intricate composite parts by 'thermomolding' and all-aircraft, rather than assembly line, construction methods. A fully automated rotor blade production facility is expected to be in operation by 1987. Attention is given to the AStar/Twin Star, Dauphin, and Super Puma helicopters. O.C.

N84-31085# Army Aviation Systems Command, St. Louis, Mo.
HISTORICAL RESEARCH AND DEVELOPMENT INFLATION INDICES FOR ARMY FIXED AND ROTOR WINGED AIRCRAFT
B. M. BARRY Mar. 1984 29 p
(AD-A142943; USAAVSCOM-TR-84-F-4) Avail: NTIS HC A03/MF A01 CSCL 05A

This technical report is a continuation of previous efforts to develop the necessary rationale and methodology needed in order to construct historical inflation indices, in the Research and Development (R/D) area, relative to Army aircraft. The R/D historical indices, and the sub-indices from which they are derived, are presented in the appendices to this report for the period FY68 through FY83. These indices are appropriate for updating statistical reports that formerly utilized the OSD forecasting indices; for initial use in bringing a cost in prior years to a present-year dollar value; and for evaluating inflation actually experienced. A computer program is utilized to make the necessary mathematical calculations. Data sources for this report were the Office of Personnel Management (OPM) and the Bureau of Labor Statistics (BLS). OPM supplied data on government salaries. BLS furnished data on industry salaries and thirteen (13) different materials. The computer program prints the R/D historical inflation indices and sub-indices by fiscal year as shown in Appendices C through G of this report. Author (GRA)

N84-32229# Denver Research Inst., Colo.
ON-LINE TASK ANALYSES IN MAINTENANCE SIMULATION
J. J. RICHARDSON *In* American Defense Preparedness Association Proc. of the 5th Interservice/Ind. Training Equipment Conf., Vol. 1 p 39-46 16 Nov. 1983
(Contract F33615-81-C-0006)
(AD-P003452) Avail: NTIS HC A17/MF A01 CSCL 05I

The Air Force Human Resources Laboratory is currently sponsoring a project to investigate the costs and benefits of interactive, computer-based simulation in support of avionics maintenance training, utilizing a video disc picture data base to represent the actual equipment. The focus is on simulations which support the development of project is the use of on-line task analyses. An on-line task analysis is defined as a computer-resident data base representing the set of goals and actions employed in accomplishing a task. Goals are divided into subgoals or actions, serving to decompose the troubleshooting problem into simpler problems. Actions involve direct manipulation of equipment. On-line task analyses may be useful in the development and delivery of quality, cost-effective maintenance simulations. Four benefits of on-line task analyses and a methodology for the development of these analyses are presented. The associated potential training effectiveness gains and cost savings are currently being tested empirically. Author (GRA)

N84-32344*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SUMMARY OF RECENT NASA PROPELLER RESEARCH
D. C. MIKKELSON, G. A. MITCHELL, and L. J. BOBER 1984 38 p refs Proposed for presentation at the AGARD Fluid Dyn. Panel Meeting on Aerodyn. and Acoustics of Propellers, Toronto, 1-4 Oct. 1984
(NASA-TM-83733; E-2216; NAS 1.15:83733) Avail: NTIS HC A03/MF A01 CSCL 01B

Advanced high-speed propellers offer large performance improvements for aircraft that cruise in the Mach 0.7 to 0.8 speed regime. At these speeds, studies indicate that there is a 15 to near 40 percent block fuel savings and associated operating cost benefits for advanced turboprops compared to equivalent technology turbofan powered aircraft. Recent wind tunnel results for five eight to ten blade advanced models are compared with analytical predictions. Test results show that blade sweep was important in achieving net efficiencies near 80 percent at Mach 0.8 and reducing nearfield cruise noise by about 6 dB. Lifting line and lifting surface aerodynamic analysis codes are under development and some results are compared with propeller force and probe data. Also, analytical predictions are compared with some initial laser velocimeter measurements of the flow field velocities of an eightbladed 45 swept propeller. Experimental aeroelastic results indicate that cascade effects and blade sweep strongly affect propeller aeroelastic characteristics. Comparisons of propeller near-field noise data with linear acoustic theory indicate that the theory adequately predicts near-field noise for subsonic tip speeds but overpredicts the noise for supersonic tip speeds. B.W.

N84-32345# SRI International Corp., Menlo Park, Calif.
ARTIFICIAL INTELLIGENCE-ROBOTICS APPLICATIONS TO NAVY AIRCRAFT MAINTENANCE Final Report, 1 Jan. 1983 - 30 Apr. 1984
D. R. BROWN, R. H. MONAHAN, and W. T. PARK Jun. 1984 200 p
(Contract N00600-82-D-8362)
(AD-A143219; SRI-4905; DTNSRDC/CMLD-CR-53-84) Avail: NTIS HC A09/MF A01 CSCL 05A

The general objective of this study was to develop a data base and methodology of assessing Artificial Intelligence (AI) robotic applications to Naval aircraft maintenance. The research was conducted in three phases: Survey of AI/Robotics, AI/Robotic Opportunities and Design Concepts, and Cost-Benefit Methodology. Chapter 2 of this report presents a summary description of the AI/Robotic technologies that are relevant to Naval aircraft maintenance. The detailed survey of AI/robotic technologies is presented in Appendix A of this report. GRA

02

AERODYNAMICS

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

A84-43316#
APPLICATION OF STREAMLINE ITERATION AND RELATIVE FLOW FIELD METHODS TO THE CALCULATION OF THE SUBSONIC FLOW FIELD OF S1 STREAM SURFACE OF TURBOMACHINERY
W. LI and Y. CAI Northwestern Polytechnical University, Journal, vol. 1, Oct. 1983, p. 161-175. In Chinese, with abstract in English. refs

Two flow-field and streamline cross-iteration methods are applied to solve flow passing through the S1 stream surface of turbomachinery. The forms of the stagnation streamlines and the velocity and pressure distributions along the blade surface of the cascade are determined. The basic equations, calculation procedures, selection of relaxation factors, and the determination of the forms of stagnation streamlines are discussed. As examples, the flow fields of two axial flow turbine cascades and two axial flow compressor cascades are calculated, and the results are in good agreement with theoretical values. C.D.

A84-43317#
THE TIME-DEPENDENT FINITE ELEMENT METHOD FOR CALCULATING TRANSONIC FLOW FIELD IN TURBOMACHINERY CASCADE
F. ZHU and X. ZHOU Northwestern Polytechnical University, Journal, vol. 1, Oct. 1983, p. 177-190. In Chinese, with abstract in English. refs

Starting from the general method of interpretation, the finite element method is used to discretize the Eulerian equations governing the inviscid unsteady flow in turbomachinery cascades. The explicit-node analysis formulas for four-node elements of aribitrary shape are derived. Calculations of subsonic and transonic steady flow fields in turbine cascades are performed. The agreement with experimental results is good. C.D.

A84-43339
A GENERAL ITERATIVE METHOD TO DESIGN KARMAN-TREFFTZ AND JOUKOWSKY AIRFOILS
M. A. YUKSELEN and M. Z. ERIM (Istanbul, Technical University, Istanbul, Turkey) International Journal for Numerical Methods in Engineering (ISSN 0029-5981), vol. 20, July 1984, p. 1349-1360.

A general iterative method is presented to design Karman-Trefftz and Joukowsky airfoils of specified thickness and camber ratios and the location of the maximum thickness point. The method has been programmed for a digital computer and results of some applications are given. Author

A84-43346

A SIMPLE METHOD FOR SOLVING THREE-DIMENSIONAL INVERSE PROBLEMS OF TURBOMACHINES FLOW AND ANNULAR CONSTRAINT CONDITION

X. ZHAO and Z. WU (Chinese Academy of Sciences, Institute of Engineering Thermophysics, Beijing, People's Republic of China) Scientia Sinica, Series A - Mathematical, Physical, Astronomical and Technical Sciences (ISSN 0253-5831), vol. 27, April 1984, p. 433-442. refs

The Taylor-series-expansion solution of Wu (1950) for the inverse problem of three-dimensional flow in turbomachines is used to calculate the family of hub-to-shroud (S2) stream surfaces, the blade shape, and the aerothermodynamic parameters of a three-dimensional blade channel. A simple approximation is applied, and an annular constraint on the fluid angular momentum in the design is derived to guarantee that the hub and shroud surfaces are surfaces of revolution. Numerical results are presented graphically for the stator of a single-stage compressor and a turbine rotor; the method is shown to be a good approximate analysis tool for engineering applications involving transonic flows without strong shocks. T.K.

A84-44133

VORTEX INDUCED LIFT ON TWO DIMENSIONAL LOW SPEED WINGS

P. G. SAFFMAN (California Institute of Technology, Pasadena, CA) and S. TANVEER Studies in Applied Mathematics (ISSN 0022-2526), vol. 71, Aug. 1984, p. 65-78. refs
(Contract DE-AM03-76SF-00767)

Exact free streamline solutions are found for two dimensional inviscid incompressible flow past a single and a multiple flap wing using a hodograph method. It is shown that solutions do not exist for arbitrary shapes, but that a geometrical constraint must be satisfied between the shape of the wing and the angle of attack. High lift coefficients are obtained for both cases. These solutions model the flow situation for a wing claimed in the past to give high lift at low speed. Author

A84-44177*# Army Propulsion Lab., Cleveland, Ohio.

APPLICATION OF A QUASI-3D INVISCID FLOW AND BOUNDARY LAYER ANALYSIS TO THE HUB-SHROUD CONTOURING OF A RADIAL TURBINE

K. CIVINSKAS (U.S. Army, Propulsion Laboratory, Cleveland, OH) and L. A. POVINELLI (NASA, Lewis Research Center, Cleveland, OH) AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 20 p. Previously announced in STAR as N84-25647. refs
(AIAA PAPER 84-1297)

Application of a quasi-3D approach to the aerodynamic analysis of several radial turbine configurations is described. The objective was to improve the rotor aerodynamic characteristics by hub-shroud contouring. The approach relies on available 2D inviscid methods coupled with boundary layer analysis to calculate profile, mixing, and endwall losses. Windage, tip clearance, incidence, and secondary flow losses are estimated from correlations. To eliminate separation along the hub and blade suction surfaces of a baseline rotor, the analysis was also applied to three alternate hub-shroud geometries. Emphasis was on elimination of an inducer velocity overshoot as well as increasing hub velocities. While separation was never eliminated, the extent of the separated area was progressively reduced. Results are presented in terms of mid-channel and blade surface velocities; kinetic energy loss coefficients; and efficiency. The calculation demonstrates a first step for a systematic approach to radial turbine design that can be used to identify and control aerodynamic characteristics that ultimately determine heat transfer and component life. Experimentation will be required to assess the extent to which flow and boundary layer behavior were predicted correctly. M.G.

A84-44187*# North Carolina State Univ., Raleigh.

ANALYTICAL STUDY OF SUCTION BOUNDARY LAYER CONTROL FOR SUBSONIC V/STOL INLETS

M. A. BOLES, K. RAMESH (North Carolina State University, Raleigh, NC), and D. P. HWANG (NASA, Lewis Research Center, Cleveland, OH) AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 11 p. refs
(Contract NSG-389)
(AIAA PAPER 84-1399)

Analytical procedures used to evaluate the application of suction boundary-layer control (BLC) to subsonic V/STOL inlets are presented. These procedures have been used to analytically predict the optimum (minimum suction power required) location and extent for a suction slot of two different surface resistances within a subsonic V/STOL inlet. Results of this analytical study are presented. Author

A84-44192*# Boeing Commercial Airplane Co., Seattle, Wash.

FLOW SIMULATIONS FOR NACELLE-PROPELLER CONFIGURATIONS USING EULER EQUATIONS

N. J. YU and H. C. CHEN (Boeing Commercial Airplane Co., Seattle, WA) American Institute of Aeronautics and Astronautics, Applied Aerodynamics Conference, 2nd, Seattle, WA, Aug. 21-23, 1984. 8 p. Research supported by the Boeing Independent Research and Development Program. refs
(Contract NAS1-17250)
(AIAA PAPER 84-2143)

Euler codes for both axisymmetric and general three-dimensional nacelle-propeller flow analysis have been developed. Surface-fitted grids are generated either by a finite difference method or by an algebraic method. The propeller is represented by an actuator disk along a computational plane where proper boundary conditions are assigned to simulate the propeller power loading. Computed results for a NASA SR3 propeller as well as a NASA turboprop configuration are compared with test data. Good agreement has been achieved through the present simulation method. Author

A84-44193#

APPLICATION OF THE SINGLE-CYCLE OPTIMIZATION APPROACH TO AERODYNAMIC DESIGN

M. H. RIZK (Flow Industries, Inc., Research and Technology Div., Kent, WA) American Institute of Aeronautics and Astronautics, Applied Aerodynamics Conference, 2nd, Seattle, WA, Aug. 21-23, 1984. 10 p. Research supported by Flow Industries, Inc. refs
(AIAA PAPER 84-2165)

The single-cycle approach is a newly developed approach for solving optimization problems in which the objective function and the constraint functions are dependent on the solution of a set of partial differential equations. This approach is very suitable for solving transonic aerodynamic design problems. The solutions of the flow equations and the design parameters are updated simultaneously, therefore this procedure presents an alternative to the costly inner-outer iterative procedures currently used in transonic aerodynamic design. The procedure is applied here to examples in which the Euler equations are assumed to be the flow governing equations. Author

A84-44194*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

APPLICATION OF PANEL METHOD TO WAKE VORTEX/WING INTERACTION AND COMPARISON WITH EXPERIMENT

B. E. SMITH and J. C. ROSS (NASA, Ames Research Center, Moffett Field, CA) American Institute of Aeronautics and Astronautics, Applied Aerodynamics Conference, 2nd, Seattle, WA, Aug. 21-23, 1984. 11 p. refs
(AIAA PAPER 84-2182)

The ability of a low-order panel method to calculate the aerodynamic loads on wings caused by interaction with wake vortices was studied. The loads were calculated for various positions of a downstream following wing relative to an upstream vortex-generating wing. Calculated vortex-induced span loads and rolling-moment coefficients on the following wing were compared with experimental data. A good agreement with experiment was obtained when the following wing was located more than one following-wing chord length from the tip vortex. The predictions deteriorated as the following wing was placed closer to the vortex. At large downstream distances (approximately 10 generating-wing chord lengths), induced rolling-moment coefficients on the following wing were consistently overestimated. Despite the strong interaction between the wake-vortex filaments and surface doublet panels, the accuracy of the calculations was in most cases independent of the panel distribution and density. A good agreement between theoretical and experimental loads was obtained with a minimum of experimentation with panel arrangements. Author

A84-44195*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

SUBSONIC/SUPERSONIC AERODYNAMIC CHARACTERISTICS FOR A TACTICAL SUPERCRUISER

F. J. CAPONE, E. A. BARE (NASA, Langley Research Center, Transonic Aerodynamics Div., Hampton, VA), D. HOLLENBACK, and R. HUTCHISON (Boeing Military Airplane Co., Seattle, WA) American Institute of Aeronautics and Astronautics, Applied Aerodynamics Conference, 2nd, Seattle, WA, Aug. 21-23, 1984. 17 p. refs

(AIAA PAPER 84-2192)

A series of cooperative NASA-Langley/Boeing experimental investigations have been conducted to determine the aeropropulsive characteristics of an advanced tactical fighter designed for supersonic cruise. These investigations were conducted in the Langley 16-Foot Transonic and Lewis 10 x 10-Foot Supersonic Wind Tunnels at Mach numbers from 0.60 to 2.47. This fighter is a Mach 2.0, 49,000 pound class vehicle that features a close-coupled canard and underwing propulsion units that utilize multifunction two-dimensional exhaust nozzles. Tests were conducted to determine the basic aerodynamic characteristics of the configuration with flow-through nacelles in which the spillage effects of representative inlets were measured. The effects of thrust-induced forces on overall aerodynamic performance were evaluated with a series of multifunction nozzles installed on air-powered nacelles. An axisymmetric nozzle configuration was also tested to obtain comparative aeropropulsive performance. Trim aerodynamic characteristics for the flow-through and powered configurations and the effect of thrust vectoring at subsonic speeds are presented. Author

A84-44196#

A TRANSONIC WING-BODY FLOWFIELD CALCULATION WITH IMPROVED GRID TOPOLOGY AND SHOCK-POINT OPERATORS

L. T. CHEN, J. C. VASSBERG, and C. C. PEAVEY (Douglas Aircraft Co., Long Beach, CA) American Institute of Aeronautics and Astronautics, Applied Aerodynamics Conference, 2nd, Seattle, WA, Aug. 21-23, 1984. 14 p. Research supported by the McDonnell Douglas Corp. refs

(AIAA PAPER 84-2157)

A transonic wing-body flowfield computational method has been developed by introducing a hybrid mapping/numerical grid generation scheme with an improved grid topology and incorporating new artificial viscosities and shock-point operators into a multigrid version of FLO-30. The improved grid topology results in a better fuselage geometry definition and a more nearly orthogonal mesh distribution, than either the FLO-28 or FLO-30 grid topologies. The hybrid mapping/numerical grid generation scheme applies a conformal mapping procedure in the farfield and a nearly orthogonal numerical scheme in the nearfield. The scheme is general and efficient, and generates nearly orthogonal grid systems in both the farfield and nearfield. Both the use of the multigrid method in the flow solver and the improvement of mesh orthogonality in the grid generation significantly reduce the number of iteration cycles required for a converged solution. Nonconservative and partially conservative artificial viscosities and shock-point operators incorporated into the flow solver improve the prediction of shocks. Author

A84-44197#

AN INVESTIGATION OF THE TABBED VORTEX FLAP

K. D. HOFFLER (North Carolina State University, Raleigh, NC) and D. M. RAO (Vigyan Research Associates, Inc., Hampton, VA) American Institute of Aeronautics and Astronautics, Applied Aerodynamics Conference, 2nd, Seattle, WA, Aug. 21-23, 1984. 12 p. refs

(AIAA PAPER 84-2173)

Exploratory wind tunnel investigations were conducted on delta wings with tabbed vortex flaps. The up-deflected leading-edge tab enhances vortex-induced thrust on the flap surface; however, the tab itself has a direct drag contribution. Balance and pressure measurements on a 74-deg. delta model were used to compare plain and tabbed vortex flaps of equal total area. Tab modifications intended to improve the L/D over plain flaps were evaluated. In a parallel study using a 65-deg. delta, detailed spanwise pressure measurements cross the wing, flap, and tab were integrated to obtain the sectional lift and drag contributions of the individual surfaces. Flow visualizations revealed the development and breakdown of the tab vortex. Free vortex sheet computations with several flap/tab deflections on the 65-deg. delta were assessed against the experimental pressures and vortex core positions. Author

A84-44198*# Naval Ship Research and Development Center, Bethesda, Md.

NUMERICAL OPTIMIZATION OF CIRCULATION CONTROL AIRFOIL AT HIGH SUBSONIC SPEED

T. C. TAI (U.S. Navy, David Taylor Naval Ship Research and Development Center, Bethesda, MD) and G. H. KIDWELL, JR. (NASA, Ames Research Center, Aeronautical Systems Branch, Moffett Field, CA) American Institute of Aeronautics and Astronautics, Applied Aerodynamics Conference, 2nd, Seattle, WA, Aug. 21-23, 1984. 10 p. Navy-supported research. refs

(AIAA PAPER 84-2162)

A numerical procedure for optimizing the design of the circulation control airfoil for use at high subsonic speeds is presented. The procedure consists of an optimization scheme coupled with a viscous potential flow analysis for the blowing jet. The desired airfoil is defined by a combination of three baseline shapes (cambered ellipse and cambered ellipse with drooped and spiraled trailing edges). The coefficients of these shapes are used as design variables in the optimization process. Under the constraints of lift augmentation and lift-to-drag ratios, the airfoil, optimized at free-stream Mach 0.54 and alpha = -2 degrees can be characterized as a cambered ellipse with a drooped trailing edge. Experimental tests support the performance improvement predicted by numerical optimization. Author

A84-44199*# Ohio State Univ., Columbus.

THE ROLE OF AIRFOIL GEOMETRY IN MINIMIZING THE EFFECT OF INSECT CONTAMINATION OF LAMINAR FLOW SECTIONS

J. L. MARESH and M. B. BRAGG (Ohio State University, Columbus, OH) American Institute of Aeronautics and Astronautics, Applied Aerodynamics Conference, 2nd, Seattle, WA, Aug. 21-23, 1984. 12 p. refs

(Contract NAG1-342)

(AIAA PAPER 84-2170)

A method has been developed to predict the contamination of an airfoil by insects and the resultant performance penalty. Insect aerodynamics have been modeled and the impingement of insects on an airfoil are solved by calculating their trajectories. Upon impact, insect rupture and the resulting height of the debris is determined based on experimental data. A boundary layer analysis is performed to determine which insects cause boundary layer transition and the resultant drag penalty. A contaminated airfoil figure of merit is presented to be used to compare airfoil susceptibility. Results show that the insect contamination effects depend on accretion conditions, airfoil angle of attack and Reynolds number. The importance of the stagnation region to designing airfoils for minimum drag penalties is discussed. Author

A84-44200#

VORTEX-FITTED POTENTIAL SOLUTION COMPARED WITH VORTEX-CAPTURED EULER SOLUTION FOR DELTA WING WITH LEADING-EDGE VORTEX SEPARATION

H. W. M. HOEIJMAKERS (National Lucht en Ruimtevaartlaboratorium, Amsterdam, Netherlands) and A. RIZZI (Flygtekniska Forsoksanstalten, Bromma, Sweden) American Institute of Aeronautics and Astronautics, Applied Aerodynamics Conference, 2nd, Seattle, WA, Aug. 21-23, 1984. 12 p. refs
(AIAA PAPER 84-2144)

The numerical solution for the inviscid incompressible flow about a 70-deg swept delta wing at 20 deg incidence is considered. Two solutions are presented and compared in detail. The first solution is obtained employing a free-vortex-sheet panel method that solves for the potential flow with 'fitted' vortical flow regions. This type of method is now relatively well-established and in use at various places. In general, its results agree reasonably well with turbulent flow data obtained in experiments. The second solution is obtained by an Euler code in which the vortical flow regions are 'captured'. This type of method is presently evolving at a rapid rate, demonstrating its potential to compute rotational flows. In the present paper, through a detailed comparison of results of a panel method and an Euler code, the validity of the Euler-equation approach is assessed and it is indicated where improvement is required. Author

A84-44201#

EULER SOLUTIONS OF TRANSONIC VORTEX FLOWS AROUND THE DILLNER WING - COMPARED AND ANALYZED

A. RIZZI (Flygtekniska Forsoksanstalten, Bromma, Sweden) American Institute of Aeronautics and Astronautics, Applied Aerodynamics Conference, 2nd, Seattle, WA, Aug. 21-23, 1984. 19 p. Research supported by the Control Data Corp. refs
(AIAA PAPER 84-2142)

The AGARD Working Group 07 has proposed two representative cases for the evaluation of computed solutions to the Euler equations for high-speed flow with vorticity being shed from the swept leading edge of a wing. The geometry is the Dillner wing, a sharp-edged nonconical 70-deg swept delta in both subsonic and supersonic flight at 15-deg angle of attack. Two sets of solutions computed ond the CYBER 205 with the WINGA2 code are presented. The first is computed on a standard mesh of 65 x 21 x 29 grid points, and the second on a denser mesh of up to 193 x 57 x 97 points (over one million). The comparison of these two sets shows that as the mesh is refined the vorticity field becomes sharper, the suction peaks higher, new shock phenomena appear, and the observed total pressure losses become more comprehensible. Author

A84-44202#

ANALYTICAL AND EXPERIMENTAL STUDY OF A COMPLEX 3-D INLET FOR TURBOPROP APPLICATIONS

G. E. JUOLA, H. R. WELGE, and D. N. SMYTH (Douglas Aircraft Co., Long Beach, CA) American Institute of Aeronautics and Astronautics, Applied Aerodynamics Conference, 2nd, Seattle, WA, Aug. 21-23, 1984. 9 p.
(AIAA PAPER 84-2203)

Several new propeller concepts have recently been developed permitting flight at cruise speeds of Mach 0.7 to 0.8 with significant reductions in fuel usage when compared to current turbofan technology. In order to realize the complete benefit of incorporating this type of propulsion system, several design issues must be resolved. One of these is the gas-generator inlet design. In order to assess the efficiency of various inlet types, several analytical techniques have been developed at Douglas Aircraft Company. An important factor in the development and use of these techniques is the accuracy of the design methods. In order to evaluate the design methods, a scale model of a complex three-dimensional single-scoop inlet duct was designed, and a static test was conducted, to provide the database necessary for comparison purposes. Pressure distributions, boundary layer characteristics, and flow visualization comparisons between the theory and the experimental results are presented along with the total pressure recovery and distortion for the different inlet configurations tested. Author

A84-44506#

ADVANCED AIRFOIL DESIGN FOR GENERAL AVIATION PROPELLERS

F. TAVERNA (Grumman Aerospace Corp., Bethpage, NY) Journal of Aircraft (ISSN 0021-8669), vol. 21, Sept. 1984, p. 649-657. Previously cited in issue 17, p. 2453, Accession no. A83-38631. refs

A84-44507#

BOUNDARY LAYER CHARACTERISTICS OF THE MILEY AIRFOIL AT LOW REYNOLDS NUMBERS

L. J. POHLEN and T. J. MUELLER (Notre Dame, University, Notre Dame, IN) Journal of Aircraft (ISSN 0021-8669), vol. 21, Sept. 1984, p. 658-664. Research supported by the University of Notre Dame. Previously cited in issue 17, p. 2453, Accession no. A83-38634. refs
(Contract N00014-81-K-2036)

A84-44509#

THE USE OF MULTIPOLES FOR CALCULATING THE AERODYNAMIC INTERFERENCE BETWEEN BODIES OF REVOLUTION

P. A. T. CHRISTOPHER (Cranfield Institute of Technology, Cranfield, England) and C. T. SHAW Journal of Aircraft (ISSN 0021-8669), vol. 21, Sept. 1984, p. 673-679. refs

A method is presented which uses the higher-order solutions of Laplace's equation to generate the flows between bodies of revolution which have complicated mutual aerodynamic interference. Such a situation commonly exists when several aircraft stores are grouped together under an aircraft. The method is shown to be a consistent approximation to the surface source methods, and gives good results for bodies with smooth meridian profiles. In particular, the improvement in accuracy due to the higher-order singularities is very evident, showing a possible modification to current techniques which lack this refinement. The method provides the basis of a simple calculation procedure which can be used, within the limits of linear theory for axisymmetric bodies, for flow speeds up to the critical speed. In particular, unless nonlinearities caused, for example, by transonic flows are evident, then the method could be used instead of the expensive computational fluid dynamics programs currently being developed. Author

A84-44510*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

LEESIDE FLOWS OVER DELTA WINGS AT SUPERSONIC SPEEDS

D. S. MILLER and R. M. WOOD (NASA, Langley Research Center, Supersonic Aerodynamics Branch, Hampton, VA) Journal of Aircraft (ISSN 0021-8669), vol. 21, Sept. 1984, p. 680-686. Previously cited in issue 17, p. 2454, Accession no. A83-38648. refs

A84-44511#

AERODYNAMIC CHARACTERISTICS OF A TWO-DIMENSIONAL MOVING SPOILER IN SUBSONIC AND TRANSONIC FLOW

H. CONSIGNY, A. GRAVELLE, and R. MOLINARO (ONERA, Chatillon-sous-Bagneux, Hauts-de-Seine, France) Journal of Aircraft (ISSN 0021-8669), vol. 21, Sept. 1984, p. 687-693. Research supported by the Direction des Recherches, Etudes et Techniques and Service Technique des Programmes Aeronautiques. Previously cited in issue 17, p. 2454, Accession no. A83-38642. refs

A84-44513*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EFFECTS OF VISCOSITY ON TRANSONIC-AERODYNAMIC AND AEROELASTIC CHARACTERISTICS OF OSCILLATING AIRFOILS
P. GURUSWAMY (NASA, Ames Research Center, Moffett Field, CA; Informatics General Corp., Palo Alto, CA) and P. M. GOORJIAN (NASA, Ames Research Center, Moffett Field, CA) (Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Technical Papers. Part 2, p. 253-265) Journal of Aircraft (ISSN 0021-8669), vol. 21, Sept. 1984, p. 700-707. Previously cited in issue 12, p. 1697, Accession no. A83-29835. refs

A84-44626#
SUBSONIC AIRFOILS WITH A GIVEN PRESSURE DISTRIBUTION
A. HASSAN (Arizona State University, Tempe, AZ), H. SOBIECZKY (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen, West Germany), and A. R. SEEBASS (Colorado, University, Boulder, CO) AIAA Journal (ISSN 0001-1452), vol. 22, Sept. 1984, p. 1185-1191. refs
(Contract AF-AFOSR-76-2954; AF-AFOSR-81-0107; N00014-76-C-0182-P0006)

An inverse design design procedure for subcritical airfols, based on hodograph techniques, has been developed. For the subcritical flows considered here, the pressure distribution is prescribed. In the special variables used, the equation for the stream function is solved iteratively using a fast Poisson solver. The results are then mapped back to the physical plane to determine the airfoil shape. Examples of subcritical airfoil designs are presented. They show good agreement with the direct computation of the flow past the designed airfoil. Author

A84-44627#
VORTEX STABILITY AND BREAKDOWN - SURVEY AND EXTENSION
S. LEIBOVICH (Cornell University, Ithaca, NY) AIAA Journal (ISSN 0001-1452), vol. 22, Sept. 1984, p. 1192-1206. refs
(Contract NSF CME-79-19817)

The precipitating conditions, phenomena and effects of vortex breakdown and stability are discussed. Breakdown occurs when a stagnation point appears, followed by the appearances of flow reversal and downstream turbulence. Laboratory techniques such as edge and trailing vortices, tangential jets and vane vortex generators for studying vortex formation are reviewed. Two types of breakdown have been identified: bubble and spiral. Transcritical wave theory is outlined, noting that the concept of critical flow is central to any description of breakdown. Consideration is given to the stability or instability of vortex cores at infinite Re. It is shown that the breakdown point may be estimated by computing the Froude number. Experimental data demonstrate that axisymmetric modes grow during propagation in a variable vortex waveguide. The wave loses stability because of three-dimensional perturbations after a critical amplitude is reached. M.S.K.

A84-44629#
TWO-DIMENSIONAL HYDRODYNAMIC CHARACTERISTICS OF A BLUFF SYMMETRICAL FAIRING SECTION
D. E. CALKINS (Washington, University, Seattle, WA) AIAA Journal (ISSN 0001-1452), vol. 22, Sept. 1984, p. 1216-1221. Previously cited in issue 18, p. 2840, Accession no. A82-37469. refs
(Contract N0014-82-K-0006)

A84-44630#
SECOND-ORDER ACCURATE BOUNDARY CONDITIONS FOR COMPRESSIBLE FLOWS
P. D. SPARIS (Thrace, University, Xanthi, Greece) AIAA Journal (ISSN 0001-1452), vol. 22, Sept. 1984, p. 1222-1228. refs

The accuracy and the consistency of the methods commonly used for the numerical application of the boundary conditions on the surface of solid bodies immerged in an inviscid compressible flow is examined. A new method is proposed for the application of second-order accurate boundary conditions in the case of isentropic irrotational compressible flows. The method is applied to a circular cylinder in uniform subsonic and low transonic flows. The conservation law equations are solved using the second-order accurate difference scheme of MacCormack. The results indicate a definite improvement over lower-accuracy methods. The method can be easily generalized to apply on three-dimensional solid surfaces. Author

A84-44635#
THE STRUCTURE OF TURBULENCE IN A SUPERSONIC SHOCK-WAVE/BOUNDARY-LAYER INTERACTION
P. L. ARDONCEAU (Poitiers, Universite, Poitiers; CNRS, Paris, France) AIAA Journal (ISSN 0001-1452), vol. 22, Sept. 1984, p. 1254-1262. refs

The results of a numerical and experimental study of turbulence structures appearing in flow across a shock wave/boundary layer interaction are reported. Data were gathered in a supersonic wind tunnel using a Mach 2.25 flow with a Re of 11 million/m. A two-dimensional flow was obtained using a full-span compression ramp. Measurements were made with pressure taps on 8, 13 and 18 deg ramps. A laser Doppler anemometer furnished velocity profiles and hot-wire anemometers furnished velocity fluctuation data. High speed schlieren photographs were also taken. The data indicated the presence of a lateral contrarotating pattern of turbulent eddies. A low frequency turbulence characteristic was detected near the separation bubble. The results revealed a strong nonlinear coupling between the mean flow and the turbulent structures. M.S.K.

A84-44639*# Georgia Inst. of Tech., Atlanta.
VISCOUS-INVISCID INTERACTIVE PROCEDURE FOR ROTATIONAL FLOW IN CASCADES OF AIRFOILS
W. JOHNSTON (Georgia Institute of Technology, Atlanta, GA) and P. SOCKOL (NASA, Lewis Research Center, Cleveland, OH) AIAA Journal (ISSN 0001-1452), vol. 22, Sept. 1984, p. 1281, 1282, Abridged. Previously cited in issue 5, p. 583, Accession no. A83-16614. refs

A84-44647#
SEPARATION JUMP AND SUDDEN STALL OVER AN ELLIPSOIDAL WING AT INCIDENCE
K. C. WANG (San Diego State University, San Diego, CA) AIAA Journal (ISSN 0001-1452), vol. 22, Sept. 1984, p. 1334-1336. refs
(Contract F49620-76-C-0004; AF-AFOSR-81-0109)

Results are reported from a numerical study of an incompressible laminar boundary layer along the lee symmetry plane of a wing-like flat ellipsoid. Boundary layer equations are defined for three variables normal to the flow across the ellipsoid. Boundary conditions, viscid inputs and skin friction are formulated. Sample calculations are provided for a large aspect ratio wing, covering three different chord configurations. A short bubble is found to appear at the leading edge and is associated with a separation which abruptly jumps from the rear to the front. The results have implications for the interpretation of stall. M.S.K.

A84-44649*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A NEW AERODYNAMIC INTEGRAL EQUATION BASED ON AN ACOUSTIC FORMULA IN THE TIME DOMAIN
F. FARASSAT (NASA, Langley Research Center, Acoustics and Noise Reduction Div., Hampton, VA) AIAA Journal (ISSN 0001-1452), vol. 22, Sept. 1984, p. 1337-1340. refs

An aerodynamic integral equation for bodies moving at transonic and supersonic speeds is presented. Based on a time-dependent acoustic formula for calculating the noise emanating from the outer portion of a propeller blade travelling at high speed (the Ffowcs Williams-Hawking formulation), the loading terms and a conventional thickness source terms are retained. Two surface and three line integrals are employed to solve an equation for the loading noise. The near-field term is regularized using the collapsing sphere approach to obtain semiconvergence on the blade surface. A singular integral equation is thereby derived for the unknown surface pressure, and is amenable to numerical solutions using Galerkin or collocation methods. The technique is useful for studying the nonuniform inflow to the propeller. M.S.K.

A84-44931#

INVESTIGATION OF THE TRIPLET CONCEPT USING A HIGHER-ORDER SUPERSONIC PANEL METHOD

F. A. WOODWARD and L. FORNASIER (Messerschmitt-Boelkow-Blohm GmbH, Ottobrunn, West Germany) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 31-40. refs

By comparison with a recently developed high-order panel method comparable to the PAN AIR code, a supersonic triplet singularity method has been evaluated, and good correspondence has been established between the two methods only for isolated bodies with regular paneling, and within two-dimensional regions of swept or unswept wings. Numerical stability problems have arisen from the application of the triplet singularity method to the analysis of intricate aircraft configurations, but these problems may be corrected through the versatility in geometric modeling and stable numerical results of the higher order methods, such as the HISS code. In conclusion, the present triplet singularity method provides only a partial solution to problems associated with the aerodynamic representation of supersonic flow complex aircraft designs. J.P.

A84-44932#

ADVANCED NUMERICAL METHODS FOR ANALYSIS AND DESIGN IN AIRCRAFT AERODYNAMICS

B. WAGNER and W. SCHMIDT (Dornier GmbH, Friedrichshafen, West Germany) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 41-51. refs

Recent developments in computational methods for aerodynamic design and analysis are reviewed, and their need in the design of aircraft and missile configurations is explored through several examples. These examples include: aircraft and missile weapon systems predesign and evaluation synthesis programs, airfoil and high lift analysis and design methodologies, and subsonic to supersonic wing-body analysis including leading edge vortex and engine inlet flows of three-dimensional transport and fighter aircraft. The cost-limiting factor of intricate geometry handling, and data pre- and post-processing is discussed. Numerical methods, considered responsible for increased aircraft performance capabilities, are used to analyze and improve future wind tunnel limitations such as wall effects, flow angularity, and Reynolds number. In the last decade, computational aerodynamics have led to research applications, and an increased use of computer methods in preliminary and final design. Future data handling improvements will allow the use of computers as routine tools during all design phases. J.P.

A84-44936#

INVESTIGATION OF THE PARTICLE TRANSPORT IN COMPRESSIBLE VORTICES PRODUCED BY SHOCK DIFFRACTION

W. JAEGER (Saint-Louis, Institut Franco-Allemand de Recherches, Saint-Louis, Haut-Rhin, France) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 85-90. refs

The transport of particles in a compressible, two-dimensional vortex behind an edge in a shock-tube is examined both experimentally and theoretically. In order to point out the limits of laser anemometry, the deviations of the particle movement from the vortex movement dependent on the particle material are calculated numerically as well as experimentally, and presented with a new optical measuring technique for the investigation of velocity distributions, by means of Doppler-pictures. Author

A84-44944#

THREE-DIMENSIONAL COMPUTATIONAL METHODS APPLIED TO AERODYNAMIC ANALYSIS OF TRANSONIC FLOWS PAST A WING-BODY CONFIGURATION

B. CHAUMET, D. DESTARAC, and T. H. LE (ONERA, Chatillon-sous-Bagneux, Hauts-de-Seine, France) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 144-156. refs

Analytical models are developed for wing-body interactions and viscous effects in the flowfield past an advanced supercritical wing on the A310 fuselage. Attention is focused on upgrading the calculations by more realistic geometrical modeling and by not using an inviscid flow assumption. The inviscid flowfield is modeled with a full potential equation and a subdomain method, while viscous effects on the wing (i.e., in the boundary layer) are analyzed using a coupling/viscous code. Both techniques were developed within ONERA, and experimental data were obtained in the S2MA transonic pressurized wind tunnel. Body effects were small and due mainly to the forebody, which shifted the shock position on the upper surface. The results demonstrate the worth of considering aeroelastic deformations and a realistic wake position. M.S.K.

A84-44945#

ANALYSIS OF TRANSONIC AND SUPERSONIC FLOWS AROUND WING-BODY-COMBINATIONS

S. LEICHER (Dornier GmbH, Friedrichshafen, West Germany) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 157-167. refs

The Dornier full potential and Euler methods in combination with a general mesh generation code are used to calculate transonic and supersonic flows around wings, wing-body combinations and bluff bodies. A short description of the two flow solvers and of the grid generation program is given. More detailed information is included in the comparison between the present Euler method in blocked and unblocked form and the very recent combination of both forms with a multigrid technique. Results are shown for wings, wing-body combinations, flows with embedded vortices, and flows around a bluff body such as a car. Author

A84-44946*# Missouri Univ., Rolla.

A FAST VISCOUS CORRECTION METHOD FOR FULL-POTENTIAL TRANSONIC WING ANALYSIS

S. C. LEE (Missouri-Rolla, University, Rolla, MO), S. D. THOMAS (Informatics General Corp., Palo Alto, CA), and T. L. HOLST (NASA, Ames Research Center, Moffett Field, CA) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 168-177. refs

An analysis of the transonic flowfield around a three-dimensional wing is carried out using a strip method. Attention is given to the boundary layer growth in the streamwise direction. A viscous correction technique is defined for the TWING code for solving the full potential equations. A viscous ramp at the base of a shock is superimposed on the boundary layer displacement thickness generated by an integral boundary layer method. A relationship is then obtained between the effective displacement thickness and a vertical component of the surface velocity, a transpirational boundary condition. The viscous correction is found to be unnecessary in weak shock conditions but gives a better shock position and pressure distribution in a strong shock condition when compared with data from an ONERA M6 airfoil and the Hinson and Burdges (1980) Wing A. M.S.K.

A84-44958#

COMPUTATION OF SUPERSONIC FLOW ABOUT COMPLEX CONFIGURATIONS

B. G. ARLINGER (Saab-Scania AB, Linkoping, Sweden) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 266-274. refs

A computational method is presented for the solution of the three-dimensional Euler equations for supersonic flow about realistic aircraft configurations. Utilizing a space-marching technique with an explicit scheme the solution is advanced between planes normal to the free stream direction. A key feature of the method is the very versatile grid generated in each cross section plane. Fuselages of widely different shape, with or without inlets, a fin, etc., can be treated. The number of wings can be from 0 to 2 without any restrictions on plan form. Computational results for a realistic aircraft configuration with canard and delta wing illustrates the capability of the code. Author

A84-44959#

NUMERICAL SOLUTIONS OF THE EULER EQUATIONS GOVERNING AXISYMMETRIC AND THREE-DIMENSIONAL TRANSONIC FLOW

D. M. CAUSON and P. J. FORD (Salford, University, Salford, Lancs., England) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 275-286. refs

A numerical technique is presented for obtaining time-dependent solutions to the Euler equations around realistic geometrical representations of aircraft forebodies in transonic flow. The model involves a finite volume concept, split operators and a switching process, and the spatially symmetric, explicit MacCormack scheme is applied in subsonic regions. The validity of the operator switching algorithm is illustrated for a NACA 0012 airfoil at Mach 0.85 at a zero angle of attack. Sample simulations are provided for an axisymmetric forebody with a canopy faired-out through a surface discontinuity and a forebody with a dipped elliptical cone and flat sides and undersides to accommodate canard foreplanes. The model is noted to have economical run times. M.S.K.

A84-44961#

TRANSONIC SHOCK-BOUNDARY LAYER INTERACTION CONTROL

P. KROGMANN, E. STANEWSKY (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Institut fuer Experimentelle Stroemungsmechanik, Goettingen, West Germany), and P. THIEDE (Messerschmitt-Boelkow-Blohm GmbH, Bremen, West Germany) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 297-307. refs

Suction slots used on transonic airfoils were studied in terms of their aerodynamic effects, together with those of a perforated slot and a double slot on a wing. The supercritical VFW-VA-2 airfoil was used for trials in a continuous circuit wind tunnel. Pitot tube pressure measurements were made, together with Schlieren video monitoring of wing root bending to detect the onset of buffeting. The wing was equipped with either a closed surface, a single slot, a double slot or the perforated slot. The flow Mach numbers ranged from 0.60-0.86, with a Re of 2.5 million. A double slot/cavity configuration provided the best aerodynamic performance, even in the passive mode. Most of the beneficial effects observed in the slot configurations are therefore attributed to passive effects. M.S.K.

A84-44962#

THE PREDICTION OF SEPARATED FLOW USING A VISCOUS-INVISCID INTERACTION METHOD

B. R. WILLIAMS (Royal Aircraft Establishment, Farnborough, Hants., England) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 308-320. refs

The incompressible flow around a two-dimensional airfoil is modeled up to and beyond stall with an integral boundary layer method. The outer inviscid flow is amenable to a linear approximation using Laplace's equations for an irrotational flow. The inner region is considered in terms of the direct form of the lag-entrainment method. A good approximation of the maximum lift is obtained by coupling the boundary layer computations to the inviscid flow model with a semi-inverse method. A linear stability analysis of three coupling methods, the semi-inverse, the fully inverse and direct methods, yield optimal relaxation factors useful for the nonlinear problem. Implementing a systematic variation of the relaxation factor from time-step to time-step results in an accelerated convergence. M.S.K.

A84-44971*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

VALIDATION OF A TRANSONIC ANALYSIS CODE FOR USE IN PRELIMINARY DESIGN OF ADVANCED TRANSPORT CONFIGURATIONS

E. G. WAGGONER (NASA, Langley Research Center, Applied Aerodynamics Group, Hampton, VA) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 377-390. refs

The WBPPW code has the capability of analyzing flow-field effects about configurations which include wing pylons and engine nacelles or pods in addition to the basic wing/fuselage combination. Using the concept of grid embedding, the code solves the extended small disturbance transonic flow equation for complex flow interactions of the various configuration components. A general description of the code and solution algorithm is included. Results are presented and compared with experiment for various configurations which encompass the code capabilities. These include wing planform and wing contour modifications and variations in nacelle position beneath a high-aspect-ratio wing. Results are analyzed in the light of preliminary design, where the capability to accurately compute flow-field effects resulting from various configuration perturbations is important. The comparisons show that the computational results are sensitive to subtle design modifications and that the code could be used as an effective guide during the design process for transport configurations. Author

A84-44972#

COMPARATIVE INVESTIGATIONS ON FRICTION DRAG MEASURING TECHNIQUES IN EXPERIMENTAL AERODYNAMICS

W. NITSCHE, C. HABERLAND, and R. THUENKER (Berlin, Technische Universitaet, Berlin, West Germany) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 391-403. Research supported by the Deutsche Forschungsgemeinschaft. refs

For practical friction drag investigations in wind tunnel or free flight tests, the applicability of some well known friction drag measuring techniques (sublayer fence, surface hot-film, Preston tube) as well as some recently or newly developed techniques (wall-fixed hot-wire, computational Preston tube method, wall-fixed double hot-wire) in typical aircraft boundary-layer flows is investigated. The emphasis is on the influence of additional test parameters (pressure gradient, heat flux or changed temperatures, compressibility) as well as on applications of the respective techniques in transition flows, separated or reattached and

three-dimensional flows. Additionally, some aspects concerning practicability, and constructional and electronic efforts are discussed and summarized comparatively in a synoptic table.
Author

A84-44974#
NEW DRAG REDUCTION METHODS FOR TRANSPORT AIRCRAFT
G. LOEBERT (Messerschmitt-Boelkow-Blohm GmbH, Munich, West Germany) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 410-420. refs

Five concepts for reducing drag on aircraft are introduced as techniques for increasing fuel efficiency. Active boundary layer thickening (ABLT) can be achieved by mounting a wind turbine at the fuselage nose and transferring the power to an aft-mounted propeller. ABLT could reduce cruise fuel consumption by 8 percent. Low pressure jet mixing using an appropriate engine location and nozzle geometry produces jet mixing in the negative pressure zone above the wing and is a potential saver of 7 percent of the cruise fuel requirements. Venting the jet propulsive stream through a linear array of slot nozzles along the wing into the upper surface boundary layer ahead of the pressure recover region induces cruise fuel consumption by 5 percent. A wingtip symmetrically bifurcated at 80 percent span would reduce vortex drag by 3.2 percent. Finally, attachment of freely-floating tip vortex sails at the wingtips offers a potential 2 percent decrease in cruise fuel consumption. Taken together, the concepts could reduce turbojet fuel consumption by 20 percent.
M.S.K.

A84-44980#
EFFICIENCY OF A TOP-MOUNTED INLET SYSTEM AT TRANSONIC/SUPERSONIC SPEEDS
K. WIDING (Flygtekniska Forsoksanstalten, Bromma, Sweden) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 465-475.

At transonic and supersonic speeds an experimental investigation has been carried out to increase the knowledge of the combined effects of the favorable wing flow and the disturbances from the forebody and especially the canopy on the inlet performance of an aircraft concept characterized by its inlet position on top of the fuselage. Wind tunnel tests were performed with a 1:23.5 model in one of FFA's transonic/supersonic wind tunnels. At the engine face station steady state pressure measurements were carried out to establish the inlet performance and the canopy was equipped with pressure taps giving the static pressure distribution. Results are presented which show that in many respects the inlet performances are very good but they also indicate some problem areas caused by the complex flow in front of the inlet.
Author

A84-44982#
STEADY AND UNSTEADY PRESSURE DISTRIBUTIONS ON A NACA 0012 PROFILE IN SEPARATED TRANSONIC FLOW
H. TRIEBSTEIN (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Institut fuer Aeroelastik, Goettingen, West Germany) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 483-493. refs

Steady and unsteady aerodynamic data were measured on a two-dimensional model with an airfoil of 12 percent thickness mounted in the Transonic Windtunnel in Goettigen. The profile was oscillated in pitch about its c/4 axis to generate the unsteady aerodynamic pressure data. The purpose of the windtunnel test was primarily to measure data for use in the development and assessment of transonic analytical codes and to show the dependence of aerodynamic responses on the following parameters: Mach number (0.5 to 1.0), reduced frequency (0.02 to 0.12) angle of attack (0 to 9 deg) and oscillation amplitude (0.5 to 2.5 deg). Emphasis is also placed on the nonlinearities which actually occur and which are peculiar to higher angles of attack. Steady and unsteady calculation results agreed fairly well with the measured data.
Author

A84-44983#
A KINEMATIC APPROACH TO UNSTEADY VISCOUS FLOWS
U. NEHRING IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 494-503. refs

A system of non-linear differential equations describing quite general flow phenomena is presented and discussed from a kinematic point of view. Reducing the dynamic variables to one scalar pressure function and a velocity vector this approach is based on a concept of viscosity diverging from the usual definition. It does not proceed on local shear stresses but on the assumption that fluid friction depends on irreversible processes within the flow field. The equations admit discontinuities in shear velocity as well as compressibility effects. In the limit of incompressibility agreement with the Euler-equations is obtained. The numerical solution by an explicit finite difference method results in the simulation of unsteady flow fields and energy distributions. For example the flow over a step within an insulated system, around a wing profile with a flap and a circular cylinder has been investigated.
Author

A84-44994#
COMPUTATION OF PROP-FAN ENGINE INSTALLATION AERODYNAMICS
C. W. BOPPE and B. S. ROSEN (Grumman Aerospace Corp., Bethpage, NY) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 580-590. refs

A computational method has been enhanced to permit numerical evaluations of transonic aerodynamic phenomena associated with prop-fan engine installations. Comparisons with experimental data and results using other algorithms provide a basis for augmenting intuition to determine which aspects of the physical flow and the computerized flow simulation are most important. Features of the prop-fan slipstream and the engine nacelle are modeled. In addition, a wind tunnel test was conducted to study the interference effect generated by a simple nacelle which is embedded in a wing surface. Observations that relate to future engineering applications are included.
Author

A84-44995*# Rockwell International Science Center, Thousand Oaks, Calif.
RELAXATION AND APPROXIMATE FACTORIZATION METHODS FOR THE UNSTEADY FULL POTENTIAL EQUATION
V. SHANKAR, H. IDE, and J. GORSKI (Rockwell International Science Center, Thousand Oaks, CA) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 591-599. refs
(Contract NAS1-15820)

The unsteady form of the full potential equation is solved in conservation form, using implicit methods based on approximate factorization and relaxation schemes. A local time linearization for density is introduced to enable solution to the equation in terms of phi, the velocity potential. A novel flux-biasing technique is applied to generate proper forms of the artificial viscosity, to treat hyperbolic regions with shocks and sonic lines present. The wake is properly modeled by accounting not only for jumps in phi, but also for jumps in higher derivatives of phi obtained from requirements of density continuity. The far field is modeled using the Riemann invariants to simulate nonreflecting boundary conditions. Results are presented for flows over airfoils, cylinders, and spheres. Comparisons are made with available Euler and full potential results.
Author

A84-44996#

MATHEMATICAL OF LINEAR UNSTEADY AERODYNAMICS OF WHOLE AIRCRAFT

Z. SKODA and V. PREJZEK (Vyzkumny a Zkusebni Letecky Ustav, Prague, Czechoslovakia) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 607-615. refs

The paper gives a brief description of a method which enables linear non-stationary aerodynamic characteristics of an aircraft as a whole to be computed. The method has been derived under the assumption that the aircraft is in an ideal gas flow in the subsonic region. The actual aircraft is simplified in the computation - it is replaced by the so-called basic shape. The basic shape is then divided into panels and the continuous load of the panels is replaced by a discrete force. The computation, conceived in this manner, contains no integration and has no particular demands on the computer; also the computer times required are sufficiently small so that the method may be used for parameteric studies. The basic computer program for computing aerodynamic loads was developed to enable the direct use of intermediate results, or of the results of the basic computation, as inputs for other computer programs, for example, the computation of the generalized aerodynamic force coefficient, the induced drag coefficient, and for simulating aero-elastic properties. Further applications were then developed by applying the reversed flow theorem. Some examples of the computations are also given. Author

A84-44997#

DESIGN STUDY OF SHORT RANGE TRANSPORT WING

K. TANAKA (Fuji Heavy Industries, Ltd., Aircraft Div., Utsunomiya, Tochigi, Japan) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 616-621. refs

The wing shape for short range transport was studied using numerical tools and high speed wing tunnel tests. In the two dimensional sense, rear loading wing, front loading wing and front-and-rear loading wing were designed and tested. Results show that the rear loading wing has some advantages in M(DD) (drag divergence mach number) but not is so good for subsonic C(D). Among the above three types of wing, front-and-rear loading wing were most promising both in M(DD) and subsonic C(D). In the three dimensional approach, numerical analysis shows that the extended leading edge of root section can bring very thick root and can reduce the root incidence which results in the relative large reduction of pressure drag at root. The transonic wind tunnel test shows very encourageous results on lowering C(D) for this wing model. Author

A84-45005#

PROPELLERS IN COMPRESSIBLE FLOW

V. L. WELLS IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 697-707. refs

This paper describes a method for solving the equation for inviscid, irrotational, compressible, potential flow about a propeller. The equation is written in a non-inertial system of coordinates rotating with the propeller in which the problem becomes a steady one. The solution is constructed by superimposing a solution to the compressible equation on an 'incompressible' or 'wake' solution. A 'modal' or 'shape' function method provides a procedure for solving the integral equation resulting from application of the final boundary condition to the superposed solution. Results are presented for an increasing number of control points and modal functions. A comparison of compressible and incompressible circulation distributions is also included. Author

A84-45008#

A PRACTICAL METHOD FOR PREDICTING TRANSONIC WING FLUTTER PHENOMENA

K. YONEMOTO (Kawasaki Heavy Industries, Ltd., Aircraft Engineering Div., Kakamigahara, Gifu, Japan) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 724-732. Research supported by the Japan Aircraft Development Corp. refs

An approach which modifies a subsonic doublet lattice method was proposed in the calculation of transonic unsteady aerodynamics. In this approach, phase shifts as well as amplitudes of pressure load distributions on a wing were modified by the use of the doublet lattice method. This method was developed as an approximate, but practical technique for calculating the transonic flutter boundary on a parametric wing design stage of an aircraft. With the aim of obtaining data for verification of the present method, a model flutter experiment was performed on an energy efficient supercritical transport wing with an aspect ratio of 10.5 and with a swept angle of 18 degrees. The measured flutter boundary exhibited a sharp drop for the narrow Mach number region around 0.8 and was 20 percent lower in dynamic pressure than that by the subsonic lifting surface theory. Flutter characteristics predicted by the present method were compared with experimental results, and it was found that their shape in a 'transonic dip' agrees well with that obtained from the experiments. Author

A84-45009#

INDICIAL AERODYNAMIC COEFFICIENTS FOR TRAPEZOIDAL WINGS

V. J. E. STARK (Saab-Scania AB, Linkoping, Sweden) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 733-738. Research supported by the Swedish Defence Administration and Saab-Scania AB. refs

Approximating the potential jump across a wing and its wake within rectangular elements by constants, indicial aerodynamic coefficients for rigid and elastic modes of a trapezoidal wing in incompressible inviscid flow have been calculated. The results show that the indicial coefficients for different modes can be described by a single simple function - a generalized Wagner function. Knowledge of initial and steady state values and apparent mass coefficients, which have been calculated too, is thus sufficient. Laplace transformation yields a generalized Theodorsen function and transfer functions for flutter or stability analysis. Author

A84-45011#

AERODYNAMIC CHARACTERISTICS OF WING-BODY-COMBINATIONS AT HIGH ANGLES OF ATTACK

D. HUMMEL (Braunschweig, Technische Universitaet, Brunswick, West Germany), H. JOHN, and W. STAUDACHER (Messerschmitt-Boelkow-Blohm GmbH, Munich, West Germany) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 747-762. refs

Wind-tunnel investigations have been carried out on a series of wing-body-combinations composed of a fuselage and 9 different wings in high wing and low wing positions. Six-component balance measurements and flow visualizations have been performed up to high angles of attack. The effects of wing planform and of a body on the c(1beta)-characteristics of the various configurations have been studied in detail. Unstable rolling moments are caused by unsymmetrical vortex breakdown, by unsymmetrical formation of deadwater regions and by different flow structures on both sides of the wing. Configurations with a high wing position are much more unstable than those with a low wing position. By means of small modifications of the body contour favourable interference effects could be created which led to stable rolling moments in the whole angle of attack range. Author

A84-45012#

THE EXPERIMENTAL INVESTIGATION OF THE SPATIAL VORTEX PATTERNS OF SOME SLENDER BODIES AT HIGH ANGLE OF ATTACK IN LOW SPEED TUNNEL

G. WU, T. WANG, and S. TIAN (Nanjing Aeronautical Institute, Nanjing, People's Republic of China) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 763-771. refs

The method of the fluorescent mini-tuft has been used to investigate the changes of the spatial vortices with the angle of attack on the lee side of some slender bodies in a low speed tunnel without sideslip. Four models of slender bodies with different sections have been used. A top view as well as a side view of the vortex have been acquired. The axial velocities of the vortex by the hot wire anemometer and the circulation of the vortex by the method of the fluorescent mini-tuft along the track of vortex are measured. This investigation clearly shows the relations of the asymmetric side force to the asymmetric vortices. Also, the model of the asymmetric vortices and the interference between the vortices are realized to some extent. The effects of the disturbance caused by a small protrusion at the fore part of the slender body on the position of vortex are also investigated. Author

A84-45014#

WING DESIGN FOR DELTA-CANARD CONFIGURATION

W. KRAUS (Messerschmitt-Boelkow-Blohm GmbH, Munich, West Germany) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 772-782. refs

Theoretical and experimental data are cited to support the inclusion of a coupled wing, body and canard configuration in supersonic aircraft modeling for moderate-lift coefficients for a delta-wing aircraft. A drag minimization procedure is recommended for the design calculations, with instability margins being set by the capabilities of the flight control system. Provision of a leading edge droop improves the lift and blunting the trailing edge through a reduced radius lowers the drag, with both benefits appearing at low speeds. M.S.K.

A84-45022*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

SUPERSONIC WING DESIGN CONCEPTS EMPLOYING NONLINEAR FLOWS

D. S. MILLER (NASA, Langley Research Center, Hampton, VA) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 849-860. refs

Three nonlinear flow concepts for the design of supersonic wings are reviewed. The specific concepts are: leading-edge thrust, supercritical crossflow, and leading-edge vortex flow. The major results of the experimental-theoretical studies supporting the development of these concepts are presented and discussed. Also, supporting aerodynamic prediction methods are described and example applications are given. Recommendations for further development of each concept are made. Author

A84-45023#

AIRFOIL OPTIMIZATION

P. KRANTZ, S. G. HEDMAN (Flygtekniska Forsoksanstalten, Bromma, Sweden), and K. P. MISEGADES (Dornier GmbH, Friedrichshafen, West Germany) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 861-867. refs

This paper describes the components and applications of a computer program system for the optimization of airfoils. The program, characterized by a fast approximate optimization technique, an aerodynamic code for subsonic and transonic viscous flow and the possibility of modifying a desired part of the contour, was developed by Misegades. However, to increase the practical use of the program two additional options have been included. To avoid oscillations in the geometry interpolation, the ordinary cubic spline functions have been replaced by the taut cubic splines. The design of an airfoil is a problem that requires the consideration of the effects of modification at off-design. Therefore the possibility of implying constraints at off-design has been included. Author

A84-45024#

AERODYNAMIC INVESTIGATION ON AN ADAPTIVE AIRFOIL FOR A TRANSONIC TRANSPORT AIRCRAFT

G. REDEKER, G. WICHMANN (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Institut fuer Entwurfs-Aerodynamik, Brunswick, West Germany), and H.-CHR. OELKER (Braunschweig, Technische Universitaet, Brunswick, West Germany) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 868-880. refs

Drag reduction and the extension of the flight region with high aerodynamic efficiency for transonic airfoils has been investigated by applying the idea of an adaptive airfoil. With the aid of the elliptic continuation method a basic airfoil has been optimized with regard to shockfree pressure distributions for three different sets of Mach number and lift coefficient. The resulting three airfoils, representing an adaptive airfoil, have been investigated numerically and in windtunnel tests. The results indicate that high aerodynamic efficiencies are connected with pressure distributions having already weak shockwaves. Furthermore the anticipated extension of the flight region with high aerodynamic efficiency by applying an adaptive airfoil could not be verified for all flight conditions. Author

A84-45025#

EXPERIMENTAL AND COMPUTATIONAL INVESTIGATION OF THE VORTEX FLOW OVER A SWEPT WING

F. MANIE, M. NERON, and V. SCHMITT (ONERA, Chatillon-sous-Bagneux, Hauts-de-Seine, France) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 881-895. refs

The development of the vortex flow that occurs at the rounded leading edge of the 60 deg swept rectangular AFV-D wing has been investigated in a wide range of Mach numbers and angles of attack. The important amount of experimental results constitutes a helpful data base for checking advanced computational methods. At low speeds, the five hole probe surveys give a precise description of the three-dimensional structure of the vortex flow, and, in particular, show a gradual loss of total pressure in the non-bursted vortex flow. Rehbach's vorticity particles method successfully predicts the mean features of the vortex flow: rolling-up, center line location and velocity field. The present modelling of the vortex shedding process should nevertheless be improved in order to get a better evaluation of the vortex lift. At transonic velocities, inviscid computations were performed with an Euler code. The wing is ended by a rounded wing tip around which a C-O type grid is built. These first computations seem to show the ability of the method to compute vortex structures, with separation starting from a smooth surface, i.e. here at the leading edge and at the wing tip. Author

A84-45026#
GROUND EFFECT ON SLENDER WINGS AT MODERATE AND HIGH ANGLES OF ATTACK
J. ER-EL and D. WEIHS (Technion - Israel Institute of Technology, Haifa, Israel) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 896-904. Research supported by the Technion - Israel Institute of Technology. refs

The effect of ground proximity on a 60 deg delta wing at angles of attack of 10 deg to 31 deg, is studied by means of surface pressure measurements and oil flow visualization tests. Results show that ground effect increases the magnitude of the low pressure regions on the upper surface of the wing, induced by the leading edge vortices. The increase diminishes at high incidence where the effect of vortex breakdown is dominant. On the lower surface, ground effect increases the pressure. This increase becomes larger as the angle of attack increases. The overall result of ground effect is an increase in the normal force. Author

A84-45027#
LEADING-EDGE FLAP SYSTEMS FOR SLENDER WINGS 'VORTEX FLAPS'?
W. STAUDACHER (Messerschmitt-Boelkow-Blohm GmbH, Munich, West Germany) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 905-913. refs

The aerodynamic effects of mechanical leading edge (LE) flaps are discussed in terms of vortex control effectiveness. The flaps are used to control the position, angle of attack and strength of the vortex systems emanating from the LE of slender wings. The study examines the results obtained with plain, Krueger, double-hinged, slat and vortex LE flaps and trailing edge (TE) flaps. Attention is given to LE flap deflection relative to the lift characteristics. It is found that the LE flap effects must be considered in combination with control and L/D ratio contributions of the LE and TE flaps. Vortex flaps exhibit decreasing effectiveness with decreasing sweep on hybrid planforms. Double-hinged flaps provide the optimal performance investigated. M.S.K.

A84-45037#
INLET DISTORTION AND COMPRESSOR BEHAVIOUR
B. DELAHAYE (SNECMA, Moissy-Cramayel, Seine-et-Marne, France) and P. SAGNES (SocieteBertin et Cie., Plaisir, Yvelines, France) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 996-1004. refs

Airflow entering an inlet at high aircraft angles of attack results in highly distorted pressure patterns at the engine compressor face. A multiyear research program has been initiated to predict compressor response to inlet distortion. So different methods with different prediction capabilities have been developed to compute the flow within a multistage compressor with nonuniform upstream conditions. Basic experiments or full scale tests are used to qualify numerical modelizations and to study compressor response to simulated dynamic inlet distortion. A high speed digital distortion analyzer has been designed to record and process the numerous data recorded during inlet tests. Author

A84-45038#
NUMERICAL SIMULATION OF UNSTEADY FLOW IN A RAMJET INLET
T. HSIEH and A. B. WARDLAW, JR. (U.S. Navy, Naval Surface Weapons Center, Silver Spring, MD) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 1005-1014. Navy-sponsored research. refs

The unsteady flow field of a two-dimensional ramjet inlet is studied numerically by solving the Navier-Stokes equation with two-equation turbulence model. Unsteadiness is introduced by prescribing the pressure disturbance at the inlet exit plane. The cases considered include the exit plane pressure disturbances which were a single pressure pulse, a rapid increase and a sinusoidal variation. The amplitude of the imposed pressure disturbance varied between 14 to 20 percent of the mean exit pressure. Viscous effects play a dominant role for all the cases investigated. Interesting phenomena are described, including the disappearing and reforming of curved terminal shocks; the appearing of shock trains; and the formation, bifurcation, and disappearance of separation pockets. Author

A84-45039#
THEORETICAL ANALYSIS OF DIFFUSER PERFORMANCE WITH AXIAL FLOW AND SWIRLING FLOW
A. THAKKER (National Institute for Higher Education, Dublin, Ireland) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 1015-1023. Research supported by the Science Research Council. refs

Theoretical models of diffuser performance are reviewed. Note is taken of expressions accounting for the presence of swirl in entry flow. The study covers the Cockrell-Markland (1962) model for nonuniform entry flow without swirl, the Sovron-Klomp (1967) one-dimensional model augmented to cover swirl and the Tyler-Williamson (1967) model, which incorporates a distortion factor for assessing diffuser efficiency. The analyses indicate that no exact procedure is currently available for predicting conical diffuser efficiency if swirl is present. The models are, however, suitable as a basis for investigating one- and two-dimensional diffuser flow. M.S.K.

A84-45040#
EXPERIMENTAL STUDIES ON SUBCRITICAL INTAKES FLOWS
K. KAPOOR (Indian Institute of Technology, Bombay, India) and T. G. PAI (Indian Institute of Technology, Bombay, India; Alfateh University, Tripoli, Libya) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 1024-1029. Research supported by the Ministry of Defence of India. refs

An experimental study on two-dimensional external compression supersonic air intakes, leading to development of subcritical flow models, forms the objective of present paper. Intake models incorporating variable geometry feature and a mass flow measuring and monitoring unit have been tested for Mach number range of 1.6 to 2.2. Based on the experimental data, a subcritical flow model correlating intake geometry, shock stand-off distance and free stream Mach number has been developed. Additive drag and stable range of intake operation using flow model evolved has been compared with the corresponding values reported in the literature and those which were obtained during current experiments. Two types of flow instabilities have also been observed. Author

A84-45043#
EFFECT OF NOSE/WING STRAKE VORTEX ON DIRECTIONAL STABILITY CHARACTERISTICS
S. XIONG, M. LIU, Y. LI, and Z. LU (Beijing Institute of Aeronautics and Astronautics, Beijing, People's Republic of China) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 1047-1057. refs

Pressure measurements and flow observations on vertical tail and fuselage were conducted to obtain a better understanding of the effect of nose/wing strake vortex on directional stability characteristics at high angles of attack. The results indicate that at sideslip strake wing vortex system can significantly influence the flow field around the vertical tail, which contributes a stabilizing or destabilizing increment to the directional stability then. Nose strake vortices can change the pressure distribution of forebody greatly at high angles of attack at sideslip and a considerably stabilizing increment in directional stability is realized. Author

A84-45051#
EFFECT OF REYNOLDS NUMBER ON UPPER COWL FLOW SEPARATION
W. HOELMER, J. L. YOUNGHANS (General Electric Co., Cincinnati, OH), and J. C. RAYNAL (ONERA, LeFauga-Mauzac, France) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 1106-1115. refs

The results of wind tunnel tests and data analyses of the Re-dependence of flow separation about an aircraft engine cowling are reported. The condition can become significant in terms of a large drag increase during climb with an inoperative engine. The trials were run in the LeFauga low speed pressurized wind tunnel using 15 and 33 percent scale models of an A300 external cowl. Lip Mach number data were gathered at varying angles of attack, flow speeds of Mach 0.2-0.35 and Re of 2-10 million. The correlations between results of the two model sizes commends the valid transfer of the results to actual flight conditions. Observed external flow separation was attributed to a turbulent boundary layer effect at the inlet lip in the conditions studied. M.S.K.

A84-45052#
NUMERICAL COMPUTATION OF TRANSONIC FLOW PAST AN AXISYMMETRIC NACELLE
PH. MORICE, L. CAMBIER, and J. P. VEUILLOT (ONERA, Chatillon-sous-Bagneux, Hauts-de-Seine, France) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 1116-1122. Research supported by the SocieteNationale Industrielle Aerospatiale. refs

A numerical model is defined for inviscid steady transonic flow over an axisymmetric nacelle with a dual-flow nozzle. The flowfield is decomposed into the outer, primary (inlet) and fan jet flows separated by fitted discontinuities and expressed by the Euler equations. A finite element method is used to solve the streamfunctions for external and inlet flows and a finite difference pseudo-unsteady technique is applied to the fan jet propulsive flow. Sample calculations are provided for three transport aircraft nacelles. Usage of a full potential equation instead of the streamfunction formulation is indicated for extending the model to the three-dimensional realm. M.S.K.

A84-45053#
MULTICOMPONENT CALCULATIONS OF THE AERODYNAMIC CHARACTERISTICS OF AIRCRAFT AFTER-BODIES
M. S. OGGIANO (CNR, Centro di Studio sulla Dinamica dei Fluidi, Turin, Italy), M. ONOFRI (Roma, Universita, Rome, Italy), M. ONORATO, and L. ZANNETTI (Torino, Politecnico, Turin, Italy) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 1123-1126. refs

The aerodynamic characteristics of aircraft after-bodies are studied by means of a multicomponent numerical technique. The case of axisymmetric flows is considered. The body is assumed to be without base, the studied region includes the external flow, the flow inside the nozzle and the plume. The analysis is limited to the case of weak viscid-inviscid interaction. The inviscid part of the calculation is based on a time-dependent technique. Starting from an initial configuration of the external and internal flows, the Euler equations are integrated in time until a steady flow configuration is achieved. The numerical scheme belongs to the lambda-family, it is based on up-wind differences in order to take into account the proper domain of dependence of each computed point during the transient. Viscous flow regions are described by compressible turbulent shear layers. The coupling with the outer inviscid flow is obtained by use of the displacement thickness concept. Validity of the calculation method is established by comparison with published experimental data. Author

A84-45055#
EFFECTS OF ENGINE NACELLES ON TRANSONIC FLOW AROUND AIRPLANE CONFIGURATIONS, CALCULATIONS BY TSP-METHOD
N. AGRELL, S. G. HEDMAN (Flygtekniska Forsoksanstalten, Bromma, Sweden), and D. Q. WANG (Northwestern Polytechnical University, Xian, People's Republic of China) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 1139-1146. Research supported by the Swedish Air Board and Chinese Aeronautical Establishment. refs

Transonic small perturbation methods have proven themselves to be able to predict aerodynamic coefficients quite accurately for wing body combinations at transonic speed. In this paper it will be shown how this capability is planned to be extended to wing body nacelle combinations through the use of the technique to embed local grids for the nacelle and the pylon into the global wing body grid. Results are shown for inlets and nacelles as well as for wing body combinations demonstrating that sufficiently accurate solutions for the components of the combination have been obtained. The computations for a wing body pylon nacelle combination are in preparation. Author

A84-45069#
ON OPTIMUM SUPERSONIC WINGS WITH SUBSONIC LEADING EDGES
H. J. BOS (Delft, Technische Hogeschool, Delft, Netherlands) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 1256-1262. refs

The planform optimization for supersonic wings with subsonic leading edges is a longstanding problem in linearized supersonic wing theory. Following Kogan, momentum flux theory in a characteristic control surface is used to minimize the drag of a supersonic non-slender wing with subsonic leading edges and a supersonic trailing edge producing a given lift. The resulting boundary value problem for Laplace's equation is solved exactly for a wing with sonic trailing edges and by approximation for a wing with a straight trailing edge perpendicular to the undisturbed flow. The resulting minimum value of the drag is compared with a flat plate wing producing the same lift. Next a method is presented to relate the optimum potential distribution on the control surface to the so-called Hayes-cuts of the optimum lift distribution on the wing. The results are compared with the elliptical distributions obtained by Jones to produce minimum wave drag. Since the shape of the subsonic leading edges need not be specified in the present method, non-uniqueness of the optimum planform seems to exist. Author

A84-45177#
THE INTERACTION OF A SHOCK WAVE AND A TURBULENT BOUNDARY LAYER AND ITS CONTROL [L'INTERACTION ONDE DE CHOC-COUCHE LIMITE TURBULENTE ET SON CONTROLE]
J. DELERY (ONERA, Chatillon-sous-Bagneux, Hauts-de-Seine, France) (NATO, AGARD, Meeting, Brussels, Belgium, May 21-23, 1984) ONERA, TP, no. 1984-27, 1984, 42 p. In French. refs
(ONERA, TP NO. 1984-27)

The basic properties of the interaction between a shock wave and a turbulent boundary layer in the transonic or supersonic flow around a wing profile are summarized, and methods proposed to limit the detrimental effects of such interactions on the performance of aircraft are surveyed. Phenomena such as upstream interaction length, incipient shock-induced separation and the evolution of the boundary layer parameters are examined; control methods characterized include wall cooling, wall mass transfer, upstream blowing, suction or injection at the shock foot, and boundary-layer

removal. Graphs, diagrams, and photographs are provided, and calculation procedures for laminar interactions are presented.
T.K.

A84-45183#

ADVANTAGE OF INTERNAL BLEED FOR THE PERFORMANCE OF A TWO-DIMENSIONAL AIR INTAKE IN THE EXTENDED MACH-NUMBER RANGE 1.8 - 3+ [INTERET DU PIEGE INTERNE POUR LE FONCTIONNEMENT D'UNE PRISE D'AIR BIDIMENSIONNELLE DANS UN DOMAINE ETENDU DU NOMBRE DE MACH /1,8 - 3+/]

G. LARUELLE, C. SANS (ONERA, Chatillon-sous-Bagneux, Hauts-de-Seine, France), and R. LEFEBVRE (Societe Nationale Industrielle Aerospatiale, Paris, France) (NATO, AGARD, Symposium on Improvement of Aerodynamic Performance Through Boundary Layer Control and High Lift Systems, Brussels, Belgium, May 21-25, 1984) ONERA, TP, no. 1984-38, 1984, 11 p. In French. refs
(ONERA, TP NO. 1984-38)

The modifications introduced to extend the performance range of a two-dimensional air intake (for a ramjet missile) with variable geometry and internal boundary-layer bleeding from Mach 2 to about Mach 3 are characterized and illustrated with graphs, drawings, and photographs obtained using a large-scale model in the S2 supersonic wind tunnel at ONERA Modane. A compromise configuration giving satisfactory performance throughout the Mach-number range and at various angles of sideslip and attack is developed by optimizing the bleed at the extreme outer edge of the external ramp and introducing complementary bleeds on the shroud or sides.
T.K.

A84-45203#

ANALYSIS ON AN IMPLICIT EULER SOLVER

V. DARU (ONERA, Chatillon-sous-Bagneux, Hauts-de-Seine, France) and A. LERAT (Ecole Nationale Superieure d'Arts et Metiers, Paris, France) (Institut National de Recherche en Informatique et en Automatique, Journee sur les Methodes Numeriques pour les Equations d'Euler pour les Fluides Compressibles non Visqueux, Rocquencourt, Yvelines, France, Dec. 7-9, 1983) ONERA, TP, no. 1984-62, 1984, 36 p. refs
(ONERA,TP NO. 1984-62)

An implicit method for the time-dependent Euler equations is analyzed, with particular emphasis on steady-state calculations. Results are obtained concerning the nonlinear stability properties, the dependence of the steady-state on the time step, the convergence rate to the steady-state, and the effects on stability of the boundary conditions and the factorization in space.
Author

A84-45524

EXPERIMENTAL STUDIES INVOLVING SWEPTBACK CORNER CONFIGURATIONS IN LONGITUDINAL FLOW OF THE HYPERSONIC RANGE [EXPERIMENTELLE UNTERSUCHUNGEN AN LAENGSANGESTROEMTEN, GEPFEILTEN ECKENKONFIGURATIONEN IM HYPERSCHALLBEREICH]

W. MOELLENSTAEDT Braunschweig, Technische Universitaet, Fakultaet fuer Maschinenbau und Elektrotechnik, Dr.-Ing. Dissertation, 1984, 165 p. In German. refs

Aircraft and flight vehicles which perform a part of their mission in the hypersonic range (at Mach numbers greater than five) are subjected to considerable thermal stresses as a consequence of kinetic heating. Thus, high thermal stresses arise at aircraft components which are exposed to an interference of compression shocks and boundary layer flows. Corner regions represent an example for such components. The present investigation forms part of a program for the systematic study of hypersonic corner flows. Results of the first part of this program have been reported by Kipke and Hummel (1975). The current investigation takes into account also the effect of the angle of sweepback of the leading edge on the characteristics of the hypersonic flow. The results of the investigation are to make it possible to gain a better understanding of the process of shock-boundary layer interference. In addition, the measured data are to provide an aid for the formulation of theoretical approximate methods permitting the calculation of fundamental interference problems.
G.R.

A84-45534#

ON THE AERODYNAMIC CHARACTERISTICS OF TWO- AND THREE-DIMENSIONAL CONCAVE BODIES

M. HAYASHI, A. SAKURAI, S. ASO, and S.-I. TENHIRO Kyushu University, Technology Reports (ISSN 0023-2718), vol. 57, March 1984, p. 137-142. In Japanese, with abstract in English.

To investigate the aerodynamic characteristics of parachutes, three series of two and three-dimensional concave models have been prepared and the flow fields around them are studied in detail using the smoke-wire technique. These models cover a range of height ratios from 0.3 to 1.5 for two-dimensional cases and from 0.2 to 1.0 for three-dimensional ones. The results indicate that the drag of two-dimensional elliptic concave bodies reaches its peak value at a height ratio of 0.8, while in three-dimensional cases the drag actually incrases until the ratio reaches the maximum. The influence of the opening section shapes is investigated by closing this section or by attaching various skirts to the front of the models. The results show that concavity of the models makes the flow fields unstable over a height range from 0.5 to 0.8. The drag decreases significantly when a skirt of height ratio 0.4 is attached to the model.
C.D.

A84-45701

A PANEL METHOD FOR CALCULATING LOADS ON THE SURFACE OF A WING OF FINITE THICKNESS VIBRATING HARMONICALLY IN A SUBSONIC FLOW [PANEL'NYI METOD RASCHETA NAGRUZKI NA POVERKHNOSTI KRYLA KONECHNOI TOLSCHINY, GARMONICHESKI KOLEBLIUSHCHEGOSIA V DOZVUKOVOM POTOKE]

P. M. GOSTEV and V. V. MOZZHILKIN TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 14, no. 1, 1983, p. 1-8. In Russian. refs

The problem of the determination of a load on the surface of a harmonically vibrating wing is examined for subsonic flight speeds over a range of moderate aspect ratios and Strouhal numbers. By applying the linear theory, the problem is split into the problems of flow past a lifting surface and past a symmetric-profile wing at zero angle of attack. Both problems are solved using the panel method. It is noted that the wing thickness must be taken into account when its vibration amplitude is of the order of the thickness.
V.L.

A84-45702

THREE-DIMENSIONAL HYPERSONIC FLOW PAST A WING WITH A LOW ASPECT RATIO [GIPERZVUKOVOE PROSTRANSTVENNOE OBTEKANIE KRYLA MALOGO UDLINENIIA]

A. I. GOLUBINSKII and V. V. NEGODA TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 14, no. 1, 1983, p. 9-17. In Russian. refs

Three-dimensional hypersonic flow of a nonviscous gas past a slender wing with an attached shock wave is analyzed assuming that the wing aspect ratio is comparable with the Mach number in the compression layer. In particular, attention is given to wings whose shape (the leading edge and the thickness) are described by smooth functions. Expressions for the shape of the attached shock wave and other gasdynamic parameters are obtained in the form of series expansions in terms of a parameter characterizing the leading edge geometry. The convergence of the series is investigated for the stream function of the wing surface and functions describing the points of intersection between the lines of flow and the shock wave.
V.L.

A84-45703
THE ABSORPTION OF AN ENTROPY LAYER ON A BLUNTED CONE IN HYPERSONIC FLOW OF A VISCOUS GAS [POGLOSHCHENIE ENTROPIINOGO SLOIA NA ZATUPLENNOM KONUSE V GIPERZVUKOVOM POTOKE VIAZKOGO GAZA]
IU. G. ELKIN, IU. N. ERMAK, I. I. LIPATOV, and V. IA. NEILAND TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 14, no. 1, 1983, p. 18-25. In Russian. refs

An asymptotic theory is developed which describes the absorption of an entropy layer by a boundary layer in hypersonic flow of a viscous gas past a blunted cone. Equations, as well as boundary and initial conditions are obtained. A similarity parameter is determined which characterizes the conditions of the absorption of the entropy layer by the boundary layer. Numerical solutions are obtained for a flow of a Newtonian gas past a hyperboloid of revolution. V.L.

A84-45704
A ONE-DIMENSIONAL THEORY FOR A SUPERSONIC GAS EJECTOR WITH AN ISOBARIC MIXING CHAMBER [ODNOMERNAIA TEORIIA SVERKHZVUKOGO GAZOVOGO EZHEKTORA S IZOBARICHESKOI KAMEROI SMESHENIIA]
V. S. BAIKOV and IU. N. VASILEV TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 14, no. 1, 1983, p. 26-38. In Russian. refs

A theory is developed for a supersonic gas ejector with an isobaric mixing chamber having a rather large initial section and a cylindrical neck. The possible operation modes of the ejector are described, and ejection equations are obtained for the case where the gases being mixed have different physical properties. Parameters of a gas-mixture jet formed in the initial section of the chamber at a constant static pressure equal to the full pressure of the low-head gas are determined. The conditions corresponding to critical regimes and mixing chamber locking are also determined. V.L.

A84-45705
CHARACTERISTICS OF FLOW PAST AN AIR INTAKE WITH A SHARP COWL EDGE AT MACH LESS THAN 1 [OSOBENNOSTI OBTEKANIIA VOZDUKHOZABORNIKA S OSTROI KROMKOI OBECHAIKI PRI M LESS THAN L]
V. O. AKINFIEV TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 14, no. 1, 1983, p. 39-47. In Russian.

Nonseparated plane flow of a nonviscous incompressible gas past an air intake with a sharp cowl edge is calculated numerically using methods of the theory of analytical functions. It is found that there is a significant difference between the cases of nonzero and zero undercut, as far as the behavior of the force applied to the dividing flow line and the position of the critical point of the flow during changes in the flow rate are concerned. V.L.

A84-45706
CHARACTERISTICS OF THE ELECTRIFICATION OF A METAL BODY MOVING AT A HIGH VELOCITY IN AN AEROSOL MEDIUM [OSOBENNOSTI ELEKTRIZATSII METALLICHESKOGO TELA, DVIZHUSHCHEGOSIIA S BOL'SHOI SKOROST'IU V AEROZOL'NOI SREDE]
A. P. KURIACHII TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 14, no. 1, 1983, p. 48-56. In Russian. refs

The mechanisms of the electrification of a blunted metal body in a flow of droplets are examined. It is found that the body is positively charged at high flow velocities, which is ascribed to the effect of exoelectron emission. An explanation is proposed for the decrease in the electrification current of the body observed at supersonic velocities in an aerosol medium. V.L.

A84-45711
A CALCULATION OF LOAD DISTRIBUTION IN WINGS IN A SUPERSONIC FLOW [RASCHET RASPREDELENIIA NAGRUZKI NA KRYL'IAKH V SVERKHZVUKOVOM POTOKE]
N. N. GLUSHKOV and V. G. KAZHAN TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 14, no. 1, 1983, p. 94-97. In Russian.

A procedure is proposed for calculating aerodynamic loads on wings of arbitrary planform in a linearized supersonic flow. The loads are calculated in the cells of a computational grid formed by Mach lines. The method proposed here can be used for the stress analysis of both a lifting surface and a wing of finite length. V.L.

A84-45712
FLOW PAST A CYLINDER IN THE PRESENCE OF A JET IN ITS WAKE [OBTEKANIE TSILINDRA PRI NALICHII STRUI V SLEDE]
I. A. BELOV and N. A. KUDRIAVTSEV TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 14, no. 1, 1983, p. 98-102. In Russian.

For a streamlined body, the problem of the propagation of a jet from the bottom section in a longitudinal flow can be solved by approximate integral methods on the basis of the assumption that the characteristics of jet propagation are independent of the body shape. However, this approach is not acceptable in the case of a bluff body, such as a cylinder with flat ends. The jet propagation problem for a cylinder in a symmetric laminar flow of a viscous incompressible fluid is solved here using exact Navier-Stokes equations. The approach is illustrated for a cylinder with an aspect ratio of 2 in a flow with Re = 500. V.L.

A84-45713
THE INTERACTION BETWEEN AN UNSTEADY BOUNDARY LAYER AND A SUPERSONIC FLOW UNDER CONDITIONS OF STRONG SLOT INJECTION [VZAIMODEISTVIE NESTATSIONARNOGO POGRANICHNOGO SLOIA I SVERKHZVUKOVOGO POTOKA PRI SIL'NOM SHCHELEVOM VDUVE]
A. V. KAZAKOV TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 14, no. 1, 1983, p. 103-107. In Russian. refs

The problem of unsteady gas injection into a supersonic laminar boundary layer on a flat plate is analyzed for the case where the characteristic Reynolds number tends to infinity. The analysis is based on a three-layer scheme of the unsteady flow formed in the region of the interaction between the supersonic flow and the boundary layer. Results are presented in graphical form. V.L.

A84-45714
THE EFFECT OF AIR CONDENSATION ON HEAT TRANSFER AND CERTAIN CHARACTERISTICS OF FLOW IN A WIND TUNNEL [VLIIANIE KONDENSATSII VOZDUKHA NA TEPLOOBMEN I NEKOTORYE KHARAKTERISTIKI TECHENIIA V AERODINAMICHESKOI TRUBE]
A. M. BESPALOV, M. I. GORSHKOV, and A. G. MIKHALCHENKO TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 14, no. 1, 1983, p. 108-112. In Russian. refs

It is shown experimentally that in the case of air condensation in a wind tunnel, the equilibrium wall temperature may be substantially lower than the stagnation temperature, giving rise to negative heat fluxes on test models. In order to avoid major errors due to the effect of air condensation, it is recommended that such a possibility be always considered during wind tunnel tests. In supersonic wind tunnels equipped with an Eiffel chamber, air condensation in the wind tunnel can be detected from the slope of the linear section of the starting characteristic. V.L.

A84-45719
INVESTIGATION OF FLOW IN THE WAKE OF A HIGH-ASPECT-RATIO WING AND THE NONLINEAR MOMENT CHARACTERISTICS OF A WING-FUSELAGE MODEL AT LARGE ANGLES OF ATTACK [ISSLEDOVANIE TECHENIIA V SLEDE ZA KRYLOM BOL'SHOGO UDLINENIIA I NELINEINYKH MOMENTNYKH KHARAKTERISTIK MODELI KRYLO + FIUZELIAZH PRI BOL'SHIKH UGLAKH ATAKI]
V. A. BARINOV, IU. V. BOCHAROVA, and G. A. IUDIN TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 14, no. 2, 1983, p. 1-7. In Russian.
The paper presents results of measurements of the model of a high-aspect-ratio swept wing and fuselage at alpha ranging from -4 to 20 deg at a Mach number of 0.8. Also presented are calculations of the lift coefficient and the longitudinal static moment according to data on static pressure on the wing and fuselage surface. Skew angles and flow velocities near the trailing edge of the wing and near the horizontal tail were measured. It is shown that the nonlinearity of the characteristics of the longitudinal static moment of the wing-fuselage combination is due to changes in aerodynamic forces acting on the wing and to corresponding changes in aerodynamic forces acting on the fuselage under the effect of the flow field near the wing. B.J.

A84-45720
CALCULATION OF INVISCID TRANSONIC FLOW PAST A WING-FUSELAGE COMBINATION [RASCHET NEVIAZKOGO OKOLOZVUKOVOGO OBTEKANIIA KRYLA S FIUZELIAZHEM]
V. I. SAVITSKII TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 14, no. 2, 1983, p. 8-16. In Russian. refs
Small-perturbation theory is used to analyze inviscid transonic flow past an arbitrary wing and infinite cylindrical fuselage. The method involves the transformation of the coordinate system, and the problem is solved by a relaxation method using a finite-difference scheme. The unsteady analogy is used to choose the finite-difference approximation of the equation and boundary equations, as well as to choose the relaxation coefficient. The calculation results are found to agree satisfactorily with experimental data. B.J.

A84-45721
METHOD OF UNIFORMLY PRECISE APPROXIMATION AND ITS APPLICATION TO THE CALCULATION OF THE AERODYNAMIC INTERACTION OF A WING-FUSELAGE COMBINATION AND A BODY OF REVOLUTION AT SUPERSONIC FLIGHT SPEEDS [METOD RAVNOMERNO TOCHNOI APPROKSIMATSII I EGO PRIMENENIE K RASCHETU AERODINAMICHESKOGO VZAIMODEISTVIIA KOMBINATSII KRYLO-FIUZELIAZH I TELA VRASHCHENIIA PRI SVERKHZVUKOVYKH SKOROSTIAKH POLETA]
S. I. KUSAKIN TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 14, no. 2, 1983, p. 17-29. In Russian. refs
Attention is given to the problem of determining the aerodynamic characteristics of a body of revolution in the three-dimensional velocity field of perturbations induced by a wing-fuselage combination (WFC) in a supersonic flow. In order to obtain results more precise than those based on linear theory, a method is formulated for the uniformly precise approximation of the nonlinear differential equation for the additional velocity potential, describing weakly perturbed three-dimensional supersonic flows by a sequence of linear equations. A determination is made of the general form of the first approximation to the solution of the precise problem near shocks or characteristic surfaces, coinciding in linear theory with Mach cones of the unperturbed flow. Attention is given to the calculation of local skews of the flow produced by the WFC as well as to the calculation of coefficients of lift and lateral forces acting on the body of revolution situated in this field. B.J.

A84-45722
SUPERSONIC FLOW IN THE CORNER FORMED BY TWO INTERSECTING WEDGES WITH SLIP [SVERKHZVUKOVOE TECHENIE V DVUGRANNOM UGLE SO SKOL'ZHENIEM]
V. S. GORISLAVSKII and G. I. TAGANOV TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 14, no. 2, 1983, p. 30-36. In Russian. refs
The paper presents results of a numerical study of the three-dimensional conical flow of an inviscid gas in the corner formed by two intersecting wedges at a freestream Mach number of 6, an angle of attack of 25 deg, and a slip angle of 5 deg. Numerical results are compared with calculations made on the basis of a simplified five-shock model in order to examine flow parameters in the corner region for differential spatial configurations. B.J.

A84-45723
EFFECT OF MACH AND REYNOLDS NUMBERS ON HEAT TRANSFER AT THE BLUNT LEADING EDGE OF A VARIABLE-SWEEP WING IN THE REGION OF BOW-WAVE INCIDENCE [VLIIANIE CHISEL MAKHA I REINOL'DSA NA TEPLOOBMEN NA ZATUPLENNOI PEREDNEI KROMKE KRYLA PEREMENNOI STRELOVIDNOSTI V OBLASTI PADENIIA GOLOVNOI VOLNY]
V. IA. BOROVOI, V. V. OSIPOV, L. A. PLESHAKOVA, and M. V. RYZHKOVA TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 14, no. 2, 1983, p. 58-66. In Russian. refs
Experimental results are presented concerning heat transfer on the blunt leading edge of a half-wing model with a sweep angle of the front part of 75 deg and a sweep angle of the back part of 45 deg at zero angle of attack. Experiments were conducted in a shock tube at freestream Mach numbers of 6.1, 8, and 16 in the Reynolds number range of 100,000 to 10,000,000. A change in the distribution of the heat transfer coefficient is observed which is due to laminar to turbulent transition of the boundary layer. B.J.

A84-45724
AN OPTIMUM GAS EJECTOR WITH AN ISOBARIC MIXING CHAMBER [OPTIMAL'NYI GAZOVYI EZHEKTOR S IZOBARICHESKOI KAMEROI SMESHENIIA]
V. S. BAIKOV and IU. N. VASILEV TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 14, no. 2, 1983, p. 77-85. In Russian.
The study is concerned with the problem of determining the optimum geometrical parameters of a gas ejector corresponding to a specified increase in pressure with a maximum ejection ratio or, conversely, a specified ejection ratio with a maximum increase in pressure. Optimality conditions are determined for a supersonic gas ejector with an isobaric mixing chamber having a sufficiently large initial section and a cylindrical neck. The limiting theoretical characteristics of such an ejector are presented. V.L.

A84-45728
A NUMERICAL SOLUTION TO THE PROBLEM OF FLOW PAST A PLATE WITH A JET FLAP OF FINITE WIDTH FOR VARIOUS BERNOULLI NUMBERS [CHISLENNOE RESHENIE ZADACHI OBTEKANIIA PLASTINKI SO STRUINYM ZAKRYLKOM KONECHNOI SHIRINY PRI RAZLICHNYKH CHISLAKH BERNULLI]
S. V. KUZMIN TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 14, no. 2, 1983, p. 113-119. In Russian. refs
The problem considered here is that of an ideal incompressible infinite flow past a plate at angle of attack, with a finite-width fluid jet issuing from the trailing edge of the plate. It is assumed that the Bernoulli constant of the jet is greater than that of the oncoming flow. Numerical solutions to a system of equations describing this problem are obtained using the method of successive approximations. V.L.

A84-45729
PRESSURE DISTRIBUTION ON A LOW-ASPECT-RATIO WING IN HYPERSONIC FLOW [RASPREDELENIE DAVLENIIA NA KRYLE MALOGO UDLINENIIA V GIPERZVUKOVOM POTOKE]
A. I. GOLUBINSKII and V. V. NEGODA TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 14, no. 2, 1983, p. 120-125. In Russian. refs
The asymptotic theory for a thin shock layer on a low-aspect-ratio wing in hypersonic flow is used here to obtain analytical formulas for pressure distribution in the perturbed flow and on the wing surface. A general solution is obtained in the form of a series expansion in terms of a small parameter characterizing the thickness of the wing and its planform. A formula for the pressure is obtained in closed form to a second approximation. V.L.

A84-45730
AN INVESTIGATION OF A METHOD FOR CONTROLLING A THREE-DIMENSIONAL SEPARATION ZONE [ISSLEDOVANIE SPOSOBA UPRAVLENIIA TREKHMERNOI OTRYVNOI ZONOI]
G. F. GLOTOV and IU. F. KORONTSVIT TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 14, no. 2, 1983, p. 126-131. In Russian. refs
A new method for controlling and stabilizing a three-dimensional separation is proposed which consists in setting up a transverse needle in the symmetry plane in front of a three-dimensional obstacle in supersonic flow. Results of an experimental investigation of the possibility of controlling the size of the separation zone in front of a three-dimensional obstacle (e.g., a jet or a cylinder) on the lateral surface of a body of revolution are presented. It is shown that the use of a transverse needle in front of the obstacle makes it possible to substantially reduce the size of the separation zone. V.L.

A84-45731
AN ANALYSIS OF FLOW PAST AXISYMMETRIC INTAKES AT LOW VELOCITIES [RASCHET OBTEKANIIA OSESIMMETRICHNYKH VOZDUKHOZABORNIKOV PRI MALYKH SKOROSTIAKH]
Z. G. LEVSHINA and T. S. PETROVSKAIA TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 14, no. 2, 1983, p. 132-137. In Russian. refs
A method is proposed for calculating flow of an ideal incompressible fluid past axisymmetric intakes at arbitrary angles of attack and with arbitrary flow coefficients. The problem is solved by considering sources and sinks uniformly distributed over the surface of a body. Some parts of the surface may be permeable, with the normal component of fluid flow specified. The calculated results are compared with experimentally determined pressure distributions. V.L.

A84-45732
SEPARATED FLOW OF A COMPRESSIBLE GAS PAST A FINITE-ASPECT-RATIO WING WITH A STRAKE [OTRYVNOE OBTEKANIE KRYL'EV KONECHNOGO UDLINENIIA S NAPLYVOM POTOKOM SZHIMAEMOGO GAZA]
S. B. ZAKHAROV and G. G. SUDAKOV TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 14, no. 3, 1983, p. 1-11. In Russian. refs
The problem of separated flow of a compressible gas past a finite-aspect-ratio wing with a strake (a low-aspect-ratio triangular plate) is analyzed using the method of matched asymptotic expansions. A solution is obtained which is equally valid for all regions, and the accuracy of the solution is evaluated asymptotically. The effect of free-stream Mach on the aerodynamic characteristics of the wing is analyzed, and calculations of aerodynamic characteristics are presented for several strake-wing configurations. V.L.

A84-45733
HYPERSONIC AIR FLOW PAST LOW-ASPECT-RATIO WINGS AND THIN BODIES [OBTEKANIE KRYL'EV MALOGO UDLINENIIA I TONKIKH TEL GIPERZVUKOVYM POTOKOM VOZDUKHA]
T. M. PRITULO TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 14, no. 3, 1983, p. 12-20. In Russian.
Hypersonic flow of a gas past a three-dimensional thin wing of low aspect ratio is analyzed from the standpoint of shock layer theory. Both direct and reverse problems are considered. Exact solutions to shock layer equations are obtained for a wide class of thin body and wing configurations. The approach proposed here is illustrated by examples. V.L.

A84-45734
A SIMILARITY LAW FOR HYPERSONIC FLOW OF UNIFORMLY REACTING AIR PAST A LOW-ASPECT-RATIO WING [ZAKON PODOBIIA PRI OBTEKANII KRYLA MALOGO UDLINENIIA GIPERZVUKOVYM POTOKOM RAVNOVESNO REAGIRUISHCHEGO VOZDUKHA]
A. I. GOLUBINSKII and V. V. NEGODA TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 14, no. 3, 1983, p. 21-29. In Russian. refs
The theory of hypersonic flow past three-dimensional thin wings of low aspect ratio (Messiter, 1959 and 1963) is extended to the case where the disturbed flow is characterized by equilibrium physicochemical processes (e.g., dissociation, vibrational excitation of air molecules, and ionization). It is found that, generally, the principal equations of the theory remain unchanged, but the theory is supplemented by two similarity parameters allowing for the effects of the real properties of the air. V.L.

A84-45736
THE EFFECT OF GAS COMPRESSIBILITY ON THE CHARACTERISTICS OF FLOW IN THE VICINITY OF THE SEPARATION POINT OF A LAMINAR BOUNDARY LAYER [VLIIANIE SZHIMAEMOSTI GAZA NA KHARAKTERISTIKI TECHENIIA V OKRESTNOSTI TOCHKI OTRYVA LAMINARNOGO POGRANICHNOGO SLOIA]
G. L. KOROLEV TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 14, no. 3, 1983, p. 37-43. In Russian. refs
Flow separation over a smooth surface is investigated for the case where the Mach number near the separation point is less than unity but transonic flow has not been realized. If the Mach number, as determined from the flow parameters in front of the separation point, is less than a certain value, then the problem of self-induced separation is reduced to the well-known separation problem for an incompressible fluid (Sychev, 1972). The numerical value of the asymptotic similarity parameter for flow at the point of separation is determined. V.L.

A84-45737
AN ASYMPTOTIC THEORY FOR THE INTERACTION BETWEEN A SUPERCRITICAL BOUNDARY LAYER AND A HYPERSONIC GAS FLOW [ASIMPTOTICHESKAIA TEORIIA VZAIMODEISTVIIA ZAKRITICHESKOGO POGRANICHNOGO SLOIA S GIPERZVUKOVYM POTOKOM GAZA]
T. V. TITOVSKAIA TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 14, no. 3, 1983, p. 44-50. In Russian. refs
The problem of hypersonic flow with disturbance propagation through a supercritical boundary layer is formulated using Navier-Stokes equations and the method of matched asymptotic expansions. A system of equations for the problem eisenvalues is solved using a second-order difference scheme and a difference factorization procedure. Estimates of flow functions are obtained in a local flow region characterized by strong interaction between the boundary layer and external flow. V.L.

A84-45738
PLANE, RECTANGULAR, AXISYMMETRIC CONVERGENT CHANNELS [PLOSKIE, PRIAMOUGOL'NYE I OSESIMMETRICHNYE KONFUZORY]
F. R. KASHAPOV, I. K. ROMASHKIN, and L. A. SIMONOV TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 14, no. 3, 1983, p. 51-58. In Russian. refs

A method is proposed for designing plane convergent channels using the angle of the channel walls as the starting data. The effect of the aspect ratio of the convergent channel on the extent of flow deceleration is examined. It is shown how rectangular and axisymmetric convergent channels can be generated by adding, in space, plane channel flows rotated to different angles relative to the symmetry axis of the channel. V.L.

A84-45739
AN OPTIMIZATION OF SUBSONIC AXISYMMETRIC TRANSITION CHANNELS [OPTIMIZATSIIA DOZVUKOVYKH OSESIMMETRICHNYKH PEREKHODNYKH KANALOV]
A. E. KONOVALOV TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 14, no. 3, 1983, p. 59-65. In Russian. refs

An engineering method is proposed for minimizing the length of annular transition channels connecting sections of a gasdynamic duct of different diameters in such a way as to assure that the flow does not separate. This condition is achieved by using a local criterion which restricts the boundary layer pressure gradient. An optimum channel profile is determined by solving numerically the corresponding boundary value problem. V.L.

A84-45744
A NUMERICAL DETERMINATION OF THE CHARACTERISTICS OF SUPERSONIC AIR INTAKES ON THE BASIS OF CALCULATIONS OF CONICAL FLOWS OF AN IDEAL GAS [CHISLENNOE OPREDELENIE KHARAKTERISTIK SVERKHZVUKOVYKH VOZDUKHOZABORNIKOV NA OSNOVE RASCHETOV KONICHESKIKH TECHENII IDEAL'NOGO GAZA]
I. M. FILIMONOV TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 14, no. 3, 1983, p. 101-106. In Russian. refs

An algorithm for calculating conical flows of an ideal gas has been developed on the basis of a modified version of the McCormack scheme. Here, the McCormack scheme is used for the numerical solution of unsteady gasdynamic equations in integral form. Boundary conditions on the surface of the body are specified numerically using the method of characteristics; the bow shock is isolated. Calculations are made of the external characteristics of an elliptic air intake in comparison with the characteristics of conventional axisymmetric (circular) intakes. V.L.

A84-45745
A STUDY OF THE SPATIAL FLOW AND AERODYNAMIC CHARACTERISTICS OF TWO-DIMENSIONAL INTAKES WITH VARIOUS INLET SHAPES AND LATERAL SURFACE DIMENSIONS [ISSLEDOVANIE PROSTRANSTVENNOGO OBTEKANIIA I AERODINAMICHESKIKH KHARAKTERISTIK PLOSKIKH VOZDUKHOZABORNIKOV S RAZLICHNOI FORMOI VKHODA I RAZMERAMI BOKOVYKH SHCHEK]
S. M. BOSNIAKOV, S. A. BYKOVA, and N. KH. REMEEV TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 14, no. 3, 1983, p. 107-113. In Russian. refs

The characteristics of a schematic two-dimensional intake in supersonic flow (free-stream Mach, 2-4) are investigated analytically and experimentally. Versions with various types of lateral surfaces and various ratios of the inlet sides are considered. It is shown that the three-dimensional nature of flow depends on the above parameters and that it has a significant effect on the intake characteristics. V.L.

A84-45956*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
APPLYING SLENDER WING BENEFITS TO MILITARY AIRCRAFT
E. C. POLHAMUS (NASA, Langley Research Center, Hampton, VA) Journal of Aircraft (ISSN 0021-8669), vol. 21, Aug. 1984, p. 545-559. Previously cited in issue 24, p. 3545, Accession no. A83-49596. refs

A84-45959*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
TRANSONIC PRESSURE DISTRIBUTIONS ON A RECTANGULAR SUPERCRITICAL WING OSCILLATING IN PITCH
R. H. RICKETTS, M. C. SANDFORD, D. A. SEIDEL, and J. J. WATSON (NASA, Langley Research Center, Hampton, VA) (Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers, Part 2, p. 399-408) Journal of Aircraft (ISSN 0021-8669), vol. 21, Aug. 1984, p. 576-582. Previously cited in issue 12, p. 1697, Accession no. A83-29849. refs

A84-45962#
UNSTEADY FLOW CONCEPTS FOR DYNAMIC STALL ANALYSIS
L. E. ERICSSON and J. P. REDING (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA) Journal of Aircraft (ISSN 0021-8669), vol. 21, Aug. 1984, p. 601-606. Previously cited in issue 19, p. 2970, Accession no. A82-39101. refs

A84-45988
AERODYNAMIC CHARACTERISTICS OF PRETENSIONED ELASTIC MEMBRANE RECTANGULAR SAILWINGS
V. S. HOLLA, K. P. RAO, A. AROKKIASWAMY (Indian Institute of Science, Bangalore, India), and C. B. ASTHANA (Indian Institute of Science, Bangalore; Air India, Bombay, India) Computer Methods in Applied Mechanics and Engineering (ISSN 0045-7825), vol. 44, June 1984, p. 1-16. refs

Presented in the paper are the details of a method for obtaining aerodynamic characteristics of pretensioned elastic membrane rectangular sailwings. This is a nonlinear problem governed by the membrane equation for the inflated sail and the lifting surface theory integral equation for aerodynamic loads on the sail. Assuming an admissible mode shape for the inflated elastic sail, an iterative procedure based on a doublet lattice method is employed to determine the inflated configuration as well as various aerodynamic characteristics. Application of the method is made to a typical nylon-cotton sailwing of AR = 6.0 and results are presented graphically to show the effect of various parameters. The results are found to tend to plane wing values when the pretensions are large in magnitude. Author

A84-46007#
CALCULATION OF TRAILING VORTEX SHEET AND DOWNWASH FIELD BEHIND A SWEPTBACK WING
G. CHEN Northwestern Polytechnical University, Journal, vol. 2, July 1984, p. 317-322. In Chinese, with abstract in English.

A numerical method for calculating the trailing vortex sheet location and the downwash field behind a sweptback wing is presented. The Prandtl-Glauert transformation is applied to make the method applicable to calculating the trailing vortex system and the downwash field of an arbitrary sweptback wing in compressible flow. The trailing vortex patterns behind the wings of two wing-tail configurations and the downwash fields in the tail regions are computed as illustrative examples. The results agree fairly well with experimental ones. The method can be used in aircraft design to determine the proper location of the horizontal tail and to determine the aerodynamic characteristics of aircraft. C.D.

A84-46023
FLOW PAST WING-BODY JUNCTIONS
F. T. SMITH (University College, London, England) and J. GAJJAR (National Maritime Institute, Ltd., Teddington, Middx., England) Journal of Fluid Mechanics (ISSN 0022-1120), vol. 144, July 1984, p. 191-215. Research supported by the Science and Engineering Research Council. refs

The three-dimensional laminar flow past a junction formed by a thin wing protruding normally from a locally flat body surface is considered for wings of finite span but short or long chord. The Reynolds number is taken to be large. The leading-edge interaction for a long wing has the triple-deck form, with the pressure due to the wing thickness forcing a three-dimensional flow response on the body surface alone. The same interaction describes the flow past an entire short wing. Linearized solutions are presented and discussed for long and short two-dimensional wings and for certain three-dimensional wings of interest. The trailing-edge interaction for a long wing is different, however, in that the three-dimensional motions on the wing and on the body are coupled together and in general the coupling is nonlinear. Linearized properties are retrieved only for reduced chord lengths. The overall flow structure for a long wing is also discussed, including the traditional three-dimensional corner layer, which is shown to have an unusual singular starting form near the leading edge. Qualitative comparisons with experiments are made. Author

A84-46102*# Lockheed-Georgia Co., Marietta.
A COMBINED DIRECT/INVERSE THREE-DIMENSIONAL TRANSONIC WING DESIGN METHOD FOR VECTOR COMPUTERS
R. A. WEED (Lockheed-Georgia Co., Marietta, GA), L. A. CARLSON (Texas A&M University, College Station, TX), and W. K. ANDERSON (NASA, Langley Research Center, Hampton, TX) American Institute of Aeronautics and Astronautics, Applied Aerodynamics Conference, 2nd, Seattle, WA, Aug. 21-23, 1984. 18 p. refs
(Contract N00167-81-C-0078)
(AIAA PAPER 84-2156)

A three-dimensional transonic-wing design algorithm for vector computers is developed, and the results of sample computations are presented graphically. The method incorporates the direct/inverse scheme of Carlson (1975), a Cartesian grid system with boundary conditions applied at a mean plane, and a potential-flow solver based on the conservative form of the full potential equation and using the ZEBRA II vectorizable solution algorithm of South et al. (1980). The accuracy and consistency of the method with regard to direct and inverse analysis and trailing-edge closure are verified in the test computations. T.K.

A84-46103*# Texas Univ., Austin.
TRANSONIC CASCADE FLOW ANALYSIS USING VISCOUS/INVISCID COUPLING CONCEPTS
C. R. OLLING and G. S. DULIKRAVICH (Texas, University, Austin, TX) American Institute of Aeronautics and Astronautics, Applied Aerodynamics Conference, 2nd, Seattle, WA, Aug. 21-23, 1984. 9 p. refs
(Contract NAG3-317)
(AIAA PAPER 84-2159)

Transonic two-dimensional cascade flows have been analyzed using viscous/inviscid coupling concepts. A full potential cascade code is coupled with an inverse integral boundary layer/wake method that permits calculation of separated laminar or turbulent flow. The semi-inverse coupling method of Wigton converges slowly in the case of a strong shock in the region between the shock and the trailing edge. The location of a strong shock is not well predicted by the coupling method, which indicates the need for an entropy correction in the potential code or the inclusion of a shock-boundary layer interaction module. Author

A84-46104*# Analytical Methods, Inc., Redmond, Wash.
THE APPLICATION OF A LOW-ORDER PANEL METHOD - PROGRAM VSAERO TO POWERPLANT AND AIRFRAME FLOW STUDIES
D. J. STRASH, J. K. NATHMAN, B. MASKEW, and F. A. DVORAK (Analytical Methods, Inc., Redmond, WA) American Institute of Aeronautics and Astronautics, Applied Aerodynamics Conference, 2nd, Seattle, WA, Aug. 21-23, 1984. 10 p. refs
(Contract NAS2-11169; NAS1-15472)
(AIAA PAPER 84-2178)

Results from the application of VSAERO, a low-order panel method, to three practical aircraft configurations are presented. The Grumman 698-411 tilt-nacelle V/STOL model is analyzed with particular emphasis on the inlet pressures and the nacelle/fuselage interference effects. Excellent correlation with experiment is reported for the inlet pressure ratio and the inlet operational boundaries. Analysis of an inlet designed for a tilt-rotor/nacelle aircraft is presented. The code was used in a design environment for this configuration to determine an inlet geometry that maintained attached flow for three design flight conditions: hover, hover-transition and cruise. VSAERO is also used to examine the prop-slipstream induced loading for the Langley prop-fan configuration. The versatility and economy of the aerodynamic modeling program, VSAERO, is demonstrated. Author

A84-46105*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AN EXPERIMENTAL STUDY OF A SUPERCRITICAL TRAILING-EDGE FLOW
J. L. BROWN (NASA, Ames Research Center, Moffett Field, CA) and P. R. VISWANATH (Stanford University, Stanford, CA) American Institute of Aeronautics and Astronautics, Applied Aerodynamics Conference, 2nd, Seattle, WA, Aug. 21-23, 1984. 19 p. refs
(AIAA PAPER 84-2187)

An experimental study has been conducted of a transonic, turbulent, high-Reynolds-number blunt trailing-edge flow. The model shape and the surface pressure distribution are characteristics of a modern supercritical airfoil under shock-free conditions. Reynolds number and pressure gradient scaling of the boundary layer are relevant to airfoil applications. The data set is exceptionally accurate and consistent, with the momentum balance accounting for the flux of momentum to within 1 percent, except in the immediate vicinity of the blunt trailing edge. The experimental flow exhibits strong viscous-inviscid interaction and higher-order boundary-layer effects including strong adverse streamwise pressure gradient, significant normal pressure gradients associated with surface and streamline curvature, and significant wake curvature. Navier-Stokes calculations with a two-equation K-epsilon turbulence model predict the correct pressure distribution which demonstrates the utility of these engineering tools. The experiment approaches separation at the strailing edge. However, in comparison to the experiment, the calculations predict too high skin friction and insufficient displacement thickness growth. An analysis of the turbulent and mean flow fields reveals the turbulence model defects are likely in modeling the dissipation source and sink terms, and in the eddy viscosity relation. Author

A84-46110#
TWO DIMENSIONAL TURBULENT BOUNDARY LAYERS OVER RIGID AND MOVING SWEPT WAVY SURFACES
T. K. SENGUPTA and S. G. LEKOUDIS (Georgia Institute of Technology, Atlanta, GA) American Institute of Aeronautics and Astronautics, Fluid Dynamics, Plasma Dynamics, and Lasers Conference, 17th, Snowmass, CO, June 25-27, 1984. 9 p. refs
(Contract N00014-83-K-0418)
(AIAA PAPER 84-1530)

The two dimensional, incompressible, turbulent boundary layer over a flexible wall is analyzed. The wall consists of sinusoidal waves that are swept with respect to the flow direction. The mean flow is a boundary layer with wave-induced stresses. These stresses are evaluated from the solution of the linear problem. It is found that the small mean skin friction reduction, observed for

the case of zero sweep, persists. The pressure drag reduces for swept wavy wall from its value for no sweep. There is a small drag reduction for the moving wall cases even for the lowest phase speed considered. Within the assumptions of the turbulence model used, a possible drag reduction mechanism is discussed.
Author

A84-46111#
COMPUTATION OF TRANSONIC VISCOUS AIRFOIL, INLET, AND WING FLOWFIELDS
R. K. AGARWAL and J. E. DEESE (McDonnell Douglas Research Laboratories, St. Louis, MO) American Institute of Aeronautics and Astronautics, Fluid Dynamics, Plasma Dynamics, and Lasers Conference, 17th, Snowmass, CO, June 25-27, 1984. 17 p. Research supported by the McDonnell Douglas Independent Research and Development Program. refs
(AIAA PAPER 84-1551)
A rapid solution procedure for calculating the transonic viscous flows about complex aerodynamic configurations, airfoils, diffusers, nacelles, and wings is presented. Reynolds-averaged, thin-layer Navier-Stokes equations are employed as the physical model; the equations are solved on body-conforming curvilinear grids using an explicit Runge-Kutta time-marching finite-volume method. Computations are compared with the results of other investigators, experimental data, and Euler solutions wherever appropriate.
Author

A84-46112*# Stanford Univ., Calif.
UNSTEADY WAKE MEASUREMENTS OF AN OSCILLATING FLAP AT TRANSONIC SPEEDS
S. BODAPATI (Stanford University, Stanford, CA) and C.-S. LEE American Institute of Aeronautics and Astronautics, Fluid Dynamics, Plasma Dynamics, and Lasers Conference, 17th, Snowmass, CO, June 25-27, 1984. 18 p. refs
(Contract NSG-2233)
(AIAA PAPER 84-1563)
The steady and unsteady wake profiles of an airfoil with an oscillating flap were measured at nominal free stream Mach number of 0.8 in the NASA Ames 11 x 11-foot wind tunnel. The instantaneous wake velocity and pressure profiles at four axial locations are presented up to one chord length from the trailing edge. Both fundamental harmonic frequency and typical time history data are presented to observe the effects of airfoil incidence and flap angle. The drag coefficient obtained from the wake pressure measurements is compared with that obtained from the airfoil pressure distribution.
Author

A84-46113#
APPLICATION OF NLR'S NUMERICAL SIMULATION METHODS TO THE TRANSONIC POTENTIAL FLOW ABOUT OSCILLATING WINGS
M. H. L. HOUNJET, J. TH. VAN DER KOLK, and J. J. MEIJER (Nationaal Lucht- en Ruimtevaartlaboratorium, Amsterdam, Netherlands) American Institute of Aeronautics and Astronautics, Fluid Dynamics, Plasma Dynamics, and Lasers Conference, 17th, Snowmass, CO, June 25-27, 1984. 12 p. Research supported by the Royal Netherlands Air Force. refs
(AIAA PAPER 84-1564)
Unsteady and quasi-steady aerodynamic loads in the transonic flow domain have been obtained from NLR's numerical simulation methods for transonic potential flow. The unsteady results have been obtained with the time-linearized finite volume method FTRAN3, embedding a so-called field panel method which accounts for proper radiation of signals towards infinity. The mean steady flow fields and the quasi-steady results have been obtained from the application of XFL022, the NLR system for the simulation of steady transonic flow about wings and wing bodies. The calculations have been performed for several wing planforms and the results are compared with experimental data. A correlation is made between quasi-steady results of FTRAN3 and XFLO22. Flutter applications have been made to a transonic transport wing model and a fighter configuration.
Author

A84-46114#
LDV MEASUREMENTS OF THREE-DIMENSIONAL FLOW DEVELOPMENT IN A CURVED RECTANGULAR DUCT WITH INLET SHEAR PROFILE
A. HAMED and M. MALAK (Cincinnati, University, Cincinnati, OH) American Institute of Aeronautics and Astronautics, Fluid Dynamics, Plasma Dynamics, and Lasers Conference, 17th, Snowmass, CO, June 25-27, 1984. 10 p. refs
(Contract AF-AFOSR-80-0242)
(AIAA PAPER 84-1601)
The results of an experimental investigation of the three-dimensional flow development in a highly curved duct with inlet shear profile are presented. The three components of the air velocity in a curved duct with a rectangular cross section are measured using Laser Doppler Anemometry. Significant through velocity contour rotations are reported with secondary velocity development of magnitudes up to 0.25 of mean inlet velocity in th 90 deg turning angle curved duct.
Author

A84-46115#
LAMINAR SEPARATION FROM AIRFOILS BEYOND TRAILING-EDGE STALL
H. K. CHENG (Southern California, University, Los Angeles, CA) American Institute of Aeronautics and Astronautics, Fluid Dynamics, Plasma Dynamics, and Lasers Conference, 17th, Snowmass, CO, June 25-27, 1984. 27 p. Navy-NSF-supported research. refs
(AIAA PAPER 84-1612)
The triple-deck/Kirchhoff-wake model of Sychev (1972) is extended to represent the steady-state Navier-Stokes solutions of the inviscid-viscous-interaction problem of asymmetric laminar separation (with lift) from an airfoil in an incompressible flow as the Reynolds number approaches infinity. Wake closure and reattachment phenomena are examined in detail, and numerical results for specific examples are presented graphically and compared to published wind-tunnel data. It is shown that the termination of a stationary stagnant wake must be a cusp, and that the shape and dimension of the wake are constant for a given separation point.
T.K.

A84-46116#
INTERACTIONS OF UNSTEADY ACOUSTIC AND VORTICAL OSCILLATIONS IN AXISYMMETRIC CYLINDRICAL CAVITY
T. J. CHUNG and J. L. SOHN (Alabama, University, Huntsville, AL) American Institute of Aeronautics and Astronautics, Fluid Dynamics, Plasma Dynamics, and Lasers Conference, 17th, Snowmass, CO, June 25-27, 1984. 13 p. refs
(AIAA PAPER 84-1635)
The mutual interaction of unsteady acoustic and hydrodynamic oscillations in a cylindrical cavity is investigated analytically. Vorticity-coupled acoustic-instability integrals are derived; turbulent mean flow and fluctuation vorticities are analyzed using a k-epsilon model; a finite-element solution procedure is employed; and numerical results are presented graphically. The stability boundaries determined in terms of Reynolds numbers are found to resemble those of classical hydrodynamic analysis but to form multiple islands. The contribution of the turbulent flow field to the instability increases with the cross-section transition angle. These results are applicable to the design of solid-fuel rockets.
T.K.

A84-46117#
CALCULATION OF TURBULENT FLOW ABOUT MISSILE AFTERBODIES CONTAINING AN EXHAUST JET
B. WAGNER (Dornier GmbH, Friedrichshafen, West Germany) American Institute of Aeronautics and Astronautics, Fluid Dynamics, Plasma Dynamics, and Lasers Conference, 17th, Snowmass, CO, June 25-27, 1984. 7 p. Sponsorship: Bundesministerium der Verteidigung. refs
(Contract BMVG-T/RF-41/C0025/C1425)
(AIAA PAPER 84-1659)
The behavior of the flow about missile afterbodies with a blunt annular base containing an exhaust jet is very important with respect to performance and stability characteristics. Since detailed experiments are expensive and the classical component approach

for supersonic flow is not flexible enough to solve all essential problems, recently also Navier-Stokes methods have been applied to those cases. Some calculations are presented which solved numerically the full Reynolds averaged Navier-Stokes equations using a finite volume method with MacCormack's hybrid scheme and the Baldwin-Lomax turbulence model implemented. Macroscopic flow field structure, surface pressures, and especially base pressures seem to be in excellent agreement with measured data. However, the comparison of shear stress correlation to LDV results exhibits some deficiencies. Author

A84-46120#

UNSTEADY VORTICAL WAKES OVER A PROLATE SPHEROID

C. E. COSTIS and D. P. TELIONIS (Virginia Polytechnic Institute and State University, Blacksburg, VA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 22nd, Reno, NV, Jan. 9-12, 1984. 9 p. refs

(Contract N00167-82-K-0085)

(AIAA PAPER 84-0419)

The Vortex-Lattice method is employed to calculate the inviscid flow and the unsteady development of separated vortex sheets over a prolate spheroid. An approximate method based on the assumption of local similarity is used to calculate the line of open separation. The two schemes interact through the line of separation which is allowed to displace as the wake grows. Author

A84-46126#

EXPERIMENTAL STUDIES OF QUASI-TWO-DIMENSIONAL AND THREE-DIMENSIONAL VISCOUS INTERACTION REGIONS INDUCED BY SKEWED-SHOCK AND SWEPT-SHOCK BOUNDARY LAYER INTERACTION

M. S. HOLDEN (Calspan Advanced Technology Center, Buffalo, NY) American Institute of Aeronautics and Astronautics, Thermophysics Conference, 19th, Snowmass, CO, June 25-28, 1984. 15 p. refs

(Contract F49620-82-C-0026)

(AIAA PAPER 84-1677)

Two experimental studies have examined the aerothermodynamic characteristics of the three-dimensional shock wave/boundary layer interaction region in high speed flows over nonadiabatic surfaces. Attention is given to the basic mechanisms of three-dimensional boundary layer separation in high speed flows, and especially to the large heat transfer rates and gradients developed in the separation and reattachment regions of the flows. The experiments were conducted at Mach 11, for Reynolds numbers of up to 50 million. The first of the studies examined the effects of crossflow on the scale and properties of the attached and separated regions induced over a flat plate at the base of skewed-oblique shocks. In the second study, a swept shock was induced normal to the flat plate boundary layer by means of a shock generator perpendicular to the flat plate. It is demonstrated that, in highly cooled hypersonic flows, the shock generator angle required to induce incipient separation is significantly larger than predicted by earlier methods based on supersonic data. O.C.

A84-46189

COMPUTER SIMULATION OF NON-POTENTIAL FLOWS AROUND WINGS

A. RIZZI (Flygtekniska Forsoksanstalten, Bromma, Sweden) Aeronautical Journal (ISSN 0001-9240), vol. 88, June-July 1984, p. 238-248. refs

The Euler equations are proving to be an appropriate model for inviscid vortex flow. This paper demonstrates the range of this model's applicability by presentation of flowfields computed around a number of different wings with either sharp or rounded edges at transonic and supersonic speeds. The emphasis here is on the physics of the flow model rather than the numerical aspects of the solution method. The results display both expected as well as unexpected vortex phenomena and they indicate the value of this computational tool. Particular attention is paid to the wake regions. Author

A84-46191

ON THE INFLUENCE OF ATMOSPHERIC DISTURBANCES ON AIRCRAFT AERODYNAMICS

L. M. B. C. CAMPOS (Lisboa, Universidade Tecnica, Lisbon, Portugal) Aeronautical Journal (ISSN 0001-9240), vol. 88, June-July 1984, p. 257-264. refs

In order to address future problems in aircraft performance and stability, an attempt is made to quantitatively treat the effects of wind, shears, turbulence, and wakes on aircraft aerodynamics. Incident flow effects are considered in the cases of vertically sheared headwind and tailwind, and extended to all three components of velocity and the six shear derivatives. A dimensionless shear number, S, is introduced with respect to vorticity, and a shear coefficient, C(S), is employed in the treatment of the aerodynamics of a body or airfoil in an incident stream containing vorticity. The use of the S and S(C) concepts allows the calculation of the uniform wind that is equivalent to a given shear. O.C.

A84-46192

DESIGN PARAMETERS AND PERFORMANCE OF TWO-DIMENSIONAL, ASYMMETRIC, 'SLIDING BLOCK', VARIABLE MACH NUMBER, SUPERSONIC NOZZLES

H. WINARTO (BPP Technologi, Jakarta, Indonesia; Queensland, University, Brisbane, Australia) and R. J. STALKER (Queensland, University, Brisbane, Australia) Aeronautical Journal (ISSN 0001-9240), vol. 88, June-July 1984, p. 270-280. refs

The mechanically simple and robust 'sliding block' axisymmetric nozzle is ideally suited for small, variable Mach number supersonic wind tunnel installations. Attention is presently given to the minimum sufficient requirements for the design of such a nozzle in terms of a shape parameter, an angular parameter, and a length parameter. Nozzle performance dependence on these parameters is investigated numerically, assuming inviscid flow and using the method of characteristics. The best nozzle shape is found to lie where the flow is rapidly expanded immediately downstream of the throat. The task of selecting correct profiles for these nozzles is reduced to the choice of appropriate nozzle parameter values from the curves presently supplied. O.C.

A84-46237

HEAT TRANSFER IN THE NOSE SECTION OF AXISYMMETRIC OBJECTS UNDER CONDITIONS OF NONSEPARATED AND SEPARATED FLOWS [TEPLOOBMEN NA GOLOVNYKH CHASTIAKH OSESIMMETRICHNYKH OB'EKTOV PRI BEZOTRYVNOM OBTEKANII I V USLOVIIAKH OTRYVA POTOKA]

A. M. PAVLIUCHENKO (Akademiia Nauk SSSR, Institut Teoreticheskoi i Prikladnoi Mekhaniki, Novosibirsk, USSR) Akademiia Nauk SSSR, Sibirskoe Otdelenie, Izvestiia, Seriia Tekhnicheskikh Nauk (ISSN 0002-3434), June 1984, p. 74-83. In Russian. refs

Aerophysical flight vehicles equipped with onboard measuring systems, multichannel standard telemetry systems, and temperatures and pressure transducers have been designed on the basis of the M100 and Oblako meteorological rockets. An efficient computer algorithm has been developed for determining the thermal state of axisymmetric flight vehicles for free-stream Mach numbers up to 5 and Reynolds numbers up to 10 to the 8th with allowance for various flow conditions in the boundary layers. Smoothing cubic splines and a thin-wall model are used to calculate heat fluxes from the experimentally determined unsteady wall temperatures of the M100, Oblako, and Viking-10 rockets. V.L.

A84-46328*# United Technologies Corp., East Hartford, Conn.
SYNTHESIZED AIRFOIL DATA METHOD FOR PREDICTION OF DYNAMIC STALL AND UNSTEADY AIRLOADS
S. T. GANGWANI (United Technologies Research Center, East Hartford, CT; Hughes Helicopters, Inc., Culver City, CA) IN: American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 15-33. Army-supported research. refs
(Contract NAS1-16803)

The synthesized unsteady airfoil data method, which accurately describes the unsteady aerodynamic characteristics of stalled airfoils in the time domain, is expanded and improved. Nine sets of unsteady drag data are synthesized, providing a basis for the successful expansion of the method to include the computation of unsteady pressure drag of airfoils and rotor blades. An improved prediction model for airfoil flow reattachment is incorporated into the method. Application of the model results in a better correlation of analytic predictions with measured full-scale helicopter blade loads and stress data. The results show that it is feasible to generalize the empirical parameters embedded in the method over a range of angles of attack, Mach number, airfoil shape, and sweep angle. C.D.

A84-46331#
AERODYNAMIC DESIGN OF THE XV-15 ADVANCED COMPOSITE TILT ROTOR BLADE
M. A. MCVEIGH, H. J. ROSENSTEIN, and F. J. MCHUGH (Boeing Vertol Co., Philadelphia, PA) IN: American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 72-80.

The aerodynamic design requirements for tilt rotor blades are reviewed and the selection of the distribution of chord, twist, and airfoil to maximize the rotor performance characteristics are discussed. The design procedure is illustrated by the development of the definition of the replacement blades for the XV-15 tilt rotor aircraft. Author

A84-46381*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A STUDY OF THE AERODYNAMIC INTERACTION BETWEEN A MAIN ROTOR AND A FUSELAGE
C. A. SMITH and M. D. BETZINA (NASA, Ames Research Center, Moffett Field, CA) IN: American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 690-702. refs

The wake of a helicopter rotor can have a significant effect on a fuselage. Results from a recent wind-tunnel investigation show that certain fuselage characteristics, normalized by rotor thrust, scale proportionally to a rotor-wake-induced velocity parameter. Effects on the body of changes in velocity, thrust, tip-path-plane angle of attack, and rotor/body position are discussed. These results show that the rotor can have a favorable or unfavorable influence on the body, depending upon the operating condition. Author

A84-46382#
AN INVESTIGATION OF THE AERODYNAMICS OF AN RAE SWEPT TIP USING A MODEL ROTOR
P. G. WILBY (Royal Aircraft Establishment, Farnborough, Hants., England) and J. J. PHILIPPE (ONERA, Chatillon-sous-Bagneux, Hauts-de-Seine, France) IN: American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 725-740. refs

Wind tunnel tests of a model swept-tip helicopter rotor blade developed by the RAE in conjunction with the French ONERA organization are described. Swept-tip rotors have a 30 deg curve sweeping back to both leading and trailing edges over about one chordlength of the blade. The change in planform starts at about 0.85 percent of the rotor radius. In the wind tunnel tests, measurements were made of power and pressure distributions on the blade tips, time-dependent effects, and noise in forward flight. The measurements obtained were compared with predictions made during the design of the blades. It is found that the onset and development of supercritical flow over the advancing tip is delayed appreciably by tip sweepback. At the same time, tip sweepback increases the effective tip Mach number over the front of the rotor disk. Noise measurements suggested that the swept-tip design may also produce a reduction of noise in forward flight. I.H.

A84-46384
EXPERIMENTAL RESEARCH ON HELICOPTER FUSELAGE AND ROTOR HUB WAKE TURBULENCE
P. ROESCH and A.-M. DEQUIN (Aerospatiale, Helicopter Div., Marignane, France) American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Paper. 19 p. refs

Flow visualization experiments that include hydrodynamic tests with small models, tuft and smoke tests with wind tunnel models, and full scale aircraft flight tests, are noted to show that large eddy structures are convected periodically in helicopter rotor hub-generated wakes. In addition, spectral analysis of hot film flow data indicates the addition of discrete energy components to the turbulent energy spectrum, both at the integer multiples of the blade passage frequency and at every rotor harmonic frequency. The ratio of discrete to turbulent energy at rotor harmonic frequencies is uniquely determined by the advance ratio. Explanations are put forward for tail-shake phenomena on the basis of spectral analyses of wake signals and fin bending stresses, together with solutions for the alleviation of the problem. O.C.

A84-46476#
DOUBLE SHOCK WAVE ALMOST HALVES DRAG
R. DEMEIS Aerospace America (ISSN 0740-722X), vol. 22, Sept. 1984, p. 26, 27.

Wing section drag reductions of as much as 46 percent have been obtained for a supercritical airfoil section wing whose top surface transition from supersonic to subsonic velocity is made milder by means of a porous surface-covered cavity over which shock waves would otherwise form. This technique transforms the normal shock into two shocks, of which an oblique one lies ahead of a normal shock, and both are joined in a lambda-shaped geometry. The experimental work conducted to explore this effect has also established that 60-70 percent of the shock-induced drag is due to boundary layer separation, while the remainder is due to wave drag. O.C.

N84-31086 West Virginia Univ., Morgantown.
STALL DELAY BY BOUNDARY LAYER BLOWING AND/OR SUCTION Ph.D. Thesis
M. BOASSON 1983 221 p
Avail: Univ. Microfilms Order No. DA8407831

High lift can be generated on an airfoil in several ways. One of the mechanically simple ways to do this is to use tangential upper surface blowing. In this work this method is combined with slot suction to find optimum blowing parameters. To keep the analysis independent of a particular geometry, a flat plate is taken as the basic geometry. The adverse pressure gradient of the rear part of an airfoil (behind the point of maximum velocity) is simulated by a source flow. The general transformed boundary layer equations are solved along the plate. The method of solution uses simple finite difference approximations, linearization and an iteration technique. The algebraic equations are solved by the TDMA algorithm. Suction is added through a boundary condition and a wall jet is added by altering the geometry and adding a wall jet velocity profile as an initial condition for the next step. The method is checked against known results and found to have good agreement with them. Turbulence is accounted for using the turbulent eddy viscosity model of Cebeci and Smith. Upstream effect of suction is also investigated and found to be negligible for all but very strong values of suction. Dissert. Abstr.

N84-31089*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
COMPUTATIONAL AERODYNAMICS AND ARTIFICIAL INTELLIGENCE
U. B. MEHTA and P. KUTLER Jun. 1984 40 p refs
(NASA-TM-85994; A-9807; NAS 1.15:85994) Avail: NTIS HC A03/MF A01 CSCL 01A

The general principles of artificial intelligence are reviewed and speculations are made concerning how knowledge based systems can accelerate the process of acquiring new knowledge in aerodynamics, how computational fluid dynamics may use expert systems, and how expert systems may speed the design and development process. In addition, the anatomy of an idealized expert system called AERODYNAMICIST is discussed. Resource requirements for using artificial intelligence in computational fluid dynamics and aerodynamics are examined. Three main conclusions are presented. First, there are two related aspects of computational aerodynamics: reasoning and calculating. Second, a substantial portion of reasoning can be achieved with artificial intelligence. It offers the opportunity of using computers as reasoning machines to set the stage for efficient calculating. Third, expert systems are likely to be new assets of institutions involved in aeronautics for various tasks of computational aerodynamics. M.G.

N84-31090*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
DEVELOPMENT AND APPLICATION OF AN ANALYSIS OF AXISYMMETRIC BODY EFFECTS ON HELICOPTER ROTOR AERODYNAMICS USING MODIFIED SLENDER BODY THEORY
G. YAMAUCHI and W. JOHNSON Jul. 1984 120 p refs
(NASA-TM-85934; A-9704; NAS 1.15:85934) Avail: NTIS HC A06/MF A01 CSCL 01A

A computationally efficient body analysis designed to couple with a comprehensive helicopter analysis is developed in order to calculate the body-induced aerodynamic effects on rotor performance and loads. A modified slender body theory is used as the body model. With the objective of demonstrating the accuracy, efficiency, and application of the method, the analysis at this stage is restricted to axisymmetric bodies at zero angle of attack. By comparing with results from an exact analysis for simple body shapes, it is found that the modified slender body theory provides an accurate potential flow solution for moderately thick bodies, with only a 10%-20% increase in computational effort over that of an isolated rotor analysis. The computational ease of this method provides a means for routine assessment of body-induced effects on a rotor. Results are given for several configurations that typify those being used in the Ames 40- by 80-Foot Wind Tunnel and in the rotor-body aerodynamic interference tests being conducted at Ames. A rotor-hybrid airship configuration is also analyzed. Author

N84-31091*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FEEDBACK IN SEPARATED FLOWS OVER SYMMETRIC AIRFOILS
H. M. ATASSI 1984 15 p refs Proposed for presentation at the 9th Aeroacoustics Conf., Williamsburg, Va., 15-17 Oct. 1984; sponsored by the American Inst. of Aeronautics and Astronautics
(NASA-TM-83758; E-2246; NAS 1.15:83758) Avail: NTIS HC A02/MF A01 CSCL 01A

For a flow over an airfoil with laminar separation, a feedback cycle may exist whereby a Kelvin-Helmholtz instability wave emanating from the separation point on the airfoil surface grows along the shear layer and is diffracted as it interacts with the sharp trailing edge of the airfoil, causing acoustic radiation which, in turn, propagates upstream and regenerates the initial instability wave. The analysis is restricted to the high frequency limit. Solutions to the boundary-value problem are obtained using the slowly varying approximation and the method of matched asymptotic expansions. Resonant solutions exist for certain discrete values of the Reynolds and Strouhal numbers. The results are discussed and compared with available data. Author

N84-31092*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
UNSTEADY TRANSONIC AERODYNAMIC AND AEROELASTIC CALCULATIONS ABOUT AIRFOILS AND WINGS
P. M. GOORJIAN and G. P. GURUSWAMY (Informatics General Corp., Palo Alto, Calif.) Aug. 1984 34 p refs
(NASA-TM-85986; A-9822; NAS 1.15:85986) Avail: NTIS HC A03/MF A01 CSCL 01A

The development and application of transonic small disturbance codes for computing two dimensional flows, using the code ATRAN2, and for computing three dimensional flows, using the code ATRAN3S, are described. Calculated and experimental results are compared for unsteady flows about airfoils and wings, including several of the cases from the AGARD Standard Aeroelastic Configurations. In two dimensions, the results include AGARD priority cases for the NACA 64A006, NACA 64A010, NACA 0012, and MBB-A3 airfoils. In three dimensions, the results include flows about the F-5 wing, a typical wing, and the AGARD rectangular wings. Viscous corrections are included in some calculations, including those for the AGARD rectangular wing. For several cases, the aerodynamic and aeroelastic calculations are compared with experimental results. M.A.C.

N84-31093*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
POTENTIAL APPLICATION OF ARTIFICIAL CONCEPTS TO AERODYNAMIC SIMULATION
P. KUTLER, U. B. MEHTA, and A. ANDREWS Jun. 1984 9 p refs
(NASA-TM-85976; A-9798; NAS 1.15:85976) Avail: NTIS HC A02/MF A01 CSCL 01A

The concept of artificial intelligence as it applies to computational fluid dynamics simulation is investigated. How expert systems can be adapted to speed the numerical aerodynamic simulation process is also examined. A proposed expert grid generation system is briefly described which, given flow parameters, configuration geometry, and simulation constraints, uses knowledge about the discretization process to determine grid point coordinates, computational surface information, and zonal interface parameters. M.A.C.

N84-31094*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
COMPARISON OF THE FULL POTENTIAL AND EULER FORMULATIONS FOR COMPUTING TRANSONIC AIRFOIL FLOWS
J. FLORES, J. BARTON, T. HOLST, and T. PULLIAM Jun. 1984 9 p refs
(NASA-TM-85983; A-9816; NAS 1.15:85983) Avail: NTIS HC A02/MF A01 CSCL 01A

A quantitative comparison between the Euler and full potential formulations with respect to speed and accuracy is presented. The robustness of the codes used is tested by a number of transonic airfoil cases. The computed results are from four transonic airfoil computer codes. The full potential codes use fully implicit iteration algorithms. The first Euler code uses a fully implicit ADI iteration scheme. The second Euler code uses an explicit Runge Kutta time stepping algorithm which is enhanced by a multigrid convergence acceleration scheme. Quantitative comparisons are made using various plots of lift coefficient versus the average mesh spacing along the airfoil. Besides yielding an asymptotic limit to the lift coefficient, these results also demonstrate the truncation error behavior of the various codes. Quantitative conclusions regarding the full potential and Euler formulations with respect to accuracy, speed, and robustness can be presented. M.A.C.

N84-31097*# College of William and Mary, Newport News, Va.
A REVIEW OF SOME REYNOLDS NUMBER EFFECTS RELATED TO BODIES AT HIGH ANGLES OF ATTACK Final Report
E. C. POLHAMUS Washington NASA Aug. 1984 125 p refs
(Contract NAG1-261)
(NASA-CR-3809; NAS 1.26:3809) Avail: NTIS HC A06/MF A01 CSCL 01A

A review of some effects of Reynolds number on selected aerodynamic characteristics of two- and three-dimensional bodies of various cross sections in relation to fuselages at high angles of attack at subsonic and transonic speeds is presented. Emphasis is placed on the Reynolds number ranges above the subcritical and angles of attack where lee side vortex flow or unsteady wake type flows predominate. Lists of references, arranged in subject categories, are presented with emphasis on those which include data over a reasonable Reynolds number range. Selected Reynolds number data representative of various aerodynamic flows around bodies are presented and analyzed and some effects of these flows on fuselage aerodynamic parameters are discussed. Author

N84-31098# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
SHOCK-FREE TRANSONIC AIRFOIL DESIGN BY A HODOGRAPH METHOD M.S. Thesis - Vermont Univ.
W. Z. STRANG 1984 96 p
(AD-A142752; AFIT/CI/NR-84-27T) Avail: NTIS HC A05/MF A01 CSCL 20D

Refined mathematical methods are required for the analytical solution of the partial differential equation governing steady, two-dimensional, compressible, transonic, potential fluid flow. This equation is nonlinear in the physical plane and so does not lend itself to standard analytical solution methods. The Molenbroek-Chaplygin transformation, where the physical Cartesian coordinates as the independent variables are replaced by the velocity magnitude and direction as the independent variables, linearizes the governing equation which may then be analytically solved. The plane where the said velocity parameters are the independent variables is termed the hodograph plane. Likewise, the transformed differential equation is known as the hodograph equation and it is solved by hodograph methods. This mathematical study addresses the solution of transonic flow phenomena by an extension of Lighthill's hodograph method. Lighthill's method transforms a given solution of the Laplace equation into a solution of the hodograph equation for subsonic flows only. A new relation is developed in this study extending this transformation technique to include flows up to Mach 2.2735 in air. Requiring only numerical data concerning the velocity field, this hodograph method is computationally efficient and mathematically straightforward. GRA

N84-31099# Naval Ship Research and Development Center, Bethesda, Md. Aviation and Surface Effects Dept.
INVESTIGATION OF PARAMETERS INFLUENCING THE DEFLECTION OF A THICK WALL JET BY A THIN WALL JET COFLOWING OVER A ROUNDED CORNER Final Report, Jan. 1981 - Jul. 1982
G. G. HUSON Dec. 1983 54 p
(AD-A142773; DTNSRDC/ASED-83/10) Avail: NTIS HC A04/MF A01 CSCL 20D

Recent investigations proved the compatibility of the Circulation Control and the Upper Surface Blowing Concepts. This static investigation is a follow-up to determine what combinations of geometric and pneumatic variables produce an effective deflection of a thick wall jet by a thin wall jet exhausting over a rounded corner. Static pressure distributions over the corner indicate that maximum deflections of the thick wall jet occur when a high average suction is distributed over the surface of the corner. Using a large corner radius, locating the source of the thick wall jet somewhat upstream from the corner and the thin wall jet source, and using a high aspect ratio thick wall jet are geometric means of producing this type of pressure distribution. Author (GRA)

N84-31100# Naval Ship Research and Development Center, Bethesda, Md. Aviation and Surface Effects Dept.
EFFECT OF RADIAL LOAD DISTRIBUTION ON THE FIRST-HARMONIC INFLOW VELOCITY OF A HELICOPTER ROTOR AT TRANSITION SPEEDS
H. R. CHAPLIN Apr. 1984 30 p
(AD-A142840; DTNSRDC/ASED-84/03) Avail: NTIS HC A03/MF A01 CSCL 12A

A joint Navy/NASA experimental investigation was conducted in October 1983 in the Langley Research Center VSTOL Wind Tunnel to test the hypothesis that helicopters with unusually hub-weighted radial load distributions should experience a more severe first harmonic inflow velocity field during transition than ordinary helicopters. This report presents an approximate analysis of the experimental results. The hypothesis is strongly supported. Compared to the rotor configuration with the most tip-weighted load distribution, the configuration with the most hub-weighted distribution appears to have experienced an approximately 50 percent greater first-harmonic inflow at a 50 percent greater critical flight speed. Author (GRA)

N84-32062# Joint Publications Research Service, Arlington, Va.
HYPERSONIC THREE-DIMENSIONAL FLOW OF RADIATING GAS AROUND WING Abstract Only
A. I. GOLUBINSKIY and V. N. GOLUBKIN *In its* USSR Rept.: Phys. and Math. (JPRS-UPM-84-003) p 52 9 Jul. 1984 Transl. into ENGLISH from Zh. Prikl. Mekhan. i Tekhn. Fiz. (Novosibirsk, USSR), v. 142, no. 6, Nov. - Dec. 1983 p 71-78
Avail: NTIS HC A08/MF A01

When a vehicle enters the upper layers of the atmosphere at velocities near escape velocity, radiation may have an appreciable effect on the flow of gas around the vehicle, and radiative heat losses may be comparable with convective losses, or even greater. Three-dimensional hypersonic flow around a wing at a finite angle of attack is studied with consideration of radiation at high temperature. It is assumed that the compressed gas layer adjacent to the windward surface of the wing is optically transparent, i.e., the mean free path of radiation is much greater than the characteristic thickness of the compressed layer. Absorption of radiation in the gas is disregarded, which is justified for flight altitudes that are not too high. The state of the gas is taken as equilibrium before and after the head shock wave. The thin shock layer method is used to find a general solution of equations of gas dynamics expressing all flow parameters in terms of the shape of the head shock wave. The problem of determining waveshape is formulated, and a class of exact solutions is obtained. An investigation is made of the influence that radiation has on thickness of the shock layer, temperature, and pressure distribution. The distribution of radiative heat flux toward the wing is calculated. Author

N84-32089# Joint Publications Research Service, Arlington, Va.
SUPERSONIC JET-CAVITY INTERACTION PULSATION Abstract Only
A. I. KOTOV and Y. A. UGRYUMOV *In its* USSR Rept.: Phys. and Math. (JPRS-UPM-84-005) p 24 15 Aug. 1984 Transl. into ENGLISH from Vestn. Leningr. Univ.: Mat., Mekhan., Astron. (Leningrad), no. 1, Jan. 1984 p 64-68 Original language document previously announced in IAA as A84-25615
Avail: NTIS HC A06/MF A01

Results are presented from a numerical investigation employing the Godunov method of the low-frequency pulsations seen in the interaction between a supersonic jet and a cavity. The process by which self-oscillations develop after the pulsed triggering of the nozzle is examined. The way in which the magnitudes of pressure and frequency that are characteristic of the pulsations depend on parameters of the incoming jet and the dimensions of the jet and cavity is determined. The results obtained from numerical computations are compared with experimental data in the literature. Methods are proposed for estimating the pressure during pulsations using known formulas. C.R.

N84-32347 Boston Univ., Mass.
AN INTEGRAL EQUATION FOR THE SOLUTION OF NONLINEAR WAVE EQUATIONS Ph.D. Thesis
D. DEUTSCH 1984 123 p
Avail: Univ. Microfilms Order No. DA8411029

The theory of distributions is used to present a derivation of the Green's function integral equation for potential aerodynamics. The integral equation is used to compute the velocity potential of an ideal fluid as it moves about the surface of an aircraft in the transonic regime. A proof is presented to justify the shock capturing nature of the integral equation. The proof incorporates the notion of weak solutions of the transonic small perturbation equation. Also a derivation is presented of the Green's function integral equation in a frame of reference that moves along a smooth path in rigid body motion. The integral equation in the moving frame of reference is based upon a technique developed in acoustics by Ffowcs-Williams and Hawkings. This integral equation is suitable for computing the velocity potential about aircrafts moving in complex flight paths as well as helicopter rotors. Dissert. Abstr.

N84-32348*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SUBSONIC AND TRANSONIC UNSTEADY- AND STEADY-PRESSURE MEASUREMENTS ON A RECTANGULAR SUPERCRITICAL WING OSCILLATED IN PITCH
R. H. RICKETS, M. C. SANDFORD, J. J. WATSON, and D. A. SEIDEL Washington Aug. 1984 405 p refs A magnetic tape is included as supplement
(NASA-TM-85765; L-15773; NAS 1.15:85765; PB85-102135)
Avail: NTIS HC A18/MF A01; magnetic tape is available as PB85-102135 $140.00 CSCL 01A

Unsteady and steady pressure measurements are presented for a rectangular planform supercritical wing with an aspect ratio of 4.0. The wing was oscillated about the wing pitch axis located at 46 percent chord in the Langley Transonic Dynamics Tunnel. Dynamic response measurements of the motion of the wing during oscillation are also presented. Test Mach numbers ranged from 0.27 to 0.90. Static angles of attack ranged from -4 deg to 14 deg. Oscillation frequencies ranged from 2 to 20 Hz, and amplitudes ranged from 0.5 to 1.5 deg about zero and nonzero mean angles. Release of these data is intended to aid in the development and evaluation of analytical transonic codes. Author

N84-32350*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
IMPROVEMENTS IN THE ACCURACY AND STABILITY OF ALGORITHMS FOR THE SMALL-DISTURBANCE AND FULL-POTENTIAL EQUATIONS APPLIED TO TRANSONIC FLOWS
P. M. GOORJIAN Jun. 1984 8 p refs
(NASA-TM-85970; A-9778; NAS 1.15:85970) Avail: NTIS HC A02/MF A01 CSCL 01A

Numerical techniques that improve the accuracy and stability of algorithms for the small disturbance and full potential equations used to calculate transonic flows are described. For the small disturbance equation, the algorithm improvements are: (1) the use of monotone switches in the type dependent finite differencing, and (2) the use of stable and simple second order accurate spatial differencing; these improvements are for steady and unsteady transonic flows. For the steady full potential equation, the improvement is in the use of a monotone switch in the type dependent finite differencing of an approximate factorization (AF2) algorithm. All these improvements are implemented in present computer codes by making minor coding modifications. Author

N84-32351*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
UNSTEADY TRANSONIC FLOW IN CASCADES
S. P. SURAMPUDI (Cleveland State Univ.) and J. J. ADAMCZYK 1984 8 p refs Presented at the Unsteady Aerodyn. of Turbomachines and propellers, Cambridge, England, 24-27 Sep. 1983; sponsored by IUTAM
(NASA-TM-83780; E-2272; NAS 1.15:83780) Avail: NTIS HC A02/MF A01 CSCL 01A

There is a need for methods to predict the unsteady air loads associated with flutter of turbomachinery blading at transonic speeds. The results of such an analysis in which the steady relative flow approaching a cascade of thin airfoils is assumed to be transonic, irrotational, and isentropic is presented. The blades in the cascade are allowed to undergo a small amplitude harmonic oscillation which generates a small unsteady flow superimposed on the existing steady flow. The blades are assumed to oscillate with a prescribed motion of constant amplitude and interblade phase angle. The equations of motion are obtained by linearizing about a uniform flow the inviscid nonheat conducting continuity and momentum equations. The resulting equations are solved by employing the Weiner Hopf technique. The solution yields the unsteady aerodynamic forces acting on the cascade at Mach number equal to 1. Making use of an unsteady transonic similarity law, these results are compared with the results obtained from linear unsteady subsonic and supersonic cascade theories. A parametric study is conducted to find the effects of reduced frequency, solidity, stagger angle, and position of pitching axis on the flutter. Author

N84-32352*# Princeton Univ., N. J. Dept. of Mechanical and Aerospace Engineering.
INVESTIGATION OF THE EXTERNAL FLOW ANALYSIS FOR DENSITY MEASUREMENTS AT HIGH ALTITUDE Final Report, 1 Jul. 1979 - 31 Aug. 1982
G. K. BIENKOWSKI 1983 225 p refs
(Contract NSG-1630)
(NASA-CR-173881; NAS 1.26:173881) Avail: NTIS HC A10/MF A01 CSCL 01A

A Monte Carlo program was developed for modeling the flow field around the space shuttle in the vicinity of the shuttle upper atmosphere mass spectrometer experiment. The operation of the EXTERNAL code is summarized. Issues associated with geometric modeling of the shuttle nose region and the modeling of intermolecular collisions including rotational energy exchange are discussed as well as a preliminary analysis of vibrational excitation and dissociation effects. The selection of trial runs is described and the parameters used for them is justified. The original version and the modified INTERNAL code for the entrance problem are reviewed. The code listing is included. A.R.H.

N84-32353*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
EXPERIENCE WITH TRANSONIC UNSTEADY AERODYNAMIC CALCULATIONS
J. W. EDWARDS, S. R. BLAND, and D. A. SEIDEL Aug. 1984 23 p refs Presented at the 59th Meeting of the AGARD Struct. and Mater. Panel of the Spec. Meeting on Transonic Unsteady Aerodyn. and its Aeroelastic Appl., Toulouse, 2-7 Sep. 1984
(NASA-TM-86278; NAS 1.15:86278) Avail: NTIS HC A02/MF A01 CSCL 01A

Comparisons of calculated and experimental transonic unsteady pressures and airloads for four of the AGARD Two Dimensional Aeroelastic Configurations and for a rectangular supercritical wing are presented. The two dimensional computer code, XTRAN2L, implementing the transonic small perturbation equation was used to obtain results for: (1) pitching oscillations of the NACA 64A010A; NLR 7301 and NACA 0012 airfoils; (2) flap oscillations for the NACA 64A006 and NRL 7301 airfoils; and (3) transient ramping motions for the NACA 0012 airfoils. Results from the three dimensional code XTRAN3S are compared with data from a rectangular supercritical wing oscillating in pitch. These cases illustrate the conditions under which the transonic inviscid small perturbation equation provides reasonable predictions. Author

N84-32354*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
FUSELAGE AND NOZZLE PRESSURE DISTRIBUTIONS OF A 1/12-SCALE F-15 PROPULSION MODEL AT TRANSONIC SPEEDS. EFFECT OF FUSELAGE MODIFICATIONS AND NOZZLE VARIABLES
O. C. PENDERGRAFT, JR. and G. T. CARSON, JR. Aug. 1984 469 p
(NASA-TP-2333; L-15755; NAS 1.60:2333) Avail: NTIS HC A20/MF A01 CSCL 01A

Static pressure coefficient distributions on the forebody, afterbody, and nozzles of a 1/12 scale F-15 propulsion model was determined in the 16 foot transonic tunnel for Mach numbers from 0.60 to 1.20, angles of attack from -2 deg to 7 deg and ratio of jet total pressure to free stream static pressure from 1 up to about 7, depending on Mach number. The effects of nozzle geometry and horizontal tail deflection on the pressure distributions were investigated. Boundary layer total pressure profiles were determined at two locations ahead of the nozzles on the top nacelle surface. Reynolds number varied from about 1.0 x 10 to the 7th power per meter, depending on Mach number. E.A.K.

N84-32356*# New York Univ., New York. Inst. of Mathematical Sciences.
ANALYSIS OF THREE-DIMENSIONAL TRANSONIC COMPRESSORS
A. BOURGEADE Feb. 1984 110 p refs
(Contract NGR-33-016-201)
(NASA-CR-166580; NAS 1.26:166580) Avail: NTIS HC A06/MF A01 CSCL 01A

A method for computing the three-dimensional transonic flow around the blades of a compressor or of a propeller is given. The method is based on the use of the velocity potential, on the hypothesis that the flow is inviscid, irrotational and isentropic. The equation of the potential is solved in a transformed space such that the surface of the blade is mapped into a plane where the periodicity is implicit. This equation is in a nonconservative form and is solved with the help of a finite difference method using artificial time. A computer code is provided and some sample results are given in order to demonstrate the influence of three-dimensional effects and the blade's rotation. R.J.F.

N84-32357*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INVESTIGATION OF THE THREE-DIMENSIONAL FLOW FIELD WITHIN A TRANSONIC FAN ROTOR: EXPERIMENT AND ANALYSIS
M. J. PIERZGA and J. R. WOOD 1984 26 p refs Presented at the 29th Ann. Intern. Gas Turbine Conf., Amsterdam, 3-7 Jun. 1984; sponsored by ASME Prepared in cooperation with Army Research and Technology Labs., Cleveland
(NASA-TM-83739; E-2150; NAS 1.15:83739; USAAVSCOM-TR-83-C-16) Avail: NTIS HC A03/MF A01 CSCL 01A

An experimental investigation of the three dimensional flow field through a low aspect ratio, transonic, axial flow fan rotor has been conducted using an advanced laser anemometer (LA) system. Laser velocimeter measurements of the rotor flow field at the design operating speed and over a range of through flow conditions are compared to analytical solutions. The numerical technique used herein yields the solution to the full, three dimensional, unsteady Euler equations using an explicit time marching, finite volume approach. The numerical analysis, when coupled with a simplified boundary layer calculation, generally yields good agreement with the experimental data. The test rotor has an aspect ratio of 1.56, a design total pressure ratio of 1.629 and a tip relative Mach number of 1.38. The high spatial resolution of the LA data matrix (9 radial by 30 axial by 50 blade to blade) permits details of the transonic flow field such as shock location, turning distribution and blade loading levels to be investigated and compared to analytical results. Author

N84-32358*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SIMULATION OF TRANSONIC SEPARATED AIRFOIL FLOW BY FINITE DIFFERENCE VISCOUS-INVISCID INTERACTION
W. R. VANDALSEM and J. L. STEGER Jun. 1984 9 p refs
(NASA-TM-85980; A-9812; NAS 1.15:85980) Avail: NTIS HC A02/MF A01 CSCL 01A

A finite difference viscous inviscid interaction program has been developed for simulating the separated transonic flow about lifting airfoils, including the wake. In contrast to most interaction programs, this code combines a finite difference boundary layer algorithm with the inviscid program. The recently developed finite difference boundary layer code efficiently simulates attached and reversed compressible boundary layer and wake flows. New viscous inviscid interaction algorithms were also developed to couple the boundary layer code with the inviscid transonic full potential program. Transonic cases with shock induced and trailing edge separation are computed and compared with experimental and Navier-Stokes results. Author

N84-32359# Aerotherm Acurex Corp., Mountain View, Calif.
AERODYNAMIC HEATING COMPUTATIONS FOR PROJECTILES. VOLUME 1: IN-DEPTH HEAT CONDUCTION MODIFICATIONS TO THE ABRES SHAPE CHANGE CODE (BRLASCC) Final Report
W. S. KOBAYASHI Jun. 1984 124 p 3 Vol.
(Contract DAAK11-81-C-0064; DA PROJ. 1L1-62618-AH-80)
(AD-A143252; AD-F300438; ARBRL-CR-00527) Avail: NTIS HC A06/MF A01 CSCL 19A

The BRL has recently applied the ABRES Shape Change Code (ASCC80) to predict the unsteady thermal response of high velocity projectile nose configurations due to aerodynamic heating. The initial application of the ASCC80 code revealed several deficiencies as applied to slender shapes of interest for Army shell. This report describes the modifications carried out that improve the capabilities of the code to address problems for Army shell. Test cases and detailed instructions are provided which describe the input data required to run the code. GRA

N84-32360# Aerotherm Acurex Corp., Mountain View, Calif.
AERODYNAMIC HEATING COMPUTATIONS FOR PROJECTILES. VOLUME 2: SWEPT WING CALCULATIONS USING THE PLANAR VERSION OF THE ABRES SHAPE CHANGE CODE (PLNRASCC) Final Report
R. C. STRAWN and W. S. KOBAYASHI Jun. 1984 89 p 3 Vol.
(Contract DAAK11-81-C-0064; DA PROJ. 1L1-62618-AH-80)
(AD-A143253; AD-F300439; ARBRL-CR-00528) Avail: NTIS HC A05/MF A01 CSCL 19A

This report documents modifications and additions incorporated into the ABRES Shape Change Code (ASCC80) to create a planar two-dimensional version of the axisymmetric computer code. This planar code predicts convective heat transfer and in-depth conduction for swept wings in supersonic flow. The report contains test cases and a detailed user's guide which describes the input data required to run the code. GRA

N84-32361# Aerotherm Acurex Corp., Mountain View, Calif.
AERODYNAMIC HEATING COMPUTATIONS FOR PROJECTILES. VOLUME 3: BRL INTERACTIVE PLOTTING PROGRAM (BRLINPLOT) Final Report
R. A. S. BECK Jun. 1984 68 p 3 Vol.
(Contract DAAK11-81-C-0064; DA PROJ. 1L1-62618-AH-80)
(AD-A143254; AD-F300440; ARBRL-CR-00529) Avail: NTIS HC A04/MF A01 CSCL 19A

This report describes the development of an interactive plotting and grid generation program for generating input data for the ARBRES Shape Change Code. The program as developed can provide grid input data for ASCC80 as well as the modified codes BRLASCC and PLNRASCC. The report contains test cases and a detailed user's guide which describes the input data required to run the code. GRA

N84-32362# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SUPERSONIC FLOWS AROUND A CIRCULAR CONE WITH OR WITHOUT BLOWING ON THE SURFACE

E. CARAFOLI, C. BERBENTE, and P. MARINESCU 2 Jul. 1984 26 p Transl. into ENGLISH from Stud. si Cercet. de Mec. Apl. (Romania), v. 36, no. 2, Mar.-Apr. 1977 p 163-180

(AD-A143258; FTD-ID(RS)T-0731-84) Avail: NTIS HC A03/MF A01 CSCL 20D

The flow around a straight circular cone with or without blowing in the presence of a supersonic current parallel to the axis of symmetry is considered. First, the case of a solid circular cone for which a nearly exact solution is found for the equation of motion is addressed. In addition, the flow around a permeable porous cone with suction or normal injection on the surface is discussed. The results apply directly to the calculation of the fuselage of supersonic and jet aircraft and the thermal protection of the tip of aircraft by sonic injection or by the injection of a liquid or gas. R.S.F.

N84-32363# Oregon State Univ., Corvallis. Dept. of Mechanical Engineering.

CALCULATION OF THE PRESSURE DISTRIBUTION ON A PITCHING AIRFOIL WITH APPLICATION TO THE DARRIEUS ROTOR

N. GHODOOSIAN May 1984 130 p refs

(Contract DE-AC04-76DP-00789)

(DE84-013571; SAND-84-7001) Avail: NTIS HC A07/MF A01

An analytical model leading to the pressure distribution on the cross section of a Darrieus Rotor Blade (airfoil) was constructed. The model is based on the inviscid flow theory and the contribution of the nonsteady wake vortices was neglected. The analytical model was translated into a computer code to study a variety of boundary conditions encountered by the rotating blades of the Darrieus Rotor. It is indicated that, for a pitching airfoil, lift can be adequately approximated by the Kutta-Joukowski forces, despite notable deviations in the pressure distribution of the airfoil. These deviations are most significant at the upwind half of the Darrieus Rotor where higher life is accompanied by increased adverse pressure gradients. The effect of pitching on lift can be approximated by a linear shift in the angle of attack proportional to the blade angular velocity. Tabulation of the fluid velocity about the pitching only NACA 0015 allows the use of the principle of superposition to determine the fluid velocity about a translating and pitching airfoil. DOE

03

AIR TRANSPORTATION AND SAFETY

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

A84-43443#

OPTIMAL GUIDANCE FOR AIRBORNE CABLE PICKUP SYSTEM

K. R. HALL, A. G. BENNETT, P. D. BRIDGES (Mississippi State University, Mississippi State, MS), and Y.-W. JUN IN: Guidance and Control Conference, Seattle, WA, August 20-22, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 379-384. refs

(AIAA PAPER 84-1893)

A computer simulation study has been conducted to assess the feasibility of an airborne cable pickup system that incorporates a vehicle with wings and control surfaces at its hook end. This vehicle will be equipped with a sensor package for the precise tracking of the payload to be picked up. The simulation indicates that the guidance system will be capable of miss distances smaller than one foot under ideal conditions, as well as the stabilization of the towed vehicle and the execution of complex obstacle-avoidance maneuvers on approaching the payload. O.C.

A84-44468*# Arizona Univ., Tucson.

ANALYSIS OF THE NATURE AND CAUSE OF TURBULENCE UPSET USING AIRLINE FLIGHT RECORDS

E. K. PARKS (Arizona, University, Tucson, AZ), R. E. BACH, JR., and R. C. WINGROVE (NASA, Ames Research Center, Aircraft Guidance and Navigation Branch, Moffett Field, CA) IN: Flight testing technology: A state-of-the-art review; Proceedings of the Thirteenth Annual Symposium, New York, NY, September 19-22, 1982 . Lancaster, CA, Society of Flight Test Engineers, 1982, p. 151-158. refs

The development and application of methods for determining aircraft motions and related winds, using data normally recorded during airline flight operations, are described. The methods are being developed, in cooperation with the National Transportation Safety Board, to aid in the analysis and understanding of circumstances associated with aircraft accidents or incidents. Data from a recent DC-10 encounter with severe, high-altitude turbulence are used to illustrate the methods. The analysis of this encounter shows the turbulence to be a series of equally spaced horizontal swirls known as 'cat's eyes' vortices. The use of flight-data analysis methods to identify this type of turbulence phenomenon is presented for the first time. Author

A84-44514#

EFFECTS OF ICING ON PERFORMANCE OF A RESEARCH AIRPLANE

W. A. COOPER, W. R. SAND, D. L. VEAL (Wyoming, University, Laramie, WY), and M. K. POLITOVICH Journal of Aircraft (ISSN 0021-8669), vol. 21, Sept. 1984, p. 708-715. NSF-NOAA-supported research; U.S. Bureau of Reclamation and U.S. Department of Transportation. refs

(Contract USBR-7-07-83-V0001; DOT-FA03-81-C-00020; DOT-FA01-81-C-00020)

The difference between the normal and actual rates of climb of a research airplane is used to measure the effect of icing on performance. The icing conditions were encountered in the course of an extensive series of meteorological research flights in various locations and seasons. Coefficients of lift and drag were determined for the airplane before and after icing encounters, and those coefficients were used to predict airplane performance for various flight conditions. The effect of icing was to increase the drag significantly, while there was little effect on the coefficient of lift. In the course of these flights, characteristics of the icing clouds (such as hydrometeor size spectrum and phase, liquid water content, temperature, etc.) were also measured, and those characteristics are compared to the summaries in the Federal Aviation Regulations and to the data sources on which those summaries were based. Most measurements lie within the envelopes suggested by earlier studies. For volume-median diameters larger than 30 microns, the liquid water contents were substantially lower than indicated by those summaries, but for other diameters measured liquid water contents extended up to and, in rare cases, exceeded the limiting envelopes of the regulations. Two exceptional cases of icing associated with droplets of 40-300 microns diameter are also discussed. The reduction in performance during these cases was anomalously large, although the liquid water content and volume-median diameter did not indicate that these cases should have been potentially hazardous. Author

A84-44738
THE AVIATION WEATHER SYSTEM, PRESENT PROBLEMS AND FUTURE PROMISES
S. H. COHEN (Martin Marietta Aerospace, Denver, CO) IN: Air Traffic Control Association, Annual Fall Conference, 27th, Atlantic City, NJ, October 18-21, 1982, Proceedings . Arlington, VA, Air Traffic Control Association, 1982, p. 153-160.

Aviation-weather systems being developed for implementation in the FAA National Airspace System Plan are discussed. The weather-information requirements of pilots, ATC, and the Center Weather Service itself are summarized; the deficiencies of the present system (slow response, multiple-step delivery, and insufficient density and frequency of observations) are reviewed; and the components of the planned system are briefly characterized, including center weather processor, flight-service automation system, national airspace data-interchange network, radar remote-weather-display system, automated weather-observing system, consolidated cab display system, low-level-wind-shear alert system, Mode-S data links, and weather displays for the general-aviation cockpit. Consideration is given to the FAA/NOAA Advanced Weather Support Evaluation Program Project being conducted at the Denver air-route traffic control center and utilizing the Prototype Regional Observing and Forecasting System: an information flow chart is provided. T.K.

A84-44739
BENIGN IMC
K. R. DILKS (Dilks Co., Inc., Washington, DC) IN: Air Traffic Control Association, Annual Fall Conference, 27th, Atlantic City, NJ, October 18-21, 1982, Proceedings . Arlington, VA, Air Traffic Control Association, 1982, p. 163-169.

The weather information needed by instrument-rated pilots to differentiate benign instrument meteorological conditions (IMC) from severe IMC is characterized, and current procedures for obtaining it are reviewed. The need for accurate, complete, and timely weather data both before takeoff and during flight is stressed; the use of graphics to enhance understanding of spoken forecasts or alphanumeric data and to obtain an overview of large-scale conditions is recommended; and the importance of the air-traffic controller as the sole disseminator of tactical weather updates is indicated. It is predicted that flight safety under IMC can be greatly improved by applying digital technology to automate the acquisition, analysis, and communication of weather information. T.K.

A84-44740
EXPERIMENTATION FOR FLIGHT SERVICE SYSTEMS
T. R. MITCHELL (MITRE Corp., Metrek Div., McLean, VA) IN: Air Traffic Control Association, Annual Fall Conference, 27th, Atlantic City, NJ, October 18-21, 1982, Proceedings . Arlington, VA, Air Traffic Control Association, 1982, p. 171-179. FAA-supported research.

Four current R&D programs for computer hardware, software, and auxiliary equipment for the FAA Flight Service System are summarized and illustrated with diagrams, flow charts, photographs, and sample graphics. Projects described are a processing and display unit (using color graphics, a digitizing-tablet data-entry system, and a microcomputer) for weather-radar information, a cockpit weather-dissemination system for smaller aircraft, a voice-response system for weather updates (based on 2.4-kbit/s linear-predictive-coding digitized speech), and the Aviation Route Forecast (ARF) grid data-base concept for constructing more complete forecasts for a given route. The forecast parameters and guidelines used at the ARF input work station are presented in a table, and the retrieval capability of the ARF system is demonstrated. T.K.

A84-44950#
LIGHTNING AND COMPOSITE MATERIALS
J. BETEILLE and R. WEBER (SocieteNationale Industrielle Aerospatiale, Paris, France) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 203-209.

Recent investigations carried out to examine the effects of lightning on composite materials in aerospace applications are summarized. The materials studied consisted of conducting carbon fiber composites and nonconducting fiber glass/epoxy and aramid/epoxy composites. The effects of lightning strokes were examined in the arc attachment zone, swept stroke zones and in transfer zones in the case of the carbon fiber materials. Indirect effects on components within the aircraft walls made of the composites include sparking, insulation breakdown and equipment damage. Protection measures investigated covered keeping the currents continuous, spread out and on the outside of the structure, and the addition of hang-on metal sheets in high strike probability zones. Indirect effects could be ameliorated by cladding wiring in metal foil and installing surge protectors on sensitive devices. Design features and test configurations for examining the effectiveness of the techniques are outlined. M.S.K.

A84-45054*# Ohio State Univ., Columbus.
EXPERIMENTAL AND ANALYTICAL INVESTIGATIONS INTO AIRFOIL ICING
M. B. BRAGG, G. M. GREGOREK, and J. D. LEE (Ohio State University, Columbus, OH) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 1127-1138. refs
(Contract NAG3-28)

Methods of analyzing and measuring experimentally the accretion of ice and its effect on airfoil aerodynamic performance are presented. An analytical method for predicting water droplet impingement has been developed and shows the influence of airfoil leading edge radius and thickness on droplet impingement to be significant. Rime ice accretions are predicted including time dependent effects and these shapes compare well to experiment. Scaling water droplet impingement and rime ice accretion is discussed. Predictions of the effect of rime ice on airfoil performance are developed based on empirical and analytical methods. Techniques for measuring and simulating ice accretions for wind tunnel tests compare well to actual iced airfoil aerodynamic data. Data showing the effect of ice on measured airfoil performance using real and simulated ice are presented. Author

A84-45066#
FULL-SCALE STUDIES OF STRUCTURE AND DEVELOPMENT OF A VORTEX WAKE OF A MEDIUM TRUNK-ROUTE AIRCRAFT IN THE ATMOSPHERIC BOUNDARY LAYER
A. N. ZAMIATIN and V. S. GRACHEV (Flight Research Institute, USSR) IN: International Council of the Aeronautical Sciences, Congress, 14th, Touluose, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 1235-1239. refs

This paper describes the developed complex technique, and the results of a full-scale investigation of a vortex wake of a medium trunk-route aircraft are presented. The results of the investigation are the basis for a schematic division of a vortex wake development process into five phases. Qualitative and quantitative characteristics are obtained for each phase of vortex wake development which define the wake structure. The investigation allowed determination of flight parameter and atmospheric condition effects on the vortex wake phase extent. Author

A84-45067#
QUALIFICATION OF A TUPOLJEW TU-154B-2 FOR LANDINGS OF CAT II OPERATION
I. SIPOS (Magyar Legikozlekedesi Vallalat, Budapest, Hungary) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 1240-1246. refs

The present material contains a summary of the experience gathered during the flights proving the airworthiness of Tu-154B and TU-154B-2 aircraft for ICAO-CAT.II. flights and in the course of training flights for the crews of the Hungarian Airlines. It will be proved that when applying noise abatement procedures the approach characteristics of the aircraft will stay within the established tolerances. On the basis of the activities of the aircrews, the effects of the failure of an external engine simulated at low heights as well as those of AFCS malfunction are analyzed. The paper gives a short description of the effect of cross-wind and wind-shear on approach. The results arrived at can primarily be utilized in training the crews to carry out ICAO-CAT.II. flights and in having them practice noise abatement procedures. Author

A84-45963*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
LIGHTNING STRIKES TO AN AIRPLANE IN A THUNDERSTORM
B. D. FISHER (NASA, Langley Research Center, Hampton, VA), J. C. GERLACH (NASA, Wallops Flight Center, Wallops Island, VA), and V. MAZUR Journal of Aircraft (ISSN 0021-8669), vol. 21, Aug. 1984, p. 607-611. Previously cited in issue 06, p. 717, Accession no. A84-18110. refs
(Contract NCC5-600)

A84-46330#
HIGH SPEED ICE ACCRETION ON ROTORCRAFT AIRFOILS
R. J. FLEMMING and D. A. LEDNICER (Sikorsky Aircraft, Stratford, CT) IN: American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 44-57. refs

A high-speed icing wind tunnel test has been conducted to measure ice growth and the associated performance degradation for two-dimensional helicopter airfoils over a wide range of angle of attack and Mach number. The test explored the temperature boundary for the onset of ice accretion, as well as the boundary between wet and dry ice growth. Ice shapes were documented by measurements, photography, and silicone rubber molding, and aerodynamic lift, drag, and pitching moment were measured. In moderate icing conditions, the airfoil lift at angles of attack was slightly reduced, the loss in lift increasing to about 20 percent at high angles. The drag coefficients increased to 0.0400 in moderate icing at low angles of attack, a factor of three to four above the drag of a clean airfoil. The drag increment increased for angles of attack above six degrees and higher liquid water content. The effect of Mach number varied with airfoil configuration. C.D.

N84-31102# Aeronautical Research Labs., Melbourne (Australia).
SIMULATED CRASH DECELERATIONS IN A LIGHT AIRCRAFT CABIN
S. R. SARRAILHE Sep. 1983 42 p
(AD-A142806; AD-E401119; ARL/STRUC NOTE-491) Avail: NTIS HC A03/MF A01 CSCL 01B

A light aircraft cabin containing a seat and anthropometric dummy was subjected to a vertical deceleration to simulate a minor crash. Several alternative seats were used, all typical of those in light aircraft. The tests showed that with most seats a moderate rate of descent (5 m/s) could produce potentially injurious forces in the spine, but one seat limited the forces to a safe value. Author (GRA)

N84-31103# Federal Aviation Administration, Washington, D.C. Office of Civil Aviation Security.
REPORT TO CONGRESS ON THE EFFECTIVENESS OF THE CIVIL AVIATION SECURITY PROGRAM Semiannual Recurring Report, 1 Jul. - 31 Dec. 1983
13 Apr. 1984 20 p
(AD-A143023; DOT/FAA/ACS-83-2(19)) Avail: NTIS HC A02/MF A01 CSCL 01B

This report details on the effectiveness of security screening of passengers and all property intended to be carried in the aircraft cabin in air transportation or intrastate air transportation. It also provides a statistical summary of aircraft hijackings and alleged violations of Federal Aviation regulations pertaining to security screening. Author (GRA)

N84-32364 Department of the Navy, Washington, D. C.
POSITION AND RESTRAINT SYSTEM FOR AIRCREWMAN Patent
M. SCHWARTZ, inventor (to Navy) 20 Mar. 1984 6 p Supersedes AD-D006748
(AD-D011058; US-PATENT-4,437,628; US-PATENT-APPL-SN-053465; US-PATENT-CLASS-244-122)
Avail: US Patent & Trademark Office CSCL 01C

An aircraft ejection seat position and restraint system for protecting an aircrewman against back injuries during emergency escape. The ejection sequence is initiated by the aircrewman pulling a lower ejection handle or a face curtain handle with both hands to release or shatter the cockpit canopy. A torso harness suit is con-committantly tightened with inflation of a vest worn between the aircrewman and the suit, and catapult rockets are fired to propel the seat out of the cockpit. The harness suit draws the aircrewman's upper torso against the back of the seat while the inflated vest pushes his hips back and down into the set pan for optimally positioning his spine before ejection thereby negating the effects of an aircrewman purposely or inadvertently flying with a loose harness. After ejection, the seat is separated from the aircrewman but the vest remains inflated inside the harness providing cushioning against the opening shock force of the parachute which is attached to the harness suit. The inflatable vest is formed as a separate, one-piece garment which may be removed between flights. Author (GRA)

N84-32365*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
LIGHTNING SWEPT-STROKE ATTACHMENT PATTERNS AND FLIGHT CONDITIONS FOR STORM HAZARDS 1981
B. D. FISHER Aug. 1984 35 p
(NASA-TM-86279; NAS 1.15:86279) Avail: NTIS HC A03/MF A01 CSCL 01C

As part of the NASA Langley Research Center Storm Hazards Program, 111 thunderstorm penetrations were made in 1981 with an F-106B airplane in order to record direct-strike lightning data and the associated flight conditions. Ground-based weather radar measurements in conjunction with these penetrations were made by NOAA National Severe Storms Laboratory in Oklahoma and by NASA Wallops Flight Facility in Virginia. In 1981, the airplane received 10 direct lightning strikes; in addition, lightning transient data were recorded from 22 nearby flashes. Following each flight, the airplane was thoroughly inspected for evidence of lightning attachment, and the individual lightning attachment points were plotted on isometric projections of the airplane to identify swept-flash patterns. This report shows the strike attachment patterns that were found, and tabulates the flight conditions at the time of each lightning event. Finally, this paper contains a table in which the data in this report are cross-referenced with the previously published electromagnetic waveform data recorded onboard the airplane. Author

N84-32366# Southwest Research Inst., San Antonio, Tex.
A RESEARCH STUDY OF THE ASSESSMENT OF ESCAPE IMPAIRMENT BY IRRITANT COMBUSTION GASES IN POSTCRASH AIRCRAFT FIRES Final Report
H. L. KAPLAN, A. F. GRAND, W. R. ROGERS, W. G. SWITZER, and G. E. HARTZELL Atlantic City FAA Sep. 1984 79 p refs
(Contract DTFA03-81-00065)
(FAA-CT-84-16; SWRI-01-6745) Avail: NTIS HC A05/MF A01

The primary objective of this research program was to assess the potential of representative combustion gases to impair human escape from a postcrash aircraft fire environment. A non-human primate model (juvenile savannah baboon) and an operant behavioral task were used to measure the individual effects of hydrogenchloride (HCL), carbonmonoxide (CO) and acrolein. A secondary objective was to evaluate the validity of laboratory tests with rodents to predict human escape impairment by combustion gases. For HCl, despite severe irritant effects, all baboons were able to perform the escape task over the range of concentrations studied (190 to 17,290 ppm). Significant post exposure effects were not observed at concentrations from 190 to 11,400 ppm; however, at the two highest concentrations, 16,570 and 17,290 ppm, the animals died 18 and 76 days past exposure, respectively. For CO, it was determined that a concentration of 6850 ppm caused escape impairment of the baboon for a five-minute exposure. The results of CO exposure with the rate and the baboon were remarkably similar. Although less definitive, the data suggest that laboratory tests with rodents may have usefulness in predicting the effects of HCl atmospheres on human escape impairment. Author

N84-32367*# Simula, Inc., Tempe, Ariz.
DEVELOPMENT OF 2 UNDERSEAT ENERGY ABSORBERS FOR APPLICATION TO CRASHWORTHY PASSENGER SEATS FOR GENERAL AVIATION AIRCRAFT Final Report
J. C. WARRICK and S. P. DESJARDINS 18 Sep. 1979 93 p refs
(Contract NAS1-14583)
(NASA-CR-158927; NAS 1.26:158927) Avail: NTIS HC A05/MF A01 CSCL 01C

This report presents the methodology and results of a program conducted to develop two underseat energy absorber (E/A) concepts for application to nonadjustable crashworthy passenger seats for general aviation aircraft. One concept utilizes an inflated air bag, and the other, a convoluted sheet metal bellows. Prototypes of both were designed, built, and tested. Both concepts demonstrated the necessary features of an energy absorber (load-limiter); however, the air bag concept is particularly encouraging because of its light weight. Several seat frame concepts also were investigated as a means of resisting longitudinal and lateral loads and of guiding the primary vertical stroke of the underseat energy absorber. Further development of a seat system design using the underseat energy absorbers is recommended because they provide greatly enhanced crash survivability as compared with existing general aviation aircraft seats. Author

N84-32368# National Transportation Safety Board, Washington, D. C.
AIRCRAFT ACCIDENT REPORT. MIDAIR COLLISION: MCDONNELL-DOUGLAS F-4C BEECH D-55 BARON, CHERRY POINT, NORTH CAROLINA, 9 JANUARY 1983
19 Jun. 1983 38 p
(PB84-910407; NTSB-AAR-84-07) Avail: NTIS HC A03/MF A01

At 1644 eastern standard time, on January 9, 1983, a Beech D-55 Baron, N7142N, and a McDonnell-Douglas F-4C Phantom II, collided in flight at 9,300 feet about 30 miles south of Cherry Point, North Carolina. The twin engine Beech Baron was operating under visual flight rules from Nassau, the Bahamas, to Norfolk, Virginia, with a pilot and six passengers on board. The Baron crashed at sea and none of the occupants were recovered during the U.S. Coast Guard's search and rescue effort; all are presumed dead. The U.S. Air Force F-4C from the Michigan Air National Guard was operating a Special Military Instrument Intercept Clearance Mission from Seymour Johnson Air Force Base, Goldsboro, North Carolina. The purpose of the mission was to intercept an unknown target. The aircrew of the F-4C consisted of a pilot and a weapons systems officer seated in tandem. The F-4C sustained substantial damage to the left wing, and the left drop tank assembly separated. The F-4C flightcrew was not injured in the accident, and the airplane returned to Seymour Johnson Air Force Base without further incident. The Safety Board did not determine the probable cause of this accident. Author

N84-32370# Civil Aeronautics Board, Washington, D.C.
ECONOMIC CASES OF THE CIVIL AERONAUTICS BOARD, VOLUME 104, OCTOBER - NOVEMBER 1983
1983 530 p
(PB84-209287) Avail: NTIS HC A23/MF A01 CSCL 05C

A detailed description of economic cases reviewed by the Civil Aeronautics Board from October 1983 to November 1983 is given. The arguments presented by the contesting parties and the case rulings are included. GRA

N84-32371# General Accounting Office, Washington, D. C. Community and Economic Development Div.
LEGISLATION NEEDED TO CLARIFY FUTURE OF CONSUMER PROTECTION AND FEDERAL PREEMPTION AFTER THE CIVIL AERONAUTICS BOARD SUNSETS
13 Jun. 1984 41 p
(PB84-210103; GAO/RCED-84-154; B-213889) Avail: NTIS HC A03/MF A01 CSCL 05C

GAO reviewed the future of CAB's consumer protection functions and regulations upon CAB's sunset. The results of that work are summarized. GAO found that the act leaves uncertain the disposition of CAB's consumer protection functions and regulations as some functions will lapse and others may continue to exist but without an agency with authority to enforce them. Also, the act is unclear as to whether federal preemption, the prohibition which prevents states from regulating air carrier services, continues upon CAB's sunset. GAO believes that legislation is needed to clarify the disposition of CAB's consumer protection functions and regulations and the status of federal preemption. Legislation was passed in the House in early June 1984 which accomplishes these objectives. GRA

04

AIRCRAFT COMMUNICATIONS AND NAVIGATION

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

A84-43368
IMAGE PROCESSING AS AN AID TO NAVIGATION SYSTEMS
T. J. PARSONS (British Aerospace, PLC, Hatfield, Herts., England) Aerospace Dynamics (ISSN 0263-2012), June 1984, p. 16-21.

Algorithms potentially useful for aiding air navigation by means of IR imagery are discussed. The algorithms are required to identify unique features in a wide set of images with varying characteristics, usually using edge detection techniques. Real time operations are also needed. A microprocessor removes noise, performs image reconstruction operations on the sensor imager, and introduces geometric and perspective corrections. Comparisons are then made in the form of correlations between image features and a library of features. Applications of the adaptive threshold algorithm, difference of Gaussian functions, and scene matching through correlation algorithms are discussed. M.S.K.

A84-43411#

MISS DISTANCE DYNAMICS IN HOMING MISSILES

F. W. NESLINE and P. ZARCHAN (Raytheon Co., System Design Laboratory, Bedford, MA) IN: Guidance and Control Conference, Seattle, WA, August 20-22, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 84-98. refs
(AIAA PAPER 84-1844)

The top down design process of an air defense missile starts with a definition of the threat targets, a desired defended zone, and a desired lethality. These quantities are used to the define the system miss distance to be achieved by the guidance system. This paper develops the relationship between this miss distance and the parameters of a generic radar guided missile system. This relationship is expressed in graphs and formulas that can be used to synthesize some of the major subsystem specifications for the missile guidance system. A design example is presented showing the use of the curves and formulas in system synthesis. Author

A84-43412#

RADOME INDUCED MISS DISTANCE IN AERODYNAMICALLY CONTROLLED HOMING MISSILES

F. W. NESLINE and P. ZARCHAN (Raytheon Co., Systems Design Laboratory, Bedford, MA) IN: Guidance and Control Conference, Seattle, WA, August 20-22, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 99-115. refs
(AIAA PAPER 84-1845)

This paper presents an analysis of radome induced miss distance in aerodynamically controlled homing missiles. The stability of the missile guidance system is analyzed and correlated with miss distance effects. Nondimensionalized curves of miss distance versus the important parameters are presented and used to show possible trade-offs between radome design and aerodynamic design. Such trade-offs are important in preliminary design to insure proper balance between aerodynamic and radome design and to insure that the system will work over the range of parameter tolerances that will be encountered in practice. Author

A84-43432#

AIRBORNE GRAVITY MEASUREMENT WITH AN ASTROINERTIAL SYSTEM

J. W. AUSTIN (Northrop Corp., Electronics Div., Hawthorne, CA) IN: Guidance and Control Conference, Seattle, WA, August 20-22, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 279-284. refs
(Contract F33657-81-F-0125)
(AIAA PAPER 84-1876)

This paper discusses tests of the 'direct recovery' method for measuring deflections of the vertical using an astroinertial system. The results indicate that accuracies of 1-2 arc sec are feasible for a single pass, and 0.5-1 arc sec for combining multiple passes over an area of interest. It is concluded that this technique is feasible for rapid DOV measurements over wide regions of the earth. Author

A84-43433#

A STATISTICAL ANALYSIS OF GRAVITY-INDUCED ERRORS IN AIRBORNE INERTIAL NAVIGATION

D. W. HARRIMAN and J. C. HARRISON (Geodynamics Corp., Santa Barbara, CA) IN: Guidance and Control Conference, Seattle, WA, August 20-22, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 285-295. refs
(AIAA PAPER 84-1877)

This paper describes a simple yet powerful statistical technique for calculating Inertial Navigation System (INS) errors due to errors in the Navigation Gravity Model (NGM). Position and velocity error variances are obtained by multiplying the Power Spectral Density (PSD) of horizontal gravity disturbance error by the time-dependent frequency response function of the INS and integrating over frequency. Two-dimensional disturbance error spectra are projected onto the flight path to obtain the along-track and cross-track PSDs. These PSDs have dramatically different shapes with the cross-track component having much greater variance at the low frequencies (especially when a detailed NGM is used). The response of a lightly damped INS is sharply peaked at the Schuler frequency so that at aircraft speeds nearly all the error is initially induced in the cross-track channel and only enters the along-track channel through Coriolis coupling. The results obtained from this simple analytical method are in excellent agreement with more complicated error analyses based on flight simulation techniques, and in addition this approach gives a great deal of insight into the way in which gravity model errors are propagated into INS errors. Author

A84-43437#

TWO-DIMENSIONAL SPATIAL FILTERING FOR TERRAIN CORRELATION ENHANCEMENT

I. Y. BAR-ITZHACK (Technion - Israel Institute of Technology, Haifa, Israel) and S. SVIRY IN: Guidance and Control Conference, Seattle, WA, August 20-22, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 326-334. refs
(AIAA PAPER 84-1884)

This paper investigates a concept for fix-error reduction in two-dimensional correlation guidance. The idea is to filter out the error involved in the measurement of the ground elevation field thereby reducing the variance of the fix-error. Six filtering algorithms are proposed in a sequence of growing complexity. Monte-Carlo simulation runs with various measurement noise levels are carried out over four typical ground elevation zones. The simulation explores the performance of each filter. In the course of this work the influence of the signal-to-noise ratio and the frame size on the fix-error generation are also investigated. Detailed conclusions are derived. Based on these conclusions it is recommended that the concept presented be tested in reality, using hardware. Author

A84-43439#

MAXIMUM-INFORMATION GUIDANCE FOR HOMING MISSILES

D. G. HULL, J. L. SPEYER (Texas, University, Austin, TX), and C. Y. TSENG (Chung Shan Institute of Science and Technology, Taipei, Republic of China) IN: Guidance and Control Conference, Seattle, WA, August 20-22, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 347-350.
(Contract F08635-81-R-0211)
(AIAA PAPER 84-1887)

A recently-defined information index is used to enhance the information content of minimum-control-effort trajectories for the homing missile intercept problem. Optimal planar intercept trajectories are obtained for a performance index which is control effort weighted by position information content. The missile and target are assumed to be operating at constant speed. The shooting method is used to compute the optimal paths, but because of the simplicity of the model, on-line optimization yielding a guidance law with information enhancement should be possible. Author

A84-43480#

BANK-TO-TURN GUIDANCE PERFORMANCE ANALYSIS WITH IN-FLIGHT RADOME ERROR COMPENSATION

W. R. YUEH (Northrop Corp., Electronics Div., Hawthorne, CA) and C.-F. LIN (Boeing Military Airplane Co., Seattle, WA) IN: Guidance and Control Conference, Seattle, WA, August 20-22, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 715-722. refs
(AIAA PAPER 84-1889)

The Kalman filter bank design employed by the present self-learning network with adaptive real time estimation is capable of in-flight radome error calibration and compensation, and may be incorporated into the guidance and control simulation loop of a bank-to-turn missile in order to generate miss distance performance indices. The estimated radome error slope is used in guidance and autopilot commands to provide the optimal pitch rate compensation for a modified proportional navigation system and an optimal controller. In calculating the critical weighting coefficients, the present Kalman filter uses the measure-predict-measure technique (where the semi-Markov statistics of a random starting process make the intermediate predictive step. Simulation results for a rapidly changing radome error slope configuration are outstanding. O.C.

A84-43499
MODERN METEOROLOGICAL RADARS FOR CIVIL AVIATION [LES RADARS METEOROLOGIQUES MODERNES POUR L'AVIATION CIVILE]
C. CASTELBOU (Compagnie Nationale Air France, Service du Developpement Technique, Paris, France) Navigation (Paris) (ISSN 0028-1530), vol. 32, July 1984, p. 284-290. In French.

Commercial passenger aircraft carry radar which functions in either the X-band (9.34 GHz) at 100 W or 5.44 GHz C-band at 200 W. Flat, slotted antennas have become the standard. Semiconductor circuitry allowed for significant reductions in the size of the apparatus by replacing the magnetron of early systems with frequency multipliers or IMPATT diodes. Numerically processed signals are color coded for CRT displays of three levels of precipitation intensity, over which the flight path can be projected. The introduction of Doppler radar will provide turbulence detection in terms of the spectra of the return signals. Finally, techniques for suppression of ground signals are being developed. M.S.K.

A84-43617
EXPERIMENTAL EVALUATION OF THE SPHERICAL NEAR FIELD TEST RANGE
B. AUDONE and A. DE LOGU (Aeritalia S.p.A., Gruppo Sistemi Avionici ed Equipaggiamenti, Turin, Italy) IEEE Transactions on Antennas and Propagation (ISSN 0018-926X), vol. AP-32, July 1984, p. 751-754. refs

The facilities and effectiveness of the spherical near field (SNF) antenna test range are described. SNF consists of a receiving/generator station, a probe and a positioner, as well as software for analyses. The probe comprises cylindrical horns with wide patterns. An antenna being tested is mounted on a rollover slide over an azimuth positioner, and is placed in either polar or equatorial orientation. All tests are performed in a 12 x 8 x 7 m anechoic chamber. The apparatus performance was examined for large beamwidth antennas by installing a closed Al cylinder and three antennas: one short monopole and two slots in waveguides. The test range set-up resulted in long data acquisition and transformation times and obstruction by the positioner turntable. Large area sampling and altered-position duplicate testing sequences are expected to eliminate the problems. M.S.K.

A84-43742
DOUBLE-POLARISATION RADAR MEASUREMENTS
M. GHERARDELLI, D. GIULI, and M. FOSSI (Firenze, Universita, Florence, Italy) Electronics Letters (ISSN 0013-5194), vol. 20, July 19, 1984, p. 633, 634. refs

This letter shows some experimental results obtained with a double-polarization S-band radar using fixed circular polarization at transmit and two orthogonal circularly polarized channels at receipt. The results refer to the short-time polarization behavior of aircraft target and ground clutter. From these results it can be inferred that adaptive polarization techniques can be effective in improving the signal/clutter ratio. Author

A84-43887
THREE-DIMENSIONAL TARGET SIGNATURE MODELING
G. A. DAVISON, R. S. DUMMER, and K. M. REITZ (Aerojet ElectroSystems Co., Azusa, CA) Aerojet Technology, vol. 2, 1984, p. 14-17.

The present investigation is concerned with approaches used in the development of selected passive target signature models. It is pointed out that all passive sensor missions depend on the radiance contrast between the targets or objects of interest and the surrounding background. Target and background characteristics can be determined with the aid of carefully planned measurements. It is, however, difficult and expensive to conduct measurement programs which cover all combinations of target/background orientations, viewing geometry, and atmospheric conditions. An approach is, therefore, employed in which measurements provide discrete verification data points over a broad parametric range, while models provide precise interpolation between data points. This approach is utilized for both targets and backgrounds. A description is presented of the modeling process (the target model) developed at an American aerospace company. Attention is given to a geometric model for target signature modeling, factors involved in modeling satellite signatures, and a thermal IR target signature model. G.R.

A84-44149
A SATELLITE SELECTION METHOD AND ACCURACY FOR THE GLOBAL POSITIONING SYSTEM
M. KIHARA and T. OKADA (Defense Academy, Yokosuka, Japan) Navigation (ISSN 0028-1522), vol. 31, Spring 1984, p. 8-20.

The Navstar/Global Positioning System (GPS) represents a long range navigation system for the next generation. The present study is concerned with the selection of satellites from the constellation which each user employs to obtain the navigation fix. The GPS, which has 24 satellites, provides a number of visible satellites (from 6 to 12) above the horizon at any time to any user in the world. A user normally selects four from the visible satellites for determining his position. It is pointed out that this selection has a great influence on the accuracy of the position determination. The relation between satellite geometry and accuracy is considered along with the derivation of optimum geometrical conditions and details regarding a simple and accurate selection method. The performance of the considered method is verified by a simulation procedure. G.R.

A84-44455#
AN EVOLUTION OF AN/ARN-101 DIGITAL MODULAR AVIONICS SYSTEM (DMAS) TESTING
R. E. VOIGT (USAF, Eglin AFB, FL) IN: Flight testing technology: A state-of-the-art review; Proceedings of the Thirteenth Annual Symposium, New York, NY, September 19-22, 1982 . Lancaster, CA, Society of Flight Test Engineers, 1982, p. 17-22. refs

The testing and acquisition process for the AN/ARN-101 avionics system for navigation and weapons delivery on the F/RF-4 fighter are outlined. System specifications included digital navigation, weapon delivery and reconnaissance capabilities, an integrated Loran-inertial guidance system, all-altitude visual/blind bombing capability, and integration with optical, radar, IR and laser sensors. The ARN-101 comprises 14 line replaceable units, e.g., a digital computer, signal-data converter, Loran receiver, and a digital inertial measurement unit. The system also interfaces with the Pave Tack external IR sensor laser ranger/designator pod for target identification/acquisition. New specifications were introduced after a fly-off identified a suitable system. Four stages of hardware and software test and evaluation became necessary for updates and validation. The entire process took over a half decade. Delays are attributed to modifications being separately managed. M.S.K.

A84-44475#
FLY BEFORE BUY SOFTWARE - THE AN/ARN-101 SERVICE REPORT CORRECTION PROGRAM
R. E. VOIGT (USAF, Eglin AFB, FL) IN: Flight testing technology: A state-of-the-art review; Proceedings of the Thirteenth Annual Symposium, New York, NY, September 19-22, 1982 . Lancaster, CA, Society of Flight Test Engineers, 1982, p. 221-226.

Software interfaces in digital avionics are increasing in complexity with each new system developed. The inability of management to recognize this fact to adapt outdated hardware acquisition concepts to a digital software era are perturbing programs such as the AN/ARN-101 Digital Modular Avionics System (DMAS). Difficulties encountered in the ARN-101 software test effort created an unique opportunity to form a modified 'fly-before-buy' concept of software development and test which was designed to correct mission essential deficiencies and field these corrections as soon as possible. A description of the ARN-101 system, a summary of test background, and a detailed discussion of the program are provided. Author

A84-44476#
RANGE TRACKING CONCEPT FOR USE OF GPS AT CANADIAN FORCES BASE COLD LAKE
C. E. HOEFENER (Interstate Electronics Corp., Anaheim, CA) and K. B. MEURER (Department of National Defence, Directorate of Aerospace Combat Systems, Ottawa, Canada) IN: Flight testing technology: A state-of-the-art review; Proceedings of the Thirteenth Annual Symposium, New York, NY, September 19-22, 1982 . Lancaster, CA, Society of Flight Test Engineers, 1982, p. 227, 228.

Characteristics, capabilities and applications of a system for using the Global Positioning System for tracking at the Canadian Cold Lake Aerospace Engineering Test Establishment (AETE) are described. Expendable targets carry a lightweight L-band receiver and S-band transmitter to interface with the GPS and the ground station with 7 m accuracy. The small size of the required ground equipment, which can be multiplexed to track up to four targets simultaneously, permits portability of the station. The system is more accurate than radar, costs less, and can be used in low altitude close range. AETE has telemetry and data recording equipment, airborne PCM systems and photography capability and a time-shared computer. One current effort is part of the CF18 program. M.S.K.

A84-44691
RETROFIT OF OLDER MILITARY AIRCRAFT WITH NEW ELECTRONIC SYSTEMS CHALLENGES EMI CONTROL ENGINEERS
L. A. MESSER (Teledyne Ryan Electronics, San Diego, CA) EMC Technology (ISSN 0278-4270), vol. 2, July-Sept. 1983, p. 41, 42, 44 (4 ff.). refs

Some typical examples of problems encountered in maintaining electromagnetic compatibility (EMC) between digital and analog electronic equipment while retrofitting older military aircraft are discussed. Consideration is given to the difficulties of electronic retrofits with older unique wiring systems without incurring substantial cost penalties. Several solutions to the problem of limited wires are discussed, including not sending analog signals from a voltage source over a link which uses a common ground wire and reserving a pair of wires for analog signals. Several misconceptions concerning the retrofitted wiring system of digital microprocessors for managing ground velocity sensor data, aircraft heading, altitude and search data, and weapons pointing data for older special purpose aircraft are discussed. I.H.

A84-44726
AIR TRAFFIC CONTROL ASSOCIATION, ANNUAL FALL CONFERENCE, 27TH, ATLANTIC CITY, NJ, OCTOBER 18-21, 1982, PROCEEDINGS
Arlington, VA, Air Traffic Control Association, 1982, 366 p. For individual items see A84-44727 to A84-44754.

Recent developments and planning in the field of ATC are presented in reviews and reports. General areas covered include the U.S. National Airspace System Plan, implementation of ATC plans and programs, airport capacity, airborne and ground equipage, weather collection and dissemination, rebuilding ATC operations, and ATC in the Republic of China, the FRG, Canada, Spain, the UK, and the Benelux countries. Consideration is given to radar detection of birds, measurement of cockpit workload, flight-management software, digital avionics systems, the weather needs of general aviation, wind-shear detection, and the integration of air-traffic flow in Europe. T.K.

A84-44727
FUTURE AIR TRAFFIC REQUIREMENTS
R. A. ALVAREZ (FAA, Air Traffic Service, Washington, DC) IN: Air Traffic Control Association, Annual Fall Conference, 27th, Atlantic City, NJ, October 18-21, 1982, Proceedings . Arlington, VA, Air Traffic Control Association, 1982, p. 32-35.

The development of plans for improving and increasing the capacity of the U.S. air-traffic system is described, and some of the specific measures are briefly characterized. The recommendations formulated in 1981 by the FAA Air Traffic Service for the period through 2010 are incorporated in the National Airspace System Plan (NASP) and may be modified to conform with the National Airspace Review and the Air Traffic Recovery Plan if necessary. The NASP includes improvements in enroute, terminal, flight-service, weather-reporting, ground-to-air, and auxiliary systems. T.K.

A84-44728
GROUND-TO-AIR FACILITIES
M. POZESKY (FAA, Washington, DC) IN: Air Traffic Control Association, Annual Fall Conference, 27th, Atlantic City, NJ, October 18-21, 1982, Proceedings . Arlington, VA, Air Traffic Control Association, 1982, p. 39-42.

The provisions of the FAA National Airspace System Plan for improving ground-to-air ATC facilities are surveyed. Improvements characterized include cover the areas surveillance (Mode-S SSR; datalinks for takeoff-clearance confirmation, minimum-safe-altitude warning, altitude-assignment confirmation, and selected weather information; airport surface surveillance; primary radar; and weather radar), navigation (increased numbers and performance of VORs), approach and landing (replacement of ILS with MLS), and communications (upgrading of equipment with solid-state devices). It is predicted that the planned improvements will increase safety, capacity, and ease of operation while reducing costs. T.K.

A84-44729
FUTURE DEVELOPMENTS IN FAA TELECOMMUNICATIONS
J. R. ETGEN and S. I. ROTHSCHILD (FAA, Washington, DC) IN: Air Traffic Control Association, Annual Fall Conference, 27th, Atlantic City, NJ, October 18-21, 1982, Proceedings . Arlington, VA, Air Traffic Control Association, 1982, p. 46-50.

The telecommunications system linking FAA facilities and its cost of operation are discussed. The system comprises 1.7 million miles of privately provided ground links and 16,000 miles of FAA-owned microwave links and joins 23 air-route traffic-control centers, over 400 ATC towers, over 300 flight-service stations, over 100 air-route surveillance radars, and several thousand remote facilities with an average link length of 175 miles. Improvements and modifications called for by present leasing-cost problems and the requirements of the National Airspace System Plan include increased use of microwave links, replacement of 2.4-kbit/s modems with 9.6-kbit/s equipment, competitive procurement of an integrated communication-switching system, and development of the National Airspace Data Interchange Network and an advanced voice switching and control system. T.K.

A84-44731
IMPROVING AIR TRAFFIC CONTROL AND AIRPORT CAPACITY
R. O. NORDHAUS (USAF, Communications Command, Scott AFB, IL) IN: Air Traffic Control Association, Annual Fall Conference, 27th, Atlantic City, NJ, October 18-21, 1982, Proceedings . Arlington, VA, Air Traffic Control Association, 1982, p. 63, 64.

Recommendations formulated by the U.S. Air Force Communications Command to increase the efficiency of ATC operations are summarized. The basic measures developed are workload redistribution, standardized speed control and slowdown points, reduced phraseology in voice communications, reduced separation at final approach, final-split-up procedures, and maximum use of airborne avionics. Recovery rates of 82, 74, and 50 per hour have been achieved using these techniques in trials with both radar and TACAN operating, with radar only, and with TACAN only, respectively. T.K.

A84-44732
THE O'HARE RUNWAY CONFIGURATION MANAGEMENT SYSTEM
R. L. FAIN and A. N. SINHA (MITRE Corp., McLean, VA) IN: Air Traffic Control Association, Annual Fall Conference, 27th, Atlantic City, NJ, October 18-21, 1982, Proceedings . Arlington, VA, Air Traffic Control Association, 1982, p. 68-75. Sponsorship: U.S. Department of Transportation. refs
(Contract DOT-FA01-82-C-10003)

The computer-logic Runway Configuration Management System (RCMS) developed for O'Hare International Airport as part of the FAA Integrated Flow Management program is characterized. The configuration of the O'Hare TCA is described, and its efficiency is shown to be primarily dependent on runway utilization. The logical structure of the RCMS is explained; the roles of the tower-cab, airway-facilities, and assistant-chief positions in its operation are described; the primary advantages of RCMS are examined; and the integration of RCMS in an overall automated ATC system is considered. Flow charts, maps, and sample printouts are provided. T.K.

A84-44733
OPERATIONAL TECHNIQUES FOR INCREASING AIRPORT CAPACITY
A. L. HAINES, R. M. HARRIS, and A. N. SINHA (MITRE Corp., McLean, VA) IN: Air Traffic Control Association, Annual Fall Conference, 27th, Atlantic City, NJ, October 18-21, 1982, Proceedings . Arlington, VA, Air Traffic Control Association, 1982, p. 79-84. Sponsorship: U.S. Department of Transportation. refs
(Contract DOT-FA01-81-C-10001)

Procedures for increasing the capacity of airports are proposed and illustrated in diagrams. The basic concepts discussed include independent parallels, dependent parallels, wake-vortex operational solutions, triple parallels, converging approaches, and separate short runways. The criteria for tailoring procedures to the specific site are examined, and the role of MLS in facilitating their implementation is considered. T.K.

A84-44734
AVIONICS REQUIREMENTS FROM THE FAA VIEWPOINT
L. WILLIAMS (FAA, Technical Center, Atlantic City, NJ) IN: Air Traffic Control Association, Annual Fall Conference, 27th, Atlantic City, NJ, October 18-21, 1982, Proceedings . Arlington, VA, Air Traffic Control Association, 1982, p. 101-106.

The additional airborne avionics which will be required by the FAA National Airspace System Plan (NASP) are surveyed. The major elements of the NASP are summarized; the FAA maximum-service/minimum-constraint goal is shown to argue for minimal avionics requirements; and the kinds of equipment to be required are described, including Mode-S SSR, Mode-S datalinks, a traffic-alert and collision-avoidance system, area-navigation equipment, MLS, and air-ground communication devices. Estimates of the costs of these items for commercial carriers are provided. T.K.

A84-44735
DIGITAL AVIONICS, AIR-GROUND DATA LINK, AND THE EVOLVING AIR TRAFFIC CONTROL SYSTEM
R. A. RUCKER (MITRE Corp., McLean, VA) IN: Air Traffic Control Association, Annual Fall Conference, 27th, Atlantic City, NJ, October 18-21, 1982, Proceedings . Arlington, VA, Air Traffic Control Association, 1982, p. 113-121.

The automation of flight planning and control, ATC, and air-ground communications using digital technology is discussed, with a focus on the computer systems (CSs) proposed in the ARINC 700 characteristics (1979-1980). Systems examined include the automated flight systems for the B757 and B767 aircraft (flight-management CS, air data system, flight-control CS, thrust-control CS, and flight-augmentation CS), the advanced CS being developed for ATC by the FAA (integrated flow management, flight-data system, radar-data processing, and flight-clearance planning), and air-ground data links based on the Mode-S SSR. A number of typical air-initiated and ATC-initiated data-link transactions are listed in tables and briefly characterized, and flow charts of flight and ATC systems are provided. T.K.

A84-44736
AIRBORNE SYSTEMS REQUIREMENTS IN THE EVOLVING NATIONAL AIRSPACE SYSTEM
W. S. LUFFSEY (FAA, Washington, DC) IN: Air Traffic Control Association, Annual Fall Conference, 27th, Atlantic City, NJ, October 18-21, 1982, Proceedings . Arlington, VA, Air Traffic Control Association, 1982, p. 125-132.

The airborne avionics which will be needed to take full advantage of the ATC improvements called for by the FAA National Airspace System Plan are characterized, and the gradual implementation order planned to ease the financial burden on users is indicated. The equipment, operation, and capabilities of the required Mode-S SSR transponders, MLS avionics, and 25-kHz-spaced communications channels are described and illustrated with diagrams; it is shown that a large degree of flexibility and ample room for innovation are provided. Consideration is also given to the optional traffic-alert and collision-avoidance system and Mode-S data links. T.K.

A84-44741
AIR TRAFFIC CONTROL IMPROVEMENTS IN THE REPUBLIC OF CHINA
T.-M. LIU (Ministry of Communications, Civil Aeronautics Administration, Taipei, Republic of China) IN: Air Traffic Control Association, Annual Fall Conference, 27th, Atlantic City, NJ, October 18-21, 1982, Proceedings . Arlington, VA, Air Traffic Control Association, 1982, p. 215-218.

The current status of air traffic control in the Republic of China is briefly reviewed, with particular attention given to the goals and constraints of the Master Plan governing the nation's air traffic control modernization efforts during the 1980s. The Master Plan provides for new air traffic control automation systems for the Taipei Area Control Center and the major terminals, significnat communication improvements, and selected navigation facility improvements. The structure and functions of the Air Traffic Control Automation System, the Flight Information Service System, and of the communication and navigation systems are discussed. V.L.

A84-44742
A MODERN ATC SYSTEM FOR SPAIN - SACTA
F. C. PARDO (Ministerio Transportes y Comunicaciones, Subsecretaria de Aviacion Civil, Madrid, Spain) IN: Air Traffic Control Association, Annual Fall Conference, 27th, Atlantic City, NJ, October 18-21, 1982, Proceedings . Arlington, VA, Air Traffic Control Association, 1982, p. 227-230.

The distinctive features of the spanish SACTA automatic air traffic control (ATC) system are described. The SACTA system was developed in order to modernize the process of air traffic control in light of increases in traffic over the last few years. The short term modernization plan involves modernization of ATC facilities airports in Madrid, Seville, and Barcelona. Each facility will receive a third set of computer equipment for simulation and training of technicians and controllers. In addition, the airspace structure through Spain will be upgraded by modernizing and implementing new NAVAIDS such as VOR/DME and Doppler VOR where necessary. The long term objective of the SACTA program is the development of an expanded system of standardized ATC hardware and software. The expanded ATC system will include functions for Flight Data Processing (FDP) and Radar Data Processing (RDP) which will provide both track data and control functions. Some of the software requirements of the SACTA systems FDP and RDP are presented. I.H.

A84-44743
PROGRESS IN THE DEVELOPMENT OF AN INTEGRATED AIR TRAFFIC FLOW MANAGEMENT SYSTEM FOR EUROPE
H. GUENTHER (EUROCONTROL, Brussels, Belgium) IN: Air Traffic Control Association, Annual Fall Conference, 27th, Atlantic City, NJ, October 18-21, 1982, Proceedings . Arlington, VA, Air Traffic Control Association, 1982, p. 237-241.

The air traffic problems encountered in Europe and their principal causes are briefly examined, and the need for more efficient management of the air traffic flows is demonstrated. An air traffic flow management (ATFM) concept is then defined, and the current status of the ATFM Service in Europe is discussed. In particular, attention is given to the purpose of the ATFM Service, the covered area, the principal functions of the service, its capacity, and the organization of the integrated ATFM Service. The discussion also covers the organization and functions of the central data bank, AFTM procedures, and the implementation of the system. V.L.

A84-44744
ELECTRONIC TABULAR DISPLAY SUBSYSTEM (ETABS) FOR FLIGHT PLAN DATA
B. C. ANDREWS (FAA, Washington, DC) and J. B. CAWLEY (Sanders Associates, Inc., Nashua, NH) IN: Air Traffic Control Association, Annual Fall Conference, 27th, Atlantic City, NJ, October 18-21, 1982, Proceedings . Arlington, VA, Air Traffic Control Association, 1982, p. 251-255. refs

The current status of the Electronic Tabular Display Subsystem (ETABS) program and the principal features of the ETABS engineering model are reviewed. The ETABS engineering model uses the latest equipment and techniques to display flight data, manage the data, and simplify message entry. ETABS replaces the flight progress strips and the sector computer update equipment comprising an alphanumeric keyboard and computer readout device. This effectively automates many manual and verbal tasks in air traffic control and eliminates labor intensive flight strip management. A block diagram of the ETABS equipment is presented. V.L.

A84-44746
RUGGEDIZED MILITARY ATC DISPLAY REQUIREMENTS - THE U.S. MARINE CORPS SOLUTION
J. D. FREESE (Sperry Corp., Sperry Univac Defense Systems Div., St. Paul, MN) IN: Air Traffic Control Association, Annual Fall Conference, 27th, Atlantic City, NJ, October 18-21, 1982, Proceedings . Arlington, VA, Air Traffic Control Association, 1982, p. 265-270.

This paper describes the U.S. Marine Corps, Marine Air Traffic Control and Landing System (MATCALS) and the integral role played within that system by a new multimode ATC display currently under development. The Sperry Univac Multimode Display (MMD) is the primary man/machine interface in MATCALS. MATCALS will provide continuous all-weather ATC services for expeditionary airfields and remote landing areas as part of the Marine Air Command and Control System. Author

A84-44747
RADAR DETECTION OF BIRDS HAZARDOUS TO AIRCRAFT
E. W. HESS (FAA, Technical Center, Atlantic City, NJ) IN: Air Traffic Control Association, Annual Fall Conference, 27th, Atlantic City, NJ, October 18-21, 1982, Proceedings . Arlington, VA, Air Traffic Control Association, 1982, p. 273-277.

The use of Doppler radar to detect birds in the vicinity of airports is demonstrated, summarizing the results of Hess and Lee (1982). Tests are performed using the ASR-7 airport-surveillance radar (with moving-target detector) at the FAA Terminal Radar Beacon Test Facility and the ASR-8 radar in the hazardous-weather test bed at the Technical Center Terminal Facility for Automated Systems Testing; Doppler processing is achieved with finite-impulse-response filters (ASR-7) or an FFT algorithm (ASR-8). Flow charts of the two systems, sample images, and a Doppler spectrum are provided, and it is shown that these radars can be used to determine the location and movement of groups of birds which could endanger airport operations. T.K.

A84-44748
COCKPIT WEATHER DISSEMINATION SYSTEM
J. P. KELLEY (Mitre Corp., Metrek Div., McLean, VA) IN: Air Traffic Control Association, Annual Fall Conference, 27th, Atlantic City, NJ, October 18-21, 1982, Proceedings . Arlington, VA, Air Traffic Control Association, 1982, p. 279-282.

As part of its support to the Federal Aviation Administration, MITRE has developed an experimental system for the dissemination of hazardous weather information to aircraft in flight. The ground portion of the system receives and processes digitized weather radar and other supplementary data and broadcasts the information over the audio channel of the standard VHF Omnidirectional Radio (VOR) navigation system. Data is recovered from the VOR receiver in the aircraft, processed by a microcomputer, and printed at pilot request. An experimental breadboard version of the proposed system is described. Design overviews of the hardware and software for both the ground and avionics portions of the system are included along with an operational description of the pilot interaction with the system. Author

A84-44754
MONOPULSE SSR - THE UNITED KINGDOM CIVIL AVIATION AUTHORITY PROGRAMME
G. D. WILSON (Civil Aviation Authority, London, England) and N. P. ROSS (Cossor Electronics, Ltd., Harlow, Essex, England) IN: Air Traffic Control Association, Annual Fall Conference, 27th, Atlantic City, NJ, October 18-21, 1982, Proceedings . Arlington, VA, Air Traffic Control Association, 1982, p. 334-337.

The monopulse SSR system currently being installed by the Civil Aviation Authority (CAA) in the UK is characterized. The disadvantages of conventional sliding-window-plotted SSRs (fruit, garble, overinterrogation, and capture) are reviewed; the development and advantages of Mode-S SSRs are discussed; the principles of monopulse bearing measurement are introduced; and the improved tracking ability of monopulse SSR is shown in sample plots. The monopulse equipment ordered by the CAA comprises interrogators, plot extractors, and improved large-vertical-aperture antennas and is compatible with Mode-S. T.K.

A84-45061#
AIR TRAFFIC CONTROL IN A ZONE OF CONVERGENCE - ASSESSMENT WITHIN BELGIAN AIRSPACE
A. BENOIT (European Organization for the Safety of Air Navigation, Brussels; Louvain, Universite Catholique, Louvain-la-Neuve, Belgium) and S. SWIERSTRA (European Organization for the Safety of Air Navigation, Brussels, Belgium) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 1197-1209. refs

Features of the Zone of Convergence (ZOC) method for optimizing the economics of flights into major airports in Europe are described, with emphasis on conditions over Belgium and techniques for simulations. ZOC is configured to conform, as far as possible, to the necessities of optimized cruise and descent, and in scheduling arrivals and integrating ATC over a large area. A series of control points are established for every route so that changing flight patterns due to entry of a new aircraft into the ZOC can be accommodated. Flight plan data from, e.g. Brussels, is filed with EUROCONTROL for centralized tracking and feedback. Simulations are performed when defining schedules to assess fuel consumption on a zone-by-zone basis, taking into account the necessity of a minimum space between aircraft. M.S.K.

A84-45062#
SIMULATION ANALYSIS OF FUTURE TERMINAL PROCEDURES WITH RESPECT TO THE REQUIRED NAVIGATION ACCURACY
M. FRICKE and A. HOERMANN (Berlin, Technische Universitaet, Berlin, West Germany) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 1210-1220. refs

To analyze the role of navigation accuracy in a future terminal area (TMA) environment two different simulation models were developed: a Monte Carlo model to study the impact of navigation and additional parameters (e.g. wind) on the delivery accuracy at a gate and to deduct accuracy requirements for the future TMA navigation systems and a program to simulate the overall TMA traffic considering the aircraft dynamics to analyze the practicability of automated flow control procedures and to compare different concepts. On the basis of a simplified model TMA (based on Frankfurt/FRG data) two different types of procedures were analyzed: a variable path speed control concept and a fixed path speed control concept. Author

A84-45063#
TWO SUGGESTIONS OF APPROACH AND LANDING METHOD BY VISUAL DISPLAY
R. YOKOI (Nihon University, Funabashi, Chiba, Japan) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 1221-1225. refs

Two techniques for display-dominated night-time landing approaches are presented. First, an HUD provides a display identical to what a pilot would see during approach at night while looking out the cockpit window under VFR. The display and image sensitivity would be generated from ILS, DME, radar altimeter and flight management system data. The second method involves mounting Luneborg radar reflective dishes along the runway to permit generation of an image using weather radar data. The approach would be of particular use in unlit runway conditions such as those found in seaplane landing fields and during wartime conditions. The reflector scheme would be effective from a distance of 10 n. mi. M.S.K.

A84-45064#
A NEW CONCEPT OF AN INTEGRATED NAVIGATION, COMMUNICATION, AND SURVEILLANCE SYSTEM BASED ON THE STANDARD DME
A. BECKER (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Institut fuer Flugfuehrung, Brunswick, West Germany) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 1225/a-1225/k. refs

Techniques are suggested for enhancing the existing Distance Measuring Equipment (DME) system currently in use for local navigation to the point where a wide-area integrated system could be brought into existence. The attractiveness of the DME is international standardization since 1959, and a pulsed format (DME/P) is soon to be introduced. Altering the pulse modulation can make it capable of carrying communication, navigation and surveillance data. The system could transmit signals for slant ranging if three pulses are used, multiple slant ranges if additional subsystems are employed and ground-to-air surveillance if a link is established between a central station and an aircraft to carry encoded data. Other sensible applications include air-to-ground selective data transfer and as a broadcast link. The integrated system would be useful in large developing nations and for oil rig helicopter traffic. M.S.K.

A84-45134
DETECTION RANGE OF AN AIRBORNE PULSE-DOPPLER RADAR USING MEDIUM AND HIGH PULSE FREQUENCIES [ENTDECKUNGSREICHWEITEN EINES PULS-DOPPLER-BORDRADARS BEI VERWENDUNG VON MITTLEREN UND HOHEN PULSFREQUENZEN]
W. KOHL (Messerschmitt-Boelkow-Blohm GmbH, Munich, West Germany) Frequenz (ISSN 0016-1136), vol. 38, July-Aug. 1984, p. 171-178. In German. refs

The basic principles of a pulse-Doppler airborne radar are described. Medium and high pulse repetition frequency modes which allow target detection in look-down situations in the presence of ground clutter are emphasized. Simple equations are used to derive an algorithm for calculating the probability of detection as a function of target range, using approximations for ground clutter. Calculations are employed to obtain the essential radar performance characteristics. C.D.

A84-45576*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AUTOMATIC HELICAL ROTORCRAFT DESCENT AND LANDING USING A MICROWAVE LANDING SYSTEM
L. A. MCGEE, J. D. FOSTER, and G. XENAKIS (NASA, Ames Research Center, Moffett Field, CA) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 7, July-Aug. 1984, p. 385-392. Previously cited in issue 21, p. 3616, Accession no. A81-44556. refs

A84-45627
DOPPLER POLARISATION SPECTRAL RESOLUTION OF RADAR SIGNALS
D. GIULI, M. FOSSI, and M. GHERARDELLI (Firenze, Universita, Florence, Italy) Electronics Letters (ISSN 0013-5194), vol. 20, Aug. 2, 1984, p. 650, 651. Research supported by the Selenia S.p.A.

This letter presents some results on dual-channel Doppler spectral analysis of radar signals received by two circularly and orthogonally polarised radar channels. These results were produced from an analysis of experimental data obtained, in the presence of both aircraft target and clutter, by an S-band air traffic control radar suitably modified for dual polarisation reception. The results illustrate that dual channel processing can improve the target resolution with respect to single-channel processing, when using maximum entropy spectral estimation methods. Author

A84-45681
NAVIGATION SATELLITES - THEIR FUTURE POTENTIAL
W. E. RAMSEY (U.S. Navy, Washington, DC) (Royal Society, Discussion on Technology in the 1990s: The Industrialization of Space, London, England, Dec. 7, 8, 1983) Royal Society (London), Philosophical Transactions, Series A (ISSN 0080-4614), vol. 312, no. 1519, July 26, 1984, p. 67-73; Discussion, p. 73.

The United States Department of Defense is developing a new generation of navigation satellites known as the Navstar Global Positioning System or GPS. When the full system of 18 satellites is deployed in the late 1980s, highly accurate information on position, velocity, and time will be available continuously to users anywhere in the world. This capability has already been demonstrated by the existing constellation of five prototype satellites. The original impetus for Navstar was the need for highly accurate positioning information by military aircraft, ships, and ground units. But Navstar also has potential for a variety of civilian uses, which include precision navigation, surveying and accurate time transfer. Moreover, the projected sharp decline in the cost of GPS user equipment will make the system available to a wide class of users. Author

A84-45901
RELATIVE PERFORMANCE OF A SIMPLE MTI CANCELLER SELECTION RULE
G. W. M. VAN MIERLO (Nederlandse Centrale Organisatie voor Toegepast-Natuurwetenschappelijk Onderzoek, The Hague, Netherlands) and H. F. A. ROEFS (Nationaal Lucht- en Ruimtevaartlaboratorium, Amsterdam, Netherlands) IEE Proceedings, Part F - Communications, Radar and Signal Processing (ISSN 0143-7070), vol. 131, pt. F, no. 5, Aug. 1984, p. 433-436. Research supported by the Nederlandse Centrale Organisatie voor Toegepast-Natuurwetenschappelijk Onderzoek. refs

The performance of an MTI canceller selection rule, which is solely based on clutter suppression, is analysed in terms of incorrect selection probability and average loss in signal-to-interference ratio (SIR). It is concluded that the variation in target signal power transfer, as a function of the target radial velocity, is responsible for most incorrect canceller choices. The resulting loss in SIR is typically around 3 dB, with peaks to 6-9 dB in worst-case situations. Author

A84-45909
INEXPENSIVE MULTIPURPOSE AIRBORNE SURVEILLANCE RADAR
P. D. L. WILLIAMS (Racal-Decca Advanced Development, Ltd., Walton-on-Thames, Surrey, England) IEE Proceedings, Part F - Communications, Radar and Signal Processing (ISSN 0143-7070), vol. 131, pt. F, no. 5, Aug. 1984, p. 507-516. refs

Airborne radar was first used during World War II. During the period from 1945 to 1975 airborne radars were designed and operated in most major countries. A description is provided of cost-effective maritime surface search equipment with an efficient CFAR (constant false alarm rate) operation. The considered equipment makes it possible to obtain good performance without the use of a physically deep cosecant-squared antenna or a stable platform. It is pointed out that the equipment has also been test flown with a novel recording method of the radar picture for subsequent playback. The recording may be used for debriefing on the ground after each flight or classroom training. Attention is given to the origins of the airborne radar equipment, early flight trials of first professional prototype equipment in Norway, the description of latest (1982) equipment, natural environmental limitations, a linescan recorder with textural display, and results from primary radar equipment. G.R.

A84-45921
NAVIGATIONAL INSTRUMENTS AND SYSTEMS [NAVIGATSIONNYE PRIBORY I SISTEMY]
I. I. POMYKAEV, V. P. SELEZNEV, and L. A. DMITROCHENKO Moscow, Izdatel'stvo Mashinostroenie, 1983, 456 p. In Russian. refs

The theory of navigation, the principal methods of determining the motion parameters of flight vehicles, and the design and operation of navigational instruments and systems are reviewed. In particular, attention is given to the geophysical phenomena used in navigation, the aeromechanical method of determining motion parameters, navigational methods based on monitoring electromagnetic emissions, and a complex method of course determination. The discussion also covers astronavigational systems, the inertial method and inertial navigational systems, and navigational complexes. V.L.

A84-45932
THE EFFECT OF GYRO RANDOM WALK ON THE NAVIGATION PERFORMANCE OF A STRAPDOWN INERTIAL NAVIGATOR
D. J. FLYNN (Royal Aircraft Establishment, Radio and Navigation Dept., Farnborough, Hants., England) IN: Symposium Gyro Technology 1982, Stuttgart, West Germany, September 15, 16, 1982, Proceedings . Duesseldorf, West Germany, Deutsche Gesellschaft fuer Ortung und Navigation, 1982, p. 11.0-11.21. refs

The presence of gyroscope random walk can significantly degrade the performance of a strapdown inertial navigator during the navigate phase particularly for high accuracy systems. Therefore a study has been made to quantify the effect on position, velocity and attitude errors. Analytic expressions for standard deviation of these system errors have been derived by mathematical analysis and cross checked by computer simulation. In addition the effect of random walk on non-Schuler-tuned systems, and also of time correlated random walk is considered. Author

A84-45951#
APPLICATION OF ESTIMATION TECHNIQUES FOR THE EVALUATION OF SENSOR ERRORS FROM FLIGHT TESTS WITH THE EXPERIMENTAL STRAPDOWN SYSTEM OF DFVLR
H. NIEDERSTRASSER (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Institut fuer Flugfuehrung, Brunswick, West Germany) IN: Symposium Gyro Technology 1983, Stuttgart, West Germany, September 14, 15, 1983, Proceedings . Duesseldorf, West Germany, Deutsche Gesellschaft fuer Ortung und Navigation, 1983, p. 16.0-16.38. refs

The inflight behavior of sensors in the MOSY experimental strapdown system has been analyzed using a reference platform of known characteristics. MOSY and the analysis method are described and the estimated sensor error coefficients are discussed. The adaptation of flight maneuvers and/or flight periods to stimulate the sensor errors is addressed. The behavior of the utilized algorithms in the case of signal noise is considered along with the estimation of the y-gyro parameters. C.D.

A84-45952#
REAL TIME GYRO ERROR COMPENSATION IN STRAPDOWN SYSTEMS
D. K. JOOS (Bodenseewerk Geraetetechnik GmbH, Ueberlingen, West Germany) (Symposium on Gyro Technology, Stuttgart, West Germany, Sept. 15, 16, 1982) IN: Symposium Gyro Technology 1983, Stuttgart, West Germany, September 14, 15, 1983, Proceedings . Duesseldorf, West Germany, Deutsche Gesellschaft fuer Ortung und Navigation, 1983, p. 18.0-18.23.

The most critical strapdown technology problems are discussed, emphasizing the origin of the rectification errors which occur in a dynamic environment during attitude determination. Methods for measuring these errors are shown and the specific problems arising in the field of real time error compensation are described. The theoretically derived results are verified by presenting dynamic test results as well as flight test results achieved with the Modular Strapdown System. C.D.

A84-46030
IMPROVED ACOUSTO-OPTIC LASER SCANNER GUIDANCE SYSTEM
M. HIGGINS, G. TITMUSS, and R. MARTYN (British Aerospace PLC, Laser Systems Dept., Bristol, England) IEE Proceedings, Part H - Microwaves, Optics and Antennas (ISSN 0143-7097), vol. 131, pt. H, no. 4, Aug. 1984, p. 229-234.

A guidance system capable of operating in a hostile ECM environment without the use of wire or similar links is described. The system consists of a high-speed laser transmitter which scans a laser beam in a rectangular pattern across a receiver which faces the transmitter. The system design permits an object to determine its position accurately within the beam pattern without requiring a separate source of synchronizing pulses or transmitter timing sequence information. Novel features of the system include the use of a single laser and a twin-axis acoustooptic deflector. The transmitter pattern allows an object to enter at any time and 'lock on' within one frame. The high scan rate allows a receiver to miss several scans without loss of guidance information and permits time multiplexing of several scan patterns, each assigned to a separate receiver. The receivers can then each be directed to separate targets. C.D.

A84-46349*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
DEVELOPMENT AND FLIGHT TEST OF A WEATHER RADAR PRECISION APPROACH CONCEPT
G. R. CLARY (NASA, Ames Research Center, Moffett Field, CA), D. J. ANDERSON (Lear Fan, Reno, NV), and J. P. CHISHOLM (Nevada, University, Reno, NV) IN: American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 240-246.

In order to make full use of the helicopter's unique capability of remote-site, off-airport landings, it would be desirable to employ a self-contained navigation system requiring minimum groundable-based equipment. For this reason, research is being conducted with the aim to develop the use of airborne weather radar as a primary navigation aid for helicopter approach and landing in instrument flight rules (IFR) conditions. Anderson et al. (1982) have reported about the first phase of this effort, taking into account the detection of passive ground-based corner reflectors with the aid of an 'echo processor'. The technology of passive-reflector detection in the overland environment provides the pilot with the range and bearing to the landing site. The present investigation is concerned with a second research phase, which was undertaken with the objective to develop and demonstrate the feasibility of a weather radar-based precision approach concept. Preliminary flight test results are considered. G.R.

A84-46350*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
OPERATION OF A SINGLE-CHANNEL, SEQUENTIAL NAVSTAR GPS RECEIVER IN A HELICOPTER MISSION ENVIRONMENT
F. G. EDWARDS (NASA, Ames Research Center, Moffett Field, CA) and J. R. HAMLIN (NASA, Ames Research Center, Moffett Field, CA; USAF, Washington, DC) IN: American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 247-258. refs

It is pointed out that the future utilization of the Navstar Global Positioning System (GPS) by civil helicopters will provide an enhanced performance not obtainable with current navigations systems. GPS will supply properly equipped users with extremely accurate three-dimensional position and velocity information anywhere in the world. Preliminary studies have been conducted to investigate differential GPS concept mechanizations and cost, and to theoretically predict navigation performance and the impact of degradation of the GPS C/A code for national security considerations. The obtained results are encouraging, but certain improvements are needed. As a second step in the program, a single-channel sequential GPS navigator was installed and operated in the NASA SH-3G helicopter. A series of flight tests were conducted. It is found that performance of the Navstar GPS Z-set is quite acceptable to support area navigation and nonprecision approach operations. G.R.

A84-46351#
ADVANCED SYSTEMS APPLICATIONS - FOUNDATIONS FOR LHX
R. E. PARKS and T. W. INGRAM (Bell Helicopter Textron, Inc., Fort Worth, TX) IN: American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 259-269. refs

A definitional foundation for LHX is provided by an analysis of the projected deficiencies in the current Army helicopter fleet and by various estimates of capabilities required to fulfill future operational requirements. Some of the deficiencies are related to adverse weather-day/night capability, aircraft survivability measures, and strategic deployment capabilities. It has been found that there is a need for a new development program which yields a family of small, lightweight, high-speed aircraft that are affordable, self-deployable, and meet the rigorous requirements of future combat operations. It appears currently that LHX meets this need. The present investigation is concerned with the LHX advanced systems which are to make the required capabilities possible. Attention is given to current generation integrated systems, LHX avionics/cockpit systems, radiation hardening, and a self-healing and fault-tolerant architecture. G.R.

A84-46352*# Analytical Mechanics Associates, Inc., Mountain View, Calif.
SENSITIVITY ANALYSIS OF HELICOPTER IMC DECELERATING STEEP APPROACH AND LANDING PERFORMANCE TO NAVIGATION SYSTEM PARAMETERS
M. S. KARMALI, A. V. PHATAK (Analytical Mechanics Associates, Inc., Mountain View, CA), J. S. BULL, L. L. PEACH (NASA, Ames Research Center, Moffett Field, CA), and P. S. DEMKO (U.S. Army, Aviation Research and Development Command, Fort Monmouth, NJ) IN: American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 270-280.

The present investigation is concerned with a sensitivity analysis of the Decelerated Steep Approach and Landing (DSAL) maneuver to on-board and ground-based navigation system parameters. The Instrument Meteorological Conditions (IMC) DSAL maneuver involves decelerating to zero range rate while tracking the localizer and glideslope. The considered study investigated the performance of the navigation systems using Constant Deceleration Profile (CDP) guidance and a six degrees glideslope trajectory. A closed-loop computer simulation of the UH1H helicopter DSAL system was developed for the sensitivity analysis. Conclusions on system performance parameter sensitivity are discussed. G.R.

N84-31104*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A ROUTE GENERATOR CONCEPT FOR AIRCRAFT ONBOARD FAULT MONITORING
M. T. PALMER and K. H. ABBOTT Aug. 1984 33 p refs
(NASA-TM-86264; NAS 1.15:86264) Avail: NTIS HC A03/MF A01 CSCL 17G

Because of the increasingly complex environments in which the flight crews of commercial aviation aircraft must operate, a research effort is currently underway at NASA Langley Research Center to investigate the potential benefits of intelligent cockpit aids, and to establish guidelines for the application of artificial intelligence techniques to advanced flight management concepts. The segment of this research area that concentrates on automated fault monitoring and diagnosis requires that a reference frame exist, against which the current state of the aircraft may be compared to determine the existence of a fault. This paper describes a computer program which generates the position of that reference frame that specifies the horizontal flight route. Author

N84-31105*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SOFTWARE MODIFICATIONS TO THE DEMONSTRATION ADVANCED AVIONICS SYSTEMS (DAAS)
B. NEDELL and G. HARDY Aug. 1984 36 p refs
(NASA-TM-85942; A-9713; NAS 1.15:85942) Avail: NTIS HC A03/MF A01 CSCL 01D

Critical information required for the design of integrated avionics suitable for generation aviation is applied towards software modifications for the Demonstration Advanced Avionics System (DAAS). The program emphasizes the use of data busing, distributed microprocessors, shared electronic displays and data entry devices, and improved functional capability. A demonstration advanced avionics system (DAAS) is designed, built, and flight tested in a Cessna 402, twin engine, general aviation aircraft. Software modifications are made to DAAS at Ames concurrent with the flight test program. The changes are the result of the experience obtained with the system at Ames, and the comments of the pilots who evaluated the system. M.A.C.

N84-31107# Engineering and Economics Research, Inc., Vienna, Va.
NATIONAL AIRSPACE REVIEW: IMPLEMENTATION PLAN
Washington Federal Aviation Administration Jun. 1984 51 p refs Sponsored by Federal Aviation Administration
Avail: NTIS HC A04/MF A01

Activities of the National Airspace Review (NAR) are examined. Using a synergistic approach, the NAR is comprehensively reviewing current air traffic control procedures, flight regulations, and airspace for the purpose of validating the current system or identifying near term changes which will promote greater efficiency and provide the operational framework for moving into the next generation National Airspace System. Specifically, purposes of the NAR are: (1) Conduct an in depth study of airspace and procedural aspects of the existing air traffic system. (2) Identify and implement changes that will promote greater efficiency for all airspace users. (3) Simplify the Air Traffic Control system. (4) Match airspace and air traffic control procedures to technological improvement and fuel efficiency programs. M.A.C.

N84-31108# RAND Corp., Santa Monica, Calif.
DISTRIBUTED PROBLEM SOLVING FOR AIR FLEET CONTROL: FRAMEWORK AND IMPLEMENTATIONS Interim Report
R. STEEB, D. MCARTHUR, S. CAMMARATA, S. NARAIN, and W. GIARLA Apr. 1984 58 p
(Contract MDA903-82-C-0061)
(AD-A143168; RAND/N-2139-ARPA) Avail: NTIS HC A04/MF A01 CSCL 17G

Distributed problem solving, or multiple-agent problem solving, refers to the process by which several agents interact to achieve goals. In this note, we describe the development of a framework for implementation of multiple cooperative agents. We also describe experiments and demonstrations with different strategies of cooperation, using air-traffic control and remotely piloted vehicle (RPV) fleet coordination as our exemplary task domains. Multiagent cooperation is discussed first in a domain-independent fashion, and then in the context of the two task domains. We contrast the methodologies, difficulties, and opportunities of distributed and centralized problem solving. From this analysis, we postulate a set of requirements on the information-gathering and organizational policies of group problem-solving agents, and we develop a general framework for implementing such policies. We then discuss a set of distributed problem solvers that we have developed for air-traffic control and surveillance RPV fleet control. Finally, we describe some experimental findings using the cooperative strategies, with particular emphasis on role assignment within the group and communications between group members. GRA

N84-32372# Southern Methodist Univ., Dallas, Tex. Dept. of Electrical Engineering.
SENSOR NOISE AND KALMAN FILTER FOR AIDED INERTIAL NAVIGATION SYSTEM Final Report, 15 Mar. 1982 - 14 Mar. 1983
G. S. GREWAL May 1984 20 p
(Contract AF-AFOSR-0006-82)
(AD-A143360; AFOSR-84-0556TR) Avail: NTIS HC A02/MF A01 CSCL 17G

Inertial Navigation System, barometric altimeter, TACAN, and ILS are used to achieve a synergistic combination of the outputs of individual subsystems. Kalman filter is used to provide an ideal method for data processing in this multisensor navigation system. The filter design begins with the development of mathematical and statistical error models to describe the truth system. The truth model is simplified and reduced, in steps, to lower the computation burden on the on-board computer. The covariance analysis and the Monte Carlo methods of testing the performance of the Kalman filters based on reduced and simplified system models are discussed. Suggestions for further research in the area of fault detection and isolation are offered. Author (GRA)

N84-32374# Transportation Systems Center, Cambridge, Mass.
THUNDERSTORM IMPACT ON DENVER AIR TRAFFIC CONTROL OPERATIONS AND THE ROLE OF NEXRAD (NEXT GENERATION WEATHER RADAR) Final Report, May 1982 - Sep. 1983
L. E. STEVENSON Apr. 1984 104 p refs Sponsored by DOT
(PB84-189729; DOT-TSC-RSPA-84-1) Avail: NTIS HC A06/MF A01 CSCL 17G

The impact of thunderstorms on the Denver Air Traffic Control (ATC) operation and the potential role of the Next Generation Weather Radar (NEXRAD) in reducing that impact was studied. The investigation was conducted in two stages. First, data collected at Denver during the summer of 1982 in collaboration with the JAWS Project was used to produce several one to two hour case studies. These case studies document specific thunderstorm impacted ATC situations in terms of traffic disruption, aircraft delay, and pilot reported encounters with turbulence, wind shear, microbursts, heavy rainfall and hail. Second, these case studies were used as a basis for follow up discussions with Denver ATC personnel. The result of the investigation is a qualitative and, where possible, quantitative description of the impact of thunderstorms on arrivals and departures at Stapleton International Airport. GRA

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AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

A84-42746
FLIGHT SERVICE OF COMPOSITE STRUCTURES ON MCDONNELL DOUGLAS COMMERCIAL AIRPLANES
C. Y. KAM and J. GAIDULIS (Douglas Aircraft Co., Long Beach, CA) IN: National Technical Conference, 15th, Cincinnati, OH, October 4-6, 1983, Proceedings . Azusa, CA, Society for the Advancement of Material and Process Engineering, 1983, p. 251-262.

The development activities that led to the introduction of advanced composite materials in Douglas Aircraft Company's commercial airplanes are reviewed. The applications of carbon/epoxy structural components on the Super 80 and DC-10 airplanes are emphasized. The design, fabrication, certification testing, and flight service of selected components are discussed. The damage and repair experience of the flight service components is also reviewed. Future plans for the development and production of advanced composite structures are summarized. Author

A84-42747
FLIGHT SERVICE EXPERIENCE WITH COMPOSITE HELICOPTER COMPONENTS
H. ZINBERG (Bell Helicopter Textron, Inc., Fort Worth, TX) IN: National Technical Conference, 15th, Cincinnati, OH, October 4-6, 1983, Proceedings . Azusa, CA, Society for the Advancement of Material and Process Engineering, 1983, p. 263-276.

Flight service experience with composite airframe structures on 40 Bell 206L helicopters is reported. The components included Kevlar fairings, baggage compartment doors and litter doors, and a graphite/epoxy vertical fin. A total of 92,000 component flight hours were accumulated in a wide variety of climatic conditions. Damages were induced by slamming doors over protruding surfaces, having a leading edge struck by a blade on another helicopter, and when thermal buckling occurred in the desert. All deficiencies were field reparable. Additional tests with fiberglass rotor blades also demonstrated acceptable service characteristics. M.S.K.

A84-42748
COMPOSITE FLIGHT SERVICE EXPERIENCE AT LOCKHEED-CALIFORNIA COMPANY
R. H. STONE (Lockheed-California Co., Burbank, CA) IN: National Technical Conference, 15th, Cincinnati, OH, October 4-6, 1983, Proceedings . Azusa, CA, Society for the Advancement of Material and Process Engineering, 1983, p. 277-287.

The performance-to-date of graphite epoxy (GRE) and Kevlar-49 (K-49) structures on Lockheed L-1011 aircraft is summarized. A GRE inboard aileron study funded by NASA featured microballoon-filled sandwich skins and led to installation of units on four different aircraft in 1982 to start a 5 yr trial. Another component, A GRE floor post made of fire-retardant material, was tested for 550 flight hours, removed for inspection and found to be free of defects or damage. The post has since accumulated over 10 yr of service life. GRE cowl doors have performed satisfactorily, provided delamination at corners due to ground handling is monitored. K-49 fairings on three aircraft displayed no significant defects after 9 yr of service. The results are encouraging increased usage of composites in future aircraft. M.S.K.

A84-42749
EFFECTS OF SERVICE ENVIRONMENT ON THE BORON/EPOXY SKINS OF THE F-15 HORIZONTAL STABILATOR
T. V. HINKLE (McDonnell Aircraft Co., St. Louis, MO) and C. L. RUPERT (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, OH) IN: National Technical Conference, 15th, Cincinnati, OH, October 4-6, 1983, Proceedings . Azusa, CA, Society for the Advancement of Material and Process Engineering, 1983, p. 288-298.
(Contract F33615-77-C-3124; F33615-79-C-3210)

The results of full scale static and environmental tests and actual use of a boron/epoxy skinned stabilator for the F-15 are reported. Two stabilators were subjected to tensile and moisture content tests. Coupons of the material were shipped to various USAF bases for long-term exposure in concert with detailed weather monitoring. The sample mounted on an aircraft for 4 yr yileded moisture content data that were used to predict the 10 yr behavior of the material. The static tests revealed that the materials could withstand conditions far more severe than could be expected in the service environments tests and still possess acceptable strengths and stiffnesses. M.S.K.

A84-42750* Sikorsky Aircraft, Stratford, Conn.
FLIGHT SERVICE EVALUATION OF COMPOSITE HELICOPTER COMPONENTS
M. J. RICH and D. W. LOWRY (Sikorsky Aircraft, Stratford, CT) IN: National Technical Conference, 15th, Cincinnati, OH, October 4-6, 1983, Proceedings . Azusa, CA, Society for the Advancement of Material and Process Engineering, 1983, p. 299-309. Army-supported research. Previously announced in STAR as N83-12071.
(Contract NAS1-16542)

This first interim report presents the technical background for including environmental effects in the design of helicopter composite structures, and test results after approximately two year field exposure of components and panels. Composite structural components were removed from Sikorsky S-76 helicopters commercially operated in the Gulf Coast region of Louisiana. Fatigue tests were conducted for a graphite/epoxy tail rotor spar and static test for a graphite/epoxy and Kevlar/epoxy stabilizer. Graphite/epoxy and Kevlar/epoxy panels are being exposed to the outdoor environment in Stratford, Connecticut and West Palm Beach, Florida. For this reporting period the two year panels were returned, moisture measurements taken, and strength tests conducted. Results are compared with initial type certificate strengths for components and with initial laboratory coupon tests for the exposed panels. Comparisons are also presented with predicted and measured moisture contents. Author

A84-42751
SERVICE EXPERIENCE WITH COMPOSITES ON BOEING COMMERCIAL AIRCRAFT
R. L. COGGESHALL (Boeing Commercial Airplane Co., Seattle, WA) IN: National Technical Conference, 15th, Cincinnati, OH, October 4-6, 1983, Proceedings . Azusa, CA, Society for the Advancement of Material and Process Engineering, 1983, p. 310-320. refs

A number of flight service test programs were carried out with composite structures on commercial aircraft in attempts to improve structural efficiencies. The composite components included a boron-epoxy (BE) B707 foreflap, graphite-skinned, end-closure ribbed B737 spoilers, Kevlar/epoxy (KE) 727 engine cowls, production-run graphite spoilers on NASA aircraft, and 727 composite elevator and stabilizer. The 757 and 767 aircraft make extensive use of composites for control surfaces, fairings, and engine nacelle components. The programs identified areas surrounding actuators and hinge attach points as stress critical zones. All the composite components yielded service performances at least as good as conventional structures. Consideration is now being given to usage of composites in primary structures. M.S.K.

A84-43444#
ANALYSIS OF A CONTROL CONCEPT FOR EJECTION SEATS
J. V. CARROLL (Scientific Systems, Inc., Cambridge, MA) IN: Guidance and Control Conference, Seattle, WA, August 20-22, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 385-392. refs
(Contract F33615-82-C-3402)
(AIAA PAPER 84-1894)

A control law design for open ejection seats is presented and analyzed. The control technique is based on nonlinear acceleration control, which exploits very well the unique and highly nonlinear characteristics of the pilot/seat system. This paper reviews the design of the controller, including the related actuator configuration and microprocessor architecture issues. Examples presented show that this design represents a reasonable approach for the control of the seat in its harsh, highly constrained environment, over several diverse escape conditions. Author

A84-43445#
OPTIMAL CATAPULT IMPULSE SHAPING FOR EJECTION SEATS
P. K. A. MENON and R. A. WALKER (Integrated Systems, Inc., Palo Alto, CA) IN: Guidance and Control Conference, Seattle, WA, August 20-22, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 393-398. refs
(AIAA PAPER 84-1895)

An important design task in the development of ejection seats is that of determining the rocket catapult impulse necessary to provide clearance of the vertical stabilizer of aircraft at higher speed while minimizing the risk of spinal injury to the ejectee. Using a linear bio-dynamical model, an optimal impulse shaping study is carried out for this problem. The main conclusion that emerges is that an optimally scheduled catapult impulse can significantly reduce the risk of serious injury due to acceleration stresses. Author

A84-43452*# Research Triangle Inst., Research Triangle Park, N.C.
EFFECTS OF AIRCRAFT AND FLIGHT PARAMETERS ON ENERGY-EFFICIENT PROFILE DESCENTS IN TIME-BASED METERED TRAFFIC
F. R. DEJARNETTE (Research Triangle Institute, Research Triangle Park; North Carolina State University, Raleigh, NC) IN: Guidance and Control Conference, Seattle, WA, August 20-22, 1984, Technical Papers . New York, American Institute of Aeronautical and Astronautics, 1984, p. 458-472. refs
(Contract NAS1-17023)
(AIAA PAPER 84-1915)

Attention is given to a computer algorithm yielding the data required for a flight crew to navigate from an entry fix, about 100 nm from an airport, to a metering fix, and arrive there at a predetermined time, altitude, and airspeed. The flight path is divided into several descent and deceleration segments. Results for the case of a B-737 airliner indicate that wind and nonstandard atmospheric properties have a significant effect on the flight path and must be taken into account. While a range of combinations of Mach number and calibrated airspeed is possible for the descent segments leading to the metering fix, only small changes in the fuel consumed were observed for this range of combinations. A combination that is based on scheduling flexibility therefore seems preferable. O.C.

A84-43487*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A FLIGHT TEST EVALUATION OF THE PILOT INTERFACE WITH A DIGITAL ADVANCED AVIONICS SYSTEM
D. A. HINTON (NASA, Langley Research Center, Flight Operation Research Branch, Hampton, VA) American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Seattle, WA, Aug. 20-22, 1984. 9 p. refs
(AIAA PAPER 84-1819)

A flight study was conducted to study pilot workload and the pilot interface with high levels of avionics capability and automation. The study was done in the context of general aviation, single-pilot IFR operations and utilized an experimental, digital, integrated avionics system. Results indicate that such advanced systems can provide improved information to the pilot and increased functional capability. The results also indicate that additional research is needed to increase the knowledge base required to design the pilot interfaces with highly capable systems. A CRT-based moving map display format tested provided excellent navigational situational awareness but was inferior to an HSI for manual path tracking. The complexity of navigation data management, autopilot management, and maintaining awareness of system status contributed to pilot workload and errors. Suggested guidelines for the design of the pilot/avionics interface for advanced avionics systems are given. Author

A84-43810
EXTENDED UPPER DECK-300
T. E. FORD Aircraft Engineering (ISSN 0002-2667), vol. 56, July 1984, p. 12-15.

The characteristics and applications options offered by the 747-300 Extended Upper Deck (EUD) are outlined. The EUD modifications comprise a 280 in. stretch tailward for the upper compartment. The new configuration can accommodate up to 91 extra seats or 21 first class sleeper seats. A larger aft upper deck galley permits removal of another galley for more passenger seats. The upper deck has a pair of double-A width emergency exit doors hinged at the top. The 747-300 has a maximum taxi weight of 379,210 kg and a maximum landing weight of 260,370 kg in the combined cargo/passenger configuration and slightly higher weight capabilities with passengers only. The aircraft was introduced for long haul routes and may presage further enhancements to 800 passengers and a wingspan of 250 ft. M.S.K.

A84-43811
TRANSPORT AIRCRAFT - PROGRESS AND PROBLEMS
J. G. BORGER Exxon Air World, vol. 36, no. 2, 1984, p. 18-22.

Progress and problems of commercial jet transport aircraft from the late 1940s to the present are reviewed. Among the topics discussed are: the development of the 707, 727, 737, 747, 757, 767, and L1011 airliners. Powerplant design and performance, range, altitude, speed, passenger cabin design and capacity, and takeoff weight requirements are also considered. Mention is also made of such problems as fatigue failure in fuselage structures of early airliners such as the Comet. Early engine selection, determination of optimum fuselage cross section, growth allowance, fuel efficiency through careful control of empty weight, and safety are some points which are stressed. J.P.

A84-43812* National Aeronautics and Space Administration, Washington, D. C.
HELICOPTERS FOR THE FUTURE
J. F. WARD (NASA, Office of Aeronautics and Space Technology, Washington, DC) Exxon Air World, vol. 36, no. 2, 1984, p. 26-30.

Technology needed to provide the basis for creating a widening rotary wing market include: well defined and proven design; reductions in noise, vibration, and fuel consumption; improvement of flying and ride quality; better safety; reliability; maintainability; and productivity. Unsteady transonic flow, yawed flow, dynamic stall, and blade vortex interaction are some of the problems faced by scientists and engineers in the helicopter industry with rotorcraft technology seen as an important development for future advanced high speed vehicle configurations. Such aircraft as the Boeing Vertol medium lift Model 360 composite aircraft, the Sikorsky Advancing Blade Concept (ABC) aircraft, the Bell Textron XV-15 Tilt Rotor Aircraft, and the X-wing rotor aircraft are discussed in detail. Even though rotorcraft technology has become an integral part of the military scene, the potential market for its civil applications has not been fully developed. J.P.

A84-43889*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
FLIGHT TESTING OF UNIQUE AIRCRAFT CONFIGURATIONS
W. D. PAINTER (NASA, Ames Research Center, Moffett Field, CA) AIAA Student Journal (ISSN 0001-1460), vol. 21, Spring 1983, p. 2-7, 23.

Some historical developments of flight testing of unique aircraft configurations by NASA and the military sector are documented. Several test aircraft are outlined including the M2-F1 (which was the first Space Shuttle concept ever demonstrated, and contributed to the present design), the X-15, the Flying Wing, the Lunar Landing Research Vehicle, the Oblique Wing Research Aircraft, and the Space Shuttle Enterprise. Future test aircraft such as the forward swept wing X-29A Advanced Technology Demonstrator Aircraft, and the X-Wing vehicle are also mentioned. It is noted that the logical preliminary to flight testing is flight simulation, and that flight testing itself is the vital final component of the development, and seems to be the most direct approach to aircraft evaluations. J.P.

A84-43891#
THE DESIGN OF A TURBOFAN VTOL AIRCRAFT FOR MILITARY APPLICATIONS
R. W. KRESS (Grumman Aerospace Corp., Bethpage, NY) AIAA Student Journal (ISSN 0001-1460), vol. 21, Spring 1983, p. 15-20.

The report describes the design of the 698 turbofan VTOL military aircraft. The twin tilt-nacelle aircraft which would carry a crew of two and have a takeoff gross weight of approximately 20,000 pounds, would be equipped with sophisticated avionics, a conformal surveillance radar (located in the leading and trailing edges of the wings), an active/passive sensor, and C3 subsystems for use in electronic and anti-electronic warfare missions. A short 170-foot takeoff run on an FFG-7 Perry-class frigate would allow the 698 to carry an additional 3000 pounds of payload which could include weapons for a variety of operations. The 698 would be equipped with dual forward landing gear, and would be powered by two TF34 high-bypass-ratio turbofan engines adapted for VTOL with provision for a backup cross shaft in the event of single engine failure. The final objective of testing. the 698 design in wind tunnel, radio-control models, and simulation categories is to provide the basis for construction of a manned flight demonstrator. J.P.

A84-43895#
SKY SHARK - A SUBSONIC V/STOL UTILITY AIRCRAFT
AIAA Student Journal (ISSN 0001-1460), vol. 21, Winter 1983, p. 16-24. refs

Preliminary and final designs for a substonic V/STOL capable of carrying a 3000-lb payload 800 n.m. at altitude 35,000 ft and airspeed 400 kts or better are presented. Tilt-nacelle, tandem-wing/tandem-fan, lift-engine/lift-cruise-engine, and

augmentor-wing designs are evaluated in. terms of safety, technology utilization, economics, performance, and market potential and found insufficient. The final design is an optimized tandem-wing configuration with a 28-ft wingspan, rear tilt nacelles housing fans driven by two turboshafts, and a nose remote lift fan driven by two gas generators. The aircraft carries 2810 lbs of fuel for a VTO weight of 18,000 lbs and costs 5.7 million dollars, assuming production of 50 units. Drawings, graphs of performance characteristics, and tables of design parameters are provided.
T.K.

A84-43911
ALL-WEATHER ATTACK FOR THE NEXT CENTURY
D. COLLINS Grumman Aerospace Horizons (ISSN 0095-7615), vol. 20, no. 1, 1984, p. 2-9.

Attention is given to the development history and further modernization prospects of the U.S. Navy/Marine Corps A-6 attack aircraft. The A-6E and A-6E/Target Recognition Advanced Multisensor (TRAM) upgraded versions may replace the current 9300 lb-thrust engines with state-of-the-art units generating in excess of 11,000 lbs despite their lower weight and fuel consumption. Multimode radar and all-solid state electronics will also be featured, together with an additional weapon store station under each wing. The wings will be modified to decrease carrier landing speeds. A 20-30 percent reduction in maintenance manhours is expected. The TRAM version will incorporate such turrent-mounted electrooptic devices as a forward-looking IR sensor and a laser designator.
O.C.

A84-44042#
HEAVY-LIFT HYBRIDS
R. DEMEIS Aerospace America (ISSN 0740-722X), vol. 22, Aug. 1984, p. 42-44.

The 'Heli-Stat' hybrid helicopter-aerostat concept encompasses a one million cu ft U.S. Navy ZPG-2 blimp hull above a truss structure, to the four corners of which are joined the forward fuselages of SH-34J helicopters. The buoyancy of the blimp nearly compensates for the weight of the four helicopters and supporting structure, leaving rotor lift to be used entirely for useful payloads and fuel. The 'Helitransport' cargo/passenger aircraft, which is of the same general configuration as the Heli-Stat vehicle, will employ a geodesic aluminum structure rigid hull and promises to cut travel time, city center-to-center, at distances of up to 250 miles by comparison with airplanes or cars and trains.
O.C.

A84-44044#
WEAPON INTEGRATION - KEY TO THE 'CLEAN MACHINE'
H. A. KING and K. J. SNEDEN (Northrop Corp., Aircraft Div., Hawthorne, CA) Aerospace America (ISSN 0740-722X), vol. 22, Aug. 1984, p. 66-68, 78.

The weapons integration schemes of next-generation tactical aircraft, including the U.S. Air Force's Advanced Technology Fighter, cannot be allowed to compromise efforts to reduce aircraft radar signature and lower aerodynamic drag while fulfilling multimission capability criteria. Airframes and weapons carriage configurations will accordingly be designed in parallel. Among the design options explored and comparatively assessed are semisubmerged, fully submerged, and internal weapons carriage configurations, as well as the novel upper aircraft surface weapons ejection concept for low altitude missions. Advanced ejector concepts under evaluation are the minimum area crutchless ejector and the air bag ejector, which solves both store carriage drag and radar signature problems.
O.C.

A84-44190*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AERODYNAMIC CHARACTERISTICS OF TWO GENERAL AVIATION CANARD CONFIGURATIONS AT HIGH ANGLES OF ATTACK
J. R. CHAMBERS and L. P. YIP (NASA, Langley Research Center, Hampton, VA) American Institute of Aeronautics and Astronautics, Applied Aerodynamics Conference, 2nd, Seattle, WA, Aug. 21-23, 1984. 12 p.
(AIAA PAPER 84-2198)

The results of wind tunnel tests of two propeller driven canard general aviation aircraft models at high angles of attack are reported. Both tractor and pusher prop configurations were examined. Angles of attack of -6 to 40 deg were used with the pusher model at Re of 1,600,000, and from -30 to 90 deg and Re of 550,000 for the tractor model. The tests showed that the canard would stall long before the wing and produce a nose-down tendency, thus effectively keeping the aircraft out of the stall regime. However, a sequence of pilot actions or design factors such as the airfoils, relative geometry of the canard and wing, the propeller location and the center of gravity location could introduce a wide variance in stall characteristics from one aircraft to another.
M.S.K.

A84-44314#
COMPUTATIONAL FLOW SIMULATION - AEROSPACE'S CAE MIDDLEMAN
C. W. BOPPE (Grumman Aerospace Corp., Bethpage, NY) Mechanical Engineering (ISSN 0025-6501), vol. 106, Aug. 1984, p. 32-43.

The use of CAD technology in the preliminary design process for providing computational simulations of three-dimensional flow is discussed. Several of the benefits of applying computational tools to the study of three-dimensional flow problems are discussed, and these include: simpler interpretations of complex flow mechanisms, reduced wind-tunnel test requirements, and more effective flight test operations. The applications of this technology to number of civilian and military design projects are discussed, with particular emphasis on experiments with the F-14 fighter aircraft and the HiMAT highly maneuverable test vehicle.
I.H.

A84-44452*# Douglas Aircraft Co., Inc., Long Beach, Calif.
DC-10-10 WINGLET FLIGHT TEST PROGRAM MANAGEMENT
J. R. AGAR (Douglas Aircraft Co., Long Beach, CA) IN: Flight testing technology: A state-of-the-art review; Proceedings of the Thirteenth Annual Symposium, New York, NY, September 19-22, 1982 . Lancaster, CA, Society of Flight Test Engineers, 1982, p. 1-3. Research supported by Douglas Aircraft Co. and NASA.

This paper discusses the McDonnell Douglas/NASA DC-10-10 winglet flight test program from a program management viewpoint. The program was conducted to obtain flight test data on the same airplane with and without winglets for direct comparison. As occasionally happens in flight tests, unexpected events occur. This program was encumbered by a low-speed buffet anomaly that required several configuration modifications before satisfactory performance could be attained. This paper relates the management techniques utilized to accommodate the unplanned increases in program scope and still complete the program on time and below the budgeted cost.
Author

A84-44453#
ADVANCED MEDIUM RANGE AIR-TO-AIR MISSILE FLIGHT TEST PROGRAM OVERVIEW
P. UNITT (USAF, Eglin AFB, FL) IN: Flight testing technology: A state-of-the-art review; Proceedings of the Thirteenth Annual Symposium, New York, NY, September 19-22, 1982 . Lancaster, CA, Society of Flight Test Engineers, 1982, p. 5-10.

The AIM-120A, Advanced Medium Range Air-to-Air Missile (AMRAAM) is being developed jointly by the Air Force and the Navy, for the F-14, F-15, F-16, and F/A-18 fighter aircraft. Interfaces are also being studied for selected NATO aircraft. Designed by the Hughes Aircraft Company to supersede current radar guided, medium range air-to-air missiles, the AIM-120A is in full scale development. The $58M flight test program has been compressed to enable meeting the most immediate Initial Operational Capability (IOC). It involves 87 pre-production guided missile firings over a 2 year period, using encrypted telemetry. There will also be supporting ground test, captive tests, free flight non-guided missile firings, and simulations. The number of test assets is limited by their expense. Some will therefore serve multiple purposes. Furthermore, they will be shared by developmental and operational test agencies, and by both services to prevent duplicative testing. Author

A84-44454#
AV-8B FLIGHT TEST PROGRAM OVERVIEW - 20 OCTOBER 1982
F. E. CHANA (McDonnell Aircraft Co., St. Louis, MO) IN: Flight testing technology: A state-of-the-art review; Proceedings of the Thirteenth Annual Symposium, New York, NY, September 19-22, 1982 . Lancaster, CA, Society of Flight Test Engineers, 1982, p. 11-15.

A84-44460#
AN INVESTIGATION OF THE EFFECTS OF A THRUST AUGMENTING EJECTOR ON THE PERFORMANCE AND HANDLING QUALITIES OF AN UPPER SURFACE BLOWN RESEARCH AIRCRAFT
R. D. KIMBERLIN (Tennessee, University, Tullahoma, TN) IN: Flight testing technology: A state-of-the-art review; Proceedings of the Thirteenth Annual Symposium, New York, NY, September 19-22, 1982 . Lancaster, CA, Society of Flight Test Engineers, 1982, p. 67-72. refs
(Contract N00019-80-C-0126; N00019-81-C-0506)

This paper describes the results of flight tests of the Ball-Bartoe Jetwing USB Research Aircraft with and without its ejector wing installed. These results show that the ejector wing has an overall negative effect upon the performance and longitudinal stability of the aircraft. These negative effects appear to be due to an increase in zero lift drag, and to the increased thickness of the USB jet when the ejector wing is installed. Author

A84-44461*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A TECHNIQUE FOR DETERMINING POWERED-LIFT STOL AIRCRAFT PERFORMANCE AT SEA LEVEL FROM FLIGHT DATA TAKEN AT ALTITUDE
V. C. STEVENS (NASA, Ames Research Center, Moffett Field, CA) IN: Flight testing technology: A state-of-the-art review; Proceedings of the Thirteenth Annual Symposium, New York, NY, September 19-22, 1982 . Lancaster, CA, Society of Flight Test Engineers, 1982, p. 73-84. refs

State-of-the-technology powered-lift STOL aircraft can develop very high lift coefficients. The determination of how this high lift capability can be utilized for landing approaches is accomplished by evaluating aircraft velocity versus flightpath performance. This paper briefly discusses upper-surface-blowing power-lift technology and some of the significant features of the velocity versus flightpath plot that are used in evaluating the performance of powered-lift aircraft. A procedure for deriving the velocity versus flightpath plot for a powered-lift aircraft at any specified weight at sea level, based on flight-test data obtained at various weights and altitudes, is discussed in detail. Actual flight-test data obtained with NASA's Quiet Short-Haul Research Aircraft (QSRA) are used to illustrate this procedure and to evaluate the results. Author

A84-44462#
F-15 INFLIGHT WING LOADS CALIBRATION
G. L. GRABER and R. D. BAUM (McDonnell Aircraft Co., St. Louis, MO) IN: Flight testing technology: A state-of-the-art review; Proceedings of the Thirteenth Annual Symposium, New York, NY, September 19-22, 1982 . Lancaster, CA, Society of Flight Test Engineers, 1982, p. 85-90.

An inflight loads calibration technique is presented for the calibration of strain gage bridge circuits installed on the F-15C aircraft. This unique procedure was developed and verified using flight measured data from previous F-15A flight loads testing. Major steps in this calibration were the selection and location of strain gages, selection of flight conditions to measure gage response, development of the calculation to determine the applied load and the derivation of equations relating gage response to applied load. The inflight loads calibration technique provides a means to obtain loads during follow-on programs without incurring the time and expense of laboratory fixture calibrations. Author

A84-44463#
FLIGHT FLUTTER TEST METHODOLOGY AT GRUMMAN
H. J. PERANGELO (Grumman Data Systems Corp., Calverton, NY) and P. R. WAISANEN (Grumman Aerospace Corp., Calverton, NY) IN: Flight testing technology: A state-of-the-art review; Proceedings of the Thirteenth Annual Symposium, New York, NY, September 19-22, 1982 . Lancaster, CA, Society of Flight Test Engineers, 1982, p. 91-100.

Requirements for an accurate and rapid flutter data analysis capability were defined in the early '70s for conduct of the F-14 flight test program. This capability was developed by utilizing a least-squares difference-equation (LSDE) approach to extract resonant frequency and damping coefficient information from fast shaker sweeps. The Grumman philosophy for quantitative determination of aeroelastic characteristics and structural stability, in a near-real-time environment, remained evident with the subsequent program improvements that were implemented with a goal toward minimizing shaker requirements. Results of improvements over the past decade will be reviewed. Specific flight test results, both successful and unsuccessful, will be discussed for shaker driven and randomly excited structural response data. Finally, an overview will be presented discussing the next generation improvements, considering advanced parameter identification methods interfaced with a detailed engineering model for optimal data analysis. Author

A84-44465#
F-14 HIGH ANGLE OF ATTACK INVESTIGATION WITH ASYMMETRIC THRUST AND EXTERNAL STORES
F. W. SCHAEFER (Grumman Aerospace Corp., Bethpage, NY) IN: Flight testing technology: A state-of-the-art review; Proceedings of the Thirteenth Annual Symposium, New York, NY, September 19-22, 1982 . Lancaster, CA, Society of Flight Test Engineers, 1982, p. 123-129.

A comparison of F-14 spin accidents showed two common factors: engine stalls resulting in asymmetric thrust and external fuel tanks. The effects of thrust asymmetry and external stores on high angle of attack departure characteristics were investigated during a recent flight test program. The program used limited initial flight and wind tunnel tests to develop a piloted simulation of the F-14 in the high angle of attack regime. The simulation was used to predict the boundaries of controlled flight, which were then verified on an F-14 equipped with spin recovery devices. Departure characteristics were categorized using criteria developed on the simulator. These criteria were used to correlate flight test and simulator results. Author

A84-44467#
OPTIMIZING THE F-14A DLC/APC SYSTEM FOR IMPROVED GLIDESLOPE PERFORMANCE
D. WILKIN and H. STILES (Grumman Aerospace Corp., Stability and Control Section, Calverton, NY) IN: Flight testing technology: A state-of-the-art review; Proceedings of the Thirteenth Annual Symposium, New York, NY, September 19-22, 1982 . Lancaster, CA, Society of Flight Test Engineers, 1982, p. 143-149.

The desired Power Approach configuration for the F-14A is with the Direct Lift Control (DLC) system engaged. The performance of the production DLC with the Approach Power Compensator (APC) engaged is currently marginal, however, due to minimal Delta-g response, residual pitching moments and excessive throttle motion. This has resulted in its limited use within the fleet. Improvement of the F-14A combined DLC/APC system performance was accomplished in two segments. The first segment included a flight test program to evaluate the performance of a modified DLC system. During this program, improved Delta-g capability and pitching moment characteristics were achieved with the redefined DLC system. The second segment was to integrate the production APC with the revised DLC. Since there is no specification applicable to integrated DLC/APC performance, new criteria and test techniques had to be developed to achieve optimum glideslope performance. The development of this program and the results obtained are discussed. Author

A84-44469#

FLIGHT FIDELITY EVALUATION OF THE T-44A OPERATIONAL FLIGHT TRAINER (OFT) (DEVICE 2F129)

D. N. CONTRACTOR (U.S. Navy, Naval Air Test Center, Patuxent River, MD) IN: Flight testing technology: A state-of-the-art review; Proceedings of the Thirteenth Annual Symposium, New York, NY, September 19-22, 1982 . Lancaster, CA, Society of Flight Test Engineers, 1982, p. 159-169. refs

The results of a comparison of in-flight T-44A data with simulation with an operational flight trainer (OFT) simulator are presented. The OFT is intended for training pilots and copilots in all operational modes of turboprop aircraft using complete instrumentation, systems and avionics simulation and a realistic control loading system. An aerodynamic code was developed from flight, ground, wind tunnel, inertial measurement, dynamic matching and pilot evaluation data. A series of evaluations of skills imparted by the trainer compared to real-world demands, followed by reconfiguration of the codes, resulted in a device considered capable of teaching skills which do not require excessive compensation in flight conditions. M.S.K.

A84-44470#

F-4S FLIGHT SIMULATION FIDELITY ENHANCEMENT AND AFT CENTER OF GRAVITY ENVELOPE EXPANSION

R. A. BURTON, B. L. HILDRETH (U.S. Navy, Naval Air Test Center, Patuxent River, MD), and J. H. VINCENT (System Control Technology, Inc., Palo Alto, CA) IN: Flight testing technology: A state-of-the-art review; Proceedings of the Thirteenth Annual Symposium, New York, NY, September 19-22, 1982 . Lancaster, CA, Society of Flight Test Engineers, 1982, p. 171-183. refs

Simulation and system identification is taking an ever-increasing role in the test and evaluation of high performance jet aircraft at the Naval Air Test Center (NAVAIRTESTCEN). This paper will overview the application of modern statistical system identification techniques to the extraction of aerodynamic characteristics of the F-4S airplane from flight test data. Aerodynamic parameter estimates will be presented in two loadings and in configurations takeoff, power approach, and cruise. The angle of attack ranges covered during the system identification analysis were 5-28 degrees in the power approach and takeoff configurations and 0-40 degrees in the cruise configuration. This analysis utilizes a nonlinear parameter identification algorithm and a spline modeling technique. Maneuvers analyzed included stall and departure aircraft responses. Specialized flight test techniques will be discussed. In addition, the conversion of this flight test derived data base to improve the fidelity of an F-4S simulation will be overviewed. The validation of this simulation with flight test data will be presented. Finally, the utilization of this simulation as a tool in the flight test program to expand the aft center of gravity limits of the F-4S airplane will be detailed. Author

A84-44474#

UNIQUE FLIGHT TEST CONSIDERATIONS FOR THE INTEGRATED FLIGHT/FIRE CONTROL PROGRAM

J. A. KOCHER (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) and S. G. JACKSON (USAF, Edwards AFB, CA) IN: Flight testing technology: A state-of-the-art review; Proceedings of the Thirteenth Annual Symposium, New York, NY, September 19-22, 1982 . Lancaster, CA, Society of Flight Test Engineers, 1982, p. 211-219. refs

The USAF initiated development of the digitized integrated flight/fire control (IFFC) system in 1981. IFFC is intended to blend pilot manual control with automatic control during air-to-air and air-to-ground gunnery and bombing. The pilot performs coarse maneuvering and the IFFC fine tunes the commands to achieve quick and accurate weapon line positioning. An F-15B has served as the testbed aircraft. The IFFC consists of an on-board computer, about 32 k of CIU software and an externally mounted tracking laser and illumination pod. Tests have included night attacks on ground and air-towed targets and computer generated simulation targets on the pilot HUD. Attention has been given to simulating anti-aircraft defenses. The level of success attained after 52 flights has been high enough that it is felt that all program goals will eventually be achieved. M.S.K.

A84-44480#

E-2C PASSIVE DETECTION SYSTEM (PDS) NOSE RADOME ANTI-ICING DEMONSTRATION TEST PROGRAM

R. KREIS (Grumman Aerospace Corp., Bethpage, NY) IN: Flight testing technology: A state-of-the-art review; Proceedings of the Thirteenth Annual Symposium, New York, NY, September 19-22, 1982 . Lancaster, CA, Society of Flight Test Engineers, 1982, p. 261-270. refs

The test techniques, instrumentation and results of the PDS nose radome anti-icing system demonstration test program for the E-2C Hawkeye aircraft are reported. The tests were conducted to yield two parameters for the anti-ice governing equations for mass and heat transfer. The parameters comprised the internal and external heat transfer coefficients of the radome. The governing equations were defined so that data from non-icing steady state flight could be extrapolated to cover the icing envelope. The system employs heat exchanger and engine bleed air controlled to within 10 F of 220 F. The water droplet trajectories were modeled in order to calculate the radome water catch rate. Sample results are calculated for a 10,000 ft altitude, 172 kt airspeed and 15 F flight with a 1.72 sq ft radome. A graphical technique is defined for solving the heat and mass transfer equations. M.S.K.

A84-44481#

AN APPLICATION OF DME FOR MEASURING REAL TIME FIELD PERFORMANCE

J. KUDIRKA (Grumman Aerospace Corp., Performance/Propulsion Section, Calverton, NY) IN: Flight testing technology: A state-of-the-art review; Proceedings of the Thirteenth Annual Symposium, New York, NY, September 19-22, 1982 . Lancaster, CA, Society of Flight Test Engineers, 1982, p. 283-288.

Measurements with a Del Norte Technology Trisponder (Trisponder is the Del Norte trade name for Transponder) and an AP/APN-194 Radar Altimeter have been successfully integrated with Grumman's Automated Telemetry System for determining FAA field performance of a Gulfstream III aircraft, in a real time mode. The combination of engine and aircraft flight test measurements with Del Norte range data provided the analyst with corrected takeoff and landing performance immediately after completion of the event. Improved productivity in altimeter air sensor calibration was also realized by replacing the traditional one-point-per-run visual tower flyby technique with an automatic constant speed or acceleration capability through DME space positioning. This report describes some of the operational features of a single remote station, and discusses some significant aspects of the data processing software. It presents examples of test results from Gulfstream III field performance maneuvers, and compares the accuracy of this system with the Fairchild Analyzer photographic process it replaced. Author

A84-44486#

STOVL TECHNOLOGY - AN OVERVIEW

S. B. WILSON, III Stanford Aerospace Engineer, vol. 4, April 1984, p. 11-13.

The comparative advantages of prospective Short Takeoff, Vertical Landing (STOVL) configurations for both subsonic and supersonic aircraft are discussed, with a view to the compilation of design information on the basis of which military planners can formulate actual requests for proposals. The STOVL concepts noted as promising employ Pegasus-type engines, 'Vented-D' vectoring nozzles, four-post twin engine exhausts, tilting engine nacelles, tandem fans, vertical axis lift engines, vectorable plenum chamber burning nozzles, engine bleed air-driven remote lift fans, and augmenting ejectors. O.C.

A84-44518#

FLUTTER CHARACTERISTICS OF HIGH ASPECT RATIO TAILLESS AIRCRAFT

J. R. BANERJEE (University of Wales Institute of Science and Technology, Cardiff, Wales) Journal of Aircraft (ISSN 0021-8669), vol. 21, Sept. 1984, p. 733-736. refs

Due to their characteristically high aspect ratios and slender wings, sailplanes are prone to such aeroelastic problems as flutter at even the lowest speeds encountered. The complexity of this behavior increases in the absence of a tail, because pitch-damping becomes weaker. Basic data for the tailless sailplane case are investigated and compared with those for a tailed sailplane. The method used selects an airspeed and evaluates the real and imaginary parts of the flutter determinant for a range of frequencies. O.C.

A84-44928*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

IMPROVING THE EFFICIENCY OF SMALLER TRANSPORT AIRCRAFT

R. T. JONES (NASA, Ames Research Center, Moffett Field, CA) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 6a-6g. refs

The efficiency of small transport aircraft can be improved through the adaptation of high altitude turbine engines, and that flights reaching altitudes of 40,000, 60,000, and 80,000 feet can show savings in both flight time and fuel consumption even for trips as short as 500 miles. Studies for a 40-passenger high altitude transport are presented. An increase in structural weight due to larger wing areas, larger engines, and larger engine frontal areas would make the ratio of gross weight to payload look less favorable, but the efficiency of the plane in passenger miles per gallon would increase with altitude. It is also suggested that supercritical airfoils be designed to achieve higher lift coefficients and speeds. A reduction of reduced drag through the use of horizontal or vertical wing tip extensions is also discussed. J.P.

A84-44947#

VALIDATION OF DESIGN METHODS AND DATA BY FLIGHT TEST

M. BESCH and H. MESTERKNECHT (Messerschmitt-Boelkow-Blohm GmbH, Hamburg, West Germany) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 178-184.

Details of flight tests to examine the loads envelope of an aircraft at tailplane due to an elevator-induced maneuver are presented to illustrate a flight loads investigation of a commercial aircraft. More than 100 flights lasting, cumulatively, more than 500 hr are performed in a year to validate overall performance, handling quality, structural loads, etc., of a new aircraft. Strain gages provide the loading data, which are usually analyzed only after control responses and flight stability have been established. The maneuver-induced loads are assayed in terms of control surface deflections, the angle of attack and pitch. The dynamic response of the aircraft is then mapped numerically, with attention focused on shear and bending forces. M.S.K.

A84-44949#

EXPERIMENTAL VALIDATION BY FLIGHT MEASUREMENT OF THE PRESSURE DISTRIBUTION COMPUTED ON PILATUS PC-7 WING USING A THREE DIMENSIONAL AERODYNAMIC PANEL PROGRAM

S. DULIO and A. TURI (Pilatus Aircraft, Ltd., Stans, Switzerland) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 196-202.

The procedures and results obtained from flight tests performed to validate the reliability of a modified version of the Hunt and Semple panel code are reported. The code was adapted to run on a VAX computer instead of an IBM computer and tested in comparisons with pressure distribution data gathered with an instrumented wing on a PC-7 aircraft. The wing airfoil, instrumentation, PCM data acquisition techniques and recording apparatus are described, together with the test data and predictions along the wing ribs. The code provided acceptable approximations and will be implemented in investigations of the effects of design changes on the flowfield and/or evaluations of configurations during the development phase of new aircraft. M.S.K.

A84-44955#

VARIABLE WING CAMBER CONTROL FOR CIVIL TRANSPORT AIRCRAFT

H. HILBIG and H. WAGNER (Messerschmitt-Boelkow-Blohm GmbH, Bremen, West Germany) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 243-248.

Variable camber wing technology is explored for its capabilities of ameliorating efforts to design and build commercial variant and derivative aircraft. The altered camber is achieved using existing high lift devices and control surfaces on leading and trailing edges. Wind tunnel aerodynamic data have characterized the L/D, polar, buffet, compressability and maneuver-load control of variable camber configurations. All known flap systems can be adapted to furnish variable camber. Comparisons with conventional wing technology indicate that fuel consumption could be cut 5 percent using variable camber, which would support larger payloads for a given wing span. M.S.K.

A84-44956#

DEVELOPMENT AND FLIGHT TESTING OF A NEW AMPHIBIAN TECHNOLOGY DEMONSTRATOR

G. K. L. KRIECHBAUM and J. SPINTZYK (Dornier GmbH, Friedrichshafen, West Germany) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 249-260. Research supported by the Bundesministerium fuer Forschung und Technologie.

Design features and test flight performance of an amphibian technology demonstrator aircraft (ATT) first flown in 1983 are outlined. The ATT has a DO A-5 airfoil canopy-mounted, three turboprops, sponsons for marine stabilization, nose wheel landing gear, a two-step flat bottom hull and a twin vertical tail. Composite materials have been incorporated into several secondary structures. Flight tests of the two-crewmember ATT covered land and water take-off and landing, stall, stability, control and handling characteristics. The ATT technology will serve as a model for constructing aircraft for missions such as maritime surveillance, fire fighting, environmental control, sea air rescue, passenger and cargo transport, ambulance and medical services and land and marine research, provided governmental funding is forthcoming for further technology development. M.S.K.

A84-44957#

THE SCOUT SYSTEM - A REAL TIME INTELLIGENCE AND SURVEILLANCE SYSTEM

D. HARARI (Israel Aircraft Industries, Lod, Israel) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 261-265.

Features of the SCOUT RPV system for intelligence and surveillance are described. The system comprises the RPV, a ground control station (GCS), a launcher and a retrieval system. The RPV carries a video camera for real time imaging. The GCS controls launch and navigation, the on-board camera, target identification and processing and transmission of flight and intelligence data. The RPV propulsion system is a rear-mounted two-cylinder gasoline/oil engine. All components are line replaceable units. An on-board guidance and navigation system allows autonomous operation without GCS control for long periods of time. M.S.K.

A84-44965#

SOLUTION OF THE NONLINEAR DYNAMIC PROBLEM OF STRUCTURAL BEHAVIOUR OF A COUPLED MODEL OF AN AIRPLANE WING WITH AN AILERON

M. J. JOSIFOVIC, Z. V. BOJANIC, and J. M. JANKOVIC (Beograd, Univerzitet, Belgrade, Yugoslavia) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 338-343.

A technique for analytical synthesis of a nonlinear dynamic model of an elastic structure system is presented. The model is applicable in the case of large displacements, and is extended to approximations for slightly nonlinear systems. Account is taken of the work expended by the external volume and surface forces, the potential energy of elastic deformations and kinetic energy released by the total number of displacements of the structure. A variational principle is defined for the structure, the external and internal structural dynamics are coupled and the order of the deformation equation is dynamically reduced. The method is intended for analyzing structural loads imparted to objects like wings, which experience large deflections. M.S.K.

A84-44966#

CURRENT AIRWORTHINESS REQUIREMENTS - A NEED TO REEXAMINE

R. SAHA (Technical Centre, Civil Aviation Dept., New Delhi, India) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 344-350. refs

Consideration is given to upgraded airworthiness criteria for jet aircraft with regard to acceleration-stop distance (ASD) and extended overwater operations by two-engined aircraft. Present ICAO regulations for ASD during take-off are based on a 2 sec pilot reaction time to abort or proceed when a malfunction such as a tire burst occurs. New incident probabilities are calculated for 2-, 3- and 4-engine aircraft. It is noted that runway friction can be weighted as much as 20 percent of the ASD performance, but no reliable models have yet been devised. For overwater flight, the existing 60/90 min rule - restriction to within 60 min flight time of an airport, 90 min for a turbine engine aircraft - does not account for improvements in modern turbojet reliability. The actual probability of failure of the second engine is 1:1 million per flight. The electrical generating system is demonstrated not to be a limiting factor in the probability estimate. It is concluded that although wider safety margins could be set with confidence, local rules could be stricter in light of the level of maturity of operations around specific locales. M.S.K.

A84-44967#

COMPARISON OF DISCRETE AND CONTINUOUS GUST METHODS FOR THE DETERMINATION OF AIRPLANE DESIGN LOADS

R. NOBACK (Lucht- en Ruimtevaartlaboratorium, Amsterdam, Netherlands) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 351-357. refs

Calculations and historical aircraft performance data are presented to show that no correlation exists between aircraft gust loading predictions made using discrete and continuous wind gust models. A periodic character is assumed in the discrete gust model, which is the normal model used for design studies. The continuous gust concept is based on atmospheric turbulence being a quasi-stationary Gaussian process and the aircraft being a linear system. The model is formulated on the bases of strengths of previous aircraft with satisfactory safety records. The models predict different loads for a rigid aircraft with one degree of freedom, due mainly to the relationship between gust velocity and length. Accurate characterization of the velocity-length relationship is required as a first step toward adopting either the discrete or continuous models for standard load calculation. M.S.K.

A84-44968#

757/767 BRAKE AND ANTISKID SYSTEM

G. H. DEVLIEG (Boeing Commercial Airplane Co., Everett, WA) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 358-365.

The design objectives of the 757/767 aircraft braking system and systems features that allow the objectives to be met are described. Goals included commonality, simple crew interface, user-tolerance, no manual antiskid switching needed, maximum redundancy, smooth, reliable and long-life performance on a variety of runway conditions and an automated monitoring system that permits easy identification of defective line replaceable components. The brakes are installed in the form of multiple disks on each wheel, with the landing gear configuration consisting of dual tandem trucks with eight wheels per truck. Braking deceleration levels can be preset in-flight, thus freeing the pilot for other landing tasks. The antiskid system is detailed, together with fault monitoring and hydroplane protection systems. M.S.K.

A84-44969#

HIGH SPEED BRAKING OF AN AIRCRAFT TIRE ON GROOVED WET SURFACES

S. K. AGRAWAL (Federal Aviation Administration, Technical Center, Atlantic City, NJ) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 366-371.

The results of FAA tests of runway treatments to ameliorate runway hydroplaning hazards are reported. Hydroplaning is assumed to occur when the coefficient of friction (COF) falls to 0.05 or lower, compared with 0.7 on a normal runway. Trials were run with V-grooves and square grooves cut in a concrete runway and tested with a jet-powered tire-wheel assembly mounted on a track. The tests covered 35 klb vertical load, worn tires, an asphaltic concrete surface, 0.01, 0.1 and 0.25 in. water depths and speeds from 70-150 kt. The V-grooves and square grooves (spaced more than 1.25 in. apart) significantly improved the COF. Square grooves were the more effective configuration. M.S.K.

A84-44976#

STRUCTURAL CERTIFICATION OF AIRBUS FIN BOX IN COMPOSITE FIBRE CONSTRUCTION

D. SCHULZ (Messerschmitt-Boelkow-Blohm GmbH, Unternehmensbereich, Transport- und Verkehrsflugzeuge, Hamburg, West Germany) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 427-438.

The design and manufacture of a certified composite material fin box for Airbus aircraft are described. The switch to composite materials offered a 20 percent weight savings if CFRP was used. The fin box consists of the leading edge, a center box and the rudder. Ti bolts and rivets were used to connect the rudder and spar and aluminum strips were added for lightning protection. Otherwise, care was taken to eliminate metal where possible. FAR and JAR specifications were met for the materials, processing, structural component suitability and protection measures. The subcomponents tests and numerical modelling have been completed. Full scale static strength, fatigue, damage tolerance and flutter tests are planned. The full scale tests will include characterization of appropriate inspection intervals and techniques. M.S.K.

A84-44984#

DESIGN, DEVELOPMENT AND MANAGEMENT OF THE SAAB-FAIRCHILD 340 PROGRAM

J. J. FOODY (Fairchild Industries, Inc., Germantown, MD) and T. R. GULLSTRAND (SAAB-Scania AB, Linkoping, Sweden) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 504-517.

The design decisions and marketing goals that guided the choice of configuration of the 340 Regional/Executive transport aircraft are described. The 340 was envisioned as satisfying a growing market in the under-100 seat class, an aircraft size best served by upgraded turboprop engines. Design constraints were low operating cost, jet comfort, advanced displays and engine, enhanced safety and reliability, low maintenance costs and long operating life, and low cabin and external noise. Two CT7-5A powerplants were selected, along with bonded aluminum for primary structures. The design mission(s) includes either four 104 n. mi stages or an 800 n. mi single stage, 35 passengers, 280 ket cruise speed, 15,000 ft ceiling, 45 min reserves, 6000 ft takeoff at 5000 ft altitude and a 4000 ft landing distance at sea level. M.S.K.

A84-44985#

TESTING THE NEW BOEING TWINJETS

B. S. WYGLE (Boeing Co., Seattle, WA) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 518-523.

The data handling, acquisition and management techniques, flight deck layout and flight test management of the 757 and 767 aircraft certification trials are reported. Development of the two aircraft was initiated in 1978 as replacements for the 727. The commercial drive to ready the aircraft mandated accelerated testing and therefore distributed telemetry systems for simultaneous flight tests and new data handling and acquisitions system were developed. Instrumentation interfaced with an airborne data analysis device, a gross weight/center of gravity computer, a water ballast system, microwave aircraft positioning system, ground data analysis systems and an interactive flight test computing system. A two-person flight deck configuration was chosen to fit customer specifications. Avionics and alert displays were given commonality in the two aircraft in order to ease the efforts for FAA certification. Solutions to problems which appeared in personnel hiring and training, stabilizer placement and due to the appearance of pitch up are described. M.S.K.

A84-44986#

ADVANCED COMMUTER AIRCRAFT - HOW TO LEAPFROG THE COMPETITION

J. ROSKAM (Kansas, University, Lawrence, KS) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 524-533.

Design and performance characteristics of a new regional commuter aircraft that incorporates modern technology and competitive operational costs are described. The aircraft would have a composite or Al-Li primary structure for fuselage and lifting surfaces, an FMC, computerized CRT displays, natural laminar flow on 40 percent of the lifting surface chord and 20 percent of the fuselage, six-bladed composite propellers, leading edge de-icing and cabin noise less than a 737. A fuselage diameter of 130 in. would permit seating 4-5 abreast with overhead storage. The sie-mounted turboprops would be counter rotating and mounted on nacelles angled inward to minimize engine-out yaw moments. A cruise speed of Mach 0.6 at 30,000 ft and a range of 700-1000 n. mi. would be the goal, with the maximum range determined by the capacity of the aircraft. M.S.K.

A84-44998#

SUBSONIC INVESTIGATIONS ON CONFIGURATIONS WITH FORWARD- AND AFT-SWEPT WINGS OF HIGH ASPECT RATIO

R. K. NANGIA (SAC Consultants, Ltd., Bristol, England) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 622-643. Research supported by the Science and Engineering Research Council. refs

Subsonic longitudinal flow tests and analyses have been conducted for two series of forward- and aft-swept wings of aspect ratio near 8.0. The first series of configurations is representative of high wing transport aircraft, while the second represents 'executive' (general aviation) aircraft. Gentler stall and improved high lift characteristics are noted for the forward-swept configurations. Compared with the equivalent gross lifting surface area aft-swept wing and tail configuration, the forward-swept wing and canard configuration generated 15-20 percent higher L/D performance. Winglets appear to be 3-4 times more effective for the forward-swept wing than the aft-swept one. O.C.

A84-44999#

WIND TUNNEL TEST OF A TWIN, REAR PROPELLER TRANSPORT AIRCRAFT CONFIGURATION AT LOW SPEEDS

S.-O. RIDDER (Flygtekniska Forsoksanstalten, Bromma, Sweden) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 644-654.

A low speed wind tunnel has been used to conduct six-component total forces and moments measurements, together with a limited flow visualization and flow field survey, for the case of a twin-engine, rear-mounted propeller transport aircraft's propeller region. The configuration features the mounting of the engine nacelles at the tips of the horizontal tail surfaces. Attention is given to the effects of varying angle-of-attack and yaw, as well as the angular settings of wing trailing edge flaps, elevator, ailerons, and rudder. Experimental results indicate that propeller thrust effects during twin- or single-engine operation contribute to stability, and can be trimmed with conventional control surfaces. O.C.

A84-45000#

A310 STRUCTURAL TESTING FOR CERTIFICATION PHILOSOPHY AND APPLICATION TO MEET CURRENT DURABILITY AND DAMAGE TOLERANCE REQUIREMENTS

H.-J. SCHMIDT and C.-L. HAMMOND (Messerschmitt-Boelkow-Blohm GmbH, Hamburg, West Germany) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 655-664. refs

Attention is given to the durability and damage tolerance tests conducted with the A310 airliner's full scale (center fuselage/wing and rear fuselage/fin) fatigue test articles. These tests are prompted by new damage tolerance requirements for civil aircraft structures. Examples are noted of areas yielding important test results for fatigue crack initiation, crack growth characteristics, and the residual strength of a damaged structure, such as frame/stringer interfaces, door and window cutouts, and pressure bulkheads. O.C.

A84-45003#

THE STALINS METHOD FOR MEASURING TRAJECTORIES FOR TAKE-OFF AND LANDING PERFORMANCE MEASUREMENTS

C. G. KRANENBURG, A. POOL, and A. J. L. WILLEKENS (Nationaal Lucht- en Ruimtevaart-Laboratorium, Amsterdam, Netherlands) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 678-684. Research supported by the Nederlands Instituut voor Vliegtuigoutwikkeling en Ruimtevaart.

This paper describes a method of trajectory measurement for the evaluation and certification of runway performance of aircraft. It was developed by the NLR at the request of Fokker, as a replacement of the nose-camera method previously used. The primary data source is an INertial Sensing system (INS). The characteristic of the nose camera method, that (nearly) all measuring equipment is carried on board the test aircraft, is retained but the data turn-around time is much reduced. A few results of tests with an F27 aircraft are presented to show that the accuracy is at least of the same order as that obtained by other methods. Data processing on the ground is fully automated, but anomalies in the flight test data can be corrected interactively afterwards. The paper also discusses the operational aspects of the application of the STALINS method and a few new developments for application in future Fokker projects. Author

A84-45010#

FLUTTER CALCULATION ON A SUPERCRITICAL WING IN THE TRANSONIC RANGE - COMPARISON THEORY-EXPERIMENT

A. GRAVELLE (ONERA, Chatillon-sous-Bagneux, Hauts-de-Seine, France), H. HOENLINGER (Messerschmitt-Boelkow-Blohm GmbH, Munich, West Germany), and S. VOGEL (Messerschmitt-Boelkow-Blohm, GmbH, Bremen, West Germany) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 739-746. refs

Wind tunnel tests were performed to provide data for comparisons of two theoretical models of the variations of the critical flutter speed with the angle of attack (AOA) of supercritical airfoils. The first approach was based on a data base of pressure data for rigid airfoil at various AOA and subsequent linearized expressions for each airfoil section. The second model relies on the transonic small perturbation equation, which accounts for deformations under load but does not address viscous effects. Data were gathered with accelerometers and strain gages attached to a wing carrying an engine nacelle and fitted to a model fuselage while subjected to violent flutter at various speeds using a new attachment and actuator apparatus. Small AOA variations produced large effects. Aeroelastic wing deformation under steady loading at positive AOA increased the critical flutter stagnation pressure, the latter being an insignificant factor in flutter. M.S.K.

A84-45013*# General Dynamics Corp., Fort Worth, Tex.

AN EVALUATION OF THE RELATIVE MERITS OF WING-CANARD, WING-TAIL, AND TAILLESS ARRANGEMENTS FOR ADVANCED FIGHTER APPLICATIONS

W. U. NICHOLAS, G. L. NAVILLE, J. E. HOFFSCHWELLE (General Dynamics Corp., Fort Worth, TX), J. K. HUFFMAN, and P. F. COVELL (NASA, Langley Research Center, Hampton, VA) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 771a-771l.

Two sets of wind tunnel tests were performed to examine the relative merits of wing-canard, wing-tail and tailless configurations for advanced fighters. Both sessions focused on variable camber using automated, prescheduled leading and trailing edge flap positioning. The trials considered a modified F-16 tail and canard configuration at subsonic, transonic and supersonic speeds, a 60 deg delta wing sweep, a 44 deg leading edge trapezoidal wing at subsonic and supersonic speeds, vortex flow effects, and flow interactions in the canard-wing-tail-tailless variations. The results showed that large negative stabilities would need to be tolerated in wing-canard arrangements to make them competitive with wing-tail arrangements. Subsonic polar shapes for canard and tailless designs were more sensitive to static design margins than were wing-tail arrangements. Canards provided better stability at supersonic speeds. The static margin limits were a critical factor in control surface selection. Finally, a tailless delta wing configuration exhibited the lowest projected gross take-off weight and drag values. M.S.K.

A84-45019#

COMPUTERIZED METHODS FOR ANALYSIS AND DESIGN OF AIRCRAFT STRUCTURES

B. FREDRIKSSON (Saab-Scania, AB, Linkoping, Sweden) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 815-827. Research supported by the Forsvaret Materielverk. refs

The developments made to utilize computerized methods for analysis and design of aircraft structures are described. The paper discusses the integration of data and methods between geometry, aerodynamics, loads, structures, etc., to form a computer aided engineering environment. The paper is concentrating on structural analysis and sizing. Methods to rationalize the finite element internal loads calculations and to increase the quality of the work is discussed. Methods have been developed to generate local spectra from the finite element result for fatigue and fracture analysis. The rationalization and quality effect of this is discussed. New design criteria and requirements of high performance, light weight and economy implies introduction of new methods for analysis. The paper discusses the developments made in some advanced topics like combined contact and crack problems and structural optimization. The combined use of mini- and supercomputers as well as the twofold effect of rationalization and quality by using supercomputers are discussed. Author

A84-45020*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

AEROSPACE ENGINEERING DESIGN BY SYSTEMATIC DECOMPOSITION AND MULTILEVEL OPTIMIZATION

J. SOBIESZCZANSKI-SOBIESKI, G. L. GILES (NASA, Langley Research Center, Hampton, VA), and J.-F. M. BARTHELEMY (Virginia Polytechnic Institute and State University, Blacksburg, VA) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 828-840. refs

This paper describes a method for systematic analysis and optimization of large engineering systems, e.g., aircraft, by decomposition of a large task into a set of smaller, self-contained subtasks that can be solved concurrently. The subtasks may be arranged in many hierarchical levels with the assembled system at the top level. Analyses are carried out in each subtask using inputs received from other subtasks, and are followed by optimizations carried out from the bottom up. Each optimization at the lower levels is augmented by analysis of its sensitivity to the inputs received from other subtasks to account for the couplings among the subtasks in a formal manner. The analysis and optimization operations alternate iteratively until they converge to a system design whose performance is maximized with all constraints satisfied. The method, which is still under development, is tentatively validated by test cases in structural applications and an aircraft configuration optimization. It is pointed out that the method is intended to be compatible with the typical engineering organization and the modern technology of distributed computing. Author

A84-45028#

APPLICATION AND INTEGRATION OF DESIGN ALLOWABLES TO MEET STRUCTURAL-LIFE REQUIREMENTS

L. A. RIEDINGER and J. M. WARANIAK (Northrop Corp., Pico Rivera, CA) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 914-921. refs

Techniques for determining the design loading allowables for aircraft structures are delineated with an eye to the available data base on composite stress tolerance. The data base is critical when projecting a component lifetime in light of expected loading scenarios and military specifications. The lifetime loading criteria cover the maximum lifetime applied load, the residual strength after a lifetime, the design limit load, the design envelope gust load and the design ultimate load. The specifications are tailored to cover the peculiarities of metallic and composite materials in areas such as damage tolerance, failure modes and durability. Sample design allowables calculated for sizing metallic and graphite/epoxy structures are provided. M.S.K.

A84-45029#

DAMAGE TOLERANCE EVALUATION OF AIRCRAFT COMPONENTS UNDER SPECTRUM LOADING

B. HECIAK, H. SCHAFF (SocieteNationale Industrielle Aerospatiale, Division Avions, Toulouse, France), D. ALIAGA, A. DAVY, and E. BUDILLON (SocieteNational Industrielle Aerospatiale, Suresnes, Hauts-de-Seine, France) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 922-931.

A crack growth analyses spectrum discretization from statistical data, propagation rates from a data base and validated spectra that take into account retardation effects and contributions from low amplitude cycles is presented. The analysis was developed to meet aircraft safety criteria that structures be damage tolerant. The tolerance factor is established by projecting a load history for each area of probable failure, characterizing a minimum detectable crack length and the maximum permissible crack length, determining the crack propagation time and establishing the mandatory inspection intervals. Calculations for each step are formulated and applied to a sample wing box panel, noting the test data required for predictions of that particular article. M.S.K.

A84-45031#

A COMPUTER AUGMENTED PROCEDURE FOR COMMERCIAL AIRCRAFT PRELIMINARY DESIGN AND OPTIMIZATION

C. HABERLAND, J. THORBECK, and W. FENSKE (Berlin, Technische Universitaet, Berlin, West Germany) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 943-953. Research supported by the Deutsche Forschungsgemeinschaft. refs

Based on an idealized computational model of the aircraft, the computer augmented preliminary design procedure CAPDA for commercial aircraft design and optimization has been developed. Contrary to the sophisticated approach of existing complex CAD-systems which consider structural and aerodynamical aspects in more detail and even lead to a CAM-interface, the emphasis of the presented system is laid on the configurational development procedure especially focussing on parametric studies and optimization. The iterative synthesis which is therefore established on a corresponding analysis level and which uses input data from an extensive statistical data bank, results in a computer-internal representation of geometry and performance. For the development of an optimized baseline configuration an optimization module based on a direct search strategy can be optionally applied. The capabilities of the program system are demonstrated by several design examples. Author

A84-45032#

MULTIVARIATE OPTIMISATION AS APPLIED TO AIRCRAFT PROJECT DESIGN

J. E. CHACKSFIELD (British Aerospace Aircraft Group, Kingston-upon-Thames, Surrey, England) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 954-959. refs

The effects of incorporating an optimization algorithm (OA) into an aircraft design project are discussed. The OA comprises multivariate optimization (MVO) and is applied in preliminary design efforts. A range of design options are generated, each dependent on performance parameters and various physical possibilities. Once a parameter is set an objective function can be calculated. The remaining design options are further explored using the MVO techniques, which are relied on for cost-effectiveness in the resulting design. Detailed trade-off studies are performed after a MVO analysis, which can cover costs, structures and aerodynamics. M.S.K.

A84-45033#

OPTIMUM DESIGN CRUISE SPEED FOR AN EFFICIENT SHORT HAUL AIRLINER

U. EDLUND and K. NILSSON (Saab-Scania AB, Commercial Aircraft Sector, Linkoeping, Sweden) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 960-966.

Comparisons were performed of costs and performance from three turboprop 90 seat short haul aircraft with different design cruise speeds. All the aircraft had propeller/propfan propulsion systems. Cruise speeds of 270, 350 and 430 kt were considered for 17,000, 20,000 and 23,000 ft altitudes, respectively. Other design parameters were scaled accordingly, except for a 1000 n mi range and 200 n mi reserve margin for all designs. An optimization study identified a 350-380 kt cruise airspeed as the most economical. Operating costs would be 15-20 percent below turbofan aircraft with conventional propeller configurations, although aft-mounted counter-rotating tractor propfans would eventually provide near-jet standard climb and cruise performance. M.S.K.

A84-45041#

DETERMINATION OF AIRCRAFT FORCE MODEL AT HIGH ANGLE OF ATTACK

G. SHADMON, S. BENOLOL, and A. VINKLER (Israel Aircraft Industries, Ltd., Lod, Israel) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 1030-1037. refs

A new method for identifying aerodynamic force model from flight data is presented. The method eliminates the need for measured angles of attack and sideslip. Thus, it is especially useful for the high angles of attack regime where problems of accurate measurement of these angles are significant. The proposed algorithm is tested on real flight data and its validity is established. Author

A84-45044#
BOEING 757/767 DURABILITY PROGRAMS
J. CHOCHOLA and M. SPENCER (Boeing Commercial Airplane Co., Seattle, WA) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 1058-1064.

Features and results of the Boeing Durability Program initiated in 1971 to eliminate 85 percent of structural metal fatigue problems using the 15 yr data base accumulated on commercial jet aircraft by that time are outlined. Design fatigue ratings were cataloged and design details were brought under a rating system that kept design changes in the design, rather than production, stage. The fatigue data base was expanded through tests of reinforcements around penetration holes, measurements of shear panel fatigue and encyclopedic tests of structural reinforcement, bracing and fastener performances. Two design guideline books were produced and issued to designers. The lessons have been applied to fatigue testing of 757/767 components and predictions of 40 yr lifetimes after simulations of fatigue behaviours. Significant weight savings have also been achieved. M.S.K.

A84-45045#
CLIMB SPEED AND RATING OPTIMISATION
D. BERGER, M. HURET, and V. RIVRON (Societe Nationale Industrielle Aerospatiale, Division Avions, Toulouse, France) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 1065-1068.

An optimization procedure is applied to the overall cost effectiveness of climb ratings for short and medium haul aircraft, for which take-off and climb represent significant portions of the flight. Attention is focused on the specific fuel consumption at various altitudes. Greater efficiency is found with high thrust at lower, instead of higher, altitudes. The optimal climb speed does not change much with altitude. Tailoring the thrust to altitude is demonstrated to offer a 15 percent fuel savings relative to current practices. M.S.K.

A84-45192#
LABORATORY EVALUATION OF LIGHTNING INDUCED TRANSIENTS IN AIRCRAFT ELECTRICAL WIRING
J. C. ALLIOT (ONERA, Chatillon-sous-Bagneux, Hauts-de-Seine, France) and P. LEVESQUE (International Conference on Lightning and Static Electricity, Orlando, FL, June 26-28, 1984) ONERA, TP, no. 1984-51, 1984, 8 p. Research supported by Direction des Recherches, Etudes et Techniques, and ONERA. refs
(ONERA, TP NO. 1984-51)

The results of a laboratory experiment investigating the process by which electromagnetic waves penetrate aircraft fuselages are reported. The experimental setup consisted of a cylindrical model (1/20 scale) of an aircraft fuselage made from foil 1 mm thick. The current was a coaxial transmission line with 50 ohm characteristic impedance. A double exponential current waveform simulating a return stroke pulse was produced by discharging a single capacitor of 75 kV through the line and a 50 ohm shaping resistor. The resulting current waveform had a time to peak of about 40 ns and the time to decay to half value was about 15 microseconds. The attenuation of the charge shape field was measured at the cylinder/aperture intersection as a reference. A DIFFRAC computer code was used to obtain a numerical calculation to compare with the experimental results. It is found that the induced voltages studied contain a very broad spectrum of energy. When injected into an unmatched transmission line (such as in aircraft windows, cockpits or dielectric access panels), they produce waveforms which are very different from the exciting pulse. I.H.

A84-45577*# Cincinnati Univ., Ohio.
OPTIMAL SHORT-RANGE TRAJECTORIES FOR HELICOPTERS
G. L. SLATER (Cincinnati, University, Cincinnati, OH) and H. ERZBERGER (NASA, Ames Research Center, Moffett Field, CA) Journal of Guidance, Control and Dynamics (ISSN 0731-5090), vol. 7, July-Aug. 1984, p. 393-400. Previously cited in issue 19, p. 2799, Accession no. A83-41962. refs
(Contract NAG2-175)

A84-45743
AN EXPERIMENTAL STUDY OF THE FLUTTER OF A CONTROLLED STABILIZER WITH NONLINEARITIES IN THE CONTROL MECHANISM DURING THE ELECTROMECHANICAL MODELING OF AERODYNAMIC FORCES [EKSPERIMENTAL'NOE ISSLEDOVANIE FLATTERA UPRAVLIAEMOGO STABILIZATORA S NELINEINYMI KHARAKTERISTIKAMI V PROVODKE UPRAVLENIIA PRI ELEKTROMEKHANICHESKOM MODELIROVANII AERODINAMICHESKIKH SIL]
N. I. BARANOV, K. I. VASILEV, D. B. KUTIN, A. G. NARIZHNYI, and V. I. SMYSLOV TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 14, no. 3, 1983, p. 94-100. In Russian. refs

During the electromechanical modeling of the aerodynamic forces acting on a controlled stabilizer, the flutter of the stabilizer has been investigated experimentally, with the backlash of the controls and friction in the rotation axis of the stabilizer used as the principal variables. The critical velocity and frequency of flutter, the excitation threshold, auto-oscillation amplitudes, and oscillation decrements under subcritical flight conditions are determined as a function of the backlash, friction, and static moment. V.L.

A84-45964*# Lockheed-Georgia Co., Marietta.
DESIGN INTEGRATION OF LAMINAR FLOW CONTROL FOR TRANSPORT AIRCRAFT
R. H. LANGE (Lockheed-Georgia Co., Advanced Design Div., Marietta, GA) Journal of Aircraft (ISSN 0021-8669), vol. 21, Aug. 1984, p. 612-617. Previously cited in issue 24, p. 3547, Accession no. A83-49577. refs
(Contract NAS1-16219; NAS1-16235)

A84-46047
AIRCRAFT STRUCTURAL DESIGN [KONSTRUKTSIIA SAMOLETOV]
O. A. GREBENKOV Moscow, Izdatel'stvo Mashinostroenie, 1984, 240 p. In Russian. refs

A training manual for the structural design of both civilian and military aircraft is presented as part of a general training program in aircraft design developed by the Kazan Institute of Aviation. The basic principles in the structural design of aircraft airframes, cockpits and undercarriages are discussed, with attention given to the effect of loads on individual airframe components on the general aerodynamic performance of the aircraft. A comparative evaluation of several structural design options is performed, taking into account the necessary aerodynamic conditions of stability, rigidity, and minimal mass for satisfying operational and production expectations. A series of schematic drawings illustrate the structural design principles under discussion. I.H.

A84-46050
THE THEORETICAL BASES OF METHODS FOR THE IN-FLIGHT DETERMINATION OF THE FLIGHT CHARACTERISTICS OF AIRCRAFT: APPLICATION OF SIMILARITY THEORY [TEORETICHESKIE OSNOVY METODOV OPREDELENIIA V POLETE LETNYKH KHARAKTERISTIK SAMOLETOV: PRIMENENIE TEORII PODOBIIA]
M. A. TAITS Moscow, Izdatel'stvo Mashinostroenie, 1983, 128 p. In Russian. refs

A general theory of three-dimensional unstable flight in a nonstandard atmosphere is developed in order to devise a methodology for interpreting the flight characteristics of aircraft during flight tests. Consideration is given to flight information measurement systems and some statistical methods for reducing instrument error. The theory is intended to be useful in the design of certification tests and to improve the safety of Soviet pilots, and passengers aboard civilian and military fixed and rotary wing aircraft. I.H.

A84-46196

FRUGAL, FAST, BUT FRACTIOUS

P. MIDDLETON Flight International (ISSN 0015-3710), vol. 126, Aug. 18, 1984, p. 113-116, 121, 122.

Propfans with swept blades that are only 2 percent thick beyond 60 percent semispan promise to deliver 82-83 percent propulsion efficiencies at Mach 0.8. The use of contrarotating propfans could further increase propulsion efficiency through the recovery of the rotor swirl energy component. Attention is presently given to the design feature tradeoff studies that are being conducted, often under NASA sponsorship and direction, in order to fashion the first generation of commercially viable propfan aircraft. The issues of greatest importance include the use of gearboxes or direct turbine drive, suppression of cabin noise, and the choice between tractor and pusher configurations. Also noted are performance projections and the comparative advantages foreseen over next-generation turbofan engines. O.C.

A84-46273

THE VIBRATORY AIRLOADING OF HELICOPTER ROTORS

W. E. HOOPER (Boeing Vertol Co., Philadelphia, PA) (European Rotorcraft and Powered Lift Aircraft Forum, 9th, Stresa, Italy, Sept. 13-15, 1983) Vertica (ISSN 0360-5450), vol. 8, no. 2, 1984, p. 73-92. refs

A survey has been made of all major wind tunnel and full-scale flight tests conducted over the last 29 years to examine the nature of the vibratory aerodynamic loading which causes helicopter vibration. Using computer generated surface plots, the present paper compares the airload distributions for rotors which have from 2 to 6 blades by presenting the data in identical plotting formats which allow comparisons of the effects of major parameters including blade number, blade/vortex proximities, propulsive force and forward speed. By harmonically analyzing the data, it has been possible to show striking similarities between the vibration-causing higher harmonics of airloading on different rotor designs and in widely varying flight conditions. By selectively eliminating the lower harmonics, the predominant modes of vibratory forcing, to which all helicopter blades are subjected, are revealed. Author

A84-46327#

EXPERIMENTAL STUDY OF MAIN ROTOR/TAIL ROTOR/AIRFRAME INTERACTION IN HOVER

D. T. BALCH (Sikorsky Aircraft, Stratford, CT) IN: American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 1-14. refs

Some of the relevant configuration parameters controlling interference effects between the main rotor, tail rotor, and airframe of single-rotor helicopters have been studied at a hover test facility, and the observed performance degradations have been quantified. Four sets of model rotor blades of differing geometry were run with and without fuselage skins over a full range of motor heights above the ground. A tail rotor was run as a pusher or tractor and located at a variety of locations with or without cant. Results are summarized for isolated main rotors, and for the interaction between main rotor and fuselage, main rotor and tail rotor, tail rotor and fuselage, and main rotor, fuselage, and tail rotor. The fuselage and tail rotor reduced the performance of an isolated main rotor by from 1 to 6 percent, depending on the configurations of the rotors. C.D.

A84-46329#

CONSIDERATIONS IN THE ESTIMATION OF FULL-SCALE ROTOR PERFORMANCE FROM MODEL ROTOR TEST DATA

C. N. KEYS, M. A. MCVEIGH, L. DADONE, and F. J. MCHUGH (Boeing Vertol Co., Philadelphia, PA) IN: American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 34-43. refs

A discussion of the factors affecting the scaling of wind tunnel performance test data to full scale is presented. Aerodynamic and structural considerations are addressed including the effect of Reynolds number, Mach number, blade exterior contour and rotor blade physical properties. Methods of scaling hover and forward flight wind tunnel test data to full scale are presented. Correlations of 1/6-scale CH47D wind tunnel data with full-scale CH-47D whirl tower and flight test results are included to illustrate the scaling techniques. Author

A84-46340#

ADVANCED TECHNOLOGY FUSELAGE RESEARCH PROGRAMME

T. M. C. H. BARTLEY (Westland Helicopters, Ltd., Advanced Technology Dept., Yeovil, Somerset, England) IN: American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 149-153. Research supported by the Royal Aircraft Establishment, British Aerospace and Bristol Composite Materials Engineering, Ltd.

The Advanced Technology Fuselage (ATF) Research Program has the objective to validate engineering advantages which, as it was claimed, could be obtained by utilizing new materials and structural configurations for the design of the helicopter primary structure. A research program was, therefore, established to obtain information on the design, manufacture, and performance of a helicopter center section fuselage constructed in advanced materials. In order to obtain a basis for a comparison with a conventional light alloy structure, the ATF structures were designed to the dimensional and static strength requirements of an early Sea King Replacement (SKR) design. The new structure includes a titanium frame section and a carbon-skinned honeycomb sandwich construction. The applicability of ATF technology is discussed, taking into account also the solution of current problems by means of developments in polymer technology. G.R.

A84-46341*# Bell Helicopter Co., Fort Worth, Tex.

MEASURED AND CALCULATED INPLANE STABILITY CHARACTERISTICS FOR AN ADVANCED BEARINGLESS MAIN ROTOR

W. H. WELLER (Bell Helicopter Textron, Fort Worth, TX) and R. L. PETERSON (NASA, Ames Research Center, Moffett Field, CA) IN: American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 160-172. refs

A program of experimental and analytical research has been performed to demonstrate the effects of rotor and fuselage design parameters on rotor in-plane stability, including aeromechanical stability. The experimental data were obtained from hover and wind-tunnel tests of a scaled advanced bearingless main rotor model. Both isolated-rotor and free-hub conditions were tested. Test parameters included blade built-in cone and sweep angles; rotor inplane structural stiffness and damping; pitch link stiffness and location; and fuselage natural frequency, damping, and inertia. The results show that rotor blade structural damping is one of the most influential design parameters in obtaining acceptable aeromechanical stability margins. Other parameters, such as blade cone angle, pitch link location (rotor delta 3) and anisotropic hub damper configurations, may be used to improve stability margins, but their individual effects are subtle. Author

A84-46342#

HUB LOADS REDUCTION BY MODIFICATION OF BLADE TORSIONAL RESPONSE

S. B. R. KOTTAPALLI (Sikorsky Aircraft, Stratford, CT) IN: American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 173-179.

The effect of blade trailing edge tab on vibratory vertical shear is discussed. Analytical results predict an 80-percent reduction in vertical shear due to a 5-deg tab deflection. Further analysis shows that NP (a frequency N times the rotor frequency) vertical shear is primarily controlled by its aerodynamic contribution rather than the inertial contribution. It was found that the reductions in the flatwise airloading are largely due to a reduction in the NP component of the local angle of attack which in turn is closely determined by changes in the NP elastic torsional response of the blade. Harmonic analysis of torsional loading in the outer portion of the blade showed that the reduction in its NP components is due to changes produced by the selected tab angle in the blade pitching moment coefficient. This analytical study shows that it is feasible to minimize vibratory vertical shear without adversely affecting performance by proper selection of the blade trailing edge tab angle. Author

A84-46343#

THEORETICAL AND EXPERIMENTAL INVESTIGATIONS INTO HELICOPTER AIR RESONANCE

S. P. KING (Westland Helicopters, Ltd., Yeovil, Somerset, England) IN: American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 180-189. Research supported by the Ministry of Defence (Procurement Executive). refs

The validation of theoretical predictions for the characteristics of the aeromechanical instability known as air resonance has been obtained by the use of a 2 m diameter Froude scaled model of the Lynx helicopter. The theoretical and experimental models are described and a simple explanation of the mechanism involved in air resonance is given. The results of an investigation into the effect of rotor in-plane stiffness, fuselage roll inertia, rotor speed and blade incidence on the regressing lead-lag mode stability are presented. A theoretical study of the importance of coning angle and forward flight on air resonance stability is also discussed. In general good agreement has been obtained; sufficient to give confidence in the use of the theory as a design tool. Author

A84-46359#

XV-15 SHIPBOARD EVALUATION

J. C. BALL (U.S. Naval Air Test Center, Patuxent River, MD) IN: American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 350-357.

The Naval Air Test Center conducted a limited shipboard evaluation of the NASA/Army XV-15 Tilt Rotor Research Aircraft onboard the USS TRIPOLI to determine the potential of the tilt rotor concept in the Navy shipboard environment. The evaluation consisted of 54 shipboard takeoffs and landings in various relative winds and included some preparatory tests ashore. The tests evaluated were deck edge effects on flying qualities, downwash effects, overwater hovers, short takeoffs (STO's) and various approaches to landing. The paper describes the flight tests, discusses the test results, and makes conclusions based on future tilt rotor missions. Within the scope of the test, the tilt rotor concept exhibits strong potential for use in the Navy shipboard environment. Author

A84-46360#

WEAPON SYSTEM INTEGRATION, TEST AND EVALUATION - THE LAMPS MK III EXPERIENCE

M. B. SCHOULTZ and O. WRIGHT, JR. (IBM Corp., Owego, NY) IN: American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 358-370. refs

In connection with Anti Submarine Warfare (ASW) efforts, the U.S. Navy developed the Light Airborne Multipurpose System (LAMPS) designed to redetect, localize, and attack enemy submarines. The primary mode of operation was to be control of the air system from the ship via a two-way data link. The SH-60B weapon system was to function in an autonomous backup mode in situations in which data link communications should be unavailable due to range/altitude limits. Computer technology was utilized within the system to reduce costs, and it was decided in 1974 to award the total system responsibility as LAMPS System Prime Contractor to an American computer company. Testing of the LAMPS MK III System was done jointly by contractor and Navy. Attention is given to the LAMPS MK III approach, aspects of airborne testing efficiency, technical test results, and operational tests. G.R.

A84-46361#

PRELIMINARY AIRWORTHINESS EVALUATION (PAE) OF THE WILLIAMS AERIAL SYSTEM PLATFORM II (WASP II), INDIVIDUAL LIFT DEVICE (ILD)

D. L. UNDERWOOD (U.S. Army, Aviation Engineering Flight Activity, Edwards AFB, CA) IN: American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 371-389. refs

Early applications of the concept of the direct thrust individual lift device (ILD) are related to the Rocket Belt and the Jet Belt designed during the 1960's. In May 1977, the U.S. Army called for a 'one man conveyance, without rotor blades, which can be operated by essentially untrained or quickly trained personnel . . .'. As a candidate for the ILD concept, an American aerospace company proposed the Williams Aerial Systems Platform II (WASP II) to the U.S. Army Tank Automotive Command (TACOM). This device is to improve individual mobility in the infantry battalion and combat support units in rough terrain. The WASP II is a one-man direct thrust lifting, vertical take-off and landing (VTOL) vehicle. Details regarding the design of the WASP II are discussed along with operational questions and aspects of the Preliminary Airworthiness Evaluation of this device. This test represents the first flight test engineering performance and handling qualities evaluation of a direct thrust individual lifting device employing a kinesthetic control principle. G.R.

A84-46362#

LHX SIMULATION - EVALUATION OF A COCKPIT OF THE FUTURE

R. E. DOMENIC and C. K. HUTCHINSON (Boeing Vertol Co., Philadelphia, PA) IN: American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 390-395.

Piloted flight simulations were conducted to determine the feasibility of a single crewman cockpit for a small scout aircraft of the 1990's. Various methods were used to simulate the conceptual control and display equipment which is not available for installation in the simulator cockpit. A large visual display, moving map, voice control of communications and systems, automatic flight functions, a smart systems monitor and overlaid symbology were evaluated. Six subject pilots flew simulated missions with threats, battlefield management tasks, systems failures, communications, precise navigation tasks and target engagements. The evaluation included subjective comments from the pilots and data collected by computer during the missions. Mission success criteria and pilot opinion indicates that a single crewman, provided with the necessary automation, displays and aids, can perform the scout mission simulated during this program. Author

A84-46363#

CONTEMPORARY TECHNIQUES FOR CONDUCT OF HELICOPTER AIRFRAME FATIGUE TESTS

J. J. CORSO and G. HOWLAND (Sikorsky Aircraft, Stratford, CT) IN: American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 396-408. Navy-supported research.

The present investigation is concerned with an airframe fatigue test on the SH-60B (Seahawk) aircraft. This aircraft is a derivative version of the successful U.S. Army UH-60A Black Hawk. The design of the Seahawk involves several significant airframe modifications, which were required to satisfy the Navy's needs for a multimission helicopter to operate from small ships in heavy seas. Aspects of test methodology are discussed, taking into account the technical approach, the test spectrum, the determination of flight load distributions, the test article, the test facility, the suspension system, the loading system, the control computer and the electronics system, the measurement system, load matching and test results. It is concluded that full scale airframe fatigue testing continues to be necessary to demonstrate that design requirements are met. G.R.

A84-46367#

STATISTICAL ENERGY ANALYSIS MODELING OF HELICOPTER CABIN NOISE

C. A. YOERKIE (Sikorsky Aircraft, Stratford, CT) and J. A. MOORE (Cambridge Collaborative, Inc., Cambridge, MA) IN: American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 458-471. refs

The high noise levels in current commercial helicopters represent an unfavorable factor with respect to the comfort of passengers and crew. The interior noise levels in rotorcraft are higher than in fixed wing aircraft because the propulsion system components are in close proximity to the cabin and are in general rigidly connected to the airframe. The situation has become worse as a consequence of the implementation of new aircraft technology. Problems arise in connection with the desire to reduce the noise level because of weight considerations. There is consequently a need for more comprehensive analytic models of the entire aircraft to evaluate potential noise control measures. The present investigation is concerned with such a model, taking into account a method for modeling the helicopter airframe and cabin interior on the basis of a statistical energy analysis. G.R.

A84-46371#

THE UTILITY OF SPEED, AGILITY, AND MANEUVERABILITY FOR AN LHX TYPE MISSION

R. VAUSE (Sikorsky Aircraft, Stratford, CT), M. HARRIS (Flight Systems, Inc., Newport Beach, CA), M. FALCO (Grumman Aerospace Corp., Bethpage, NY), D. SHAW (System Planning Corp., Arlington, VA), and R. MCDANIEL (Science and Technology Associates, Inc., Arlington, VA) IN: American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 537-549. refs

One of the most exciting and innovative rotary wing programs anticipated in the next decade is the Army's LHX Family of Light Helicopters program. Among the most critical issues yet to be adequately addressed is the utility of speed and agility in the context of the Army's mission in the year 2000. The results of efforts in this area are generalized in ways meaningful to industry and government developers, and to the military requirements writers. The results are presented parametrically in terms such as load factor, speed, acceleration, and deceleration, and measures of effectiveness are used which are applicable to the military environment, e.g. sorties delivered, time on station, response time, and changes in survivability. The results take into account three dimensional considerations, including the effects of both macro and micro terrain. Author

A84-46372#

TECHNOLOGY ADVANCES IN THE AH-64 APACHE ADVANCED ATTACK HELICOPTER

K. B. AMER and R. W. PROUTY (Hughes Helicopters, Inc., Culver City, CA) IN: American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 550-568.

The AH-64 Apache Advanced Attack Helicopter has recently been put into production and will be entering the U.S. Army inventory in the near future. In order to achieve the many advanced characteristics desired by the U.S. Army, many technology advances were incorporated in the design of the Apache. This paper describes these technology advances in the rotor systems, drive system, control system, airframe engine, avionics and weaponization. These component advances have resulted in major improvements in combat performance, structural integrity, crashworthiness, invulnerability and environmental capability. Author

A84-46373#

SOVIET VS. U.S. HELICOPTER WEIGHT-PREDICTION METHODS

W. Z. STEPNIEWSKI (International Technical Associates, Ltd., Upper Darby, PA) and R. A. SHINN (U.S. Army, Army Aviation Research and Development Command, St. Louis, MO) IN: American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 569-582. refs

One Soviet and two U.S. methods suitable for weight estimation of major helicopter components in concept formulation and preliminary design stages are compared. First, basic philosophies and structure of weight formulas are discussed. Next, their effectiveness is examined by predicting the weights of main-rotor blades and hubs, tail-rotor group, landing gear, drive system, fuel system, propulsion subsystems, and flight control group; and showing the ratios of predicted to actual component weights for three pairs of Soviet and Western helicopters: Mi-2 - BO-105; Mi-8 - UH-60A; and Mi-6 - CH-53E. Then, the average values of the ratios for each major component are given for each method, and margins of errors are indicated. Although none of the compared methods demonstrates a consistently high degree of accuracy (say, + or - 10 percent) in predicting the actual weights, the Western approaches, in general, appear as more accurate and better adaptable to weight predictions of structures representing a variety of design concepts and materials than those of the Soviets. This is especially true in such areas as main-rotor blades and hubs. Author

A84-46374#

DEVELOPMENT AND CERTIFICATION OF THE BK 117 MULTIPURPOSE HELICOPTER

V. VON TEIN (Messerschmitt-Boelkow-Blohm GmbH, Munich, West Germany) IN: American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 583-591.

A development history is presented for the BK 117 multipurpose helicopter, which is the result of cooperation between German and Japanese manufacturers. The twin-engine helicopter (8-11 seats) incoporates a hingeless main rotor, a 'seesaw' tail rotor, and an exceptionally simple, two-stage main rotor gearbox. Level flight speeds of 143 kt from sea level to 10,000 ft have been achieved in flight tests, and it is noted that the helicopter is completely free from ground and air resonance phenomena. O.C.

A84-46375#

ON DEVELOPING AND FLIGHT TESTING A HIGHER HARMONIC CONTROL SYSTEM

E. R. WOOD, R. W. POWERS (Hughes Helicopters, Inc., Culver City, CA), J. H. CLINE (U.S. Army, Structures Laboratory, Hampton, VA), and C. E. HAMMOND (U.S. Army, Applied Technology Laboratory, Fort Eustis, VA) IN: American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 592-612. refs

The results of a flight test program using a modified US Army OH-6A helicopter to evaluate higher-harmonic rotor-blade-pitch control as a means for reducing helicopter vibrations. Higher-harmonic blade-pitch control is achieved by superimposing 4/rev swashplate motion upon basic collective and cyclic control inputs. The aircraft was flown from zero airspeed to 100 knots with the system operated both open-loop (manually) and closed-loop (computer-controlled). Flight test results presented show that the system provides a significant reduction in helicopter vibrations without undue penalties in blade loads or aircraft performance. Author

A84-46378#

PREDICTING STRUCTURAL DYNAMIC BEHAVIOR USING A COMBINED EXPERIMENTAL/ANALYTICAL MODEL

M. R. SMITH (Bell Helicopter Textron, Inc., Fort Worth, TX) and F.-S. WEI (Bell Helicopter Textron, Inc., Fort Worth, TX; Kaman Aerospace Corp., Bloomfield, CT) IN: American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 648-655. refs

(Contract N00019-82-G-0009)

A procedure by means of which to couple an analytically developed helicopter finite element model with experimentally derived structural parameters of wing-mounted store components that can predict overall aircraft system dynamic behavior has been developed. The procedure utilizes an incomplete number of measured mode shapes and modal frequencies to obtain dynamically equivalent stiffness and mass matrices for each externally mounted component. To verify the technique, stiffness and mass matrices are developed for the LAU-68 and Hellfire missile systems, coupled with a finite element model of the U.S. Navy AH-1J helicopter. The results obtained from this method correlate well with actual vibration test data of the total helicopter/store system. This method is valuable for field deployment of a new externally mounted store system which requires integration with a large matrix of existing store configurations. Utilization of this technique should minimize costly flight testing and provide a method to experimentally obtain a mathematical model for highly nonlinear, complex structures. Author

A84-46379*# California Univ., Los Angeles.

OPTIMUM DESIGN OF ROTOR BLADES FOR VIBRATION REDUCTION IN FORWARD FLIGHT

P. P. FRIEDMANN and P. SHANTHAKUMARAN (California, University, Los Angeles, CA) IN: American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 656-673. Army-supported research. refs

(Contract NSG-1578)

Modern structural optimization techniques are applied to vibration reduction of helicopter rotor blades in forward flight. The objective function minimized consists of the oscillatory vertical hub shears or the hub rolling moments at one particular advance ratio. The behavior constraints are the frequency placements of the blade and the requirement that aeroelastic stability margins, in hover, remain unaffected by the optimization process. The aeroelastic stability and response analysis is based on a fully coupled flap-lag-torsional analysis of the blade. Numerical results are presented for some typical soft-in-plane hingeless rotor configurations indicating a 15-40 percent reduction in vibration levels, as well as a blade which is 20 percent lighter than the initial design. These results imply that structural optimization techniques can yield substantial practical benefits in the design process of rotor systems. Author

A84-46380*# Washington Univ., St. Louis, Mo.

DESIGN OF HELICOPTER ROTOR BLADES FOR DESIRED PLACEMENT OF NATURAL FREQUENCIES

D. A. PETERS, T. KO (Washington University, St. Louis, MO), A. KORN, and M. P. ROSSOW (Southern Illinois, University, Edwardsville, IL) IN: American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 674-689. refs

(Contract NAG1-250)

The mass and stiffness distributions for helicopter rotor blades are to be tailored in such a way to give a predetermined placement of blade natural frequencies. This optimization problem is addressed in a methodical, step-by-step process in which each aspect of the optimization is studied in detail. Careful consideration is also given to the mathematical formulation of the problem and to the introduction of appropriate constraints. Author

A84-46485#

DESIGNING THE MILITARY HELICOPTER - BELL'S OH-58 SCOUT

R. DEMEIS Aerospace America (ISSN 0740-722X), vol. 22, Sept. 1984, p. 88-90, 92.

Attention is given to the design features and performance capabilities of the U.S. Army's OH-58 helicopter. This craft depends on maneuverability and concealment for survivability, and accordingly incorporates a mast-mounted sight above the four-blade rotor in order to peer over terrain and vegetation while flying nap-of-the-earth mode. In addition, the armor plate used can stop 50-cal projectiles, and the airframe as a whole can withstand 7.62 mm-round damage. Active defenses include either a 7.62 mm 'Minigun' or two Stinger antiaircraft missiles. The mast-mounted imaging system is of the Forward Looking IR type. Attention is given to cockpit multiplexed control and display subsystems that reduce pilot workloads. O.C.

N84-31109 Stanford Univ., Calif.

WING DESIGN FOR MINIMUM DRAG WITH PRACTICAL CONSTRAINTS Ph.D. Thesis

T. MCGEER 1984 239 p

Avail: Univ. Microfilms Order No. DA8408326

General wing design characteristics which offer minimum drag while satisfying practical constraints were discussed including above all a constraint upon structural weight. The essential elements of aerodynamics and structures, when combined with analytical optimization, lead to a series of solutions for lift, chord, and thickness distributions across the span. These provide recipes for selecting a basic wing geometry once a set of parameters and constraints has been specified. Often the results simply endorse present design practice, but by exploring parameter variations we can see some room for improvement. Particularly provocative is the potential of forward swept wings for reducing the induced drag of high subsonic transports despite their aeroelastic disadvantages. Dissert. Abstr.

N84-31110 Illinois Univ., Urbana.

FLAPPING-TORSIONAL RESPONSE OF HELICOPTER ROTOR BLADES TO TURBULENCE EXCITATION Ph.D. Thesis

J. S. FUM 1983 166 p

Avail: Univ. Microfilms Order No. DA8409925

Dynamics of a helicopter rotor system in atmospheric turbulence is investigated theoretically. Modeling turbulence components as stationary random processes, differential equations governing the coupled flapping-torsional motion of a rotor blade are derived. The blade is treated as being rigid and centrally hinged for the flapping motion, and as being elastic with a linear deformation mode for the torsional motion. Classical theory is used to formulate the aerodynamic forces due to blade flapping. For those due to blade pitching, a quasi-steady theory is used. The governing equations so obtained contain random turbulence terms in the coefficients and the inhomogeneous parts. By the use of the stochastic averaging method introduced by Strotonovich, the original physical equations are converted to the Ito equations governing a Markov vector process, which is an approximation for the original physical response state vector. These Ito equations are then used to derive the equations for the statistical moments of the response variables. · Dissert. Abstr.

N84-31111*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
RESULTS OF THE FIRST COMPLETE STATIC CALIBRATION OF THE RSRA ROTOR-LOAD-MEASUREMENT SYSTEM
C. W. ACREE, JR. Aug. 1984 57 p refs
(NASA-TP-2327; A-9593; NAS 1.60:2327) Avail: NTIS HC A04/MF A01 CSCL 01C
The compound Rotor System Research Aircraft (RSRA) is designed to make high-accuracy, simultaneous measurements of all rotor forces and moments in flight. Physical calibration of the rotor force- and moment-measurement system when installed in the aircraft is required to account for known errors and to ensure that measurement-system accuracy is traceable to the National Bureau of Standards. The first static calibration and associated analysis have been completed with good results. Hysteresis was a potential cause of static calibration errors, but was found to be negligible in flight compared to full-scale loads, and analytical methods have been devised to eliminate hysteresis effects on calibration data. Flight tests confirmed that the calibrated rotor-load-measurement system performs as expected in flight and that it can dependably make direct measurements of fuselage vertical drag in hover. Author

N84-31112*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.
SOFTWARE CONTROL AND SYSTEM CONFIGURATION MANAGEMENT: A SYSTEMS-WIDE APPROACH
K. L. PETERSEN and C. FLORES, JR. Aug. 1984 21 p refs Presented at IEEE/AIAA 5th Digital Avionics Systems Conf., Seattle, 31 Oct. - 3 Nov. 1983 Previously announced in IAA as A84-26713 Prepared in cooperation with NASA. Ames Research Center, Moffett Field, Calif.
(NASA-TM-85908; H-1256; NAS 1.15:85908) Avail: NTIS HC A02/MF A01 CSCL 01C
A comprehensive software control and system configuration management process for flight-crucial digital control systems of advanced aircraft has been developed and refined to insure efficient flight system development and safe flight operations. Because of the highly complex interactions among the hardware, software, and system elements of state-of-the-art digital flight control system designs, a systems-wide approach to configuration control and management has been used. Specific procedures are implemented to govern discrepancy reporting and reconciliation, software and hardware change control, systems verification and validation testing, and formal documentation requirements. An active and knowledgeable configuration control board reviews and approves all flight system configuration modifications and revalidation tests. This flexible process has proved effective during the development and flight testing of several research aircraft and remotely piloted research vehicles with digital flight control systems that ranged from relatively simple to highly complex, integrated mechanizations. Author

N84-31113# Aeronautical Research Labs., Melbourne (Australia).
EXTENSIONS AND MODIFICATIONS TO THE ARL POINT-PERFORMANCE PROGRAM
V. A. E. ROUQUEIROL Sep. 1983 93 p
(AD-A142078; ARL/SYS-TM-67) Avail: NTIS HC A05/MF A01 CSCL 09B
Several years of usage of the ARL point performance program described in ARL Technical Engineering Report 160 have indicated the desirability of certain improvements and extensions which have been incorporated. This document describes the purpose and nature of the various changes in sufficient detail to allow it to be used independently of the original report. Author (GRA)

N84-31114# Aeronautical Research Labs., Melbourne (Australia).
FUSELAGE TORSION OF A CT4 AIRCRAFT
P. M. COX and A. GOLDMAN Dec. 1983 25 p
(AD-A142753; ARL/STRUC-TM-368) Avail: NTIS HC A02/MF A01 CSCL 14B
The fuselage torsion mode of a CT4 aircraft has been examined using an impulsive testing technique. The mode shape and natural frequency are presented. Author (GRA)

N84-31115# Aeronautical Research Labs., Melbourne (Australia).
CALIBRATION OF CT-4A FATIGUE TEST ARTICLE, MARCH 1983
R. P. CAREY and D. G. FORD Jan. 1984 38 p
(AD-A142880; ARL/STRUC-TM-373) Avail: NTIS HC A03/MF A01 CSCL 01C
In preparation for fatigue testing, a strain gauged CT-4A fatigue test article has been calibrated by discrete static loadings. The strain/load data are analyzed herein and strain sensitivities to various load parameters are reported. The responses of some gauges have been compared with flight strains and ground calibrations. Author (GRA)

N84-31117# Messerschmitt-Boelkow-Blohm G.m.b.H., Hamburg (West Germany). Unternehmensbereich Transport- und Verkehrsflugzeuge.
UNSTEADY AERODYNAMICS OF FAST MOVING CONTROL SURFACES Final Report, Nov. 1983
W. KOLANDER and H. HANSEN Bonn Bundesministerium fuer Forschung und Technologie Jun. 1984 79 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-W-84-020; ISSN-0170-1339) Avail: NTIS HC A05/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 16.50
Active control technology in the unsteady aerodynamics of fast moving surfaces, and systems identification technology are reviewed. Computation programs were developed for the prediction of the unsteady flow about airfoils and wings, with fast control surface movements. Wind tunnel tests with a supercritical airfoil model and two very large halfwing models with fast moving control surfaces, including spoilers, provide the data base for extrapolation to full scale conditions. Author (ESA)

N84-31118# Societe Nationale Industrielle Aerospatiale, Suresnes (France). Laboratoire Central.
MODERN STRUCTURE MATERIALS: PRESENT SITUATION AND EVOLUTION PERSPECTIVES [LES MATERIAUX STRUCTURAUX MODERNES: SITUATION ACTUELLE ET PERSPECTIVES D'EVOLUTION]
G. HILAIRE 1984 60 p In FRENCH Presented at Semaine Aeron. G.I.F.A.S., Madrid, 12-15 Jun. 1984
(SNIAS-841-551-103) Avail: NTIS HC A04/MF A01
The replacement of metals by composites in aircraft construction is noted. Materials selection criteria are reviewed. The composition of civil and military airplanes, helicopters, and engines is discussed. Author (ESA)

N84-31119# Joint Publications Research Service, Arlington, Va.
USSR REPORT: TRANSPORTATION
13 Aug. 1984 50 p Transl. into ENGLISH from various Russian articles
(JPRS-UTR-84-024) Avail: NTIS HC A03/MF A01
Various aspects of transportation in the U.S.S.R. are addressed. Specific topics are: civil aviation, motor vehicles and highways, rail systems, and maritime and river fleets.

N84-31120# Joint Publications Research Service, Arlington, Va.
ADVANCED SYSTEM FOR TESTING NEW HELICOPTER TRANSMISSIONS
G. IVANOV *In its* USSR Rept.: Transportation (JPRS-UTR-84-024) p 3-4 13 Aug. 1984 Transl. into ENGLISH from Vozdushnyy Transport (Moscow), 19 Jun. 1984 p 4
Avail: NTIS HC A03/MF A01

Devices and methods available to test helicopter transmission performance are described briefly. Two test devices, the near full scale stand and the closed mechanical stand, are mentioned. These devices provide mechanical loads to the helicopter transmission. An electromechanical method used in conjunction with a minicomputerized, automated control system is discussed in contrast to the test devices. R.S.F.

N84-31174# British Aerospace Public Ltd. Co., Brough (England). Act Design Group.
ADVANCED COCKPIT-SYSTEMS INTEGRATION
G. ROE *In* ASD Proc. Papers of the 2nd AFSC Avionics Std. Conf., Vol. 2 p 695-717 Nov. 1982 Proc. held in Dayton, Ohio, 30 Nov. - 2 Dec. 1982
(AD-P003569) Avail: NTIS HC A25/MF A01 CSCL 01C

The present paper describes two major complementary activities funded by the United Kingdom Ministry of Defense which are being undertaken at the Brough site of British Aerospace. These studies are addressing the problem of pilots task optimization and the overall system architecture needed to meet the operational requirements of the next tactical combat aircraft. These activities are the Advanced Cockpit Design Studies and the Tactical Combat Aircraft Avionic Demonstrator Rig. The Advanced Cockpit Studies have been underway for some 6 years. The scope of these studies has been extensive, covering escape system design, g' alleviation techniques, advance pilot and equipment cooling techniques, information and control task rationalization and the development of workload prediction and measurement techniques. The studies have, after a number of iterations, culminated in the development of a dynamic cockpit mockup. The studies specifically related to the information and control task rationalization will be discussed in this paper in some detail. The Tactical Combat Aircraft Avionic Demonstrator Rig is presently at the mid point of a 3-4 year evolutionary design program investigating such topics as, total system integration, standardization of interfaces, effective sub-system inter communication, graceful degradation of the system and improved maintenance procedures. The architecture being developed has a multi bus hierarchy and implements the data transmission standard 1553B for sub system to sub system and bus to bus communications. GRA

N84-32087# Joint Publications Research Service, Arlington, Va.
OSCILLATIONS OF ELASTIC AIRPLANE DUE TO WIND GUST Abstract Only
A. V. IVANOVA *In its* USSR Rept.: Phys. and Math. (JPRS-UPM-84-005) p 23 15 Aug. 1984 Transl. into ENGLISH from Vestn. Leningr. Univ.: Mat., Mekhan., Astron. (Leningrad), no. 1, Jan. 1984
Avail: NTIS HC A06/MF A01

The reaction of a sweptback wing aircraft at constant speed to a single gust of wind with arbitrary speed distribution was investigated. The wing is considered a thin and elastic bar, and the fuselage as a heavy body capable of vertical movement and rotation around the center of gravity. Symmetrical oscillations are considered. A set of differential equations is developed describing combined flexional-torsional oscillations of a thin-walled bar, taking into account the transverse cross-section deformation and displacement. There are boundary conditions for the free end of the bar and for the union of wing and fuselage. The introduction of a dimensionless time factor and an aerodynamic load expression leads to the final form of the equations for which specific gust conditions are chosen. Author

N84-32375 Mississippi State Univ., State College.
AN INVESTIGATION OF A NEW FLIGHT TEST METHOD FOR MEASURING THE PERFORMANCE OF GENERAL AVIATION AIRCRAFT Ph.D. Thesis
P. D. BRIDGES 1983 70 p
Avail: Univ. Microfilms Order No. DA8410661

A new procedure for using level flight accelerations and decelerations of propeller-driven general aviation aircraft to measure propulsive efficiency and aircraft drag is investigated. An approximate closed-form solution for the velocity change as a function of time is found, and the influence of the system time constant on aircraft disturbances is discussed. The maneuver is then executed on a six degree-of-freedom computer simulation to provide simulated flight test data. Two estimation procedures, maximum likelihood and extended Kalman filtering, are used to extract the propulsive efficiency and aircraft drag from the simulation data. Various levels of measurement noise and bias are investigated, and their effects on the estimates are discussed. It is found that the maximum likelihood estimator is preferred because of faster convergence and the ability of combine multiple runs. The method is then applied to actual flight test data. Dissert. Abstr.

N84-32376 Department of the Air Force, Washington, D.C.
METHOD OF MAKING COMPARTMENTED, FILAMENT WOUND, ONE-PIECE AIRCRAFT FUEL TANKS Patent
E. J. MORRISEY, inventor (to Air Force) 12 Jun. 1984 6 p Supersedes AD-D009351
(AD-D011144; US-PATENT-4,453,995; US-PATENT-APPL-SN-339258; US-PATENT-CLASS-156-172)
Avail: US Patent & Trademark Office CSCL 13D

An external aircraft fuel tank is provided which comprises a filament-reinforced fuel cell assembled with aerodynamic end shapes having a plurality of layers of adhesive resin-impregnated filament wrappings over the assembly. Also provided is a method for making the fuel tank. Author (GRA)

N84-32377*# Texas A&M Univ., College Station. Dept. of Aerospace Engineering.
DESIGN OF A COMPOSITE WING EXTENSION FOR A GENERAL AVIATION AIRCRAFT Final Report
P. S. ADNEY and W. J. HORN Sep. 1984 49 p refs
(Contract NAG1-184)
(NASA-CR-173832; NAS 1.26:173832) Avail: NTIS HC A03/MF A01 CSCL 01C

A composite wing extension was designed for a typical general aviation aircraft to improve lift curve slope, dihedral effect, and lift to drag ratio. Advanced composite materials were used in the design to evaluate their use as primary structural components in general aviation aircraft. Extensive wind tunnel tests were used to evaluate six extension shapes. The extension shape chosen as the best choice was 28 inches long with a total area of 17 square feet. Subsequent flight tests showed the wing extension's predicted aerodynamic improvements to be correct. The structural design of the wing extension consisted of a hybrid laminate carbon core with outer layers of Kevlar - layed up over a foam interior which acted as an internal support. The laminate skin of the wing extension was designed from strength requirements, and the foam core was included to prevent buckling. A joint lap was recommended to attach the wing extension to the main wing structure. Author

N84-32378*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
VALIDATION OF AN ACTIVE GEAR, FLEXIBLE AIRCRAFT TAKE-OFF AND LANDING ANALYSIS (AGFATL)
J. R. MCGEHEE Sep. 1984 31 p refs
(NASA-TP-2353; L-15807; NAS 1.60:2353) Avail: NTIS HC A03/MF A01 CSCL 01C

The results of an analytical investigation using a computer program for active gear, flexible aircraft take off and landing analysis (AGFATL) are compared with experimental data from shaker tests, drop tests, and simulated landing tests to validate the AGFATL computer program. Comparison of experimental and analytical responses for both passive and active gears indicates good agreement for shaker tests and drop tests. For the simulated landing tests, the passive and active gears were influenced by large strut binding friction forces. The inclusion of these undefined forces in the analytical simulations was difficult, and consequently only fair to good agreement was obtained. An assessment of the results from the investigation indicates that the AGFATL computer program is a valid tool for the study and initial design of series hydraulic active control landing gear systems. Author

N84-32379*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
COMPUTER STUDIES OF HYBRID-SLOTTED WORKING SECTIONS WITH MINIMUM INTERFERENCE AT SUBSONIC SPEEDS
F. W. STEINLE, JR. and D. G. MABEY Aug. 1984 20 p refs
(NASA-TM-86002; A-9845; NAS 1.15:86002) Avail: NTIS HC A02/MF A01 CSCL 01C

A series of computations on tunnel boundary-interference effects for hybrid-slotted working sections was performed using the WALINT code. The slots were modeled as lines of porosity with linear crossflow characteristics. The basic shape evaluated was for a rectangular section with height-to-width ratio = 0.835 and its companion in the duplex mode (half model testing) with height-to-width ratio = 0.6. A best overall basic configuration was determined with seven slots on each wall with open area ratio on each wall of 17.5%. For both full-span and half-model testing, the optimum solution required closing all but two slots on each of the half-walls parallel to the plane of the wing (equivalent to four slots on the full floor and ceiling). The results are presented here for the best configurations and are shown to be within the figure-of-merit range of + or - 0.04 in upwash, and + or - 0.1 in curvature for the Mach number range 0.6 to 0.85. Blockage effects are shown to be small. Author

N84-32380*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A MATHEMATICAL SIMULATION MODEL OF THE CH-46B HELICOPTER, VOLUME 2
J. M. WEBER, T. Y. LIU (Computer Sciences Corp., Mountain View, Calif.), and W. CHUNG (Computer Sciences Corp., Mountain View, Calif.) Aug. 1984 164 p refs 2 Vol.
(NASA-TM-84351; A-9303; NAS 1.15:84351) Avail: NTIS HC A08/MF A01 CSCL 01C

A nonlinear simulation model of the CH-47B helicopter, was adapted for use in a simulation facility. The model represents the specific configuration of the variable stability CH-47B helicopter. Modeling of the helicopter uses a total force approach in six rigid body degrees of freedom. Rotor dynamics are simulated using the Wheatley-Bailey equations, steady state flapping dynamics and included in the model of the option for simulation of external suspension, slung load equations of motion. Validation of the model was accomplished by static and dynamic data from the original Boeing Vertol mathematical model and flight test data. The model is appropriate for use in real time piloted simulation and is implemented on the ARC Sigma IX computer where it may be operated with a digital cycle time of 0.03 sec. E.A.K.

N84-32381*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
NASA ROTOR SYSTEM RESEARCH AIRCRAFT FLIGHT-TEST DATA REPORT: HELICOPTER AND COMPOUND CONFIGURATION
R. E. ERICKSON, R. M. KUFELD, J. L. CROSS, R. W. HODGE (Sikorsky Aircraft Co., Stratford, Conn.), W. F. ERICSON (Sikorsky Aircraft Co., Stratford, Conn.), and R. D. G. CARTER (Sikorsky Aircraft Co., Stratford, Conn.) Aug. 1984 244 p refs
(NASA-TM-85843; NAS 1.15:85843) Avail: NTIS HC A11/MF A01 CSCL 01C

The flight test activities of the Rotor System Research Aircraft (RSRA), NASA 740, from June 30, 1981 to August 5, 1982 are reported. Tests were conducted in both the helicopter and compound configurations. Compound tests reconfirmed the Sikorsky flight envelope except that main rotor blade bending loads reached endurance at a speed about 10 knots lower than previously. Wing incidence changes were made from 0 to 10 deg. Author

N84-32382# Naval War Coll., Newport, R. I.
THE FEASIBILITY, PRACTICALITY AND UTILITY OF P-3 INFLIGHT REFUELING
D. J. BRENNOCK 22 Jun. 1984 47 p
(AD-A143419) Avail: NTIS HC A03/MF A01 CSCL 01B

The U.S. Navy's primary long-range maritime patrol aircraft no longer possesses the necessary range and time on station to fulfill its missions of antisubmarine warfare, anti-surface warfare, open ocean surveillance and intelligence collection. The capability to refuel the P-3 inflight would allow coverage of key ocean areas of vital interest in wartime as well as peacetime, but are not presently and in the future may not be accessible. Constraints placed upon this study include the lack of actual flights involving the transfer of fuel, but detailed analysis of accurately predicted performance data suffices. Questionable political stability of some friendly nations was assumed in the final analysis to be unfavorable in respect to forward basing facilities. This paper does not address the financial aspect of the necessary modifications but emphasizes its feasibility, practicality, and applicability. Inflight refueling would enable the P-3 to extend its range and remain on station for sufficient duration, so as to provide the necessary coverage of vital areas of the Indian Ocean, Atlantic Ocean, and Greenland and Barents Seas, recognizing that all present deployment areas are not restricted by fuel limitations. The author recommends that an appropriate number of squadrons be retrofitted to provide an inflight refueling capability. GRA

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AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

A84-43305* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AIRBORNE TUNABLE DIODE LASER SYSTEM FOR TRACE GAS MEASUREMENTS
G. W. SACHSE, G. F. HILL, and J. M. HOELL, JR. (NASA, Langley Research Center, Hampton, VA) IN: Tunable diode laser development and spectroscopy applications; Proceedings of the Meeting, San Diego, CA, August 25, 26, 1983 . Bellingham, WA, SPIE The International Society for Optical Engineering, 1983, p. 99-104. refs

Sachse et al. (1976) have reported the development of an airborne tunable diode laser (TDL) system, named the Differential Absorption CO Monitor (DACOM). The absorption path was 10 m long and located in the free airstream along the fuselage of a C-54 aircraft. The present investigation is concerned with a modification of the DACOM instrument. Differences between the new instrument and the original one are related to a replacement of the external absorption path with a White cell. The instrument has the capability to suppress TDL excess noise. The laser refrigerator has been redesigned to permit an alternative method of cooling the TDL when electric power is not available. G.R.

A84-43454#

AN AIRBORNE WIND SHEAR DETECTION SYSTEM

D. MCLEAN (Loughborough University of Technology, Loughborough, Leics., England) and M. SAMAKA IN: Guidance and Control Conference, Seattle, WA, August 20-22, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 480-486. refs

(AIAA PAPER 84-1918)

For general aviation aircraft, encountering wind shear during landing or take-off is an extremely hazardous situation. This paper describes the design and simulation of a wind shear detection system which has been arranged to provide pilots of such aircraft with a voice alert and vocal annunciation of horizontal wind shear velocities, and also a visual indication of the vertical component. The system is based upon observer theory and the scheme involves an 8-bit microprocessor and voice synthesis device. Results of an automatic landing in the presence of an acute wind shear are used to illustrate the effectiveness of the system which is intended for immediate use in a 3-axis moving-base simulator of a typical twin-engined general aviation aircraft. Author

A84-43500

MODE S AND T.CAS - THE FRENCH DESIGN AND PROGRAM [MODE S ET T.CAS - CONCEPTION EN FRANCE ET PROGRAMME]

A. PRINTEMPS Navigation (Paris) (ISSN 0028-1530), vol. 32, July 1984, p. 291-301. In French.

Two secondary radar systems for civil aviation aircraft have been studied internationally for several years for two purposes: to permit aircraft identification through automatic interrogation equipment and to make on-board anticollision systems (T.CAS) standard equipment. Mode S assures a ground-air link and utilizes secondary surveillance radar (SSR) frequencies and a monopulse mode, the latter furnishing azimuthal data for ATC. The T.CAS system automatically interrogates aircraft equipped with SSR equipment at 1.03 GHz. The direction of the interrogated aircraft, with either circling or en route headings, is obtained. The data received are sufficient for the pilot to make visual contact, but lack the resolution necessary for evasive maneuvers. M.S.K.

A84-44472#

OPERATIONAL AIRCRAFT PERFORMANCE EVALUATION - AN APPROACH TO TESTING USING A HEAD-UP DISPLAY SYSTEM

S. C. MERCER (General Dynamics Corp., Fort Worth, TX) IN: Flight testing technology: A state-of-the-art review; Proceedings of the Thirteenth Annual Symposium, New York, NY, September 19-22, 1982 . Lancaster, CA, Society of Flight Test Engineers, 1982, p. 193-200.

Operational verification of estimated aircraft performance can be a significant challenge to the performance engineer. This paper describes a simple, but very effective, method of meeting that challenge. Using operational F-16's equipped with a video recording system to record the information displayed on the pilot's Head-Up Display, a large amount of tactically significant performance data were obtained during operational evaluation missions. Analysis of the data thus gathered, and the correlation of the results with performance engineers' predictions, resulted in full verification of predicted performance characteristics as well as a very high level of confidence in other calculated performance capabilities. This paper discusses the Head-Up Display, the video system used, and the basic approach utilized for analysis and correlation of the data. Author

A84-44752

FLIGHT TESTING THE CDTI CONCEPT

E. S. STEIN and J. M. FABRY (FAA, Technical Center, Atlantic City, NJ) IN: Air Traffic Control Association, Annual Fall Conference, 27th, Atlantic City, NJ, October 18-21, 1982, Proceedings . Arlington, VA, Air Traffic Control Association, 1982, p. 316-318.

The results of flight tests of a Cockpit Display of Traffic Information (CDTI) concept are reported. The tests measured the abilities of seven general aviation pilots to maintain primary separation from other aircraft on random paths and altitudes. Minor software modifications were made to the Mode S ground sensors and in the airborne CDTI hardware package to allow the display of traffic information at distances beyond the normal CAS ranges. The flight test area was enlarged to 8 nautical miles and + or - 2,000 feet of vertical separation. It was found that while the flight series included only a small sample of local pilots, they were able to maintain vertical separation most of the time using prototype equipment. The overall relative violation frequency was about 6 percent. The median relative violation frequency was 3.9 percent. I.H.

A84-45047#

DEVELOPMENT OF MODULAR AIR DATA COMPUTER FAMILY FOR MINIMUM COST OF OWNERSHIP

J. M. COLSTON and F. T. MACKLEY (Marconi Avionics, Ltd., Rochester, England) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 1075-1078.

Design features, qualification tests, production techniques and life cycle costs for new USAF/USN Standard Central Air Data Computers (SCADC) for replacing pre-digital avionics with no modifications to older aircraft are outlined. The SCADC, being modular, can be adapted to any aircraft, including those requiring analog interfaces. The qualifications tests have satisfied Mil Std 810-C environmental requirements and Mil Std 461-B EMC criteria. Built-in test capabilities have been included in all modules, which are line replaceable units. All assembly and test procedures have been optimized. The resulting equipment has a MTBF over 4000 hr, with repairs being a low skill operation. M.S.K.

A84-46274

MAST MOUNTED VISUAL AIDS

R. D. VON RETH and M. KLOSTER (Messerschmitt-Bolkow-Blohm GmbH, Munich, West Germany) Vertica (ISSN 0360-5450), vol. 8, no. 2, 1984, p. 183-195.

Initial flight tests with a spherical mock up, having the same shape, weight and moments of inertia as the actual system were carried out on a BO 105 with two different rotor mast extensions (90 and 120 cm). A vibration survey over most of the BO 105's flight envelope showed vibrational loads which can be tolerated by the actual system. Investigations of the controllability and stability are also presented. No significant influence in the flight mechanical behavior of the helicopter was found during the flight tests so far. The major influence being a slight reduction of the maximum horizontal speed. As the next step the actual stabilized platform with FLIR, t.v.-camera and a laser range finder was installed on the rotor mast. In addition several subsystems used for the display of the video images with superimposed symbology are described. For direct comparison purposes three different systems, Head Up, Head Down and Helmet Mounted Sight and Display will be evaluated. The influence of the rotor plane, vibrational loads and meteorological conditions on the performance of the FLIR image is described. Author

A84-46353#

DEVELOPMENT OF AVIONIC SYSTEMS FOR FUTURE HELICOPTERS

R.-D. VON RETH (Messerschmitt-Boelkow-Blohm GmbH, Munich, West Germany) IN: American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 281-292.

A new advanced technology simulator is currently being developed by a German aerospace company. Major systems of this simulator include the digital simulation computer, the digital image generator with data base, and the projection system. The use of suitable interfaces makes it possible to operate interchangeable cockpit stations and specific integration-rigs with the simulator. The simulator is to be employed in connection with work related to the various design phases involved in the development of future helicopters. A heterogeneous element processor is used as simulation computer. High performance real time simulation is obtained on the basis of parallel processing involving up to ten concurrent procedures. Attention is also given to night vision sensors, a mast mounted observation platform, a pilot vision system, night vision goggles, an obstacle warning radar, display systems, a central control unit, and an outlook for the future. G.R.

A84-46385
INTEGRATION OF USER REQUIREMENTS INTO THE HH-60D COCKPIT DESIGN
J. R. BARNEY, O. WRIGHT (IBM Federal Systems Div., Owego, NY), T. G. DRENNEN, and J. ELLIS (Sperry Flight Systems, Defense Systems Div., Albuquerque, NM) American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Paper. 10 p.

The development of avionics for the cockpit of the USAF HH-60 D terrain-following night-combat-rescue helicopter is described. The analysis of the aircraft mission and crew tasks and the design process for the avionics hardware and software are examined, emphasizing the importance of continuous input from the user groups. The final designs for the instrument panel, displays, flight-control grips, sensor-tracking handle, shortened center console, and overhead console are presented graphically and discussed. T.K.

N84-31121# Aeronautical Systems Div., Wright-Patterson AFB, Ohio. Directorate of Avionics Engineering.
PROCEEDINGS PAPERS OF THE 2ND AFSC (AIR FORCE SYSTEMS COMMAND) AVIONICS STANDARDIZATION CONFERENCE, VOLUME 1 Final Report
C. A. PORUBCANSKY Nov. 1982 582 p Conf. held in Dayton, Ohio, 30 Nov. - 2 Dec. 1982
(AD-A142776; ASD(ENA)-TR-82-5031-VOL-1) Avail: NTIS HC A25/MF A01 CSCL 09C

This is a collection of UNCLASSIFIED papers to be distributed to the attendees to the Second AFSC Avionics Standardization Conference at the Convention Center, Dayton, Ohio. The scope of the conference includes the complete range of DOD approved embedded computer hardware/software and related interface standards as well as standard subsystems used within the Tri-Service community and NATO. The theme of the conference is Rational Standardization. Lessons learned as well as the pros and cons of standardization are highlighted.

N84-31128# Intermetrics, Inc., Huntington Beach, Calif.
THE MULTIPLE SYSTEM OFP SUPPORT (MSOS) SYSTEM, A PRE-PMRT CAPABILITY FOR EVALUATING TACTICAL SOFTWARE
M. KIRCHOFF, V. VAJO, and H. LOWERY *In* ASD Proc. Papers of the 2nd AFSC Avionics Standardization Conf., Vol. 1 p 85-92 Nov. 1982
(AD-P003524) Avail: NTIS HC A25/MF A01 CSCL 09B

A generic software testing facility is presently under development at Warner-Robins Air Logistics Command. The Multiple-System OFP Support System will allow independent verification and validation of avionic software for a variety of systems to be conducted early in the development cycle, reducing costs to the Air Force. Intermetrics, Inc. is linking via hardware and associated software the Nanodata QM-1 microprogrammable computer and the VAX-11/780. The AM-1 hosts emulations of tactical embedded computers and the VAX hosts simulations of real environments. Overlaying the emulation/simulation system in a UNIX-based monitor tailored to provide absolute control and complete visibility into the executing target machine software. A variety of static test tools for analyzing JOVIAL and, eventually, Ada code is being hosted on the VAX. A primary function of these tools will be to verify the conformance of the code to the specific standards. Author (GRA)

N84-31130# Air Force Armament Lab., Eglin AFB, Fla.
MIL-STD-1760 DEVELOPMENT PROGRAM
C. M. CONNELL and B. M. SUNDSTROM *In* ASD Proc. Papers of the 2nd AFSC Avionics Standardization Conf., Vol. 1 p 103-107 Nov. 1982
(AD-P003526) Avail: NTIS HC A25/MF A01 CSCL 09C

The Joint Air Force/Navy program to develop MIL-STD-1760, Aircraft and Store Electrical Interconnection System, is described. The rationale for the program and the program approach and status is presented. Each of the three interface elements of MIL-STD-1760 are discussed with emphasis on how the elements enhance aircraft/store interoperability and reduce future aircraft modification cost. Implementation of MIL-STD-1760 is advocated for all future US and NATO aircraft and stores. Author (GRA)

N84-31133# Fairchild Space and Electronics Co., Germantown, Md.
CONSIDERATION OF MIL-STD-1760, AIRCRAFT/STORE ELECTRICAL INTERFACE STANDARD ON STORES MANAGEMENT SYSTEM ARCHITECTURES
J. E. SILL *In* ASD Proc. Papers of the 2nd AFSC Avionics Standardization Conf., Vol. 1 p 139-159 Nov. 1982
(AD-P003529) Avail: NTIS HC A25/MF A01 CSCL 05A

Stores Management Systems (SMS) have usually been developed to satisfy point design needs of a particular store suite on particular military aircraft. Typically during aircraft service life the carriage of additional store types, either newly developed or existing, becomes desirable. This frequently requires major surgery to make the aircraft compatible. MIL-STD-1760 is under development to ease that problem at the aircraft/store connection point. Several implications exist for the Stores Management System (which controls that connection point on the aircraft side) if the interoperability objectives of MIL-STD-1760 are to be fully exploited. The analysis presented takes a four step approach to defining an advanced SMS that can provide the interoperability and flexibility desired. First a top-down look into how an SMS fits into an advanced avionics system is presented. The second step is a bottoms-up look into what a multiplicity standard store interfaces imply for the SMS. Third is an analysis of other SMS requirements which must be considered. Finally, an SMS system is projected which can fulfill many of the derived requirements. The flexibility area can be achieved but they require an intergrated analysis which must address mechanical, electrical, and functional compatibility issues for both stores and aircraft. This paper addresses an important part of that analysis, the Stores Management System. Author (GRA)

N84-31134# Grumman Aerospace Corp., Bethpage, N.Y.
AIRCRAFT MULTIPLEXING SYSTEM ARCHITECTURE AND STORES COMPATIBILITY
A. DERUGGIERO and B. ZEMPOLICH *In* ASD Proc. Papers of the 2nd AFSC Avionics Standardization Conf., Vol. 1 p 161-174 Nov. 1982
(AD-P003530) Avail: NTIS HC A25/MF A01 CSCL 09C

The introduction of more capable and more complex vehicle avionics systems and the emphasis on the aircraft as a holistic system has led to a trend toward distribution of subsystem functions and a greater need to provide effective control over total system operation. Author (GRA)

N84-31150# General Dynamics Corp., Fort Worth, Tex.
A COMMON 1553B I/O CHANNEL FOR THE F-16
S. ALFORD *In* ASD Proc. Papers of the 2nd AFSC Avionics Standardization Conf., Vol. 1 p 367-382 Nov. 1982
(AD-P003546) Avail: NTIS HC A25/MF A01 CSCL 09C

The 1980's will see increased standardization in military avionics. MIL-STD-1553 has proven to be an effective means of assuring communications among independently developed avionic subsystems. Future applications of the Air Force standard computer architecture, MIL-STD-1750A, and standard programming language, MIL-STD-1589B, will further decrease the life cycle costs of many systems currently under development. While MIL-STD-1750A defines a specific CPU architecture, and MIL-STD-1553B defines the method of communication among subsystems, no current Air Force standard defines the I/O channel that links the 1750 processor to the 1553 bus. In order to reduce both the cost of software development and maintenance, General Dynamics has developed a 1553 channel architecture to be applied to all the subsystems being programmed in-house for the F-16 Multi-National Staged Improvement Program (MSIP). Author (GRA)

N84-31165# Aeronautical Systems Div., Wright-Patterson AFB, Ohio. Directorate of Avionics Engineering.
PROCEEDINGS PAPERS OF THE 2ND AFSC (AIR FORCE SYSTEMS COMMAND) AVIONICS STANDARDIZATION CONFERENCE, VOLUME 2 Final Report
C. A. PORUBCANSKY, ed. Nov. 1982 596 p Proc. held in Dayton, Ohio, 30 Nov. - 2 Dec. 1982
(AD-A142777; ASD(ENA)-TR-82-5031-VOL-2) Avail: NTIS HC A25/MF A01 CSCL 09C

This is a collection of UNCLASSIFIED papers to be distributed to the attendees of the Second AFSC Avionics Standardization Conference at the Convention Center, Dayton, Ohio. The scope of the Conference includes the complete range of DOD approved embedded computer hardware/software and related interface standards as well as standard subsystems used within the Tri-Service community and NATO. The theme of the conference is Rational Standardization. Lessons learned as well as the pros and cons of standardization are highlighted.

N84-31167# Boeing Military Airplane Development, Seattle, Wash.
ACHIEVING THE BENEFITS OF MODULAR AVIONICS DESIGN
S. W. BEHNEN, F. M. LIGHTFOOT, and P. R. METZ *In* ASD Proc. Papers of the 2nd AFSC Avionics Std. Conf., Vol. 2 p 583-595 Nov. 1982 Proc. held in Dayton, Ohio, 30 Nov. - 2 Dec. 1982
(AD-P003562) Avail: NTIS HC A25/MF A01 CSCL 05A

New system development programs are adopting the principles of modular design to reduce the number of unique parts, increase capability, improve fault tolerance, lower costs, and encourage transition to new technologies. Programs such as Integrated Communication, Navigation, Identification Avionics are proving the value of this approach. Even greater benefits will be obtained from modular design, however, when the use of common modules spreads across, and into, dissimilar subsystems. The creation and adoption of new military standards, which will complement existing standards, are needed to encourage widespread use of compatible modular avionics. Examples are given, as well as suggestions as to the most efficient way of circumventing inherent industry reluctance to adopt national standards. Author (GRA)

N84-31170# Aeronautical Systems Div., Wright-Patterson AFB, Ohio.
AN INTRODUCTION TO THE AVIONICS INTEGRITY PROGRAM
J. E. VERDIER *In its* Proc. Papers of the 2nd AFSC Avionics Std. Conf., Vol. 2 p 633-637 Nov. 1982 Proc. held in Dayton, Ohio, 30 Nov. - 2 Dec. 1982
(AD-P003565) Avail: NTIS HC A25/MF A01 CSCL 09C

This paper describes the Avionics Integrity Program which will develop a MIL-STD and an implementation handbook for the development and operation of avionics systems. The objectives of the program are to reduce the cost of ownership and increase availability while meeting user requirements. The basic approach is presented and the outline of the MIL-STD and handbook are explained. Author (GRA)

N84-31171# General Dynamics/Fort Worth, Tex.
ELEMENTS FOR SUCCESSFUL IMPLEMENTATION OF COMPUTING STANDARDS
G. R. ENGLAND *In* ASD Proc. Papers of the 2nd AFSC Avionics Std. Conf., Vol. 2 p 643-653 Nov. 1982 Proc. held in Dayton, Ohio, 30 Nov. - 2 Dec. 1982
(AD-P003566) Avail: NTIS HC A25/MF A01 CSCL 09C

The F-16 avionics implements what is likely the broadest application of standards of any USAF weapon system. Standards available in 1976 were applied which consisted of the MIL-STD-1553 Multiplex Data Bus, JOVIAL J3B which was the defacto software HOL and precursor to JOVIAL J73 dialect and the MIL-STD-483/490 software documentation standard. These standards were instrumental in making the F-16 a very successful program. The F-16 avionic system is now being greatly expanded to accommodate advanced sensors and weapons currently in USAF funded development. Once again the F-16 is at the forefront in implementing the latest USAF standards. A key feature of the enhanced avionics is the application of JOVIAL J73 (MIL-STD-1589B) for all subsystem, the MIL-STD-1553B Multiplex Data Bus, the MIL-STD-1750A Computer Instruction Set Architecture and the MIL-STD-1760 Stores Interface. This paper describes the implementation of standards in both the current and the enhanced F-16 avionics. Author (GRA)

N84-31173# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.
PAVE PILLAR: A MATURATION PROCESS FOR AN ADVANCED AVIONICS ARCHITECTURE
D. R. MORGAN and R. D. BELLEM *In* ASD Proc. Papers of the 2nd AFSC Avionics Std. Conf., Vol. 2 p 675-690 Nov. 1982 Proc. held in Dayton, Ohio, 30 Dec. - 2 Dec. 1982
(AD-P003568) Avail: NTIS HC A25/MF A01 CSCL 09B

Recent speed and density advancements in microelectronics will now permit the development of powerful and affordable avionic architectural elements - viz. processing, memories and wide band data buses. An advanced architecture making use of these elements and coupled with highly flexible software, will enhance the capability to fully exploit information integration and automation processes. An abundance of real-time data is available for integration from diverse subsystems aboard advanced military aircraft. Dramatic improvements in avionic system availability, crew workload reduction, weapon system survivability and supportability are possible using this approach. The introduction of these system integration technologies into the force structure is needed at the earliest opportunity to meet expanding mission requirements. However, care must be exercised to ensure that concepts and standards have been matured through validation testing to avoid potentially costly mistakes. The Air Force has establishd the PAVE PILLAR Program to provide the needed maturation of advanced avionic system architectural approaches, system elements and potential system standards during advanced development. This Program also initiates the concept of establishing system integration technology as a separate discipline within the Laboratory framework. This paper describes the PAVE PILLAR Program being pursued within the Avionics Laboratory of the Wright Aeronautical Laboratories. Enhancements to operational force effectiveness resulting from system integration will be described, along with advanced system technology elements and potential standards which will be developed and demonstrated. Author (GRA)

N84-31176# Battelle Columbus Labs., Ohio.
DIGITAL AVIONICS DESIGN FOR VALIDATION
E. F. HITT *In* ASD Proc. Papers of the 2nd AFSC Avionics Std. Conf., Vol. 2 p 729-749 Nov. 1982 Proc. held in Dayton, Ohio, 30 Nov. - 2 Dec. 1982
(AD-P003571) Avail: NTIS HC A25/MF A01 CSCL 09C

The designer/developer of fault tolerant avionics must consider the requirements to validate these digital systems. These requirements should be primary factors influencing the design and hence the sustainability of these systems. This paper presents a synopsis of a methodology of design and validation of digital avionics and flight control systems based upon early consideration of validation requirements. Avionics developed using this methodology will provide real time fault detection and isolation and hence reduce aircraft down time due to avionics failures. Changes in mission requirements will be reflected in the need to modify or add software modules throughout the system's life cycle. This necessitates design and control of hardware and software interfaces in order to keep the time required to validate the change to a minimum and speed retrofit of the modification in the operational units. Author (GRA)

N84-31180# Army Aviation Center, Fort Rucker, Ala.
CONCEPTS FOR LHX AVIONICS
R. H. SMITH *In* ASD Proc. Papers of the 2nd AFSC Avionics Std. Conf., Vol. 2 p 815-819 Nov. 1982 Proc. held in Dayton, Ohio, 30 Nov. - 2 Dec. 1982
(AD-P003575) Avail: NTIS HC A25/MF A01 CSCL 09C

LHX is the acronym for a family of light, highly capable aircraft intended for operational use in the airland battle well beyond the year 2000. They will be capable of operation in a wide variety of adverse environments on a very hostile battlefield (lasers and other directed energy weapons will be commonplace). Accordingly, the conceptual designs being considered are very different from today's helicopters One major thrust is toward automation of crew duties, with a goal of achieving single pilot operation. GRA

N84-31183# Aeronautical Systems Div., Wright-Patterson AFB, Ohio.
PROPOSED MIL-STD FOR AVIONICS INSTALLATION INTERFACES
G. SCHOPF *In its* Proc. Papers of the 2nd AFSC Avionics Std. Conf., Vol. 2 p 861-870 Nov. 1982 Proc. held in Dayton, Ohio, 30 Nov. - 2 Dec. 1982
(AD-P003578) Avail: NTIS HC A25/MF A01 CSCL 05A

This paper describes the Military Standard (MIL-STD) now in development for avionics installation interface standardization. Originally based upon the interface standard used by the commercial airlines, this new MIL-STD, now extensively revised, is scheduled for coordination at the end of 1982. The background which led to the development of the standard includes on analysis of the benefits expected to result from its application, the relationship between this standard and other military standards, and the similarities between this standard and the commercial (ARINC 600) standard. The open forum approach, using maximum industry participation, was used extensively over a two-year period to produce the document. The technical highlights of the standard, including weight and power dissipation limits, environmental requirements, and LRU form factors are presented. A new electrical connector, which also serves as a hold-down device, is a key element in the design approach. Air Force plans for implementation of the standard are aimed primarily at new airframes and major avionics updates of existing airframes. Also, those avionics subsystems being developed for multiple airframe application are prime candidates. Author (GRA)

N84-31185# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.
INTEGRATED CNI (COMMUNICATION NAVIGATION AND IDENTIFICATION) AVIONICS AND FUTURE STANDARDIZATION
D. BOTHA *In* ASD Proc. Papers of the 2nd AFSC Avionics Std. Conf., Vol. 2 p 889-897 Nov. 1982 Proc. held in Dayton, Ohio, 30 Nov. - 2 Dec. 1982
(AD-P003580) Avail: NTIS HC A25/MF A01 CSCL 09C

The Integrated Communication Navigation and Identification Avionics (ICNIA) project is a system design and validation effort within service laboratories; the system includes the full suite of CNI functions, and is an alternative to a collection of independent C, N, and I system black boxes. The concept is that of a family of modules; front end, preprocessor, signal processor, data processor, clock, COMSEC/TRANSEC, etc. which can be tailored to an individual aircraft type and mission, implying that there could be unique LRUs for each aircraft type. This presents a logistically intolerable situation unless the LRUs, fleetwide, consist almost entirely of standard SRUs of relatively few types across the fleet; standardization at the module, subassembly, or SRU level is required. This paper discusses the system approach to CNI implementation in 1990s procurement, current standards already adopted in the program, and the future standards which appear to be necessary for fullest benefit from the ICNIA concept. Author (GRA)

N84-31189# General Dynamics/Fort Worth, Tex.
QUANTUM LEAP IN AVIONICS
W. E. CANTRELL *In* ASD Proc. Papers of the 2nd AFSC Avionics Std. Conf., Vol. 2 p 959-975 Nov. 1982 Proc. held in Dayton, Ohio, 30 Nov. - 2 Dec. 1982
(AD-P003584) Avail: NTIS HC A25/MF A01 CSCL 09C

Current standardization levels in such programs as the F-16 are providing benefits of productivity and growth that have been significant in the success of that program. The ever-increasing drive to performance, multi-use systems and diverse weapons has heavily taxed current avionic resources. In addition, the data transfer requirement is complicated by the high speed data flow that modern computers both feed on an produce; by multiple source-multiple destination video distribution requirement; the need to self-test the system to lower levels; and the desire to dynamically reconfigure from a failure. Fortunately, the technology to achieve solutions to these new problems is evolving in the VHSIC and fiber optics programs, so that it is possible to rearchitecture the system at the module level as opposed to the LRU level. Module level standardization around a small number of types allows a large number of system level combinations while achieving economies of scale at the module level. The usual objection to standardization, that it freezes innovation, is avoided by technology transparency provisions; while at the same time the objection that standardization obsoletes the present is avoided by downward compatibility provisions. Candidates for standardization in this approach include bus interfaces, the system network, modules and racks. Author (GRA)

N84-31201# Aeronautical Systems Div., Wright-Patterson AFB, Ohio. Directorate of Avionics Engineering.
PROCEEDINGS OF THE 2ND AFSC (AIR FORCE SYSTEMS COMMAND) AVIONICS STANDARDIZATION CONFERENCE. VOLUME 3: EMBEDDED COMPUTER RESOURCES GOVERNING DOCUMENTS Final Report
C. A. PORUBCANSKY, ed. Nov. 1982 337 p Proc. held in Dayton, Ohio, 30 Nov. - 2 Dec. 1982 9 Vol.
(AD-A142778; ASD(ENA)-TR-82-5031-VOL-3) Avail: NTIS HC A15/MF A01 CSCL 09B

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N84-31202# Aeronautical Systems Div., Wright-Patterson AFB, Ohio. Directorate of Avionics Engineering.
PROCEEDINGS OF THE 2ND AFSC (AIR FORCE SYSTEMS COMMAND) AVIONICS STANDARDIZATION CONFERENCE. VOLUME 4: TUTORIAL: MIL-STD-1553 MULTIPLEX DATA BUS Final Report
C. A. PORUBCANSKY, ed. Nov. 1982 112 p Proc. held in Dayton, Ohio, 30 Nov. - 2 Dec. 1982 9 Vol.
(AD-A142779; ASD(ENA)-TR-82-5031-VOL-4) Avail: NTIS HC A06/MF A01 CSCL 09B

This is a collection of papers to be distributed to the attendees of the Second AFSC Avionics Standardization Conference at the Convention Center, Dayton, Ohio. The scope of the conference includes the complete range of DOD approved embedded computer hardware/software and related interface standards as well as standard subsystems used within the Tri-Service community and NATO. The theme of the conference is Rational Standardization. Lessons learned as well as the pros and cons of standardization are highlighted. The Military Standard 1553 for the multiplex data bus is discussed. Author (GRA)

N84-31203# Aeronautical Systems Div., Wright-Patterson AFB, Ohio. Directorate of Avionics Engineering.
PROCEEDINGS OF THE 2ND AFSC (AIR FORCE SYSTEMS COMMAND) AVIONICS STANDARDIZATION CONFERENCE. VOLUME 5: TUTORIAL: MIL-STD-1589 JOVIAL (J-73) HIGH ORDER LANGUAGE Final Report
C. A. PORUBCANSKY, ed. Nov. 1982 194 p Proc. held in Dayton, Ohio, 30 Nov. - 2 Dec. 1982 9 Vol.
(AD-A142780; ASD(ENA)-TR-82-5031-VOL-5) Avail: NTIS HC A09/MF A01 CSCL 09B

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N84-31204# Aeronautical Systems Div., Wright-Patterson AFB, Ohio. Directorate of Avionics Engineering.
PROCEEDINGS OF THE 2ND AFSC (AIR FORCE SYSTEMS COMMAND) AVIONICS STANDARDIZATION CONFERENCE. VOLUME 6: TUTORIAL: MIL-STD-1679 WEAPON SYSTEM SOFTWARE DEVELOPMENT Final Report
C. A. PORUBCANSKY, ed. Nov. 1982 36 p Proc. held in Dayton, Ohio, 30 Nov. - 2 Dec. 1982 9 Vol.
(AD-A142781; ASD(ENA)-TR-82-5031-VOL-6) Avail: NTIS HC A03/MF A01 CSCL 09B

This is a collection of papers to be distributed to the attendees of the Second AFSC Avionics Standardization Conference at the Convention Center, Dayton, Ohio. The scope of the conference includes the complete range of DOD approved embedded computer hardware/software and related interface standards as well as standard subsystems used within the Tri-Service community and NATO. The theme of the conference is Rational Standardization. Lessons learned as well as the pros and cons of standardization are highlighted. A tutorial on Military Standard 1679 dealing with weapon system hardware development is given. Author (GRA)

N84-31205# Aeronautical Systems Div., Wright-Patterson AFB, Ohio. Directorate of Avionics Engineering.
PROCEEDINGS OF THE 2ND AFSC (AIR FORCE SYSTEMS COMMAND) AVIONICS STANDARDIZATION CONFERENCE. VOLUME 7: TUTORIAL: MIL-STD-1750, 16 BIT INSTRUCTION SET ARCHITECTURE Final Report
C. A. PORUBCANSKY, ed. Nov. 1982 52 p Proc. held in Dayton, Ohio, 30 Nov. - 2 Dec. 1982 9 Vol.
(AD-A142782; ASD(ENA)-TR-82-5031-VOL-7) Avail: NTIS HC A04/MF A01 CSCL 09B

This is a collection of papers to be distributed to the attendees of the Second AFSC Avionics Standardization Conference at the Convention Center, Dayton, Ohio. The scope of the conference includes the complete range of DOD approved embedded computer hardware/software and related interface standards as well as standard subsystems used within the Tri-Service community and NATO. The theme of the conference is Rational Standardization. Lessons learned as well as the pros and cons of standardization are highlighted. A tutorial on Military Standard 1750 dealing with 16 bit instruction set architecture is given. Author (GRA)

N84-31206# Aeronautical Systems Div., Wright-Patterson AFB, Ohio. Directorate of, Avionics Engineering.
PROCEEDINGS OF THE 2ND AFSC (AIR FORCE SYSTEMS COMMAND) AVIONICS STANDARDIZATION CONFERENCE. VOLUME 8: TUTORIAL: MIL-STD-1815 ADA HIGH ORDER LANGUAGE Final Report
C. A. PORUBCANSKY, ed. Nov. 1982 170 p Proc. held in Dayton, Ohio, 30 Nov. - 2 Dec. 1982 9 Vol.
(AD-A142783; ASD(ENA)-TR-82-5031-VOL-8) Avail: NTIS HC A08/MF A01 CSCL 09B

This is a collection of papers to be distributed to the attendees of the Second AFSC Avionics Standardization Conference at the Convention Center, Dayton, Ohio. The scope of the conference includes the complete range of DOD approved embedded computer hardware/software and related interface standards as well as standard subsystems used within the Tri-Service community and NATO. The theme of the conference is Rational Standardization. Lessons learned as well as the pros and cons of standardization are highlighted. A tutorial on Military Standard 1815 dealing with the high order language Ada is given. Author (GRA)

N84-31207# Aeronautical Systems Div., Wright-Patterson AFB, Ohio. Directorate of Avionics Engineering.
PROCEEDINGS OF THE 2ND AFSC (AIR FORCE SYSTEMS COMMAND) AVIONICS STANDARDIZATION CONFERENCE. VOLUME 9: TUTORIAL: NAVY CASE STUDY IMPLEMENTATION OF MILITARY STANDARDS Final Report
C. A. PORUBCANSKY, ed. Nov. 1982 139 p Proc. held in Dayton, Ohio, 30 Nov. - 2 Dec. 1982 9 Vol.
(AD-A142784; ASD(ENA)-TR-82-5031-VOL-9) Avail: NTIS HC A07/MF A01 CSCL 09B

This a collection of papers to be distributed to the attendees of the Second AFSC Avionics Standardization Conference at the convention Center, Dayton, Ohio. The scope of the Conference includes the complete range of DOD approved embedded computer hardware/software and related interface standards as well as standard subsystems used within the Tri-Service community and NATO. The theme of the conference is Rational Standardization. Lessons learned as well as the pros and cons of standardization are highlighted. A tutorial on a Navy case study implementation of military standards is given. Author (GRA)

N84-32249# Air Force Human Resources Lab., Williams AFB, Ariz.
FIBER OPTIC HELMET MOUNTED DISPLAY: A COST EFFECTIVE APPROACH TO FULL VISUAL FLIGHT SIMULATION
C. L. HANSON *In* American Defense Preparedness Association Proc. of the 5th Interservice/Ind. Training Equipment Conf., Vol. 1 p 262-268 16 Nov. 1983
(AD-P003482) Avail: NTIS HC A17/MF A01 CSCL 05I

Wide field-of-view, high resolution, detailed visual displays are crucial for the effective simulation of complex air-to-air and air-to-ground combat environments. Current dome and dodecahedron systems are far to costly and lack the combination of required capabilities. The Air Force Human Resources Laboratory (AFHRL) is currently developing a fiber optic helmet mounted display (FOHMD) system which has the potential for filling these demanding requirements. The breadboard FOHMD, built through a Canadian cost-sharing contract with CAE Electronics, displays a head-slaved high resolution area of interest surrounded by a low resolution background in color. The instantaneous field-of-view is comparable to the view available to a pilot when wearing an Air Force helmet. Four image generation channels and projectors are used to generate individual displays for each eye. The imagery is piped to the helmet via coherent fiber optic bundles. This system is a valuable research tool for studying many of the issues associated with helmet mounted displays such as image stability, resolution/brightness/field-of-view trade-offs, and visual perception/fatigue. GRA

N84-32383*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AIRCRAFT LIFTMETER Patent Application
E. W. MILLEN, inventor (to NASA) 8 Feb. 1984 15 p
(NASA-CASE-LAR-12518-1; NAS 1.71:LAR-12518-1; US-PATENT-APPL-SN-578388) Avail: NTIS HC A02/MF A01 CSCL 01D

A display for aiding the pilot of an aircraft in anomalous wind environments is described. Wind velocity components are measured by an instrument, processed by a computer and a vector generator and then displayed as a vector. The display utilizes the measurements of ground speed and of wind velocity in three mutually perpendicular directions. This display will also show changes in lift of an aircraft. B.W.

N84-32384*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AIR DATA POSITION-ERROR CALIBRATION USING STATE RECONSTRUCTION TECHNIQUES Final Report
S. A. WHITMORE, T. J. LARSON, and L. J. EHERNBERGER Sep. 1984 31 p refs
(NASA-TM-86029; H-1217; NAS 1.15:86029) Avail: NTIS HC A03/MF A01 CSCL 01D

During the highly maneuverable aircraft technology (HiMAT) flight test program recently completed at NASA Ames Research Center's Dryden Flight Research Facility, numerous problems were experienced in airspeed calibration. This necessitated the use of state reconstruction techniques to arrive at a position-error calibration. For the HiMAT aircraft, most of the calibration effort was expended on flights in which the air data pressure transducers were not performing accurately. Following discovery of this problem, the air data transducers of both aircraft were wrapped in heater blankets to correct the problem. Additional calibration flights were performed, and from the resulting data a satisfactory position-error calibration was obtained. This calibration and data obtained before installation of the heater blankets were used to develop an alternate calibration method. The alternate approach took advantage of high-quality inertial data that was readily available. A linearized Kalman filter (LKF) was used to reconstruct the aircraft's wind-relative trajectory; the trajectory was then used to separate transducer measurement errors from the aircraft position error. This calibration method is accurate and inexpensive. The LKF technique has an inherent advantage of requiring that no flight maneuvers be specially designed for airspeed calibrations. It is of particular use when the measurements of the wind-relative quantities are suspected to have transducer-related errors. Author

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.

A84-43450*# Massachusetts Inst. of Tech., Cambridge.
MULTIVARIABLE CONTROL FOR THE F-100 ENGINE USING THE LQG/LTR METHODOLOGY
M. ATHANS, P. KAPASOURIS, E. KAPPOS (MIT, Cambridge, MA), and H. A. SPANG, III (MIT, Cambridge, MA; GE Corporate Research and Development Center, Schenectady, NY) IN: Guidance and Control Conference, Seattle, WA, August 20-22, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 434-444. Research supported by the General Electric Co. refs
(Contract NGL-22-009-124)
(AIAA PAPER 84-1910)

The design of a multivariable feedback control system for the Pratt and Whitney F-100 turbofan jet engine is a challenging task for control engineers. This paper employs a linearized model of the F-100 engine to demonstrate the use of the newly developed Linear Quadratic Gaussian/Loop Transfer Recovery (LQG/LTR) design methodology, which adopts an integrated frequency-domain and time-domain approach to multivariable feedback control synthesis so as to meet stability-robustness, command-following, and disturbance-rejection specifications. Author

A84-43809
CIVIL TURBOFAN TECHNOLOGY TO THE YEAR 2000
D. PICKERELL (Rolls-Royce, Ltd., London, England) Aircraft Engineering (ISSN 0002-2667), vol. 56, July 1984, p. 2-11.

The state of the art in aircraft turbofan engines in service or expected by the end of the century is discussed with respect to design features that lower the specific fuel consumption (SFC). SFC optimization involves maximizing both the thermal and propulsive efficiencies of the engines. Techniques to attain closer approximations to optimization include higher pressure ratios, increased bypass ratios, and reduction of the turbine flow entry temperatures. The success with enhancing the required areas in the RB211-535E4, RB211-524, Tay and V2500 engines is examined. The next improvements are predicted to come from either a fourth generation turbofan or a propfan. The turbofan improvements will be extracted from higher component efficiencies, rather than from thermodynamic considerations. A 20 percent efficiency enhancement is still possible with the turbofan. M.S.K.

A84-43920
AN ANALYSIS OF THE FLANGED JOINTS OF THE STATOR OF AN AIRCRAFT GAS TURBINE ENGINE [RASCHET FLANTSEVYKH SOEDINENII STATORA AVIATSIONNOGO GTD]
V. B. ZHUKOV Problemy Prochnosti (ISSN 0556-171X), July 1984, p. 95-101. In Russian. refs

A stress-strain analysis is presented for the flanged joints of the stator structure of gas turbine engines. In accordance with the approach used, the flanges are treated as very short orthotropic cylindrical shells. The use of the theory of such shells has yielded a refined computational model for flanged joints of this type. V.L.

A84-43921
THE FRACTURE OF THE BINDING RINGS OF A REINFORCED CYLINDRICAL SHELL CYCLICALLY HEATED BY INTERNAL GAS FLOW [RAZRUSHENIE BANDAZHNYKH KOLETS PODKREPLENNOI TSILINDRICHESKOI OBOLOCHKI, TSIKLICHESKI NAGREVAEMOI VNUTRENNIM POTOKOM GAZA]
A. G. ZGUROVSKII, A. I. KASHCHUK, and I. I. MARINETS Problemy Prochnosti (ISSN 0556-171X), July 1984, p. 109-113. In Russian. refs

The performance of cyclically heated cylindrical shells is examined, with the exhaust pipes of the turboprop power plants of the AN-22 aircraft used as an example. It is shown that the performance of the shells is largely determined by the level of thermal stresses in the binding rings under transient heating conditions. Another important factor is the stressed state of the shell directly under the binding rings and in adjacent regions affected by the edge effect. V.L.

A84-44178*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DEVELOPMENT OF DYNAMIC SIMULATION OF TF34-GE-100 TURBOFAN ENGINE WITH POST-STALL CAPABILITY
S. M. KROSEL (NASA, Lewis Research Center, Cleveland, OH) AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 11 p. Previously announced in STAR as N84-25712. refs
(AIAA PAPER 84-1184)

This paper describes the development of a hybrid computer simulation of a TF34-GE-100 turbofan engine with post-stall capability. The simulation operates in real-time and will be used to test and evaluate stall recovery control modes for this engine.

The simulation calculations are performed by an analog computer with a peripheral multivariable function generation unit used for computing bivariate functions. Tabular listings of simulation variables are obtained by interfacing to a digital computer and using a custom software package for data collection and display.
Author

A84-44180*# Army Propulsion Lab., Cleveland, Ohio.
AN ANALYTICAL METHOD TO PREDICT EFFICIENCY OF AIRCRAFT GEARBOXES
N. E. ANDERSON (U.S. Army, Propulsion Laboratory, Cleveland, OH), S. H. LOEWENTHAL (NASA, Lewis Research Center, Cleveland, OH), and J. D. BLACK (General Motors Corp., Detroit Diesel Allison Div., Indianapolis, IN) AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 15 p. Previously announced in STAR as N84-25606. refs
(AIAA PAPER 84-1500)
A spur gear efficiency prediction method previously developed by the authors was extended to include power loss of planetary gearsets. A friction coefficient model was developed for MIL-L-7808 oil based on disc machine data. This combined with the recent capability of predicting losses in spur gears of nonstandard proportions allows the calculation of power loss for complete aircraft gearboxes that utilize spur gears. The method was applied to the T56/501 turboprop gearbox and compared with measured test data. Bearing losses were calculated with large scale computer programs. Breakdowns of the gearbox losses point out areas for possible improvement.
Author

A84-44181*# Purdue Univ., Lafayette, Ind.
APPLICATION OF AN OPTIMIZATION METHOD TO HIGH PERFORMANCE PROPELLER DESIGNS
K. C. LI (Purdue University, West Lafayette, IN) and G. L. STEFKO (NASA, Lewis Research Center, Cleveland, OH) AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 7 p. Previously announced in STAR as N84-25607. refs
(AIAA PAPER 84-1203)
The application of an optimization method to determine the propeller blade twist distribution which maximizes propeller efficiency is presented. The optimization employs a previously developed method which has been improved to include the effects of blade drag, camber and thickness. Before the optimization portion of the computer code is used, comparisons of calculated propeller efficiencies and power coefficients are made with experimental data for one NACA propeller at Mach numbers in the range of 0.24 to 0.50 and another NACA propeller at a Mach number of 0.71 to validate the propeller aerodynamic analysis portion of the computer code. Then comparisons of calculated propeller efficiencies for the optimized and the original propellers show the benefits of the optimization method in improving propeller performance. This method can be applied to the aerodynamic design of propellers having straight, swept, or nonplanar propeller blades.
Author

A84-44182*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AN ADVANCED PITCH CHANGE MECHANISM INCORPORATING A HYBRID TRACTION DRIVE
B. M. STEINETZ, S. H. LOEWENTHAL (NASA, Lewis Research Center, Cleveland, OH), D. F. SARGISSON (General Electric Co., Evendale, OH), and G. WHITE (Transmission Research, Inc., Cleveland, OH) AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 12 p. Previously announced in STAR as N84-25605. refs
(Contract NAS3-23044)
(AIAA PAPER 84-1383)
A design of a propeller pitch control mechanism is described that meets the demanding requirements of a high-power, advanced turboprop. In this application, blade twisting moment torque can be comparable to that of the main reduction gearbox output: precise pitch control, reliability and compactness are all at a premium. A key element in the design is a compact, high-ratio hybrid traction drive which offers low torque ripple and high torsional stiffness. The traction drive couples a high speed electric motor/alternator unit to a ball screw that actuates the blade control links. The technical merits of this arrangement and the performance characteristics of the traction drive are discussed.
Author

A84-44185*# General Electric Co., Lynn, Mass.
THE APPLICATION OF LQR SYNTHESIS TECHNIQUES TO THE TURBOSHAFT ENGINE CONTROL PROBLEM
W. H. PFEIL, G. DE LOS REYES (General Electric Co., Aircraft Engine Business Group, Lynn, MA), and G. A. BOBULA (U.S. Army, Propulsion Laboratory, Cleveland, OH) AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 8 p. refs
(Contract NAS3-22763)
(AIAA PAPER 84-1455)
A power turbine governor was designed for a recent-technology turboshaft engine coupled to a modern, articulated rotor system using Linear Quadratic Regulator (LQR) and Kalman Filter (KF) techniques. A linear, state-space model of the engine and rotor system was derived for six engine power settings from flight idle to maximum continuous. An integrator was appended to the fuel flow input to reduce the steady-state governor error to zero. Feedback gains were calculated for the system states at each power setting using the LQR technique. The main rotor tip speed state is not measurable, so a Kalman Filter of the rotor was used to estimate this state. The crossover of the system was increased to 10 rad/s compared to 2 rad/sec for a current governor. Initial computer simulations with a nonlinear engine model indicate a significant decrease in power turbine speed variation with the LQR governor compared to a conventional governor.
Author

A84-44186*# General Electric Co., Cincinnati, Ohio.
THE AERODYNAMIC DESIGN AND PERFORMANCE OF THE NASA/GE E3 LOW PRESSURE TURBINE
D. G. CHERRY (General Electric Co., Cincinnati, OH) and R. P. DENGLER (NASA, Lewis Research Center, Cleveland, OH) AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 8 p.
(AIAA PAPER 84-1162)
The aerodynamic design and scaled rig test results of the low pressure turbine (LPT) component for the NASA/General Electric Energy Efficient Engine (E3) are presented. The low pressure turbine is a highly loaded five-stage design featuring high outer wall slope, controlled vortex aerodynamics, low stage flow coefficient, and reduced clearances. An assessment of its performance has been made based on a series of scaled air turbine tests which were divided into two phases: Block I (March through August, 1979) and Block II (June through September, 1981). Results from the Block II five-stage test, summarized in the paper, indicate that the E3 LPT will attain an efficiency level of 91.5 percent at the Mach 0.8/35,000 ft. max. climb altitude design point. This is relative to program goals of 91.1 percent for the E3 demonstrator engine and 91.7 percent for a fully developed flight propulsion system LPT.
Author

A84-44456#
EFFECTS OF GUN GAS INGESTION ON ENGINE PERFORMANCE
R. E. HART (USAF, Flight Dynamics Div., Edwards AFB, CA) and S. HELFMAN (Fairchild Republic Co., Edwards AFB, CA) IN: Flight testing technology: A state-of-the-art review; Proceedings of the Thirteenth Annual Symposium, New York, NY, September 19-22, 1982 . Lancaster, CA, Society of Flight Test Engineers, 1982, p. 23-32.
The ingestion of gun gas from the baseline bare barrel gun configuration into the engines of the A-10A/TF34 has resulted in significant performance degradation as well as dynamic effects such as compressor stalls and flameouts. Two gun gas devices recently flight tested have significantly alleviated the ingestion problem. This paper discusses the capability of these devices to direct the gun gas away from the engine inlets. The methods of analytically determining the temperature of the ingested gun gas

and the resulting engine degradation, as well as illustrations of the effects of rounds fired on engine performance loss is discussed in the paper. Author

A84-44457#
DIRECT MEASUREMENT OF IN-FLIGHT THRUST FOR AIRCRAFT ENGINES
A. FOGG (Grumman Aerospace Corp., Calverton, NY) IN: Flight testing technology: A state-of-the-art review; Proceedings of the Thirteenth Annual Symposium, New York, NY, September 19-22, 1982 . Lancaster, CA, Society of Flight Test Engineers, 1982, p. 33-41. refs

A review of the accuracies attainable for in-flight engine thrust measurements is presented. The study was limited to turbojet/turbofan engines, with numerical analyses further constrained to the F-14A/TF30 engine. Attention was given to the ease of accessability of separately podded and internal engines. An analytical model was defined for relating engine mount loads to the net thrust for the internal engine. The only available instruments judged suitable for in situ thrust assessment were resistance-type strain gages, provided compensations are made for temperature changes. Transient responses could be accounted for by numerical analyses or accelerometer data. Test measurements, in comparison with the available data base on the F-14A/TF30, showed that direct measurement is at least as or more accurate than conventional thrust determination techniques. M.S.K.

A84-44458#
F101 DFE FLIGHT TEST EVALUATION IN THE F-14 AIRCRAFT
J. T. STRONG, JR. (Grumman Aerospace Corp., Calverton, NY) IN: Flight testing technology: A state-of-the-art review; Proceedings of the Thirteenth Annual Symposium, New York, NY, September 19-22, 1982 . Lancaster, CA, Society of Flight Test Engineers, 1982, p. 43-55.

Tests and results from flight evaluations of the GE F101 Derivative Fighter Engine (DFE) are reported. The trials were run to validate operational suitability, reliability/durability, maintainability, cost, performance and weight. The F101 DFE is a modified version of the B1 aircraft engine. All data were telemetered and stored on board during tests from sea level to 49,000 ft, minimum speed to Mach 2.0, angles of attack up to 55 deg and sideslip to 28 deg. Performance improvements were most noticeable for single engine climb and supersonic maneuvering. Afterburner lights were successful 97 percent of the time they were attempted. M.S.K.

A84-44459#
F101 DFE FLIGHT TEST EVALUATION IN THE F-16 AIRCRAFT
R. A. KNEZEK (General Dynamics Corp., Fort Worth, TX) IN: Flight testing technology: A state-of-the-art review; Proceedings of the Thirteenth Annual Symposium, New York, NY, September 19-22, 1982 . Lancaster, CA, Society of Flight Test Engineers, 1982, p. 57-66.

The flight demonstration of the General Electric F101 Derivative Fighter Engine in the F-16 aircraft is described in this paper. Flight test objectives included determination of: (1) engine/airframe operability and compatibility characteristics, (2) engine usage characteristics during simulated mission profiles, (3) installation effects, and (4) performance. All of the objectives of the flight test program were accomplished within the original program schedule with no indication of need for further significant engine development. The capability of full-envelope augmentor operation without engine stalls or throttle restrictions, the elimination of need for engine trim and performance that met predictions were demonstrated. Other engine characteristics and minor problems encountered in flight test are also described in the paper. Author

A84-44505#
THE INFLUENCE OF BLADE WAKES ON THE PERFORMANCE OF COMBUSTOR SHORTENED PREDIFFUSERS
S. J. STEVENS, S. P. HARASGAMA (Loughborough University of Technology, Loughborough, England), and P. WRAY (Rolls-Royce, Ltd., Derby, England) Journal of Aircraft (ISSN 0021-8669), vol. 21, Sept. 1984, p. 641-648. Research supported by Rolls-Royce, Ltd.; Ministry of Defence. Previously cited in issue 19, p. 3265, Accession no. A81-40856. refs
(Contract MOD-AT/2170/065/XR)

A84-44645*# Rensselaer Polytechnic Inst., Troy, N. Y.
STRUCTURAL DYNAMICS OF ROTATING BLADED-DISK ASSEMBLIES COUPLED WITH FLEXIBLE SHAFT MOTIONS
R. G. LOEWY (Rensselaer Polytechnic Institute, Troy, NY) and N. KHADER AIAA Journal (ISSN 0001-1452), vol. 22, Sept. 1984, p. 1319-1327. Previously cited in issue 14, p. 1976, Accession no. A83-32787. refs
(Contract NAG3-37)

A84-44943#
EFFECT OF ENGINE TECHNOLOGY ON ADVANCED FIGHTER DESIGN AND COST
O. HERRMANN and W. BIEHL (Messerschmitt-Boelkow-Blohm GmbH, Munich, West Germany) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 137-143. refs

The improvements possible in a new engine for a European air superiority fighter for the mid-1990s are discussed, together with the cost effectiveness of developing a new engine. Improvements must be made in performance, reliability, operational suitability, maintainability and cost. The design would need to deliver 40 percent higher thrust/weight and thrust/frontal area ratios, a 30 percent higher thrust/airflow ratio, a 10 percent higher airflow/frontal area ratio, improved specific fuel flow and 40 percent fewer parts. Consideration is given to air superiority and patrol missions, to installation on a production or a new small aircraft, and to projected life cycle costs (LCC) compared to those for existing high bypass ratio engines. It is found that the procurement of at least 450 aircraft would make a small new aircraft with the new engine reach a breakeven point by the 270th aircraft. M.S.K.

A84-44963#
THE STRUCTURAL MODELLING OF ROTATING BLADES
A. ROSEN and O. RAND (Technion - Israel Institute of Technology, Haifa, Israel) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 321-330. refs

A generalized nonlinear model for the structural behavior of rotating blades is presented. The blades are treated as slender rods and the Bernoulli-Euler hypothesis is employed to formulate the problem in a one-dimensional form. Attention is focused on describing the deformation at each point of a blade as a function of deformations of the elastic axis. Equilibrium equations are defined, along with boundary conditions at the six boundaries of a blade. The equilibrium equations are solved with the Galerkin method, which yields the forces and moments. The technique is applied to a blade clamped at the root and free at the end, and to a blade experiencing inertial and aerodynamic loading. Both curved and straight blades are considered, and acceptable results are obtained for both. M.S.K.

A84-44970#

MODERN TECHNOLOGY SECONDARY POWER SYSTEMS FOR NEXT GENERATION MILITARY AIRCRAFT

J. A. RHODEN (Garrett Turbine Engine Co., Phoenix, AZ) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 372-376.

The next generation of military aircraft will require significantly increased internal power capability, with high density packaging and integration of secondary power system elements. These aircraft will be self-sufficient for autonomous operation free of ground support equipment. This paper reviews the concepts and capabilities of modern technology secondary power systems and the application to meet the requirements for these aircraft. The secondary power system elements include the gas turbine auxiliary power unit, aircraft mounted accessory gearboxes, emergency power units, pumps, and pneumatic drives. Mechanical, pneumatic, electric and hybrid techniques to integrate the subsystem will be reviewed and evaluated. In addition, a technology assessment is presented for future gas turbine auxiliary power units. Author

A84-44981#

F404 NEW STANDARDS FOR FIGHTER AIRCRAFT ENGINES

B. A. RIEMER and S. F. POWEL, IV (General Electric Co., Lynn, MA) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 476-482.

Design features, performance capabilities and applications of the F404 jet engine are described. The F404 supplies 16-22 klb thrust, is 159 in. long and 35 in. in diameter and has a pressure ratio of 25:1. The engine includes wide chord, low aspect ratio fan blades, enhanced aerodynamics and a high stall margin. Early usage has revealed an unrestricted throttle movement throughout the performance envelope, a 3.25 sec interval from idle to full power, high inlet distortion tolerance, reliable air starts and dependable afterburner light. The digital controls are built into two ceramic modules which permit easy installation of redundancy. Testing has surpassed 500 hr in the F-20 and will be initiated in the F/A-18. Other potential applications are in the MAS39, the A-6, the ACX demonstrator and the X-29. M.S.K.

A84-44991#

REVIEW OF AIRCRAFT-ENGINE LINKS AS A CONSEQUENCE OF ENGINE DIGITAL CONTROL

D. RAMBACH (SocieteNationale d'Etude et Construction de Motoeurs d'Aviation, Paris, France) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 566-570.

The evolutions and problems inherent in digital flight control systems, which feature progressively larger computers, are discussed from a manufacturer's point of view. The computer architecture may be centralized or distributed, arrangements which impinge on the ease of software integration. It is cautioned that a distributed digital controller architecture does not guarantee that all software requirements can be specified in advance. Problems arise, and must be worked out, when the distributed digital accessories interact with other accessories. Control functions are devised by compromising among the performance criteria of various components of the entire system, as well as introducing variations for specific flight phases. The engine performance must be optimized while simultaneously reducing the pilot workload. A sample architecture is provided and used for decisions regarding the hierarchy of software criticality levels and techniques which will permit the presence of downgraded modes. M.S.K.

A84-44992#

COMPRESSOR RESPONSE TO PERIODIC TRANSIENTS

J. PAULON (ONERA, Chatillon-sous-Bagneux, Hauts-de-Seine, France) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 571-575. refs

A progress report is presented on ONERA research targeted at characterizing the response of a rotating axial cascade to periodic transients. Test results are provided for an open-circuit compressor with a rotor and stator exposed to flows through rotating disks having 16, 32 or triangular holes. Transducers gathered pressure distribution data upstream and downstream of the rotor. Trials were run at low flow velocities, different rotor speeds and variable inlet and outlet duct lengths and configurations. The results were used to define a theoretical model of the response of a compressor to a downstream pressure modulation, a transfer function for the compressor, a relationship between the velocity and the pressure perturbation terms at the inlet and transient force model. The pressure fluctuations were found to behave as small amplitude disturbances over the 100-1000 Hz range assayed. The validity of relaxation models for the transient body forces was proven, although further tests are required in order to analyze the memory term in the relaxation model. M.S.K.

A84-45006#

SINGLE ROTATION AND COUNTER ROTATION PROP-FAN PROPULSION SYSTEM TECHNOLOGIES

B. S. GATZEN (United Technologies Corp., Hamilton Standard Div., Windsor Locks, CT) and C. N. REYNOLDS (United Technologies Corp., Pratt and Whitney Group, East Hartford, CT) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 708-717. refs

The potential benefits and technologies necessary for development of counter-rotating (CR) propfan propulsion systems are evaluated, based on NASA studies initiated in 1982. The CR concept is interesting because of the potential for recapturing the swirl energy of the first propfan, thus improving the cruise efficiency by 8 percent. The propfans could be mounted either in tractor position in front of the wing, thus improving the wing low-speed aerodynamics, or in an aft pusher configuration, which would keep the aircraft streamlines clean but introduce structural acoustic problems. The pusher propfan may also require new materials to maintain structural integrity and compact, lightweight gearboxes to avoid weight penalties (should a gearbox be used). Electronic pitch control of the propfan blades, although mechanically validated, has yet to undergo EM interference trials. Trial flights with a propfan-powered aircraft are scheduled to commence in 1987 at the same time the CR concept is being investigated on models. M.S.K.

A84-45007#

DYNAMIC CONTROL ASPECTS OF DEVELOPMENT OF THREE SHAFT TURBOPROP ENGINE

B. RIHA (Ceske Vysoke Uceni Technicke, Prague, Czechoslovakia) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 718-723. refs

A numerical model of the dynamics of a three-shaft turboprop is compared with calculations for a two-shaft version. A matrix of the three-shaft linear dynamic coefficients is defined in order to obtain control laws. A continuous function is derived for the equilibrium modes of the high pressure compressor. The results indicate that all transfer functions will be one order higher than those of two-shaft systems. Finally, reverse calculations are investigated for time-optimal control laws. M.S.K.

A84-45036#
TURBOSHAFT ENGINE NOISE STUDY
A. GUEDEL (ONERA, Chatillon-sous-Bagneux, Hauts-de-Seine, France) and A. FARRANDO (Turbomeca, S.A., Bizanos, Pyrenees-Atlantiques, France) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 989-995. Research sponsored by the Service Technique des Programmes Aeronautiques. refs

Researches on the reduction of helicopter turboshaft engine noise are important since the engine noise contribution to the overall helicopter noise can become significant in certain flight conditions. Turbomeca Company has recently built a static teststand in order to characterize and to reduce the noise of gas turbine engines. The static test facility is made up of a half-circle concrete area of 30 meter radius. A ground-level microphone is used to get rid of ground reflection effects and to deduce free-field engine radiation. The experimental method to locate engine noise sources, especially core noise sources, is described. It is based on a three-signal coherence technique between the signals of two internal pressure probes and an external microphone.
Author

A84-45715
A FEASIBILITY STUDY OF OPEN-TYPE EJECTOR THRUST AUGMENTERS [ISSLEDOVANIE VOZMOZHNOSTEI SOZDANIIA EZHEKTORNYKH UVELICHITELEI TIAGI RAZOMKNUTYKH SKHEM]
IU. G. ZHULEV and S. I. INSHAKOV TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 14, no. 1, 1983, p. 113-115. In Russian. refs

The feasibility of ejector thrust augmenters in which the rigid walls of the ejector nozzle are partially replaced by the jet surface is demonstrated experimentally. For a thrust augmentation device with a rectangular ejector nozzle producing a plane 8 mm-thick jet, it is shown that the surface of the jet can replace one or even three walls of the nozzle. In the latter case, the thrust augmenter is reduced to a flat plate with a rounded edge. Experimental results are presented.
V.L.

A84-45823
AN ANALYSIS OF TRENDS IN THE DEVELOPMENT OF BLADE COOLING SYSTEMS FOR THE HIGH-TEMPERATURE TURBINES OF SOME FOREIGN-MADE GAS-TURBINE AIRCRAFT ENGINES [ANALIZ TENDENTSII RAZVITIIA SISTEM OKHLAZHDENIIA RABOCHIKH LOPATOK VYSOKOTEMPERATURNYKH TURBIN NEKOTORYKH INOSTRANNYKH AVIATSIONNYKH GTD]
V. P. LUKACHEV, V. P. DANILCHENKO, and V. E. REZNIK Promyshlennaia Teplotekhnika (ISSN 0204-3602), vol. 6, no. 4, 1984, p. 68-75. In Russian. refs

The principal features of the blade cooling systems of gas-turbine aircraft engines manufactured by Rolls Royce, Pratt Whitney, and General Electric are reviewed, and some general trends are discussed. In particular, attention is given to the use of developed convective cooling, protective film cooling, and the initial twisting of the cooling air. A comparative analysis of the efficiency of cooling systems used in specific gas-turbine aircraft engines is presented.
V.L.

A84-45957#
A COST MODELING APPROACH TO ENGINE OPTIMIZATION
D. G. CULY and R. C. GUNNESS (Garrett Turbine Engine Co., Phoenix, AZ) Journal of Aircraft (ISSN 0021-8669), vol. 21, Aug. 1984, p. 560-566. Previously cited in issue 18, p. 2933, Accession no. A82-37698.

A84-45958#
EXPERIMENTAL PERFORMANCE EVALUATION OF VENTILATED MIXERS - A NEW MIXER CONCEPT FOR HIGH-BYPASS TURBOFAN ENGINES
J. S. SOKHEY (Boeing Commercial Airplane Co., Seattle, WA) Journal of Aircraft (ISSN 0021-8669), vol. 21, Aug. 1984, p. 567-575. Previously cited in issue 18, p. 2849, Accession no. A82-37695. refs

A84-45961#
MAXIMUM LOADING CAPABILITY OF AXIAL FLOW COMPRESSORS
J. K. SCHWEITZER and J. E. GARBEROGLIO (United Technologies Corp., Pratt and Whitney Aircraft, West Palm Beach, FL) Journal of Aircraft (ISSN 0021-8669), vol. 21, Aug. 1984, p. 593-600. Previously cited in issue 16, p. 2306, Accession no. A83-36254. refs
(Contract F33615-76-C-2091)

A84-46015#
THE PREDICTION AND ANALYSIS OF THE RESPONSE OF A TURBOJET ENGINE TO THE BLAST WAVE
H. SHEN (Northwestern Polytechnical University, Xi'an, Shaanxi, People's Republic of China) (International Union of Theoretical and Applied Mechanics, International Congress of Theoretical and Applied Mechanics, 16th, Lyngby, Denmark, Aug. 19-25, 1984) Northwestern Polytechnical University, Journal, Aug. 1984, p. 17-31. refs

The effect of a blast wave with overpressure 50-100 g/sq cm on the performance of a single-spool turbojet engine is simulated numerically; the results are presented in graphs and compared with published experimental data. More severe impairment and/or damage is found to occur at higher engine rpms, for rear rather than front incidence, and for longer-duration blasts at a given overpressure. The accuracy of the simulation is shown to decrease with increasing overpressure due to more complex blast effects.
T.K.

A84-46106*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
VELOCITY AND TEMPERATURE CHARACTERISTICS OF TWO-STREAM, COPLANAR JET EXHUST PLUMES
U. VON GLAHN, J. GOODYKOONTZ, and C. WASSERBAUER (NASA, Lewis Research Center, Cleveland, OH) American Institute of Aeronautics and Astronautics, Applied Aerodynamics Conference, 2nd, Seattle, WA, Aug. 21-23, 1984. 38 p. Previously announced in STAR as N84-28790. refs
(AIAA PAPER 84-2205)

The subsonic jet exhaust velocity and temperature characteristics of model scale, two stream coplanar nozzles were obtained experimentally. The data obtained included the effects of fan to primary stream velocity and temperature ratios on the jet axial and radial flow characteristics. Empirical parameters were developed to correlate the measured data. The resultant equations were shown to be extensions of a previously published single stream jet velocity and temperature correlation.
Author

A84-46334#
T700 ENGINE - DESIGNED FOR THE PILOT AND MECHANIC
J. F. WANSONG (General Electric Co., Aircraft Engine Business Group, Lynn, MA) IN: American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 102-107.

The development of the T700 engine is traced from its inception through its first 250,000 hours of fielded operation from the perspective of reliability, maintainability, and human factors. The design requirements are discussed and the control system is described. The impact of the design considerations on the integrated logistics support of the engine is considered.
C.D.

A84-46354*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DEVELOPMENT OF LARGE ROTORCRAFT TRANSMISSIONS
N. E. SAMANICH (NASA, Lewis Research Center, Cleveland, OH), R. J. DRAGO, and J. C. MACK (Boeing Vertol Co., Philadelphia, PA) IN: American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 293-302. refs
(Contract NAS3-22143)
The U.S. Army Heavy Lift Helicopter (HLH) represents a large rotorcraft which was developed by an American aerospace company. In the early 1970's with the HLH Advanced Technology Components (ATC) program, the development of large rotorcraft transmission and drive systems was started. Failures in the spiral bevel gearing were experienced in tests because the employed method of analysis had not considered the effect of rim bending. Consequently, new gears with strengthened rims were designed and fabricated. For a more accurate prediction of the load capacity of the gears, an extensive Finite Element Method (FEM) system was developed. The U.S. Army's XCH-62 HLH aft rotor transmission was finally successfully tested at full design torque and speed. A description of the test program is provided, and the analytical program is discussed. The analytical phase includes the development of a preprocessing program which aids in the review of calculated FEM stresses. G.R.

A84-46356#
CONVERTIBLE ENGINES FOR FOLD TILT ROTOR AIRCRAFT AND ABC ROTORCRAFT
J. C. GILL and J. D. SAUER (General Motors Co., Detroit Diesel Allison Div., Indianapolis, IN) IN: American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 321-333.
Some results of a study identifying the design requirements of convertible engines for Fold Tilt Rotor (FTR) and Advancing Blade Concept (ABC) aircraft are presented. The FTR aircraft requires a convertible turbofan/turboshaft engine which can produce thrust at speeds of 0.75 Mach and shaft power to proprotors for vertical and low-speed flight. Because the fan is disengaged when operating in the turboshaft mode, the fan may be designed for use only in the turbofan mode to ensure maximum cruising efficiency. The ABC aircraft requires a conventional turboshaft engine which can provide power efficiently at an output rpm of 77 percent at a true air speed of 250 knots and 100 percent at takeoff. Particular attention is given to the design of a torque converter for converting from turboshaft to turbofan propulsion. A series of schematic drawings and graphs representing the distinctive design features of the aircraft and their respective advantages is provided. I.H.

A84-46357#
CONVERTIBLE FAN/SHAFT ENGINE DEMONSTRATION
G. JASAS (Teledyne-CAE Turbine Engines, Toledo, OH) and J. C. FOURNY (Turbomeca, S.A., Bordes, Pyrenees-Atlantique, France) IN: American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 334-341.
(Contract DAAK51-81-C-0043)
An employment of variable cycle engines makes it possible to improve air vehicle performance throughout the flight envelope. Changes from one cycle operating point to another can be achieved by using variable geometry engine components, such as inlet, low pressure compressor, high pressure compressor, combustor, turbines, and exhaust. The present investigation is concerned with a variable geometry fan compressor which, when coupled to a core and associated controls, provides a convertible fan/shaft engine. In the reported demonstration, the fan pitch angle is changed to continuously vary the engine airflow path and cycle from a thrust output mode to a shaft power output mode or vice versa. The investigation shows that variable pitch fan compressor blading can effectively be used to modulate horsepower and thrust output for a convertible engine. G.R.

A84-46358#
RELIABILITY AND MAINTAINABILITY ISSUES FOR FUTURE MILITARY HELICOPTER ENGINES
T. L. HOUSE (U.S. Army, Applied Technology Laboratory, Fort Eustis, VA) and J. M. WELLBORN (General Electric Co., Lynn, MA) IN: American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 342-349.
Reliability and maintainability (R&M) achievements in the second generation of military helicopter turboshaft engines are exceptional. It is clear, however, that this occurred primarily because of extensive R&M efforts during the technology demonstrator phase and was followed by a highly aggressive customer/developer R&M program during the development, production, and operational phases. Lessons learned from the first generation engines provided the primary basis for directing R&M efforts for the second generation. It is reasonable to expect even greater achievements in the third generation of engines if the customer and developer maintain a diligent attitude toward R&M and pay close attention to the lessons learned with the second generation. Author

A84-46411
COMBINED FILM-AND CONVECTION-COOLING IN A GAS TURBINE COMBUSTOR
B. SJOBLOM (Volvo Flygmotor AB, Trollhattan, Sweden) International Journal of Turbo and Jet-Engines, vol. 1, no. 2,, 1984, p. 97-107. Research supported by the Forsvaret Materielverk. refs
The potential use of film cooling air for simultaneous forced convection cooling in a gas turbine combustor has been investigated. Rig tests were conducted that validated a model developed for wall temperature calculations. This model was incorporated into a computer program for calculating the cooling air requirements of a gas turbine combustor, thus allowing for a comparison between the use of conventional film cooling and film/convection cooling in a simulated gas turbine combustor environment. The calculations showed that film/convection cooling offers about 50 percent cooling air reduction when applied to a typical aircraft gas turbine combustor. Author

A84-46412
COMBUSTOR PERFORMANCE WITH ALTERNATIVE FUELS
E. ZAHAVI and B. GAL-OR (Technion - Israel Institute of Technology, Haifa, Israel) International Journal of Turbo and Jet-Engines, vol. 1, no. 2, 1984, p. 109-122. refs
Fuel shortages, higher safety considerations, or unified fuel-supply requirements dictate the use of alternative fuels. This paper presents the results of cannular combustor performance with petroleum-based alternative fuels ranging from Jet A-1 to DF-2 fuels and their blends. Ignition and stability (blowout) performance at low combustor pressures are presented together with average liner temperatures. The effect of increasing the percentage of DF-2 in Jet A-1 fuel is to reduce the ignition and stability envelopes on the one hand, and to increase the average liner temperature up to a maximum of 100 C at 1500 K combustor exit temperature, on the other. The results of this study may be especially useful for high altitude, low Mach-number flights as well as for ground starting/blowouts. Author

A84-46415
THE SOVIET AIRCRAFT ENGINES. I
A. RASPUTNIS (Technion - Israel Institute of Technology, Haifa, Israel) International Journal of Turbo and Jet-Engines, vol. 1, no. 2, 1984, p. 157-179.
Development histories and tabular presentations of performance data on the derivatives and uses of each engine's design are given for the Soviet turbojet, turbofan, turboshaft, and turboprop engines that have equipped tactical and strategic military aircraft since the 1950s. Noteworthy powerplants are the R-11 and R-13 series turbojets of the MiG-21 fighters, the R-25 and -29 series turbojets of the MiG 23/27 fighters, the NK-12M turboprop, which drives four-blade contrarotating propellers and is the most powerful engine of its type in existence, and the NK-144 augmented turbofan

engine of the Tu-144 SST and Backfire-B bomber. It is noted that Soviet air-cooled turbines are less effective than their Western counterparts, operating at lower inlet temperatures and therefore lower efficiencies. O.C.

A84-46502
THERMAL ANALYSIS OF A HIGH-PRESSURE COMPRESSOR ROTOR OF AN AERO-ENGINE - VENTING AS A MEANS FOR LIFE IMPROVEMENT
D. K. HENNECKE (Motoren- und Turbinen-Union Muenchen GmbH, Munich, West Germany) Waerme- und Stoffuebertragung (ISSN 0042-9929), vol. 18, July 31, 1984, p. 227-230. refs

The design procedure in the case of aircraft engines has to ensure that the obtained engine meets requirements regarding safe life under minimum weight conditions. A detailed thermal analysis forms a part of a suitable design procedure. The present investigation provides a description of an appropriate thermal analysis procedure, taking into account the case of a high-pressure compressor of an aircraft engine. It is shown that considerable improvements can be achieved by enhancing the heat transfer at the hubs. By making use of advanced computational methods for the prediction of transient temperature fields, it is feasible to improve the design of aircraft engines very significantly. Attention is given to a finite element method for solving the unsteady two-dimensional heat conduction equation. G.R.

N84-31209 Pennsylvania State Univ., University Park.
BLADE ENDWALL FLOWS IN AN AXIAL FLOW COMPRESSOR STAGE Ph.D. Thesis
N. SITARAM 1983 229 p
Avail: Univ. Microfilms Order No. DA8409098

The existing literature on the complex endwall flows in axial flow turbomachines is reviewed critically. This review also indicates future directions for research on endwall flows in axial flow compressors. The secondary flow calculation presented in this thesis includes the effects of rotation and viscosity. The development of momentum integral equations for the endwall flow in a compressor includes blade boundary layer effects. The axial flow compressor facility of the Department of Aerospace Engineering at the Pennsylvania State University, which was used for experimental investigations of the endwall flows, is described. The overall performance and other preliminary experimental results are presented. Extensive radial flow surveys, carried out at design and at off design conditions, are presented and interpreted.
Dissert. Abstr.

N84-31211# Institute for Defense Analyses, Alexandria, Va.
T700 ENGINE CASE STUDY REPORT. IDA/OSD R AND M (INSTITUTE FOR DEFENSE ANALYSES/OFFICE OF THE SECRETARY OF DEFENSE RELIABILITY AND MAINTAINABILITY) STUDY Final Report, Jul. 1982 - Aug. 1983
P. F. GOREE Aug. 1983 362 p
(Contract MDA903-79-C-0018)
(AD-A143104; AD-E500670; IDA-D-22; IDA/HQ-83-25969) Avail: NTIS HC A16/MF A01 CSCL 13J

This document records the activities and presents the findings of the T700 Engine Case Study Report part of the IDA/OSD Reliability and Maintainability Study conducted during the period from July 1982 through August 1983. GRA

N84-31212# Motoren- und Turbinen-Union Muenchen G.m.b.H. (West Germany).
INCREASE OF EFFICIENCY IN COOLED HIGH TEMPERATURE TURBINES Final Report, Dec. 1982
H. J. DIETRICHS, H. W. HAPPEL, and K. HEINIG Bonn Bundesministerium fuer Forschung und Technologie May 1984 128 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-W-84-019; ISSN-0170-1339) Avail: NTIS HC A07/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 27

Experimental and theoretical studies were carried out in order to improve accuracy and cost effectiveness in the aerodynamic design of highly loaded high pressure turbines. Aerodynamic and heat transfer tests in cold air rigs and demonstration engines; inverse design of airfoils; a turbine noise calculation method; and basic studies for the development of an inviscid three-dimensional code are discussed. Author (ESA)

N84-32386 Department of the Air Force, Washington, D.C.
AXISYMMETRIC THRUST AUGMENTING EJECTOR WITH DISCRETE PRIMARY AIR SLOT NOZZLES Patent
S. G. REZNICK and M. E. FRANKE, inventors (to Air Force) 15 May 1984 5 p Supersedes AD-D009765
(AD-D011129; US-PATENT-4,448,354; US-PATENT-APPL-SN-401163; US-PATENT-CLASS-239-265.17)
Avail: US Patent & Trademark Office CSCL 21E

A circular thrust augmenting ejector has an annular wall which defines a central passageway and a convergent contoured inlet section, a constant area cylindrical mixing section and a divergent conical diffuser outlet section. The inlet, mixing and outlet sections merge one into the next in axisymmetric serial relationship. The ejector also has a plurality of discrete primary nozzles arrange about the periphery of the annular wall at the entrance to the inlet section thereof for injecting a primary flow of high velocity air into the inlet section and thereby entraining a secondary flow of ambient air into the central passageway of the ejector.
Author (GRA)

N84-32387*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Business Group.
JT15D SIMULATED FLIGHT DATA EVALUATION Final Report
R. G. HOLM Sep. 1984 217 p refs
(NASA-CR-172322; NAS 1.26:172322) Avail: NTIS HC A10/MF A01 CSCL 21E

The noise characteristics of the JT15D turbofan engine was analyzed with the objectives of: (1) assessing the state-of-art ability to simulate flight acoustic data using test results acquired in wind tunnel and outdoor (turbulence controlled) environments; and (2) predicting the farfield noise directivity of the blade passage frequency (BPF) tonal components using results from rotor blade mounted dynamic pressure instrumentation. Engine rotor tip speeds at subsonic, transonic, and supersonic conditions were evaluated. The ability to simulate flight results was generally within 2-3 dB for both outdoor and wind tunnel acoustic results. Some differences did occur in the broadband noise level and in the multiple-pure-tone harmonics at supersonic tip speeds. The prediction of blade passage frequency tone directivity from dynamic pressure measurements was accomplished for the three tip speed conditions. Predictions were made of the random and periodic components of the tone directivity. The technique for estimating the random tone component used hot wire data to establish a correlation between dynamic pressure and turbulence intensity. This prediction overestimated the tone level by typically 10 dB with the greatest overestimates occurring at supersonic conditions. B.W.

N84-32388*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ANALYTICAL AND EXPERIMENTAL INVESTIGATION OF STATOR ENDWALL COUNTOURING IN A SMALL AXIAL-FLOW TURBINE
J. E. HAAS and R. J. BOYLE Sep. 1984 23 p refs Prepared in cooperation with Army Research and Technology Labs., Cleveland
(NASA-TP-2309; E-2050; NAS 1.60:2309; AVSCOM-TR-84-C-5)
Avail: NTIS HC A02/MF A01 CSCL 21E

An experimental and analytical investigation was conducted to determine the effect of stator endwall contouring on turbine stage performance. In this investigation three stator configurations were evaluated using a common rotor. The three stator configurations were a cylindrical endwall design and two contoured endwall designs, one having a S-shaped outer wall profile and the other having a conical-shaped outer wall profile. Experimental data were obtained over a range of equivalent speeds, total pressure ratios, and rotor tip clearances for each stator-rotor combination. Detailed analytical loss assessments were conducted to aid in the

determination of the contouring effect on turbine performance.
Author

N84-32389*# Pratt and Whitney Aircraft Group, East Hartford, Conn. Commercial Products Div.
ENERGY EFFICIENT ENGINE COMPONENT DEVELOPMENT AND INTEGRATION PROGRAM Semiannual Status Report, 1 Apr. - 30 Sep. 1980
19 Dec. 1980 392 p
(Contract NAS3-20646)
(NASA-CR-173884; NAS 1.26:173884; SASR-5; PWA-5594-142)
Avail: NTIS HC A17/MF A01 CSCL 21E

The design of an energy efficient commercial turbofan engine is examined with emphasis on lower fuel consumption and operating costs. Propulsion system performance, emission standards, and noise reduction are also investigated. A detailed design analysis of the engine/aircraft configuration, engine components, and core engine is presented along with an evaluation of the technology and testing involved. M.A.C.

N84-32392# Department of the Air Force, Washington, D.C.
THRUST REVERSER/EXHAUST NOZZLE ASSEMBLY FOR A GAS TURBINE ENGINE Patent Application
E. B. THAYER, inventor (to Air Force) 16 May 1984 16 p
(AD-D011101; US-PATENT-APPL-SN-611041) Avail: NTIS HC A02/MF A01 CSCL 21E

An improved thrust reverser/exhaust nozzle assembly has a plurality of blocker devices located in the divergent section of the exhaust nozzle and plurality of deflector devices located in the convergent section of of the nozzle. The blocker and deflector devices are linked together such that they move simultaneously and maintain a substantially constant engine flowrate during transitions of the engine between forward and reverse thrust conditions. Author (GRA)

08

AIRCRAFT STABILITY AND CONTROL

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

A84-43414#
ROBUST MISSILE AUTOPILOT DESIGN USING GENERALIZED SINGULAR OPTIMAL CONTROL TECHNIQUE
C.-F. LIN and S.-P. LEE (Boeing Military Airplane Co., Seattle, WA) IN: Guidance and Control Conference, Seattle, WA, August 20-22, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 124-132. refs
(AIAA PAPER 84-1847)

An optimal, time-varying trajectory tracking system is designed on the basis of the generalized singular linear quadratic (GSLQ) control technique. An application of the GSLQ technique to a bank-to-turn missile's coordinated autopilot system is presented in which the time-varying tracking autopilot is formulated as an optimal linear tracking system problem consisting of an adaptive feedforward controller and a robust output feedback controller with robust feedback gains. The control loop frequency response of six flight conditions during the terminal phase of missile flight are presented to illustrate the robustness of an output feedback controller design achieved by means of GSLQ. O.C.

A84-43424*# Grumman Aerospace Corp., Bethpage, N.Y.
CONTROL OF FORWARD SWEPT WING CONFIGURATIONS DOMINATED BY FLIGHT-DYNAMIC/AEROELASTIC INTERACTIONS
M. RIMER, R. CHIPMAN, and B. MUNIZ (Grumman Aerospace Corp., Bethpage, NY) IN: Guidance and Control Conference, Seattle, WA, August 20-22, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 212-221. refs
(Contract NAS1-17102)
(AIAA PAPER 84-1866)

An active control system concept for an aeroelastic wind-tunnel model of a statically unstable FSW configuration with wing-mounted stores is developed to provide acceptable longitudinal flying qualities while maintaining adequate flutter speed margin. On FSW configurations, the inherent aeroelastic wing divergence tendency causes strong flight-dynamic/aeroelastic interactions that in certain cases can produce a dynamic instability known as body-freedom flutter (BFF). The carriage of wing-mounted stores is shown to severely aggravate this problem. The control system developed combines a canard-based SAS with an Active Divergence/Flutter Suppression (ADFS) system which relies on wing-mounted sensors and a trailing-edge device (flaperon). Synergism between these two systems is exploited to obtain the flying qualities and flutter speed objectives. Author

A84-43425*# Minnesota Univ., Minneapolis.
EIGENSPACE DESIGN OF AN ACTIVE FLUTTER SUPPRESSION SYSTEM
B. S. LIEBST, W. L. GARRARD (Minnesota, University, Minneapolis, MN), and W. M. ADAMS (NASA, Langley Research Center, Flight Dynamics and Control Div., Hampton, VA) IN: Guidance and Control Conference, Seattle, WA, August 20-22, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 222-232. refs
(Contract NAG1-217)
(AIAA PAPER 84-1867)

An active control system is designed for the suppression of wing flutter in a flight test vehicle. Eigenvalue placement is used to synthesize a full state controller which satisfies performance specifications on control surface activity and which exhibits excellent gain and phase margins. The use of limited state feedback is examined; however, it is found that a simple frequency response matching technique can be used to design a realizable compensator which reproduces the feedback properties of the full state controller. The performance of the control system using this compensator is evaluated at various flight conditions and found to be satisfactory. In addition eigenvector shaping is used to enhance the gust load alleviation capabilities of the flutter control system.
Author

A84-43426#
NEW SIMPLIFIED WAYS TO UNDERSTAND THE INTERACTION BETWEEN AIRCRAFT STRUCTURE AND ACTIVE CONTROL SYSTEMS
R. FREYMANN (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Institut fuer Aeroelastik, Goettingen, West Germany) IN: Guidance and Control Conference, Seattle, WA, August 20-22, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 233-245. refs
(AIAA PAPER 84-1868)

This paper deals with general problems encountered during the design of active control systems. Special emphasis is placed on the understanding of interaction effects between active control systems and aircraft structure. New methods developed for the design of active flutter suppression and stability augmentation systems are presented. The applicability of the developed methods is demonstrated by experimental results from wind tunnel tests performed on a dynamically scaled fighter aircraft model. Author

A84-43427#
DESIGN OF A FLUTTER MODE CONTROLLER USING POSITIVE REAL FEEDBACK
G. L. SLATER (Cincinnati, University, Cincinnati, OH) and M. TAKAHASHI IN: Guidance and Control Conference, Seattle, WA, August 20-22, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 246-253. USAF-supported research. refs
(AIAA PAPER 84-1869)

The use of positive real feedback for the design of a flutter mode control system is examined. Results indicate that this technique is a meaningful synthesis procedure for the design of low order controllers. The synthesis is achieved through the design of a positive real observer using a low order approximation to the governing system equations. Results obtained for a realistic aerolastic model show that flutter dynamic pressure can be increased over 50 percent. The effect of unmodeled phase shift caused by aerodynamic and actuation lags can be avoided in the positive real design by suitable choice of control bandwidth. This technique thus appears as a viable design technique for flutter and aeroelastic modal control. Author

A84-43442#
PILOT MODELING AND CONTROL AUGMENTATION FOR THE XV-15 IN IN-GROUND-EFFECT HOVER
R. S. EDMUNDS (Sperry Corp., Albuquerque, NM) and J. VANGAASBEEK (Bell Helicopter Textron, Fort Worth, TX) IN: Guidance and Control Conference, Seattle, WA, August 20-22, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 368-378. refs
(AIAA PAPER 84-1892)

This paper presents design and simulation results related to pilot modeling and control augmentation for the NASA-Army-Navy-Bell XV-15 tilt rotor aircraft during hover in ground effect. Pilot models are developed using a combination of optimal and classical control theory. These models, when combined with the aircraft, its stability and control augmentation system (SCAS), and a gust disturbance model, reproduce the flight test results observed during in-ground-effect (IGE) hover with good fidelity. Pilot work load is considered high with the present SCAS and there is a tendency toward pilot-induced oscillation (PIO). The control augmentation systems presented in this paper reduce pilot work load and the tendency toward PIO. Author

A84-43453*# Lockheed-Georgia Co., Marietta.
ALLOWABLE RESPONSE DELAY FOR LARGE AIRCRAFT
R. T. MEYER, S. A. TINGAS (Lockheed-Georgia Co., Marietta, GA), and W. D. GRANTHAM (NASA, Langley Research Center, Hampton, VA) IN: Guidance and Control Conference, Seattle, WA, August 20-22, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 473-479. refs
(AIAA PAPER 84-1917)

The degree of permissible time delay in an airliner flight control system is presently sought by means of a pilot-in-the-loop moving base flight simulator, assuming the characteristics of an advanced L-1011 aircraft variant. Test pilots and engineers from the U.S. Navy, the airliner manufacturer, and NASA Langley were used in a task which encompassed approach and landing after recovery from offsets in localizer and glide slope, during calm, turbulent, and cross-wind conditions. The data obtained in the course of 279 runs included statistics on pilot workload and performance as well as pilot opinion. Preliminary results indicate that requirements for a 0.1-sec maximum delay in aircraft response are excessively conservative for large aircraft, where an offset landing maneuver is the critical design task. Lateral axis delays appear to be more critical than longitudinal ones. O.C.

A84-43460#
CONTROL LAW SYNTHESIS FOR ACTIVE FLUTTER SUPPRESSION BASED ON THE MODAL COST ANALYSIS
H. OHTA (Nagoya University, Nagoya, Japan), P. N. NIKIFORUK, M. M. GUPTA (Saskatchewan, University, Saskatoon, Canada), and A. FUJIMORI IN: Guidance and Control Conference, Seattle, WA, August 20-22, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 535-543. Sponsorship: Natural Sciences and Engineering Research Council of Canada. refs
(Contract NSERC-A-5625; NSERC-A-1080)
(AIAA PAPER 84-1931)

Active flutter suppression (AFS) for a typical two-dimensional section in an incompressible flow is studied in this paper. Root loci with single feedback variable are first investigated to obtain physical insights into the system described by three aerodynamic modelings. It is shown that relative location of the three points, which represent section characteristics, plays an important role on the mechanism of aeroelastic instability. Positive and negative feedbacks of the bending displacement or torsion angle can be interpreted to have a virtual effect of reconfigurating such three points. The feedback gains for the AFS system are chosen next by a sequence of truncations from the optimal gains based on the Modal Cost Analysis (MCA). The modal truncation is examined for several weightings in the cost function. The sequence of truncation, associate cost increase, and closed loop poles are calculated for each truncation. Essential feedback modes and their associated gains for flutter suppression can be determined efficiently using the MCA. It is illustrated, however, that robustness of the controllers is of practical significance because free stream velocity can cause parameter changes. Author

A84-43464#
DESIGN OF DIRECT DIGITAL FLIGHT-MODE CONTROL SYSTEMS FOR HIGH-PERFORMANCE AIRCRAFT WITH FLIGHT PROPULSION CONTROL COUPLING
B. PORTER (Salford, University, Salford, England) and T. MANGANAS IN: Guidance and Control Conference, Seattle, WA, August 20-22, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 563-569. refs
(AIAA PAPER 84-1937)

The synthesis of discrete-time tracking systems incorporating Lur'e plants with multiple actuator non-linearities is illustrated by the design of fast-sampling digital controllers and associated inner-loop compensators for the automatic control of the longitudinal motions of a statically unstable high-performance aircraft with canard, lift flap, and engine actuator non-linearities. In particular, it is demonstrated by considering the vertical translation maneuver that such flight-mode maneuvers are readily achievable by this aircraft for large classes of non-linear actuator characteristics such as 'deadzone' provided only that the controller and associated transducer parameters are chosen so as to ensure that state-bounded absolutely stable tracking occurs. Author

A84-43465#
DESIGN OF A DECENTRALIZED FLIGHT CONTROL SYSTEM
C. P. LEE, R. H. TRAVASSOS (Systolic Systems, Inc., Campbell, CA), and K. A. FARRY (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) IN: Guidance and Control Conference, Seattle, WA, August 20-22, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 570-580. refs
(Contract F33615-82-C-3604)
(AIAA PAPER 84-1938)

A decentralized control algorithm has been used to design a regulator to maintain a fighter aircraft in a high-g level turn. The design algorithm (originally developed to handle computationally large control design problems off-line) allows the control computations to be distributed among several processors. This feature of the decentralized design approach makes real-time control gain synthesis feasible. The performance of the resulting controller is shown to be equivalent to that of a baseline controller designed using conventional multivariable control techniques. A stability analysis of the decentralized control system design indicates that its closed loop eigenvalues are stable and equal to the eigenvalues of the baseline control design. Author

A84-43468*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

THE DESIGN OF A MODEL-FOLLOWING CONTROL SYSTEM FOR HELICOPTERS

K. B. HILBERT (NASA, Ames Research Center, Moffett Field, CA) and G. BOUWER (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Institut fuer Flugmechanik, Brunswick, West Germany) IN: Guidance and Control Conference, Seattle, WA, August 20-22, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 601-617. refs
(AIAA PAPER 84-1941)

The design of an explicit model-following control system is described and the results of a ground-based simulation experiment investigating the performance and limitations of this control system for a hingeless-rotor and a teetering-rotor helicopter are 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 vertical velocity with the collective. A new model-following performance criterion was developed to optimize the control-law design and to evaluate the model-following performance. The results of the simulation indicate that the performance of the model-following control system is dependent on the dynamics of the explicit model and on the limitations of the actuating system. Increases in the bandwidth of the explicit model placed higher demands on the control system and resulted in degraded model-following performance. Significant improvements in model-following performance were achieved when a control-law switching feature, which was designed to account for position- or rate-limited actuators, was included in the control system. The excellent overall model-following performance obtained for these two radically different helicopters indicates the flexibility and versatility of this control technique. Author

A84-43482*# Calspan Corp., Buffalo, N. Y.

AN IN FLIGHT INVESTIGATION OF PITCH RATE FLIGHT CONTROL SYSTEMS AND APPLICATION OF FREQUENCY DOMAIN AND TIME DOMAIN PREDICTIVE CRITERIA

C. J. BERTHE, C. R. CHALK (Calspan Advanced Technology Center, Buffalo, NY), and S. SARRAFIAN (NASA, Flight Research Center, Edwards, CA) IN: Guidance and Control Conference, Seattle, WA, August 20-22, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 731-742. refs
(AIAA PAPER 84-1897)

The degree of attitude control provided by current integral-proportional pitch rate command-type control systems, while a prerequisite for flared landing, is insufficient for 'Level 1' performance. The pilot requires 'surrogate' feedback cues to precisely control flight path in the landing flare. Monotonic stick forces and pilot station vertical acceleration are important cues which can be provided by means of angle-of-attack and pitch rate feedback in order to achieve conventional short period and phugoid characteristics. Integral-proportional pitch rate flight control systems can be upgraded to Level 1 flared landing performance by means of lead/lag and washout prefilters in the command path. Strong pilot station vertical acceleration cues can provide Level 1 flared landing performance even in the absence of monotonic stick forces. O.C.

A84-43483#

OPTIMAL LOW ORDER FLIGHT CRITICAL PITCH AUGMENTATION CONTROL LAW FOR A TRANSPORT AIRPLANE

U.-L. LY (Boeing Commercial Airplane Co., Seattle, WA) IN: Guidance and Control Conference, Seattle, WA, August 20-22, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 743-757. refs
(AIAA PAPER 84-1911)

A flight-critical pitch augmentation control law for a relaxed static stability airplane has been developed using methods which combine the LQC design procedure with a direct parameter opitmization for robust low-order controllers. The latter approach permits designers to include nonlinear equality and inequality constraints in the iterative design process. The resulting optimal controller possesses the same structure as a classical control law. Design performance has been evaluated and compared among different controller designs: a classical design via single-loop closure method, a reduced LQG design and a direct optimal low-order controller. Author

A84-43485#

IMPROVEMENT OF THE 767 LATERAL AUTOPILOT USING OPTIMAL CONTROL DESIGN TECHNIQUES

K. R. BRUCE and D. GANGSAAS (Boeing Commercial Airplane Co., Seattle, WA) IN: Guidance and Control Conference, Seattle, WA, August 20-22, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 761-768.
(AIAA PAPER 84-1956)

During early passenger service of the Boeing 767, passengers and crew would occasionally report ride discomfort. The condition occurred during high altitude cruise with the autopilot and yaw damper engaged. It was known that at certain cruise conditions the dutch roll mode was marginally stable in the unusual configuration of autopilot engaged and yaw damper disengaged. It was reasoned that rudder hysteresis or dead zone was contributing to the problem. One way to improve the ride is to improve the dutch roll damping for operations with the autopilot-on and yaw damper-off situation. This is accomplished by computing new feedback gains using modern control design techniques. An optimal full-state feedback system is developed which stabilizes dutch roll mode at all cruise flight conditions. A practical suboptimal autopilot design is developed from the full-state design. The system has been successfully test flown and is now being used on 767 production aircraft. Author

A84-43486*# Air Force Academy, Colo.

DESIGN OF A DIGITAL RIDE QUALITY AUGMENTATION SYSTEM FOR A COMMUTER AIRCRAFT

T. A. HAMMOND (U.S. Air Force Academy, Colorado Springs, CO), D. R. DOWNING, S. P. AMIN, and J. PADUANO (Kansas, University, Lawrence, KS) IN: Guidance and Control Conference, Seattle, WA, August 20-22, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 769-774. refs
(Contract NAG1-345)
(AIAA PAPER 84-1958)

Commuter aircraft with low wing loading that operate at low altitudes are particularly susceptible to unwanted accelerations caused by atmospheric gusts. This paper describes the design and analysis of a longitudinal digital Ride Quality Augmentation System (RQAS). The RQAS designs were conducted for a Cessna 402B aircraft using the flaps and the elevator as the control surfaces. The designs are generated using linear quadratic Gaussian theory and analyzed in both the time and frequency domains. Nominal designs are presented at five flight conditions that cover a total mission. Trade-off studies are conducted to investigate the effect of sample time, computational delay time, servo bandwidth and control power. Author

A84-43488*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

AN EVALUATION AND FORCE GRADIENT DETERMINATION OF MECHANICALLY LINKED REVERSIBLE SIDESTICK CONTROLLERS FOR GENERAL AVIATION AIRCRAFT

H. P. BERGERON (NASA, Langley Research Center, Flight Control Systems Div., Hampton, VA) American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Seattle, WA, Aug. 20-22, 1984. 10 p. refs

(AIAA PAPER 84-1916)

In connection with the increase in air traffic, IFR (Instrument Flight Rules) flight in the air traffic control system has become very demanding. It has, therefore, become imperative to optimize the pilot's skills in his management of the various aircraft systems. The present investigation is concerned with the human factors aspects of the use of sidesticks in direct mechanical linkage (reversible) control systems in a production General Aviation (G.A.) aircraft. A total of 140 fifteen to twenty minute flight tasks were flown on the NASA Langley G.A. motion base simulator. The study involved a comparison of three locations of the sidestick, left side, center, and right side, and the standard yoke. It was found that the sidestick is preferable to the standard yoke. However, some of the design and installation features of the sidestick are critical for pilot acceptance. G.R.

A84-44464*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.

AUTOMATED FLIGHT TEST MANEUVERS - THE DEVELOPMENT OF A NEW TECHNIQUE

E. L. DUKE (NASA, Flight Research Center, Edwards, CA) IN: Flight testing technology: A state-of-the-art review; Proceedings of the Thirteenth Annual Symposium, New York, NY, September 19-22, 1982 . Lancaster, CA, Society of Flight Test Engineers, 1982, p. 101-119. refs

A new flight test technique using a maneuver autopilot is being applied at the Dryden Flight Research Facility of the NASA Ames Research Center. The flight test maneuver autopilot (FTMAP) is designed to provide precise, repeatable control of an aircraft during certain prescribed maneuvers so that a large quantity of high quality test data can be obtained with a minimum of flight time. This paper discusses the control algorithms, the flight test application, and the preliminary flight demonstration results of the FTMAP. Author

A84-44466#

ENGINEERING ASPECTS OF THE F/A-18A HIGH AOA/SPIN PROGRAM

W. G. MCNAMARA (U.S. Navy, Naval Air Test Center, Patuxent River, MD) IN: Flight testing technology: A state-of-the-art review; Proceedings of the Thirteenth Annual Symposium, New York, NY, September 19-22, 1982 . Lancaster, CA, Society of Flight Test Engineers, 1982, p. 131-142.

Engineering aspects of the F/A-18A high angle of attack (AOA)/spin program are discussed. Emphasis is placed on the impacts on the digital flight control system (DFCS), aerodynamic modifications, model/simulator predictions, test methodologies and data analysis techniques. Modifications were introduced in the leading edge flaps and scheduling, trailing edge scheduling, aileron sizing, nose strakes and leading edge extension slots. A manual spin recovery mode option was added to the controls. The AOA/spin program had provided data for upgrading the spin resistance/recovery and the AOA failure monitoring codes. Simulator and wind tunnel drop tests performed prior to flight tests had indicated that the control laws were deficient in low yaw rate spin, a decisive factor in a later crash during the flight tests. A real time spin graphics display capability is under development for analyses of test maneuvers. M.S.K.

A84-44471*# Calspan Advanced Technology Center, Buffalo, N.Y.

AN IN-FLIGHT INVESTIGATION OF PILOT-INDUCED OSCILLATION SUPPRESSION FILTERS DURING THE FIGHTER APPROACH AND LANDING TASK

R. E. BAILEY, R. E. SMITH (Calspan Advanced Technology Center, Buffalo, NY), and M. F. SHAFER (NASA, Flight Research Center, Edwards, CA) IN: Flight testing technology: A state-of-the-art review; Proceedings of the Thirteenth Annual Symposium, New York, NY, September 19-22, 1982 . Lancaster, CA, Society of Flight Test Engineers, 1982, p. 185-191. Previously announced in STAR as N83-13110. refs

(Contract F33615-79-C-3618)

An investigation of pilot-induced oscillation suppression (PIOS) filters was performed using the USAF/Flight Dynamics Laboratory variable stability NT-33 aircraft, modified and operated by Calspan. This program examined the effects of PIOS filtering on the longitudinal flying qualities of fighter aircraft during the visual approach and landing task. Forty evaluations were flown to test the effects of different PIOS filters. Although detailed analyses were not undertaken, the results indicate that PIOS filtering can improve the flying qualities of an otherwise unacceptable aircraft configuration (Level 3 flying qualities). However, the ability of the filters to suppress pilot-induced oscillations appears to be dependent upon the aircraft configuration characteristics. Further, the data show that the filters can adversely affect landing flying qualities if improperly designed. The data provide an excellent foundation from which detail analyses can be performed. Author

A84-44515#

RECENT DEVELOPMENTS IN THE F-16 FLUTTER SUPPRESSION WITH ACTIVE CONTROL PROGRAM

R. P. PELOUBET, JR., R. L. HALLER, and R. M. BOLDING (General Dynamics, Corp., Fort Worth, TX) Journal of Aircraft (ISSN 0021-8669), vol. 21, Sept. 1984, p. 716-721. refs

(Contract F33615-80-C-3210)

(AIAA PAPER 83-0995)

A series of wind tunnel tests of the F-16 flutter model employing active control to suppress flutter was conducted during October 1981. These tests complemented the initial series of tests conducted in February 1979. Questions associated with the validity of the measured open-loop frequency response function (FRF) as a true indicator of the model's unaugmented stability with the flutter suppression system (FSS) engaged were resolved by temporarily disengaging the system. The accuracy of the measured open-loop FRF as a function of excitation level, frequency resolution, and number of ensemble averages was investigated. FSS gain and phase margins were measured directly. Tests were conducted for a simulated actuator failure. Flutter suppression was demonstrated for two external store configurations. One configuration exhibited symmetric flutter and the other exhibited antisymmetric flutter. Author

A84-44713

AIRCRAFT STABILITY AND CONTROL. PART 1 [STABILNOST I UPRAVLJIVOST LETELICA. PART 1]

M. NENADOVIC (Beograd, Univerzitet, Belgrade, Yugoslavia) Belgrade, Univerzitet u Beogradu, 1981, 770 p. In Serbo-Croatian. refs

The theory of aircraft stability and control is examined, with attention given to the derivation of systems of differential equations describing the motion of aircraft and to various methods used in solving these equations. Particular topics discussed include aerodynamic characteristics of wings and control surfaces, dimensions of the control surfaces of aircraft, and stability criteria for linear and nonlinear dynamic systems. The discussion also covers the stability and control of rockets, inverse stability problems, and the response of aircraft to atmospheric turbulence. V.L.

A84-44714

AIRCRAFT STABILITY AND CONTROL. PART 3 - MATHEMATICAL ANALYSIS IN APPLIED AIRCRAFT STABILITY [STABILNOST I UPRAVLJIVOST LETELICA. PART 3 - MATEMATICKA ANALIZA U PRIMENAMA STABILNOSTI LETELICA]

M. NENADOVIC (Beograd, Univerzitet, Belgrade, Yugoslavia) Belgrade, Univerzitet u Beogradu, 1981, 247 p. In Serbo-Croatian. refs

Elements of vector analysis and differential geometry used in deriving equations of motion for a rigid body are examined. Attention is then given to mathematical operators, Fourier and Laplace transforms, and formal procedures for solving systems of equations. Characteristic functions used in the analysis of dynamic systems are examined, and methods are presented for solving systems of differential equations in dynamic stability. The discussion also covers algebraic operations on block diagrams and the use of analog and digital computers in stability analysis. V.L.

A84-44929#

FLIGHT CONTROL SYSTEM ON MODERN CIVIL AIRCRAFT

B. ZIEGLER (Airbus Industrie, Blagnac, Haute-Garonne, France) and M. DURANDEAU (SocieteNationale Industrielle Aerospatiale, Toulouse, France) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 7-15.

In order to achieve maximum benefits from modern technology, an Electrical Flight Control System is proposed. Advantages are discussed for several areas such as safety, where stall, overspeed, or overstress are eliminated. In the area of training, the possibility of offering similar handling characteristics for any aircraft is expected to reduce training costs by approximately 30 percent. In maintenance, there would be four times less line replaceable units and easier troubleshooting, while a reduction in line maintenance adjustment procedures would lead to cost reductions of up to 40 percent. In efficiency, through the proper use of relaxed stability potential, a 600-kg weight saving has been computed, with an expected fuel saving of about 5 percent. Electrical flying control tests performed on the A300 aircraft, and the Electrical Flight Control System architecture of the A320 aircraft are described. J.P.

A84-44948#

PARAMETERS ESTIMATION OF A NONSTATIONARY AERODYNAMICS MODEL FOR LONGITUDINAL MOTION OF AEROPLANE FROM FLIGHT MEASUREMENTS

V. KOCKA (Vyzkumny a Zkusebni Letecky Ustav, Prague, Czechoslovakia) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 185-195. Translation. refs

A technique for estimating parameters for an analytical model of unsteady aerodynamics is reported. Consideration is given to longitudinally unsteady motions of an aircraft at constant flight speed experiencing a pulse deflection of the elevator while in level flight. It is shown that aerodynamic frequency transfers from the whole rigid aircraft for attitude changes in the angle of attack are equal to the sum of path changes of the angle of attack and transfers for time rates of the attitude angle. An expression is defined for deviations of the moment equation of motion as a function of frequency. Finally, a loss function is used to avoid problems associated with a priori estimation of the covariance matrix of the motion equation deviations by instead obtaining a sum of the squares of deviations expressed as real and imaginary components. M.S.K.

A84-44952#

BIFURCATION ANALYSIS OF CRITICAL AIRCRAFT FLIGHT REGIMES

G. I. ZAGAINOV and M. G. GOMAN (Tsentral'nyi Aero-Gidrodinamicheskii Institut, Moscow, USSR) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 217-223. refs

An analysis of quasi-equilibrium motions and their stability is used to model aircraft critical flight regimes. The technique employs a qualitative theory of nonlinear dynamic systems, differential geometry, bifurcation analysis, catastrophe theory and efficient numerical formulations for equilibrium steady and oscillatory motions, their stability and control bifurcations. The numerical procedures of the continuation method are modified to include convergence and crossing of complex bifurcations. A control algorithm is developed for control recovery in critical flight conditions. The Poincare point mapping method is combined with the modified continuation model and applied to analyzing the periodic solution stability of aircraft equations of motion in spin conditions. Finally, the appearance of an invariant toroidal manifold of phase trajectories in association with complex aperiodic aircraft oscillations in spin is demonstrated. M.S.K.

A84-44954*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

ACTIVE CONTROL - A LOOK AT ANALYTICAL METHODS AND ASSOCIATED TOOLS

J. R. NEWSOM, W. M. ADAMS, JR., V. MUKHOPADHYAY, S. H. TIFFANY, and I. ABEL (NASA, Langley Research Center, Hampton, VA) IN: International Council of the Aeronautical Sciences, Contress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 230-242. refs

A review of analytical methods and associated tools for active controls analysis and design problems is presented. Approaches employed to develop mathematical models suitable for control system analysis and/or design are discussed. Significant efforts have been expended to develop tools to generate the models from the standpoint of control system designers' needs and to develop the tools necessary to analyze and design active control systems. Representative examples of these tools are discussed. Examples where results from the methods and tools have been compared with experimental data are also presented. Finally, a perspective on future trends in analysis and design methods is presented. Author

A84-44977#

PREVENTION OF FORWARD SWEPT WING AEROELASTIC INSTABILITIES WITH ACTIVE CONTROLS

T. E. NOLL (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH), F. E. EASTEP (Dayton, University, Dayton, OH), and R. A. CALICO (USAF, Institute of Technology, Wright-Patterson AFB, OH) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 439-448. refs

The potential application of active feedback control systems for avoiding instabilities in the flight of forward-swept wing aircraft is explored in terms of an aeroelastic analysis. Attention is focused on two unstable modes: divergence and high frequency bending/torsion flutter modes of the wing, and a rigid body pitch/wing bending instability and flutter with the wing free in pitch or free in pitch and plunge. The study was performed to define linear control techniques for raising the instability onset 20 percent over the wing bending/torsion flutter speed. Adapting aeroelastic control is shown to be an acceptable way of preventing aeroelastic instabilities by incorporating the flutter and divergence control systems into the digital flight control system. The technique would potentially permit aircraft operation near maximum speed. Further wind tunnel studies are recommended in order to identify other, currently unknown aeroelastic instabilities. M.S.K.

A84-44978#
LANDING APPROACH HANDLING QUALITIES OF TRANSPORT AIRCRAFT WITH RELAXED STATIC STABILITY
K. WILHELM and D. SCHAFRANEK (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Institut fuer Flugmechanik, Brunswick, West Germany) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 449-458. refs

An in-flight simulator was used to examine the effects on flying qualities produced by moving the center of gravity (CG) aftward in an aircraft with relaxed static stability (RSS) and pitch damping and pitch control effectiveness in a static instability (SI) mode. A major concern raised by increased performance through allowance of RSS and SI in the flight envelope by introduction of automated controls is the flying quality remaining if the computer goes down. The trials were run for a commercial aircraft configuration, with pitch damping values selected as half and double the reference values. All trials involved a landing approach, with attention given to the dynamic behavior of the aircraft. Pilot effort and accuracy was found to increase with the demands of the situation, although flying qualities became unacceptable when the pitch damping increased and the SI remained unchanged. The significance of turbulence grew with the difficulty of the manual control tasks. M.S.K.

A84-44979#
DESIGN PROCEDURE OF AN ACTIVE LOAD ALLEVIATION SYSTEM (LAS)
H. G. GIESSELER and G. BEUCK (Messerschmitt-Boelkow-Blohm GmbH, Hamburg, West Germany) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 459-464.

The results of theoretical design work and wind tunnel studies of LAS for reducing wing structural loads due to longitudinal maneuvers and vertical gusts are reported. The design studies covered the geometry, aerodynamics, stiffness, mass, operational limits for a given mission and the necessary control laws. Sensor placements were characterized for actuator initiation for LAS operations. The load alleviation functions were identified and comprised reduction of low frequency loads and maneuver loads. A pointwise frequency response function was devised to model the unsteady aerodynamics. Results are provided for incorporation of the system into a modern aircraft during a simulation. M.S.K.

A84-44990#
DESIGN ON DIGITAL FLIGHT-MODE CONTROL SYSTEMS FOR HELICOPTERS WITH NON-LINEAR ACTUATORS
B. PORTER (Salford, University, Salford, Lancs., England) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 557-565. refs

The design of a fast sampling digital controller and associated transducers for automated control of longitudinal motions of a CH-47 helicopter with gang- and differential-collective nonlinearities is summarized. Noninteractive control of the vertical velocity and pitch attitude is proven feasible for a broad range of nonlinear actuator characteristics. The noninteractive control is attainable provided the controller and transducer parameters that are selected ensure that state-bounded stable-tracking occurs in regions such as 'dead' zones. The error-actuated controllers thus provide robustness for digital flight control systems by means of accommodating severe multiple nonlinearities by appropriate 'tuning' of the responses within the design envelope. M.S.K.

A84-45002#
COMPUTER AIDED FLIGHT TESTING OF A DIGITAL AUTOPILOT ON BOARD A RESEARCH AIRCRAFT
A. REDEKER (Braunschweig, Technische Universitaet, Brunswick, West Germany) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 669-677. Research supported by the Deutsche Forschungsgemeinschaft. refs

In-flight integration of the various elements of an experimental digital autopilot for the longitudinal motion of the Do 28 aircraft is presently based on the formulation of a strategy for the iterative optimization of flight controller forward loops and feedbacks. After this optimization process, a cross-coupled autopilot was dimensioned which is found to perform satisfactorily with respect to the on-line calculated quality criterion. Different software tools have been used for troubleshooting and observing the experimental autopilot. O.C.

A84-45046#
A NEW APPROACH TO MISSION MANAGEMENT FOR COMBAT AIRCRAFT
PH. DIRINGER and J. THEBAUD (Societe Francaise d'Equipements pour la Navigation Aerienne, Velizy-Villacoublay, Yvelines, France) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 1069-1074.

Techniques for maximizing modern fighter aircraft performance and minimizing the pilot workload are discussed. Maximizing performance depends on an optimized mission trajectory and fuel management scheme, provision of flight parameter values for pilot decision aids when carrying out interception or specific target missions and the trajectory requires reconfiguring. The information conveyance needs to be automated for optimizing the decision-making process. The trajectories entered should be flown in the most efficient, automated mode possible. A performance optimization system (POS) and associated algorithms have been devised for the Mirage 2000. The POS is based on energy management and is fed waypoints, navigation, estimated flight duration and estimated fuel consumption parameters. The results obtained during simulated attack and intercept missions are described. M.S.K.

A84-45049#
ROBUST BACK-UP STABILIZATION FOR ARTIFICIAL-STABILITY AIRCRAFT
G. GRUEBEL, D. JOOS, D. KAESBAUER (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Institut fuer Dynamik der Flugsysteme, Oberpfaffenhofen, West Germany), and R. HILLGREN (Saab-Scania AB, Linkoping, Sweden) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 1085-1095. refs

An aircraft whose centre of gravity is behind the aerodynamic centre has to be provided with 'artificial stability' by an automatic control system. The performance benefits of such an aircraft are obtained at the expense of a severe safety problem in case of control system failure. Hence extreme reliability requirements have to be met for the automatic stabilization unit. For the new Swedish JAS 39 multi-role combat aircraft this problem has been approached by designing a simplest possible analog stabilization back-up unit. Without gain-scheduling and by using pitch rate feedback only, this back-up unit provides remarkably good flying qualities over the entire flight envelope. To achieve this result a complex 'robust control' design problem has to be solved. The paper deals with the design and performance evaluation of this stabilization unit. *Author*

A84-45526

LONGITUDINAL MOTION OF AIRCRAFT IN WIND SHEARS [BEITRAEGE ZUR LAENGSBEWEGUNG VON FLUGZEUGEN IN WINDSCHERUNGEN]

P. KRAUSPE Braunschweig, Technische Universitaet, Fakultaet fuer Maschinenbau und Elektrotechnik, Dr.-Ing. Dissertation, 1983, 233 p. In German. refs

The effect of downburst-type wind shears on the longitudinal dynamic behavior of an unguided aircraft is simulated numerically on the basis of published meteorological data and the flight characteristics of an A300-B passenger jet. The nonlinear differential equations of the aircraft motion are linearized by conventional methods, and the wind effects are introduced via the linear derivatives of the wind components referred to the wind gradients to obtain simplified technical models of the longitudinal response to all possible types of constant-gradient wind shears during the first 20-60 sec. Graphs, maps, and diagrams are provided, and a number of accidents presumed to have involved wind shears are analyzed in detail. T.K.

A84-45578#

SUPPRESSION OF BIODYNAMIC DISTURBANCES AND PILOT-INDUCED OSCILLATIONS BY ADAPTIVE FILTERING

A. GRUNWALD, S. MERHAV (Technion - Israel Institute of Technology, Haifa, Israel), and M. VELGER Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 7, July-Aug. 1984, p. 401-409. Research supported by the Technion - Israel Institute of Technology. refs

A method for reducing the effects of biodynamic interferences due to whole-body vibrations is described. Manual control tasks are particularly addressed. The method, based on adaptive filtering, enables a substantial attenuation of additive stick involuntary control commands due to pilot body vibrations (stick feedthrough). By means of computer simulations the feasibility of the proposed filtering method is demonstrated for two examples: (1) adaptive filtering of biodynamic interferences due to stick feedthrough in manual vehicular control, (2) suppression of pilot-induced oscillations (PIO) due to stick feedthrough. This form of PIO is particularly anticipated for flexible aircraft having a high-gain, stiff stick. It is demonstrated that adaptive filtering is capable of suppressing the biodynamic interferences without substantially affecting the control characteristics of the aircraft/pilot system. Author

A84-45579#

PREDICTION AND OCCURRENCE OF PILOT-INDUCED OSCILLATIONS IN A FLIGHT TEST AIRCRAFT

T. R. TWISDALE and P. W. KIRSTEN (USAF, Flight Test Center, Edwards AFB, CA) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 7, July-Aug. 1984, p. 410-415. refs

Flight testing of a high-performance aircraft was conducted several years ago and again during the past two years. During the first flight tests, a pilot-induced oscillation was experienced in the pitch axis during the time between the landing flare and touchdown. During the more recent flight tests two pilot-induced oscillations were experienced in the pitch axis during up-and-away flight. One of these occurred while the pilot attempted to track a cockpit display. Math models of the aircraft were used with three handling qualities criteria to determine the predicted handling qualities of the aircraft. These predictions were compared with flight test results. The handling qualities criteria used were the equivalent systems, bandwidth, and R. Smith criteria. The handling qualities predicted by each of these criteria agreed well with flight test results. The R. Smith criteria were especially interesting because they predicted the likelihood of pilot-induced oscillation explicitly and correctly and also predicted the frequency of each pilot-induced oscillation correctly. The predictions and flight test results also highlighted the impact that pilot displays can have on handling qualities. Author

A84-45580#* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

EFFECTS OF TIME DELAYS ON SYSTEMS SUBJECT TO MANUAL CONTROL

R. A. HESS (NASA, Ames Research Center, Aircraft Guidance and Navigation Branch, Moffett Field, CA) (Guidance and Control Conference, San Diego, CA, August 9-11, 1982, Collection of Technical Papers, p. 165-172) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 7, July-Aug. 1984, p. 416-421. Previously cited in issue 19, p. 2981, Accession no. A82-38943. refs

A84-45596#

MODIFICATION OF PITCHING STABILITY BY AN ATMOSPHERIC WAVE

G. CHIMONAS (Georgia Institute of Technology, Atlanta, GA) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 7, July-Aug. 1984, p. 507-509. refs

High frequency oscillation modification upon an aircraft's encounter with a coherent wave disturbance is most noticeable when the frequency, as experienced in the aircraft, is twice the frequency of the free pitching mode. The atmospheric waves in question are internal gravity waves of the gravity shear or Kelvin-Helmholtz variety. It is likely that the more extreme cases of wave activity will be avoided, since they coincide with several clear air turbulence. O.C.

A84-45611#

DYNAMICS OF AN AIRCRAFT IN WIND SHEAR OF ARBITRARY DIRECTION

V. BOCHIS (Institutul National pentru Creatie Stiintifica si Tehnica, Bucharest, Rumania) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 7, Sept.-Oct. 1984, p. 615-619. refs

The paper investigates dynamic characteristics of an aircraft in wind shear of an arbitrary direction. The steady-state solution allowing for the wind shear is defined and the linearized system about this solution is investigated. Wind shear accounts for coupling the longitudinal and the lateral-directional motions and for an additional mode as well. The thrust required for the steady-state motion, the characteristics of the modes, and the state variables they affect are decisively influenced by the wind shear intensity and direction and the vertical velocity of the aircraft. The new mode is either an aperiodic divergent one corresponding to the consideration of a specific azimuth angle as an additional state variable, or an oscillatory mode obtained by the coupling of the former with the spiral mode. Author

A84-45612#* Drexel Univ., Philadelphia, Pa.

A VARIABLE STRUCTURE APPROACH TO ROBUST CONTROL OF VTOL AIRCRAFT

A. J. CALISE (Drexel University, Philadelphia, PA) and F. S. KRAMER Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 7, Sept.-Oct. 1984, p. 620-626. refs (Contract N00019-81-C-0178; NAG2-8)

This paper examines the application of variable structure control theory to the design of a flight control system for the AV-8A Harrier in a hover mode. The objective in variable structure design is to confine the state trajectories to a subspace of the total state space. The motion in this subspace is insensitive to system parameter variations and external disturbances that lie in the range space of the control. A switching type of control law results from the design procedure. The control system was designed to track a vector-valued velocity command. For comparison, a proportional controller was designed using optimal linear regulator theory. Both controllers were evaluated for their transient response performance using a linear model; then a nonlinear simulation study of a hovering approach to landing was conducted. The variable structure controller outperformed its linear counterpart in the presence of wind disturbances and plant parameter uncertainties afforded by the simulation. Author

A84-45900
COMPUTER ASSISTED ANALYSIS OF AIRCRAFT: PERFORMANCE STABILITY AND CONTROL
F. O. SMETANA (North Carolina State University, Raleigh, NC) New York, McGraw-Hill Book Co., 1984, 646 p. refs

A text for undergraduate engineering students on the aerodynamics of aircraft stability, performance, and control is presented which incorporates the advances made in the last 10 years in the development of computer-assisted analysis of engineering problems. The text is presented as a detailed user's manual to accompany a package of FORTRAN computer programs which perform aircraft performance, stability, and control determinations on the basis of information concerning aircraft geometry, inertial characteristics, and power plant characteristics. Treatment is restricted to aircraft with moderate-to-high aspect ratio wings at subsonic speeds. Several charts, graphs and diagrams of computer assisted solutions to the problems are provided, as well as the important FORTRAN computational subroutines. I.H.

A84-45966*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
APPLICATION OF TRANSONIC CODES TO AEROELASTIC MODELING OF AIRFOILS INCLUDING ACTIVE CONTROLS
J. T. BATINA (NASA, Langley Research Center, Unsteady Aerodynamics Branch, Hampton, VA; Purdue University, West Lafayette, IN) and T. Y. YANG (Purdue University, West Lafayette, IN) Journal of Aircraft (ISSN 0021-8669), vol. 21, Aug. 1984, p. 623-630. refs

A study is performed using aeroelastic modeling to investigate the stability behavior of airfoils in small-disturbance transonic flow. Two conventional airfoils, NACA 64.A006 and NACA 64A010, and a supercritical airfoil, MBB A-3, are considered. Three sets of unsteady aerodynamic data are computed using three different transonic codes (LTRAN2-NLR, LTRAN2-HI, and USTS) for comparison purposes. Stability results obtained using a constant matrix, state-space, aeroelastic model are presented in a root-locus format. Use of the state-space model is demonstrated through application to flutter suppression using active controls. Aeroelastic effects due to simple, constant gain, partial feedback, control laws that utilize displacement, velocity, and acceleration sensing are studied using a variety of control gains. Calculations are also performed using linear subsonic aerodynamic theory to reveal the differences between including and not including transonic effects in the aeroelastic model. Aeroelastic stability behavior of these airfoils is physically interpreted and discussed in detail. Author

A84-45967#
DIVERGENCE/FLUTTER SUPPRESSION SYSTEM FOR A FORWARD SWEPT-WING CONFIGURATION WITH WING-MOUNTED STORES
M. RIMER, R. CHIPMAN, and R. MERCADANTE (Grumman Aerospace Corp., Bethpage, NY) Journal of Aircraft (ISSN 0021-8669), vol. 21, Aug. 1984, p. 631-638. Previously cited in issue 19, p. 2806, Accession no. A83-41949. refs

A84-46368#
MODELLING THE EFFECTS OF BLADE TORSIONAL FLEXIBILITY IN HELICOPTER STABILITY AND CONTROL
H. C. CURTISS, JR. (Princeton University, Princeton, NJ) IN: American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 472-482. Navy-supported research. refs

Various aspects of the coupled flap-torsion motion of an articulated rotor blade are discussed. The rotor blade is assumed to be rigid in the flap-wise direction, with torsional flexibility concetrated at the root of the blade. This analytical model was developed to model the response of a servoflap-controlled rotor. The servoflap rotor is torsionally soft and as a result is very sensitive to aerodynamic modeling assumptions. The influence of modeling assumptions on the flutter boundaries of a rotor blade in hover and the effects of torsional flexibility on flapping behavior of conventional rotors are discussed. It is shown that prediction of the flap-torsion dynamics of torsionally soft rotors is very sensitive to a number of small parameters. The formulation of the aerodynamic forces and moments presented here indicates that torsionally soft rotors have very low levels of damping even for the case of an aerodynamically and inertially balanced rotor blade. Author

A84-46376*# Massachusetts Inst. of Tech., Cambridge.
HELICOPTER INDIVIDUAL-BLADE-CONTROL AND ITS APPLICATIONS
N. D. HAM (MIT, Cambridge, MA) IN: American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 613-623. NASA-supported research. refs

A new, advanced type of active control for helicopters and its applications are described. The system, based on previously developed M.I.T. Individual-Blade-Control hardware, employs blade-mounted accelerometers to sense blade motion and feeds back information to control blade pitch in such a manner as to reduce the response of selected blade modes. A linear model of the blade and control system dynamics is used to give guidance in the design process as well as to aid in analysis of experimental results. System performance in wind tunnel tests is described, and evidence is given of the system's ability to provide substantial reduction in blade modal responses, including blade bending vibration. Author

A84-46524* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ROTORCRAFT FLIGHT-PROPULSION CONTROL INTEGRATION
J. R. MIHALOEW (NASA, Lewis Research Center, Cleveland, OH) and R. T. N. CHEN (NASA, Ames Research Center, Moffett Field, CA) Vertiflite (ISSN 0042-4455), vol. 30, Sept.-Oct. 1984, p. 45-47.

The parallel development of digital engine and flight controls for U.S. Army helicopters has made possible the future derivation of a fully integrated digital flight/propulsion control system. A NASA/Army research program has been undertaken to exploit these possibilities, ultimately yielding a generation of helicopters with exceptional agility and maneuverability in military roles and low pilot workloads in all-weather civil aviation missions. The program's three phases respectively address system modeling and analysis, flight hardware and software development, and flight evaluations aboard a research vehicle. O.C.

N84-31129# General Dynamics Corp., Fort Worth, Tex. Fort Worth Div.
APPLICATION OF JOVIAL (J-73) TO DIGITAL FLIGHT CONTROLS
J. H. ROBB, P. J. BOATMAN, and P. H. LANG *In* ASD Proc. Papers of the 2nd AFSC Avionics Standardization Conf., Vol. 1 p 93-100 Nov. 1982
(AD-P003525) Avail: NTIS HC A25/MF A01 CSCL 09B

This paper presents a brief outline of the history of the General Dynamics/Fort Worth Division Production Digital Flight Controls Program. Two flight demonstration programs will be discussed: the single channel digital F-16 and the four channel digital F-16. These were the first flights ever of a microprocessor-based digital fly-by-wire system in a relaxed static stability aircraft. Both demo programs use a pseudo Higher Order Language (HOL) tailored for flight control system applications. This paper describes the techniques used in applying the JOVIAL J-73 HOL to Digital Flight Control System Operational Flight Program (OFP) mechanization. Results are presented from testing the OFP on flight hardware. Included in this paper are JOVIAL J-73 language issues such as subroutine implementation and their associated efficiencies, the test set, and testing methods. Author (GRA)

N84-31214*# Purdue Univ., Lafayette, Ind. School of Aeronautics and Astronautics.
INTERACTIVE AIRCRAFT FLIGHT CONTROL AND AEROELASTIC STABILIZATION Semiannual Report, 1 Nov. 1983 - 30 Apr. 1984
T. A. WEISSHAAR and D. K. SCHMIDT May 1984 13 p
(Contract NAG1-157)
(NASA-CR-173866; NAS 1.26:173866) Avail: NTIS HC A02/MF A01 CSCL 01C

The potential benefits and costs of optimizing both the structural stiffness and the active control of aircraft in a rational manner are investigated. The ultimate goal is to arrive at a unified treatment of structural and active control design for the stability augmentation of flexible aircraft. An exhaustive literature evaluation in the area of passive tailoring for aircraft performance is undertaken. A mathematical technique to be used for aeroservoelastic tailoring studies is described. Two analytical models, one elementary, the other sophisticated, are developed to illustrate the potential for aeroservoelastic tailoring. Both models have essential features of real world hardware, yet the physical understanding is not buried in a myriad of detail. These models are also described. M.A.C.

N84-31215*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
FUEL CONSERVATIVE GUIDANCE CONCEPT FOR SHIPBOARD LANDING OF POWERED-LIFT AIRCRAFT
D. N. WARNER, JR., L. A. MCGHEE (Analytical Mechanics Associates, Inc.), J. D. MCLEAN (Analytical Mechanics Associates, Inc.), and G. K. SCHMIDT Jun. 1984 79 p refs
(NASA-TM-85971; A-9783; NAS 1.15:85971) Avail: NTIS HC A05/MF A01 CSCL 01C

A simulation study was undertaken to investigate the application of energy conservative guidance (ECG) software, developed at NASA Ames Research Center, to improve the time and fuel efficiency of powered lift airplanes operating from aircraft carriers at sea. When a flightpath is indicated by a set of initial conditions for the aircraft and a set of positional waypoints with associated airspeeds, the ECG software synthesizes the necessary guidance commands to optimize fuel and time along the specified path. A major feature of the ECG system is the ability to synthesize a trajectory that will allow the aircraft to capture the specified path at any waypoint with the desired heading and airspeed from an arbitrary set of initial conditions. Five paths were identified and studied. These paths demonstrate the ECG system's ability to save flight time and fuel by more efficiently managing the aircraft's capabilities. Results of this simulation study show that when restrictions on the approach flightpath imposed for manual operation are removed completely, fuel consumption during the approach was reduced by as much as 49% (610 lb fuel) and the time required to fly the flightpath was reduced by as much as 41% (5 min). Savings due to ECG were produced by: (1) shortening the total flight time; (2) keeping the airspeed high as long as possible to minimize time spent flying in a regime in which more engine thrust is required for lift to aid the aerodynamic lift; (3) minimizing time spent flying at constant altitude at slow airspeeds; and (4) synthesizing a path from any location for a direct approach to landing without entering a holding pattern or other fixed approach path. E.R.

N84-31216*# California Univ., Los Angeles. Dept. of Mechanics and Structures.
AEROELASTIC EFFECTS IN MULTI-ROTOR VEHICLES WITH APPLICATION TO A HYBRID HEAVY LIFT SYSTEM. PART 1: FORMULATION OF EQUATIONS OF MOTION Final Report
C. VENKATESAN and P. FRIEDMAN Washington NASA Aug. 1984 145 p refs
(Contract NAG2-116)
(NASA-CR-3822; NAS 1.26:3822) Avail: NTIS HC A07/MF A01 CSCL 01C

This report presents a set of governing coupled differential equations for a model of a hybrid aircraft. The model consists of multiple rotor systems connected by an elastic interconnecting structure, with options to add any combination of or all of the following components; i.e., thrusters, a buoyant hull, and an underslung weight. The dynamic equations are written for the individual blade with hub motions, for the rigid body motions of the whole model, and also for the flexible modes of the interconnecting structure. One of the purposes of this study is to serve as the basis of a numerical study aimed at determining the aeroelastic stability and structural response characteristics of a Hybrid Heavy Lift Airship (HHLA). It is also expected that the formulation may be applicable to analyzing stability and responses of dual rotor helicopters such as a Heavy Lift Helicopter (HLH). Futhermore, the model is capable of representing coupled rotor/body aeromechanical problems of single rotor helicopters. Author

N84-31217*# Information and Control Systems, Inc., Hampton, Va.
INVESTIGATION AND APPRECIATION OF OPTIMAL OUTPUT FEEDBACK. VOLUME 1: A CONVERGENT ALGORITHM FOR THE STOCHASTIC INFINITE-TIME DISCRETE OPTIMAL OUTPUT FEEDBACK PROBLEM Final Report
N. HALYO and J. R. BROUSSARD Washington NASA Aug. 1984 56 p refs
(Contract NAS1-15759)
(NASA-CR-3828; NAS 1.26:3828; FR-683101-VOL-1) Avail: NTIS HC A04/MF A01 CSCL 01C

The stochastic, infinite time, discrete output feedback problem for time invariant linear systems is examined. Two sets of sufficient conditions for the existence of a stable, globally optimal solution are presented. An expression for the total change in the cost function due to a change in the feedback gain is obtained. This expression is used to show that a sequence of gains can be obtained by an algorithm, so that the corresponding cost sequence is monotonically decreasing and the corresponding sequence of the cost gradient converges to zero. The algorithm is guaranteed to obtain a critical point of the cost function. The computational steps necessary to implement the algorithm on a computer are presented. The results are applied to a digital outer loop flight control problem. The numerical results for this 13th order problem indicate a rate of convergence considerably faster than two other algorithms used for comparison. M.A.C.

N84-31218*# Information and Control Systems, Inc., Hampton, Va.
INVESTIGATION, DEVELOPMENT AND APPLICATION OF OPTIMAL OUTPUT FEEDBACK THEORY. VOLUME 2: DEVELOPMENT OF AN OPTIMAL, LIMITED STATE FEEDBACK OUTER-LOOP DIGITAL FLIGHT CONTROL SYSTEM FOR 3-D TERMINAL AREA OPERATION Final Report
J. R. BROUSSARD and N. HALYO Washington NASA Aug. 1984 136 p refs
(Contract NAS1-15759)
(NASA-CR-3829; NAS 1.26:3829; FR-683111-VOL-2) Avail: NTIS HC A07/MF A01 CSCL 01C

This report contains the development of a digital outer-loop three dimensional radio navigation (3-D RNAV) flight control system for a small commercial jet transport. The outer-loop control system is designed using optimal stochastic limited state feedback techniques. Options investigated using the optimal limited state feedback approach include integrated versus hierarchical control loop designs, 20 samples per second versus 5 samples per second outer-loop operation and alternative Type 1 integration command errors. Command generator tracking techniques used in the digital control design enable the jet transport to automatically track arbitrary curved flight paths generated by waypoints. The performance of the design is demonstrated using detailed nonlinear aircraft simulations in the terminal area, frequency domain multi-input sigma plots, frequency domain single-input Bode plots and closed-loop poles. The response of the system to a severe wind shear during a landing approach is also presented. Author

N84-31219*# Search Technology, Inc., Palo Alto, Calif.
RELIABILITY ANALYSIS OF AN ULTRA-RELIABLE FAULT TOLERANT CONTROL SYSTEM
R. E. CURRY, W. E. VANDERVELDE, and P. R. FREY Jul. 1984 55 p refs
(NASA-CR-166594; NAS 1.26:166594; REPT-8404-1) Avail: NTIS HC A04/MF A01 CSCL 01C

This report analyzes the reliability of NASA's Ultra-reliable Fault Tolerant Control System (UFTCS) architecture as it is currently envisioned for helicopter control. The analysis is extended to air transport and spacecraft control using the same computational and voter modules applied within the UFTCS architecture. The system reliability is calculated for several points in the helicopter, air transport, and space flight missions when there are initially 4, 5, and 6 operating channels. Sensitivity analyses are used to explore the effects of sensor failure rates and different system configurations at the 10 hour point of the helicopter mission. These analyses show that the primary limitation to system reliability is the number of flux windings on each flux summer (4 are assumed for the baseline case). Tables of system reliability at the 10 hour point are provided to allow designers to choose a configuration to meet specified reliability goals. Author

N84-32393*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A FLIGHT-TEST AND SIMULATION EVALUATION OF THE LONGITUDINAL FINAL APPROACH AND LANDING PERFORMANCE OF AN AUTOMATIC SYSTEM FOR A LIGHT WING LOADING STOL AIRCRAFT EQUIPPED WITH WING SPOILERS
S. C. BROWN, G. H. HARDY, and W. S. HINDSON Sep. 1984 46 p refs
(NASA-TM-85873; A-9222; NAS 1.15:85873) Avail: NTIS HC A03/MF A01 CSCL 01C

As part of a comprehensive flight-test investigation of short takeoff and landing (STOL) operating systems for the terminal systems for the terminal area, an automatic landing system has been developed and evaluated for a light wing-loading turboprop-powered aircraft. An advanced digital avionics system performed display, navigation, guidance, and control functions for the test aircraft. Control signals were generated in order to command powered actuators for all conventional controls and for a set of symmetrically driven wing spoilers. This report describes effects of the spoiler control on longitudinal autoland (automatic landing) performance. Flight-test results, with and without spoiler control, are presented and compared with available (basically, conventional takeoff and landing) performance criteria. These comparisons are augmented by results from a comprehensive simulation of the controlled aircraft that included representations of the microwave landing system navigation errors that were encountered in flight as well as expected variations in atmospheric turbulence and wind shear. Flight-test results show that the addition of spoiler control improves the touchdown performance of the automatic landing system. Spoilers improve longitudinal touchdown and landing pitch-attitude performance, particularly in tailwind conditions. Furthermore, simulation results indicate that performance would probably be satisfactory for a wider range of atmospheric disturbances than those encountered in flight. Flight results also indicate that the addition of spoiler control during the final approach does not result in any measurable change in glidepath track performance, and results in a very small deterioration in airspeed tracking. This difference contrasts with simulations results, which indicate some improvement in glidepath tracking and no appreciable change in airspeed tracking. The modeling problem in the simulation that contributed to this discrepancy with flight was not resolved. Author

N84-32394*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
MINIMUM-FUEL, 3-DIMENSIONAL FLIGHTPATH GUIDANCE OF TRANSFER JETS
F. NEUMAN and E. KREINDLER (Technion Israel Inst. of Tech., Haifa) Sep. 1984 90 p refs
(NASA-TP-2326; A-9533; NAS 1.60:2326) Avail: NTIS HC A05/MF A01 CSCL 01C

Minimum fuel, three dimensional flightpaths for commercial jet aircraft are discussed. The theoretical development is divided into two sections. In both sections, the necessary conditions of optimal control, including singular arcs and state constraints, are used. One section treats the initial and final portions (below 10,000 ft) of long optimal flightpaths. Here all possible paths can be derived by generating fields of extremals. Another section treats the complete intermediate length, three dimensional terminal area flightpaths. Here only representative sample flightpaths can be computed. Sufficient detail is provided to give the student of optimal control a complex example of a useful application of optimal control theory. R.J.F.

N84-32395*# Lockheed-California Co., Burbank.
DEVELOPMENT AND FLIGHT EVALUATION OF AN AUGMENTED STABILITY ACTIVE CONTROLS CONCEPT WITH A SMALL TAIL
9 Oct. 1980 96 p
(Contract NAS1-15326)
(NASA-CR-173880; NAS 1.26:173880; LR-29619) Avail: NTIS HC A05/MF A01 CSCL 01C

Parasite drag reduction evaluation is composed of wind tunnel tests with a standard L-1011 tail and two reduced area tail configurations. Trim drag reduction is evaluated by rebalancing the airplane for relaxed static stability. This is accomplished by pumping water to tanks in the forward and aft of the airplane to acheive desired center of gravity location. Also, the L-1011 is modified to incorporate term and advanced augmented systems. By using advanced wings and aircraft relaxed static stability significant fuel savings can be realized. An airplane's dynamic stability becomes more sensitive for decreased tail size, relaxed static stability, and advanced wing configurations. Active control pitch augmentation will be used to acheive the required handling qualities. Flight tests will be performed to evaluate the pitch augmentation systems. The effect of elevator downrig on stabilizer/elevator hinge moments will be measured. For control system analysis, the normal acceleration feedback and pitch rate feedback are analyzed. S.B.

N84-32396# Vought Corp., Dallas, Tex.
LOW TEMPERATURE EVALUATION OF ADVANCED TECHNOLOGY HYDRAULIC SYSTEM (8,000 PSI) Final Report, Sep. 1982 - Apr. 1983
R. B. OLSEN Warminster, Pa. Naval Air Development Center Aug. 1983 37 p
(Contract N62269-82-C-0362)
(AD-A143389; NADC-82132-60) Avail: NTIS HC A03/MF A01 CSCL 01C

Tests were conducted at temperatures from - 40 F to + 120 F on two simulated aircraft flight control hydraulic circuits. One of the circuits used an A-7 aileron flight control actuator designed for 3000 psi operating pressure with 3/8 and 1/4 inch diameter tubing. The other circuit used an actuator designed for 8000 psi operation with 1/4 and 3/16 inch diameter tubing. Both actuators were designed for the same frequency response, rate and thrust requirements. MIL-H-83282 fluid was used for all tests. Frequency response and zero load rate tests at varying temperatures on the two circuits established the minimum temperatures at which performance requirements were met. Time versus temperature data from A-7D Category II Tests was used in heat transfer calculations to provide a comparison of warm up times for aircraft systems using 3000 or 8000 psi. Results of all tests and analysis indicate that there is no essential difference in warm up time for systems operating at 3000 or 8000 psi. GRA

09

RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tube facilities; and engine test blocks.

A84-42900*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

CRYOGENIC WIND TUNNELS FOR HIGH REYNOLDS NUMBER TESTING

R. A. KILGORE (NASA, Langley Research Center, Hampton, VA) University of Tennessee, Short Course on Aerospace Test Facilities and Flight Testing, University of Tennessee, Tullahoma, TN, May 8, 1984, Paper. 65 p.

The evolution and early development of cryogenic wind tunnels is reviewed, and consideration is given to current and future research in cryogenic wind tunnel testing. Emphasis is placed on the problem of low Reynolds numbers in current cryogenic wind tunnel tests as well as flow instability, wall interference and support interference which can inhibit a reliable simulation of complex three-dimensional flows. The operating characteristics of several of the worlds low-speed and high-speed cryogenic wind tunnel testing facilities are presented in the form of several graphs and photographs. I.H.

A84-43318#

A STUDY OF BLOCKAGE ERRORS

S. LIU and Z. HUANG Northwestern Polytechnical University, Journal, vol. 1, Oct. 1983, p. 191-199. In Chinese, with abstract in English.

It is shown that placing of probes in the flow passageways of turbojets, gas turbines, and their components during tests to measure aerodynamic parameters causes blockage of the passageways, distortion of the flow fields, and changes in operating conditions. A systematic theoretical analysis of the resulting blockage errors and relevant experimental results are presented. Geometric and aerodynamic blockage are considered. The different characteristics of blockage errors corresponding to different positions of the probe are examined. Experimental curves showing the variation of blockage errors with blockage ratios are given for the compressor, turbine, and exhaust nozzle of a turbojet engine. Some practical methods for reducing blockage errors are presented. C.D.

A84-43622

TERMINAL 1 OPENED AT LAX

Airport Forum (ISSN 0002-2802), vol. 13, June 1984, p. 20-22, 25, 26.

The capabilities of the new Terminal 1 at Los Angeles International Airport are outlined. Designed to handle 6,000,000 passengers per year, the facility was constructed without disrupting airport functions. The terminal will have a 2500 stall contiguous parking structure and a 500 ft main concourse with aircraft gates on both sides. Attempts were made to remove all interior obstructions to movement. M.S.K.

A84-43623

MOUNTAINS CUT DOWN, LAND CREATED TO BUILD NEW ST. THOMAS RUNWAY

A. C. SCHWARTZ Airport Forum (ISSN 0002-2802), vol. 13, June 1984, p. 26-28, 30.

The construction efforts, upgraded capabilities, and main uses of the new St. Thomas International Airport are described. The project took 5 yr and involved removing two mountaintops, as well as building 60.75 ha of new land. The airport has a new 2133 m runway, a 305 m overrun, a two-storey terminal, and a new control tower. The terminal has been certified to handle 727-200 and 757 aircraft, thus allowing direct tourist flights with no transfers necessary from nearby islands. Construction is scheduled for completion in 1986-87. M.S.K.

A84-43624

AIR TRANSPORT RECOVERING - BEN GURION AIRPORT TO BE IMPROVED

R. SCHANO Airport Forum (ISSN 0002-2802), vol. 13, June 1984, p. 31, 33, 34, 36-39.

The planned improvements for Ben Gurion International Airport (BGIA) are delineated and the Israel airport system is outlined. The other two international airports in Israel are located in Eilat, a tourist center. Over 3 million passengers a year pass through BGIA on more than 22,000 flights. The number of passengers is expected to grow to 18 million passengers a year by the year 2000. New radar and control tower facilities are under construction. The airport may be expanded by the acquisition of surrounding fruit farm land in order to extend the runway. Air traffic routing is being considered in a clockwise configuration to permit 75-80 landings and 20 departures per hour. Railway feeders are being examined as a means of alleviating the congestion of nearby road systems. M.S.K.

A84-43625

MULTIAIRPORT SYSTEMS - HOW DO THEY WORK BEST?

R. DE NEUFVILLE (MIT, Cambridge, MA) Airport Forum (ISSN 0002-2802), vol. 13, June 1984, p. 55-58.

Past strategies for siting new major airports near cities are examined in an attempt to identify methods that result in successful airports. Recently built airports near Montreal and Washington, DC are asserted to have been constructed prematurely, resulting in underutilization. Attempts to control air traffic have failed in terms of passenger satisfaction and airline profitability. Airlines are constrained to operate in areas of the largest market, as well as to consolidate operations wherever feasible. Construction of a second airport in a city is contingent on the traffic projected for the specific site, which must be over 2 million passengers per year, unless most of the passengers are transfers. The success of the added airport may also be due to its ability to satisfy a specific market, e.g., international traffic, business and commuter passengers, or low-cost fare travelers. M.S.K.

A84-44189*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

THE NATIONAL TRANSONIC FACILITY - A RESEARCH PERSPECTIVE

J. F. CAMPBELL (NASA, Langley Research Center, National Transonic Facility, Hampton, VA) American Institute of Aeronautics and Astronautics, Applied Aerodynamics Conference, 2nd, Seattle, WA, Aug. 21-23, 1984. 18 p. refs

(AIAA PAPER 84-2150)

The capabilities of the National Transonic Facility (NTF) at NASA-Langley and its impact on aerodynamics investigations are surveyed. The fan-driven, closed-circuit transonic wind tunnel has an 8.2 sq ft slotted test section. Trials can be run from Mach 0.2-1.2, pressures of 1-8.9 atm, and temperatures of -320 to 150 F using nitrogen as the working gas. Instrumentation has been developed for monitoring force, pressure, attitude, deformation, temperature, skin friction, flow transition, and flow velocity as well as visualizing flows around the models. Pressures of 15-130 psi are available, as are Re up to 120 million at Mach 1. Correlations are being made with flight data from the Shuttle, 767, X-29A, and TACT aircraft for real-world extrapolations. The NTF, when combined with computational fluid dynamics techniques, will permit testing of aerodynamically sophisticated shapes while narrowing the design goals for each model during basic research in fluid mechanics, transport, and aerodynamic phenomena. M.S.K.

A84-44191*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

VALIDATION OF A WALL-INTERFERENCE ASSESSMENT/CORRECTION PROCEDURE FOR AIRFOIL TESTS IN THE LANGLEY 0.3-METER TRANSONIC CRYOGENIC TUNNEL

C. R. GUMBERT and P. A. NEWMAN (NASA, Langley Research Center, Transonic Aerodynamics Div., Hampton, VA) American Institute of Aeronautics and Astronautics, Applied Aerodynamics Conference, 2nd, Seattle, WA, Aug. 21-23, 1984. 18 p. refs
(AIAA PAPER 84-2151)

Validation of a wall-interference assessment/correction (WIAC) procedure for a given facility requires its application to several sets of test data. It is necessary therefore to create a somewhat automated method for processing data through the various steps in the procedure. An automated procedure is also welcomed by the test engineer or eventual user in order to reduce the required effort and opportunity for error. Such a procedure has been developed for the Langley 0.3-m Transonic Cryogenic Tunnel using the TWINTN4 WIAC code. This code provides a four-wall, 2-D, transonic correction; that is, it accounts for sidewall boundary-layer effects, as well as for top and bottom wall effects on the airfoil tests. The TWINTN4 code utilizes measured pressure data at the tunnel walls and on the airfoil model; thus, classical homogeneous-wall boundary conditions are not used in the correction procedure. Author

A84-44477#

A GROUND TEST INSTRUMENTATION DATA SYSTEM FOR EW SYSTEMS FLIGHT TESTING

P. C. ANDERSON (Grumman Aerospace Corp., Bethpage, NY) IN: Flight testing technology: A state-of-the-art review; Proceedings of the Thirteenth Annual Symposium, New York, NY, September 19-22, 1982 . Lancaster, CA, Society of Flight Test Engineers, 1982, p. 229-232.

This paper describes a data acquisition, recording and processing system that is used for the flight testing of EW Systems aircraft. All data are derived from ground based radar tracking systems and a slaved receiver antenna mount. Receiver and tracking radar characteristics, as well as aircraft jammer characteristics, are entered as a test setup data base file in advance of actual EW System flight testing. This data base, along with real time measurements taken during the test mission, provides on-line results in the form of graphical plots and tabulations for use by the flight test engineer. Author

A84-44512#

TRANSONIC WIND TUNNEL WALL INTERFERENCE MINIMIZATION

J. L. GRUNNET (FluiDyne Engineering Corp., Minneapolis, MN) Journal of Aircraft (ISSN 0021-8669), vol. 21, Sept. 1984, p. 694-699. refs

Obtaining accurate predictions of aircraft aerodynamic coefficients from wind tunnel tests is a difficult task. Wind tunnel users have struggled with the effects of wall interference, model support interference, subscale Reynolds number, etc., for almost the entire history of powered flight. Since wall interference is one of the principal problems, this paper emphasizes the need to minimize it, especially in the near-sonic test regime. Practical ways of minimizing wall interference are identified. This is best accomplished for near-sonic testing by locally variable porosity with inclined hole perforations. A number of porosity setting schemes are identified, some of which are quite simple. Author

A84-44730

A VIEW FROM THE AUXILIARY SIDE OF THE FAA'S NATIONAL AIRSPACE SYSTEM

F. E. GILMORE and B. J. JONES (FAA, Airway Facilities Service, Washington, DC) IN: Air Traffic Control Association, Annual Fall Conference, 27th, Atlantic City, NJ, October 18-21, 1982, Proceedings . Arlington, VA, Air Traffic Control Association, 1982, p. 53-56.

The new construction and modernization of auxiliary systems to support the FAA National Airspace System Plan are reviewed. Structural, electrical, climate-control, energy, and power-conditioning requirements for air-route traffic-control centers, ATC towers, terminal radar-control facilities, flight service stations, and unmanned facilities are listed in a table and briefly characterized. T.K.

A84-44933#

DESIGN AND OPERATION OF TU-BERLIN WIND TUNNEL WITH ADAPTABLE WALLS

U. GANZER, Y. IGETA, and J. ZIEMANN (Berlin, Technische Universitaet, Berlin, West Germany) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 52-65. Sponsorship: Research sponsored by the Bundesministerium fuer Forschung und Technologie and Deutsche Forschungsgemeinschaft. refs

At the Technical University of Berlin two test sections with adaptive walls have been developed: A 2-D section with flexible top and bottom wall is mainly used for aerofoil tests but also for some 3-D model tests. An octagon test section with eight flexible walls was specifically designed for the test of three-dimensional models. The test sections are described with particular reference to their constructional details and their automatic control system. Representative test results are exhibited and the problems which have occurred in course of the first years of operation are discussed. The implications of using the octagon test section at supersonic flow conditions are outlined in some detail. Author

A84-44934#

DEFORMABLE ADAPTIVE WALL TEST SECTION FOR THREE-DIMENSIONAL WIND TUNNEL TESTING

A. HEDDERGOTT and E. WEDEMEYER (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Institut fuer Experimentelle Stroemungsmechanik, Goettingen, West Germany) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 66-75. refs

To realize three-dimensional adaptive wind tunnel walls, a test section was constructed from a thick walled rubber tube. The new test section with a length of 240 cm and a circular cross section of 80 cm-diameter is installed in the high speed wind tunnel of the DFVLR Goettingen. The cylindrical walls of the test section can be adapted to interference-free boundary conditions by a set of 64 jacks which are driven by stepping motors. The measurement and evaluation of wall pressures, the computation of the interference-free wall contour and the wall adaptation by the 64 jacks are computer controlled and performed automatically. First model tests have demonstrated the achievement of interference-free flow. Author

A84-44935#

WIND TUNNEL WALL INFLUENCE CONSIDERING 2D HIGH LIFT CONFIGURATIONS

TH. E. LABRUJERE, R. A. MAARSINGH, and J. SMITH (Nationaal Lucht- en Ruimtevaartlaboratorium, Amsterdam, Netherlands) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 76-84.

The present paper describes two alternative correction methods for wall interference based on measured boundary conditions. In both methods it is assumed that at or near the tunnel boundary the flow velocity will be measured in magnitude and direction and that the main part of the flow field may be considered irrotational and subsonic. One method aims at a correction in terms of changes in free stream velocity and angle of attack. The other method aims at corrections of the velocity distribution along the model. The application of both methods is demonstrated numerically for the case of a single and a multiple airfoil in a solid wall test section. Author

A84-45004#
A NEW METHOD OF MODAL ANALYSIS - MULTIPLE INPUT BY UNCORRELATED SIGNALS
C. HUTIN and G. CATTEAU (Societe pour le Perfectionnement des Materiels et Equipements Aerospatiaux, Velizy-Villacoublay, Yvelines, France) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 685-696.

A multiinput excitation apparatus for on-site modal analysis of aircraft structures, which simultaneously excites the structure at several points with uncorrelated signals, has been used for the case of an external stores-bearing Mirage F1 aircraft. Structural response of the aircraft is measured by means of piezoelectric accelerometers. Signals are dispatched to a multiplexer whose channels are fitted to both an antialiasing filter and a sample-and-hold unit. It is noted that the use of up to six excitation inputs does not result in a loss of quality in either the measurement or the data processing phases of the test process. O.C.

A84-45042*# Joint Inst. for Advancement of Flight Sciences, Hampton, Va.
ESTIMATED LOW-SPEED AERODYNAMIC PARAMETERS OF AN ADVANCED FIGHTER FROM FLIGHT AND WIND TUNNEL DATA
V. KLEIN (Joint Institute for Advancement of Flight Sciences, Hampton, VA) and J. G. BATTERSON (NASA, Langley Research Center, Hampton, VA) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 1038-1046. refs

A procedure for determination of aerodynamic model structure and estimation of aerodynamic parameters is applied to data from a modern fighter operating within an angle of attack range of 5 to 60 deg. The paper briefly describes the airplane, flight and wind tunnel data available, postulated models for airplane aerodynamic coefficients and flight data analysis. The results presented contain only a small number of selected longitudinal and lateral parameters. These parameters were obtained from various maneuvers and subsets of joined data from several flights. The estimated parameters are in good agreement with the wind tunnel measurements. The resulting aerodynamic model equations seem to be satisfactory for the prediction of airplane motion. Author

A84-45056#
LOW SPEED TWIN ENGINE SIMULATION ON A LARGE SCALE TRANSPORT AIRCRAFT MODEL IN THE DNW
D. ECKERT, J. C. A. VAN DITSHUIZEN (Duits-Nederlandse Windtunnel, Noordoostpolder, Netherlands), B. MUNNIKSMA (Nationaal Lucht- en Ruimtevaartlaboratorium, Amsterdam, Netherlands), and W. BURGSMUELLER (Messerschmitt-Boelkow-Blohm GmbH, Bremen, West Germany) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 1147-1155. refs

A series of investigations with engine simulation on a transport aircraft model has been performed in the DNW 8 x 6 sq m test section. For the tests a complete twin-engined model of the Airbus A-300 is used (scale 1:9.5) equipped with two independently controlled turbine-powered simulators. Attention is given to the wind tunnel technique and the calibration technique of the model engines as applied in the calibration facility of NLR. Results are presented for the low speed regime where the engine effects are of major interest, i.e. influences on drag during second segment climb conditions, especially at the one-engine-out case including side-slip. The conclusion is that at DNW a testing technique is available which allows accurate simulation and determination of engine-airframe interferences at low speed with complete models. Author

A84-45161
FLIGHT TESTING - ON TRACK
J. B. MCDONALD (USAF, Holloman AFB, NM) (Society of Experimental Test Pilots, Mini-Symposium, 14th, San Diego, CA, May 13, 14, 1984) Cockpit (ISSN 0742-1508), vol. 19, Apr.-June 1984, p. 5-13. refs

The use of high-speed test tracks for ejection and components testing is discussed. Attention is given to the use of a triple rail sled train for determining the causes of injury in ejections at velocities of 500 knots-equivalent airspeed, and for assessing the effectiveness of limb restraint systems for next-generation aircraft ejection seats. The development of a computer-controlled test sled for more realistic testing under dynamic conditions is also discussed. A diagram of the current test sled system is provided. I.H.

A84-45968#
VISUALLY COUPLED SYSTEMS AS SIMULATION DEVICES
M. W. HAAS (USAF, Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH) Journal of Aircraft (ISSN 0021-8669), vol. 21, Aug. 1984, p. 639, 640. Previously cited in issue 16, p. 2312, Accession no. A83-36224.

A84-46370*# Boeing Vertol Co., Philadelphia, Pa.
A PILOTED SIMULATOR INVESTIGATION OF SIDE-STICK CONTROLLER/STABILITY AND CONTROL AUGMENTATION SYSTEM REQUIREMENTS FOR HELICOPTER VISUAL FLIGHT TASKS
K. H. LANDIS, P. J. DUNFORD (Boeing Vertol Co., Philadelphia, PA), E. W. AIKEN, and K. B. HILBERT (U.S. Army, Aeromechanics Laboratory, Moffett Field, CA) IN: American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 493-508. Previously announced in STAR as N83-36041. refs
(Contract NAS2-10880)

A piloted simulator experiment was conducted to assess the effects of side-stick controller characteristics and level of stability and control augmentation on handling qualities for several low-altitude control tasks. Visual flight tasks were simulated using four-window computer-generated imagery depicting either a nap-of-the-earth course or a runway with obstacles positioned to provide a slalom course. Both low speed and forward flight control laws were implemented, and a method for automatically switching control modes was developed. Variations in force-deflection characteristics and the number of axes controlled through an integrated side-stick were investigated. With high levels of stability and control augmentation, a four-axis controller with small-deflection in all four axes achieved satisfactory handling qualities for low-speed tasks. G.R.A.

N84-31220 Clemson Univ., S.C.
MULTI-VARIATE ACCEPTANCE PLANS FOR FLEXIBLE AIRPORT PAVEMENTS Ph.D. Thesis
M. G. TARAKJI 1983 219 p
Avail: Univ. Microfilms Order No. DA8408879

In 1980, the Federal Aviation Administration (FAA), Eastern Region, incorporated a price adjustment schedule for the mat density in their Bituminous Surface Course Specifications (item P-401). The FAA did not include the rest of the acceptance variables (Marshall stability, flow and voids) in the price adjustment schedule because some of these variables are physically related. In this study, the relationships between the four acceptance variables are studied, and a theoretical procedure (general model) is formulated to measure the quality of asphalt mixtures in terms of a trivariate Percentage Within Limits (PWL) which is a function

of the three Marshall properties. Because this procedure was found to have practical limitations, a univariate-bivariate mixed approach (mixed model) was formulated to approximate the trivariate PWL. For the mixed model, the asphalt mixture's PWL is calculated as the product of the stability univariate PWL and the flow-voids bivariate PWL. This approach gave satisfactory results when tested by computer simulation using various sample statistics.
Dissert. Abstr.

N84-31221# Chinese Aerodynamic Research and Development Center, Mianyang.
THE 6M X 8M LOW SPEED WIND TUNNEL
1983 8 p
Avail: NTIS HC A02/MF A01
The CARDC 8M X 6M low speed wind tunnel is presented. The wind tunnel is of the open circuit type with two tandem test sections: the first is 12 X 16 X 24M and the 2nd is 8 X 6 X 15M. The range of wind velocities of the 2nd section is 20-90 m/s. Three fans arranged in a triangle are driven by three motors with maximum total rated power 7800 kW. The tunnel was put into use in 1978. Force, moment, pressure and dynamic tests were conducted to evaluate aeronautical and wind engineering characteristics.
E.A.K.

N84-31222# Aeronautical Research Labs., Melbourne (Australia).
SOME FACTORS AFFECTING THE SELECTION OF THE TYPE OF NEW TRANSONIC TUNNEL TO BEST MEET AUSTRALIAN NEEDS
N. POLLOCK Dec. 1983 20 p
(AD-A142957; ARL/AERO-TM-359) Avail: NTIS HC A02/MF A01 CSCL 14B
A consideration of the new transonic wind tunnel options identified at the Dec. 1982 workshop held at ARL is presented. Factors discussed include: Reynolds number requirements, test section dimensions, operating pressure, individual run duration, total available testing time and operating costs. It is concluded that, despite the lower test Reynolds number capability, a continuous flow, conventional fan driven tunnel is more suited to Australian requirements than an intermittent blowdown tunnel. If a significant supersonic requirement existed this preference would probably be reversed.
Author (GRA)

N84-32061# Joint Publications Research Service, Arlington, Va.
GASDYNAMIC STUDY OF MODEL WITH COMBUSTION IN SHOCK TUNNEL Abstract Only
V. K. BAYEV, V. V. SHUMSKIY, and M. I. YAROSLAVTSEV *In its* USSR Rept.: Phys. and Math. (JPRS-UPM-84-003) p 51-52 9 Jul. 1984 Transl. into ENGLISH from Zh. Prikl. Mekhan. i Tekhn. (Novosibirsk, USSR), v. 142, no. 6, Nov. - Dec. 1983 p 58-66
Avail: NTIS HC A08/MF A01
The experimental difficulties involved in studies of supersonic or hypersonic airflows on facilities with combustion processes have led to the idea of using high-enthalpy facilities with short test time. However, the earliest attempts at using shock tubes for this purpose were not completely successful because times of the order of 3 ms are simply inadequate for studying the working process and force characteristics. Shock tunnels can provide a working time from a few hundredths to several tenths of a second, and initial research has shown that they should be completely suitable for testing models with combustion in a high-enthalpy airflow. The results of such studies in the IT-301 shock tunnel on a gas dynamic model with hydrogen combustion are given. The purpose of the research was to determine the force characteristics of the model, compare theoretical and experimental data, evaluate weight measurements of completeness of hydrogen combustion inside the model, and determine the effect that operation of the internal duct has on operation of the airscoop of the model.
Author

N84-32225# Goodyear Aerospace Corp., Akron, Ohio. Simulator Systems Engineering Div.
CLOSING THE GAP BETWEEN AIRCRAFT AND SIMULATOR TRAINING WITH LIMITED FIELD-OF-VIEW (LFOV) VISUAL SYSTEMS
W. P. LEAVY and M. FORTIN (Rediffusion Simulation, Inc., Akron, Ohio) *In* American Defense Preparedness Association Proc. of the 5th Interservice/Ind. Training Equipment Conf., Vol. 1 p 10-18 16 Nov. 1983
(AD-P003448) Avail: NTIS HC A17/MF A01 CSCL 05I
A limited field-of-view (LFOV) visual system for the F-15 flight simulator (FS) - developed and built by Goodyear Aerospace Corporation - would greatly increase the already proven training capability of the FS. The current F-15 FS, having no visual system, readily handles all its assigned instrument and emergency procedure training tasks. The LFOV system - capable of adapting to cost parameters - will enhance the overall training capability of the F-15 FS by adding out-the-window visual cues. The overall training capability, particularly in the visual air-to-air and air-to-ground modes, is expected to be significantly improved by the addition of the LFOV system. The data base for the LFOV system is intended to support air-to-ground, air-to-air, and normal airfield operations. Air Force instructor pilots will evaluate the LFOV for a three-month period by following specific evaluation plans and by using strict grading procedures.
Author (GRA)

N84-32226# Singer Co., Sunnyvale, Calif. Link Flight Simulation Div.
IMAGE GENERATOR ARCHITECTURES AND FEATURES
R. LATHAM *In* American Defense Preparedness Association Proc. of the 5th Interservice/Ind. Training Equipment Conf., Vol. 1 p 19-26 16 Nov. 1983
(AD-P003449) Avail: NTIS HC A17/MF A01 CSCL 20F
In order to meet user requirements, tradeoffs are made in the implementation of the four functions (scene management, prioritization, geometric processing, and video processing) that comprise a digital image generation system of the sort used for flight training. This paper discusses how different approaches to image generator architecture affect the features apparent to the user. Among the architectural variations discussed are programmable versus pipelined geometric processing, and four variations of video processor (scanline, reverse-priority-ordered frame buffering, priority-ordered frame buffering, and distance sensitivity, and the implementation of anti-aliasing, texture, and translucency features, among others. Understanding the tradeoffs involved will help designers and users better meet the requirements of a training task.
Author (GRA)

N84-32231# Boeing Military Airplane Development, Wichita, Kans.
CONCURRENCY OF DESIGN CRITERIA: A KEY TO TRAINER READINESS
J. CASPERSON and J. JONAS *In* American Defense Preparedness Association Proc. of the 5th Interservice/Ind. Training Equipment Conf., Vol. 1 p 60-63 16 Nov. 1983
(AD-P003454) Avail: NTIS HC A17/MF A01 CSCL 05I
The benefits associated with combat crew readiness are obvious. What may not be so obvious are the benefits associated with timely acquisition and availability of training and training devices. As new aircraft programs develop and present aircraft programs mature, the crews must either train on the operational equipment or wait until the associated trainers are developed or updated. If the trainers are developed and updated in concert with the aircraft program, the Air Force is provided not only with combat-ready crews at the correct time, but also at the correct cost. The key to keeping the training devices in concert with the aircraft is Concurrency Program. On the B-1B program, a complete concurrency program is being addressed. By complete, it is meant a program which addresses the two major issues associated with keeping the trainer concurrent with the aircraft. (1) Cost-effective development and distribution of the required design criteria data. (2) Inherent flexibility designed into the training device to

accommodate changes in a cost-effective manner.
Author (GRA)

N84-32233# Eagle Technology, Inc., Orlando, Fla.
COST-EFFECTIVE AND EFFICIENT MAINTENANCE TRAINING DEVICES: A USER ACCEPTED DESIGN PROCESS
W. F. JORGENSEN and P. H. L. BROWN *In* American Defense Preparedness Association Proc. of the 5th Interservice/Ind. Training Equipment Conf., Vol. 1 p 74-83 16 Nov. 1983
(AD-P003456) Avail: NTIS HC A17/MF A01 CSCL 05I

In response to a USAF need for cost-effective and efficient training devices for the F-16 aircraft, a design process which was largely adapted from U.S. Air Force instructional design procedures was used and modified to ensure the efficient integration of these devices within the USAF training and logistics environments. Two specific and unique training device suites were conceptualized for the F-16 Fire Control and Armament systems. Physical and functional characteristics were specified for each training device suite to meet the specific hands-on training needs for Fire Control (AFSC 32X6C) and Weapons Control (AFSC 462XO) maintenance technicians. Author (GRA)

N84-32234# Air Force Human Resources Lab., Williams AFB, Ariz.
TRAINING CAPABILITIES: THE FACILITY PART OF THE EQUATION
J. S. KAMCHI and W. DUBE *In* American Defense Preparedness Association Proc. of the 5th Interservice/Ind. Training Equipment Conf., Vol. 1 p 84-91 16 Nov. 1983
(AD-P003457) Avail: NTIS HC A17/MF A01 CSCL 13M

The theme of increased readiness through training has an inherent assumption that adequate facilitates either exist, can be modified, or can be built to house computerized training devices. Too often adequate facilities do not exist or require long lead times to acquire. Training capabilities can become a myth to the realities of not having an adequate facility or of having modern training equipment fail because of facility deficiencies such as high temperatures and power spikes. But what are adequate facilities for computerized training devices, and how do we acquire them? This paper will review the time phasing and types of funding available within the Department of Defense for construction projects, design concepts of a flexible modular training building including security and environmental considerations. Without understanding the time phasing for acquisition of training facilities, the effectiveness of training devices can be reduced to zero.
Author (GRA)

N84-32250# Singer Co., Lancing (England). Link-Miles Div.
DIGITAL CONTROL LOADING: A MICROPROCESSOR-BASED APPROACH
D. PARKINSON *In* American Defense Preparedness Association Proc. of the 5th Interservice/Ind. Training Equipment Conf., Vol. 1 p 269-273 16 Nov. 1983
(AD-P003483) Avail: NTIS HC A17/MF A01 CSCL 05I

This paper reports on a multi-year development effort to provide exact simulation of aircraft primary control systems under all conditions of aircraft control and operation for all regimes of flight and environment conditions. The development demonstrated the ability to develop realistic models and provide for their exact solution via digital computation while integrated with a highly responsive control force simulation system. Digital quantization effects are eliminated by very high rates of computation achieved by using dedicated microprocessors within the control loop, resulting in no degradation of control feel, smoothness, or response. Further improvements in long-term stability, calibration, and measurement are also achieved. The paper discloses the results of various comparative analyses between digital and analog, for various force and position servo loops, leading to the development of a microprocessor-based digital control loading system. Trace comparisons are made between the final breadboard system versus actual aircraft control measurements for force/displacement and dynamic stick response tests to demonstrate the fidelity achieved by the system. Author (GRA)

N84-32258# Singer Co., Binghamton, N.Y. Link Flight Simulation Div.
A FOUR-DIMENSIONAL THUNDERSTORM MODEL FOR FLIGHT SIMULATORS
J. T. KLEHR *In* American Defense Preparedness Association Proc. of the 5th Interservice/Ind. Training Equipment Conf., Vol. 1 p 335-338 16 Nov. 1983
(AD-P003492) Avail: NTIS HC A17/MF A01 CSCL 05I

The recent airliner crash at New Orleans indicates that windshears due to thunderstorm downbursts challenge the most experienced and well-trained pilots. Much controversy exists as to the correct flight procedures for takeoff and landing under downburst windshear conditions. Flight simulators provide a safe environment to test procedures and train pilots for hazardous flight situations, but in the past, flight simulators have been unable to realistically duplicate the complex changes that occur temporally and spatially in real-world thunderstorms. A thunderstorm model based upon real-world data has now been developed for flight simulators, which provides twelve meteorological flight parameters which change in three-dimensional space and over a thirty-minute time span with color weather radar representations of the storm coordinated in time and space. The storm data set (representing a 20nm x 20nm x 3200-ft volume) is based upon multiple Doppler radar analyses of a 1978 Illinois thunderstorm. This data has been supplemented by a well-documented, fine resolution, downdraft model to provide realistic values in the hazardous regions of the sudden downdraft and its resulting turbulent gust front. GRA

N84-32398*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
WARM FOG DISSIPATION USING LARGE VOLUME WATER SPRAYS Patent Application
V. W. KELLER, inventor (to NASA) 23 Jul. 1984 17 p
(NASA-CASE-MFS-25962-1; NAS 1.71:MFS-25962-1; US-PATENT-APPL-SN-633180) Avail: NTIS HC A02/MF A01 CSCL 01E

This research relates to warm fog dissipation by using large volume water sprays, and to water spray systems for spraying large quantities of water in a specific area to eliminate warm fogs. To accomplish the removal of warm fog about an area such as an airport runway, a plurality of nozzles along a line adjacent the area propells water jets through the fog to heights of approximately twenty-five meters. Each water jet breaks up forming a water drop size distribution that falls through the fog overtaking, colliding, and coalescing with individual fog droplets and thereby removes the fog. A water retrieval system is used to collect the water and return it to reservoirs for pumping it to the nozzles once again.
NASA

N84-32399*# Stanford Univ., Calif.
STUDIES IN A TRANSONIC ROTOR AERODYNAMICS AND NOISE FACILITY
S. E. WRIGHT, D. J. LEE, and W. CROSBY Aug. 1984 22 p refs
(Contract NCC2-89)
(NASA-CR-166588; NAS 1.26:166588) Avail: NTIS HC A02/MF A01 CSCL 14B

The design, construction and testing of a transonic rotor aerodynamics and noise facility was undertaken, using a rotating arm blade element support technique. This approach provides a research capability intermediate between that of a stationary element in a moving flow and that of a complete rotating blade system, and permits the acoustic properties of blade tip elements to be studied in isolation. This approach is an inexpensive means of obtaining data at high subsonic and transonic tip speeds on the effect of variations in tip geometry. The facility may be suitable for research on broad band noise and discrete noise in addition to high-speed noise. Initial tests were conducted over the Mach number range 0.3 to 0.93 and confirmed the adequacy of the acoustic treatment used in the facility to avoid reflection from the enclosure. R.J.F.

N84-32400# Federal Aviation Agency, Atlantic City, N.J.
MODIFIED REFLEX-PERCUSSIVE GROOVES FOR RUNWAYS Final Report
S. K. AGRAWAL Apr. 1984 25 p
(AD-A143569; DOT/FAA/CT-84/7; DOT/FAA/PM-84/8) Avail: NTIS HC A02/MF A01 CSCL 01E

Runway surface treatments, such as grooves, can minimize the danger of aircraft hydroplanning by reducing the water buildup on the runway and by facilitating forced water escape from tire-runway interface. Square saw-cut grooves of 1/4-inch size with spacing between 1 inch and 2 1/2 inches have been widely used, the former providing a higher resistance to hydroplanning. Other surface treatments that have been reported as being effective in minimizing aircraft hydroplanning include porous friction overlay and reflex-percussive grooves. The latter being offered as a cost-effective alternative to square saw-cut grooves. As the title of this report suggests, the modified reflex-percussive grooves are a derivative of reflex-percussive grooves; the cutting heads for the latter were modified to produce smoother groove edges which tend to improve water flow through the groove channels. Comparative dynamic tests showed that the braking performance of an aircraft tire on modified reflex-percussive grooves is equivalent to the performance on square saw-cut grooves spaced between 1 1/4 inches and 2 inches. Results also showed that hydroplanning was not initiated up to 150 knots speed. The lower cost of the modified grooves makes them a viable cost-competitive method; however, realistic cost estimates and full-savings potential can only be affirmed after application of these grooves in an operational environment. GRA

N84-32401# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Flight Mechanics Panel.
FUTURE REQUIREMENTS FOR AIRBORNE SIMULATION
J. BUHRMAN (National Aerospace Lab.) Apr. 1984 17 p refs
(AGARD-AR-188; ISBN-92-835-1471-8) Avail: NTIS HC A02/MF A01

Airborne and ground-based flight simulation are complementary techniques widely used in aeronautical research and development. The rapid advances in recent years both in the level of sophistication and in the degree of attainable fidelity for modern ground-based flight simulation systems has, however, called into question the future role of in-flight simulators in the research and development processes. The premise that this role may soon disappear has been addressed by a Subcommittee of the AGARD Flight Mechanics Panel. General purpose airborne simulators and special purpose research aircraft will continue to serve a useful complementary role to the ground-based simulator through the next generation of aircraft development programs. Author

N84-32402# National Aerospace Lab., Amsterdam (Netherlands). Compressible Aerodynamics Dept.
TECHNICAL EVALUATION REPORT ON THE FLUID DYNAMICS PANEL SYMPOSIUM ON WIND TUNNELS AND TESTING TECHNIQUES
A. ELSENAAR May 1984 13 p refs Symp. held in Cesme, Turkey, 26-29 Sep. 1983
(AGARD-AR-193; ISBN-92-835-1473-4) Avail: NTIS HC A02/MF A01 CSCL 14B

Testing techniques and wind tunnels were discussed. New facilities and their performance, design, wind tunnel tests like scale effects and disturbance effect were reported. New developments in cryogenic testing techniques, and refinement of conventional techniques, instrumentation, model design and construction are reported. The increasing impact of computer development on wind tunnel testing is addressed. E.A.K.

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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.

A84-43415*# Michigan Univ., Ann Arbor.
EXPLICIT GUIDANCE OF DRAG MODULATED AEROASSISTED TRANSFER BETWEEN ELLIPTICAL ORBITS
N. X. VINH (Michigan, University, Ann Arbor, MI), K. D. MEASE (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA), J. M. HANSON (Analytic Services, Inc., Arlington, VA), and J. R. JOHANNESEN IN: Guidance and Control Conference, Seattle, WA, August 20-22, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 133-142. refs
(Contract JPL-956416)
(AIAA PAPER 84-1848)

This paper presents the complete analysis of the problem of minimum-fuel aeroassisted transfer between coplanar elliptical orbits in the case where the orientation of the final orbit is free for selection in the optimization process. The comparison between the optimal pure propulsive transfer and the idealized aeroassisted transfer, by several passages through the atmosphere, is made. In the case where aeroassisted transfer provides fuel saving, a practical scheme for its realization by one passage is proposed. The maneuver consists of three phases: a deorbit phase for nonzero entry angle, followed by an atmospheric fly-through with variable drag control and completed by a postatmospheric phase. An explicit guidance formula for drag control is derived and it is shown that the required exit speed for ascent to the final orbit can be obtained with a very high degree of accuracy. Author

A84-44219*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
CONSTRAINED MANEUVER STRATEGIES FOR PROJECT GALILEO
R. H. STANFORD (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) American Institute of Aeronautics and Astronautics and American Astronautical Society, Astrodynamics Conference, Seattle, WA, Aug. 20-22, 1984. 9 p. NASA-supported research.
(AIAA PAPER 84-2026)

The design of maneuvers for Project Galileo is constrained by thruster configuration, modes of thruster usage and limitations required for the safety of the spacecraft and its instruments. The methods used to analyze maneuvers with respect to these constraints is described. The velocity changes necessary for the implementation of a candidate trajectory have been studied and some general conclusions are described. Author

A84-44222#
SOLVING THE OPTIMAL CONTROL PROBLEM USING A NONLINEAR PROGRAMMING TECHNIQUE. II - OPTIMAL SHUTTLE ASCENT TRAJECTORIES
T. P. BAUER, J. T. BETTS, W. P. HALLMAN, W. P. HUFFMAN, and K. P. ZONDERVAN (Aerospace Corp., El Segundo, CA) American Institute of Aeronautics and Astronautics and American Astronautical Society, Astrodynamics Conference, Seattle, WA, Aug. 20-22, 1984. 12 p. refs
(AIAA PAPER 84-2038)

The optimal control for the second stage of the Space Shuttle ascent has been determined using a nonlinear programming method. The optimality conditions for such a problem are implicit in the control for a general representation of the aerodynamic data. Since the optimality conditions of this problem could not be solved explicitly for the control, a differential-algebraic integrator was required. The problem was first solved using an approximation of the aerodynamic data in a special form. This approximation produced optimality conditions that could be explicitly solved for the control, allowing the use of a fast, standard integrator. A comparison of the optimal control solution with the linear tangent solution was made for several cases of 'yaw steering'. The phrase 'yaw steering' refers to changes, after staging, in desired final inclination or right ascension of the ascending node (terminal constraints). Linear tangent steering yields a final weight within a few pounds of the optimal control weight. Author

A84-44223#
SOLVING THE OPTIMAL CONTROL PROBLEM USING A NONLINEAR PROGRAMMING TECHNIQUE. III - OPTIMAL SHUTTLE REENTRY TRAJECTORIES
K. P. ZONDERVAN, T. P. BAUER, J. T. BETTS, and W. P. HUFFMAN (Aerospace Corp., El Segundo, CA) American Institute of Aeronautics and Astronautics and American Astronautical Society, Astrodynamics Conference, Seattle, WA, Aug. 20-22, 1984. 10 p. refs
(AIAA PAPER 84-2039)
The optimal control for a reentry trajectory of a representative Space Shuttle vehicle has been determined using a generalized nonlinear programming technique which combines the Direct and Indirect methods to form a Hybrid Nonlinear Programming (HNLP) method. Exact solutions to the maximum downrange and crossrange reentry problems using representative Shuttle aerodynamics are presented. The effect of decreases in the maximum allowable heating rate has been assessed for the maximum crossrange reentry and is shown to have a relatively small impact on the maximum crossrange. Author

A84-46119#
EXTENDED CAPABILITIES FOR HIGH ALTITUDE REENTRY SIMULATION IN THE NSWC HYPERVELOCITY WIND TUNNEL
M. M. ROBERTS, R. L. P. VOISINET, E. R. HEDLUND (U.S. Navy, Naval Surface Weapons Center, Silver Spring, MD), and C. FISCINA (General Dynamics Corp., San Diego, CA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 22nd, Reno, NV, Jan. 9-12, 1984. 14 p. refs
(AIAA PAPER 84-0412)
The capabilities of the Naval Surface Weapons Center Hypervelocity Wind Tunnel 9 have been extended to simulate high altitude reentry. To raise the simulated altitude above 160,000 feet, the wind tunnel had to be operated at nozzle supply pressures as low as 100 psia. In addition, a supersonic ejector had to be designed to maintain a lower diffuser pressure. A new porous material and model fabrication procedure was used to simulate high altitude outgassing processes in the wind tunnel. The porous material is low cost, easily machinable, uniformly porous, and can be designed to provide accurate symmetric and asymmetric blowing distributions over model surfaces. A pressure measuring system capable of measuring model surface pressures as low as 0.001 psi (0.05 torr) was also utilized. These new capabilities have been verified in tests, the results of which are described herein. Author

N84-31225*# Martin Marietta Corp., Denver, Colo.
APPLICATION OF TOS/AMS TO TDRS E AND F Final Report
30 May 1984 207 p
(Contract NAS8-35617)
(NASA-CR-171124; NAS 1.26:171124; MCR-84-2140) Avail: NTIS HC A10/MF A01 CSCL 22A
The development of the Transfer Orbit Stage (TOS) and the study of an Apogee and Maneuvering Stage (AMS) to be used in conjunction with the TOS are presented. A definition of the TOS/AMS configuration is provided along with a detailed design analysis including layout drawings, component definition, performance, sts and spacecraft interface definition, schedules, cost estimates, and specifications documents. M.A.C.

N84-31246# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
PITCH CONTROL OF A SATELLITE USING STABILIZING FLAPS [CONTROLE DO MOVIMENTO DE ARFAGEM DE UM SATELITE FOR ALETAS ESTABILIZADORAS]
L. D. D. FERREIRA, A. R. NETO, and N. S. VENKATARAMAN Jul. 1984 8 p refs In PORTUGUESE; ENGLISH summary Presented at the 10th Congr. Latino-Am. de Automatica/50th Congr. Brasileiro de Automatica - 1 CLA/50 CBA - Campina Grande, 3-6 Sep. 1984
(INPE-3185-PRE/550) Avail: NTIS HC A02/MF A01
The modelling and analysis of the attitude control system for low orbit artificial satellites, using stabilizing flaps are presented. The function of the system is to maintain the satellite aligned with the local vertical. The aerodynamic forces on the satellite are modelled assuming free molecular flow using the Kinetic Theory of Gases. The control system development is considered through the application of stochastic control concepts. The satellite motion is described by the equations of motion based on Newtonian formulation. Starting from separation principle, and sequential procedure is developed in which the state estimation and control problems are handled simultaneously. State estimate is provided by Kalman filter by using the information about the position of the satellite and of the flaps. The controller acts on the satellite in real time, and the stabilizing flaps being the only control elements. Author

N84-31253# Societe Nationale Industrielle Aerospatiale, Paris (France). Div. des Engins Tactiques.
A NEW CONCEPT FOR GUIDING MISSILES WITH AN APPLICATION TO THE GROUND-AIR SYSTEM [UN NOUVEAU CONCEPT DE PILOTAGE DES MISSILES APPLICATION AUX SOL-AIR]
G. SELINCE *In* AGARD Advan. Technol. for SAM Systems Anal. Syn. and Simulation 12 p May 1984 refs In FRENCH Avail: NTIS HC A06/MF A01
The PIF,PAF system associates to conventional control surfaces the action of gas jets creating lateral forces applied near the missile center of gravity. The advantages of the two devices are then cumulated, leading to very short response time and large lateral accelerations, even at low speed or high altitude, as the PIF rapidity makes up for the PAF dynamic error. The result is a notable decrease of miss distance against highly maneuvering targets. General principles of such a guidance system and examples of possible applications to surface to air missiles with antimissile capability are presented. Transl. by A.R.H.

N84-31255# Selenia S.p.A., Rome (Italy). Defence Systems Div.
MISSILE SYSTEM FOR LOW ALTITUDE AIR DEFENCE
R. BROWN and G. SANTI *In* AGARD Advan. Technol. for SAM Systems Anal. Syn. and Simulation 8 p May 1984 refs Avail: NTIS HC A06/MF A01
Simulation techniques adopted in the design and development phases of the low altitude surface to air missile system SPADA are described. Two distinct areas are examined: one as a tool to validate system concepts, the other in conjunction with field tests to complete operational evaluation. The defense of high value targets (typically airports), within friendly territory, from low level, high speed air raids is examined. The location of such defended targets which is known to the enemy, and attacks are preplanned to take advantage of terrain contours and of electronic countermeasures (screening and deception) to avoid or to delay detection by the defence systems and therefore narrow in to the target, reaching useful weapon release distances. A missile system which is specifically designed for airport defence and considers identification and integrity of friendly A/C was developed. The system named SPADA enchances system survivability to attacks and adapts to the change of objective which are to be defended. E.A.K.

N84-31259*# Chrysler Corp., Huntsville, Ala. Data Management *Services.*
AEROTHERMODYNAMIC DATA BASE, PHASE C Data File Contents Report, Jan. - Jun. 1984
10 Jul. 1984 424 p
(Contract NAS9-16283)
(NASA-CR-173862; NAS 1.26:173862; DMS-DFR-2098) Avail: NTIS HC A18/MF A01 CSCL 22B

Space shuttle aerothermodynamic data, collected from a continuing series of wind tunnel tests, are permanently stored with the Data Management Services (DMS) system. Information pertaining to current baseline configuration definition is also stored. Documentation of DMS processed data is listed, arranged sequentially and by space shuttle configuration. An up-to-date record of all applicable aerothermodynamic data collected, processed, or summarized during the space shuttle program is provided. Tables are designed to provide survey information to the various space shuttle managerial and technical levels. M.G.

N84-31260*# Chrysler Corp., Michoud, La. Data Management Services.
RESULTS OF THE AFRSI DETAILED-ENVIRONMENT TEST OF THE 0.035-SCALE SSV PRESSURE-LOADS MODEL 84-0 IN THE AMES 11X11 FT. TWT AND THE LEWIS 8X6 FT. AND 10X10 FT. SWT (OA-310A, B, C), VOLUME 2
B. A. MARSHALL and J. MARROQUIN Jul. 1984 63 p refs
Prepared in cooperation with Rockwell International, Downey, Calif. Document includes microfiche supplement 2 Vol.
(Contract NAS9-16283)
(NASA-CR-167686; NAS 1.26:167686; DMS-DR-1459-VOL-2)
Avail: NTIS HC E16/MF A01 CSCL 22B

In order to support analysis of the STS-6 advanced flexible reusable surface insulation (AFRSI) anomaly, data were obtained for aerodynamic and aeroacoustic environments in affected areas of the orbiter. Data are presented in tabular form. M.G.

N84-31261*# Chrysler Corp., Michoud, La. Data Management Services.
RESULTS OF THE AFRSI DETAILED-ENVIRONMENT TEST OF THE 0.035-SCALE SSV PRESSURE-LOADS MODEL 84-0 IN THE AMES 11X11 FT. TWT AND THE LEWIS 8X6 FT. AND 10X10 FT. SWT (OA-310A, B, C), VOLUME 1
B. A. MARSHALL and J. MARROQUIN Jul. 1984 386 p refs
Prepared in cooperation with Rockwell International, Downey, Calif. 2 Vol.
(NASA-CR-167685; NAS 1.26:167685; DMS-DR-2459-VOL-1)
Avail: NTIS HC A17/MF A01 CSCL 22B

Detailed orbiter aerodynamic and aeroacoustic pressure data were obtained in a three-part experimental investigation (OA-310A, B and C). The tests were conducted in three NASA facilities: OA-310A in the Ames 11x11-foot Transonic Wind Tunnel; OA-310B in the Lewis 8x6-foot Supersonic Wind Tunnel; and OA-310C in the Lewis 10x10-foot Supersonic Wind Tunnel. Test data were obtained to support analysis of the Space Transportation System (STS)-6 advanced flexible reusable surface insulation (AFRSI) anomaly using the 0.035-scale space shuttle vehicle pressure-loads Model 84-0. Data were obtained in the areas of the orbiter where AFRSI is to be applied to OV-099 and OV-103. Emphasis was placed on acquiring detailed aeroacoustic data and time-averaged pressure distributions on five affected areas: (1) canopy; (2) side of fuselage; (3) upper surface of wing; (4) OMS pods; and (5) vertical tail. Data were obtained at nominal ascent and entry atmospheric flight trajectory conditions between M=0.6 through M-3.5. Sample plotted data are given. aba M.G.

N84-31275*# Colorado State Univ., Fort Collins. Dept. of *Mechanical Engineering.*
THE ANNULAR FLOW ELECTROTHERMAL RAMJET M.S. Thesis
B. D. SHAW Jul. 1984 109 p refs
(Contract NGR-06-002-112)
(NASA-CR-174704; NAS 1.26:174704) Avail: NTIS HC A06/MF A01 CSCL 21C

The annular flow, electrothermal, plug ramjet is examined as a possible means of achieving rapid projectile acceleration to velocities for such applications as direct launch of spacebound payloads. The performance of this ramjet operating with hydrogen propellant is examined for cases where this working fluid is treated: (1) as a perfect gas, and (2) as a gas that is allowed to dissociate and ionize and then recombine with finite reaction rates in the nozzle. Performance results for these cases are compared to the performance of a conventional ramjet operating with perfect gas hydrogen propellant. The performance of the conventional ramjet is superior to that of the annular flow, electrothermal ramjet. However, it is argued that the mechanical complexities associated with conventional ramjet operation are difficult to attain, and for this reason the annular flow, electrothermal ramjet is more desirable as a launch system. Models are presented which describe both electrothermal plug ramjet and conventional ramjet operation, and it is shown that for a given flight velocity there is a rate of heat addition per unit propellant mass for which ramjet operation is optimized. Author

N84-32404*# Computer Sciences Corp., Silver Spring, Md.
SOFTWARE CONVERSION HISTORY OF THE FLIGHT DYNAMICS SYSTEM (FDS)
K. LIU Jun. 1984 176 p
(Contract NAS5-27888)
(NASA-CR-175257; NAS 1.26:175257; CSC/TM-84/6059) Avail: NTIS HC A09/MF A01 CSCL 22A

This report summarizes the overall history of the Flight Dynamics System (FDS) applications software conversion project. It describes the background and nature of the project; traces the actual course of conversion; assesses the process, product, and personnel involved; and offers suggestions for future projects. It also contains lists of pertinent reference material and examples of supporting data. Author

N84-32410*# McDonnell-Douglas Astronautics Co., St. Louis, Mo.
A STUDY OF LEESIDE FLOW FIELD HEAT TRANSFER ON SHUTTLE ORBITER CONFIGURATION Final Report
L. C. BARANOWSKI and H. W. KIPP Hampton, Va. NASA. Langley Research Center Aug. 1984 316 p refs
(Contract NAS1-16839)
(NASA-CR-172362; NAS 1.26:172362) Avail: NTIS HC A14/MF A01 CSCL 20D

A coupled inviscid and viscous theoretical solution of the flow about the entire configuration is the desirable and comprehensive approach to defining thermal environments about the space shuttle orbiter. Simplified methods for predicting entry heating on leeside surfaces of the orbiter are considered. Wind tunnel heat transfer and oil flow data at Mach 6 and 10 and Reynolds numbers ranging from 500,000 to 73 million were used to develop correlations for the wing upper surface and the top surface of the fuselage. These correlations were extrapolated to flight Reynolds number and compared with heating data obtained during the shuttle STS-2 reentry. Efforts directed toward the wing leeside surface resulted in an approach which generally agreed with the flight data. Heating predictions for the upper fuselage were less successful due to the extreme complexity of local flow interactions and the associated heating environment. A.R.H.

N84-32411*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A HIGH ENERGY STAGE FOR THE NATIONAL SPACE TRANSPORATION SYSTEM
A. J. STOFAN Washington 1984 13 p refs Presented at the 35th Congr. of the Intern. Astronautical Federation, Lausanne, Switzerland, 7-13 Oct. 1984
(NASA-TM-83795; E-2292; NAS 1.15:83795; IAF-84-15) Avail: NTIS HC A02/MF A01 CSCL 22B

The Shuttle/Centaur is an expendable hydrogen/oxygen cryogenic upper stage for use with the National Space Transportation System. It is a modification of the existing Atlas/Centaur which was used by NASA since 1966 to launch interplanetary and Earth orbital payloads for numerous organizations. Two configurations of the Shuttle/Centaur are being developed. Vehicle capability includes placing approximately 4500 kg (10,000 lb) in geostationary orbit, and initial applications will be for the interplanetary Galileo and Ulysses Missions in 1986. The Shuttle/Centaur development program is discussed, the configurations and performance are described, and the unique integration and operations requirements related to the Shuttle are indicated. Design changes to the current Atlas/Centaur required for Shuttle operation are described here, and include those related to Orbiter cargo bay dimensions, environment, and safety considerations. Author

N84-32415*# Chrysler Corp., New Orleans, La. Engineering Office.
AEROTHERMODYNAMIC DATA BASE Data File Contents Report, Jan. - Jun. 1984
10 Jul. 1984 424 p
(Contract NAS9-16283)
(NASA-CR-171807; NAS 1.26:171807; DMS-DFR-2098) Avail: NTIS HC A18/MF A01 CSCL 01A

Space shuttle aerothermodynamic data, collected from a continuing series of wind tunnel tests, are permanently stored with the Data Management Services (DMS) system. Information pertaining to current baseline configuration definition is also stored. A list of documentation of DMS processed data arranged sequentially and by space shuttle configuration is presented. The listing provides an up to date record of all applicable aerothermodynamic data collected, processed, or summarized during the space shuttle program. Tables are designed to provide survey information to the various space shuttle managerial and technical levels. M.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.

A84-42765
VOID FORMATION IN ADHESIVE BONDS
T. M. DONNELLAN, J. G. WILLIAMS, and R. E. TRABOCCO (U.S. Naval Material Command, Naval Air Development Center, Warminster, PA) IN: National Technical Conference, 15th, Cincinnati, OH, October 4-6, 1983, Proceedings . Azusa, CA, Society for the Advancement of Material and Process Engineering, 1983, p. 478-488. refs

A vacuum bag technique developed for the field repair of aircraft composite materials using a new adhesive at NAVAIRDEVCEN is described. The adhesive was a two-part rubber-modified resin cured with a cycloaliphatic amine, which must be cured at 150 C for 1 hr. The substance was studied in terms of the void formation process and for evidence of the generation of volatiles. The voids appeared in a four-stage sequence, delineating surface features and migrating toward edges. It was determined that water vapor was the volatile inducing the voids. A numerical model was developed for the pressure distribution in the patch, with local hydrostatic pressure increasing as a cube of the film thickness. The model was verified by tests and can be used to delineate procedures which would avoid void formation. M.S.K.

A84-42766
CONDUCTIVE COMPOSITE MATERIALS FOR ELECTRONIC PACKAGES
J. F. MAGUIRE (Boeing Aerospace Co., Seattle, WA) IN: National Technical Conference, 15th, Cincinnati, OH, October 4-6, 1983, Proceedings . Azusa, CA, Society for the Advancement of Material and Process Engineering, 1983, p. 489-503.

Progress made toward verifying composite performance as a replacement for aluminum avionics chassis in space applications is reported. The critical area was determined to be the electrical resistance of graphite/epoxy (GRE) bond joints and mechanical interfaces. The solution was to attain low contact resistance at the termination of an electrical path between plated nickel and the composite. Hand lay-ups were chosen and a NASTRAN analysis with a finite element model verified the stress behavior. The electrical resistance was found to arise from formation of a thin epoxy resin layer after curing the nickel clad fabric. Although abrading the surface lowered the resistivity, grounding and cable shielding resuirements forced installation of a metal cover grounded with a jumper strap. The GRE chassis is concluded acceptable for space applications and capable of offering a 35 percent weight savings. M.S.K.

A84-42776
KEVLAR EPOXY SUBSTRATE FOR INTERCONNECTING LEADLESS CHIP CARRIER
D. C. PACKARD (General Electric Co., Aerospace Electronic Systems Dept., Utica, NY) IN: National Technical Conference, 15th, Cincinnati, OH, October 4-6, 1983, Proceedings . Azusa, CA, Society for the Advancement of Material and Process Engineering, 1983, p. 636-644. refs

The characteristics of Kevlar cloth reinforced resin matrix (KRM) leadless ceramic chip carrier (LCCC) are described. The KRM boards have been developed to satisfy thermal expansion coefficient (CTE) requirements for the number of temperature cycles defined in military specifications. The CTEs of the multilayer boards had to match CTEs of currently used alumina ceramic boards. Thermal cycle stress tests on the KRM revealed microcracking tendencies but no board failures. KRM board electrical resistivities were equivalent to standard fiber glass reinforced materials. Sealed-off air cooling flows were devised for the boards. Early results indicate that solder joint lives of over 1000 cycles from -65 to 125 C are possible with KRM multilayer boards, which have been assembled in configurations of 8-14 layers. M.S.K.

A84-42778
CHARACTERIZATION OF MY 720 IV
M. CHAUDHARI and J. J. KING (Ciba-Geigy Corp., Ardsley, NY) IN: National Technical Conference, 15th, Cincinnati, OH, October 4-6, 1983, Proceedings . Azusa, CA, Society for the Advancement of Material and Process Engineering, 1983, p. 676-687.

The main focus of this paper is on determining and comparing the long term storage stability and batch to batch reactivity of MY 720 (tetraglycidylated methylene dianiline) and a competitive offset of MY 720. Changes in viscosity and epoxy content after prolonged storage at various temperatures (0, 25, 50 C) have been followed to check stability. Differential scanning calorimetric techniques have been used to check batch to batch reactivity consistency. Initial results indicate that MY 720 is superior in storage stability and has excellent batch to batch consistency. Author

A84-42861
FIBRE-RESIN COMPOSITES - NEW APPLICATIONS AND DEVELOPMENTS; PROCEEDINGS OF THE SEMINAR AND WORKSHOP, UNIVERSITY OF MANCHESTER INSTITUTE OF SCIENCE AND TECHNOLOGY, MANCHESTER, ENGLAND, JUNE 22, 1982
Seminar and Workshop sponsored by the Institution of Mechanical Engineers. London, Mechanical Engineering Publications, Ltd., 1983, 55 p. For individual items see A84-42862 to A84-42866.

The present volume on composite materials developments covers their design methods, including those formulated for glass fiber-reinforced plastic bonded jonts, as well as large area (primary structure) aerospace composite structure fabrication technologies such as those developed for the Jaguar attack aircraft, service experience with carbon fiber-reinforced plastics in aircraft and automotive applications, and filament winding developments for helical reinforcement of pultrusions, tubular shafts, and leaf springs. Also discussed are the use of aramid matrices for carbon-reinforced composites, the development of aramid-reinforced aluminum laminate materials (designated 'ARALL'), and trends in composite materials design in the automotive industry. O.C.

A84-42866
DEVELOPMENT OF A NEW HYBRID MATERIAL (ARALL) FOR AIRCRAFT STRUCTURES
L. B. VOGELESANG (Delft, Technische Hogeschool, Delft, Netherlands) IN: Fiber-resin composites - New applications and developments; Proceedings of the Seminar and Workshop, Manchester, England, June 22, 1982 . London, Mechanical Engineering Publications, Ltd., 1983, p. 40-45. refs

A promising, novel hybrid material for aircraft primary structures is obtainable through the bonding of several thin sheets of aluminum alloy to others of unidirectionally reinforced aramid plastic. This material, aramid-reinforced aluminum laminate (ARALL), has exceptional fatigue crack growth properties and a high tensile yield strength. The results obtained in constant amplitude tests and flight simulation fatigue tests for the cases of lugs, centrally cracked specimens, and bolted and riveted joint specimens, indicate ARALL fatigue properties superior to those of monolithic aluminum alloys. In addition, all advantages of metals over pure composites are retained; for instance, plasticity, impact strength, lightning resistance, and ease of machining. O.C.

A84-43544
THIOCARBAMIDE DERIVATIVES OF 2,6-DI-TERT-BUTYLPHENOL AS JET FUEL STABILIZERS [TIOKARBAMIDNYE PROIZVODNYE 2,6-DI-TRET-BUTILFENOLA-STABILIZATORY REAKTIVNYKH TOPLIV]
I. A. GOLUBEVA, V. S. SHAULOV, and T. P. VISHNIAKOVA (Moskovskii Institut Neftekhimicheskoi i Gazovoi Promyshlennosti, Moscow, USSR) Khimiia i Tekhnologiia Topliv i Masel (ISSN 0023-1169), no. 7, 1984, p. 24-26. In Russian. refs

Jet fuel stabilizers capable of both rupturing peroxide radicals and destroying hydroperoxides can be obtained from dithiocarbamide acid derivatives containing fragments of spatially inhibited phenols. Test results are presented for a series of dithiocarbamide acid derivatives containing fragments of spatially inhibited di-tert-butylphenol. The antioxidation effect of these compounds in jet fuels is discussed as a function of their composition. V.L.

A84-43893#
BALLISTIC TESTING OF COMPOSITE MATERIALS
P. DONNELLY (Boeing Vertol Co., Philadelphia, PA) AIAA Student Journal (ISSN 0001-1460), vol. 21, Winter 1983, p. 5-9. refs

Results of the ballistic testing of composite materials are presented and discussed in connection with military helicopter survivability. The behavior of composites is compared with that of metals on the basis of numerous ballistic tests. It is pointed out that damage to metals results in cracks which have a tendency to propagate, while composites do not show any damage propagation due to low notch sensitivity. Relative fatigue performance of 2024-T3 aluminum vs. S-glass laminate is given and discussed. Honeycomb sandwiches which are used for rotor blades and thick laminates which are used for helicopter structural elements were tested. It is revealed that honeycomb sandwich shows excellent damage tolerance to both armor piercing and high explosive rounds. After the ballistic testing, some components were fatigue tested for several hours with no indication of potential failure. Eight configurations of the thick laminates with longitudinal fibers in an epoxy matrix were prepared: layups made of S-glass, Kevlar, graphite and graphite/S-glass hybrid with and without a section of glass fabric embedded in the coupon lay-up. The test results show that S-glass has the best overall ballistic tolerance. The glass fabric insert limited the splitting and delamination along the fibers. I.R.

A84-44173#
EFFECTS OF METAL FLOW ON FATIGUE STRENGTH AND MECHANICAL PROPERTIES OF ZK60A MAGNESIUM ALLOY FORGING
M. HARADA (Kobe Steel, Ltd., Nagoya Plant, Nagoya, Japan), T. SUZUKI, and I. FUKUI (Kkusi Kogio, Kobe, Japan) Japan Institute of Light Metals, Journal (ISSN 0451-5994), vol. 34, May 1984, p. 265-272. In Japanese, with abstract in English. refs

Effects of metal flow on mechanical properties particularly on fatigue strength of ZK60A forgings were studied. The forgings are the most strong in yield, tensile and fatigue strength in the longitudinal direction and weaken as the loading direction turns to the transverse direction. They have particularly the yield strength so weak as 13 to 15 kgf/sq mm that corresponds to only a half of the strength in the longitudinal direction. The maximum elongation is achieved at angles 45 deg to 60 deg to the metal flow direction. The fatigue strength sigma-W is expressed as a function of tensile strength sigma-B, sigma-W/sigma-B 0.87-0.07 log N. where N is cycles: ZK60A magnesium forgings have a greater effect of metal flow on strength than aluminum alloy and AZ80A magnesium alloy forgings. Author

A84-44930#
ADVANCED MATERIALS IN PERSPECTIVE
R. L. CIRCLE and J. R. CARROLL (Lockheed-Georgia Co., Marietta, GA) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 26-30. refs

A summary of advanced materials is presented from the designer and material supplier point of view through four major areas: a review of the material development process, the potential payoff of advanced materials, new materials, and future requirements of the marketplace. Even though many advanced materials are available, and others are in various development stages, all go through several general steps. These steps are discussed, and the development process is illustrated through several examples. For the near future, materials promise the most significant payoff of any emerging technology. The state of the art of composites and advanced metals is reviewed, and an outline is made of relative advantages and disadvantages. Through the use of materials such as graphite epoxy and advanced aluminum, payoffs to the operator may be maximized. J.P.

A84-45015#
SHORT CRACKS AND CRACK CLOSURE IN AL 2024-T3
D. K. HOLM (Kungl. Tekniska Hogskolan, Stockholm, Sweden) and A. F. BLOM (Flygtekniska Forsoksanstalten, Bromma, Sweden) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 783-790. refs

Short fatigue cracks are known to propagate at rates faster than corresponding long cracks at the same nominal driving force. This anomalous behavior can be considered to arise from a number of different reasons. In this paper it is shown that one significant contribution to the different behavior of short and long cracks is due to plasticity-induced crack closure effects. The effective range of stress intensity factor at short crack lengths is greater than at long crack lengths and crack propagates faster. The analysis is carried out by elastic-plastic finite element calculations for a growing fatigue crack. Author

A84-46339#
SURFACE CRACKING OF QUENCHED AND TEMPERED STEEL BY SHEAR INSTABILITY - CAUSE OF PREMATURE FATIGUE CRACKS IN HELICOPTER MAIN ROTOR SPINDLE LUGS?
G. WOLD (Norske Veritas, Oslo, Norway) and J. SKAAR (Helicopter Service A/S, Stavanger, Norway) IN: American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 140-148. refs

Cases of early fatigue cracking of main rotor spindle lugs made from a quenched and tempered steel have been studied. Experiments have shown that the material in question is prone to surface cracking by shear instability when moderately strained under a multiaxial stress state resembling that of a lug and pin joint. Fatigue testing has shown that the presence of shear instability cracks can lead to rapid, multiple fatigue initiation in a local area, as was observed in the real cases of lug cracking. It is considered that the first step in the initiation of the spindle lug fatigue cracks is some degree of highly local plastic deformation in the lug, triggering microcrack formation by shear instability. Arguments are presented to explain how deformation may have occurred in the critical position of the spindle lug. Author

A84-46344#
MATERIALS DETERIORATION PREVENTION AND CONTROL (MADPAC)
J. T. CONROY and W. M. BAKER (U.S. Army, Aviation Research and Development Command, St. Louis, MO) IN: American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 200-205.

The U.S. Army Aviation Research and Development Command, under the direction of the Army Materiel Development and Acquisition Command, has implemented a program to identify potential and actual materials properties and uses that adversely affect the service life of Army aviation equipment. This paper presents a status of this ongoing effort with specific examples of how the program is implemented and some actual cases which will illustrate the results of 'typical' MADPAC problems and the approaches to the solutions to these problems. A variety of aircraft systems are included which indicates that the topic MADPAC - is not exclusive to any system, manufacturer or user environment. Author

A84-46513
INFLUENCE OF ADIABATIC SHEAR BANDS ON THE FATIGUE STRENGTH OF A TITANIUM ALLOY
S. P. TIMOTHY and I. M. HUTCHINGS (Cambridge University, Cambridge, England) Fatigue of Engineering Materials and Structures (ISSN 0160-4112), vol. 7, no. 3, 1984, p. 223-227. Research supported by Rolls-Royce PLC. refs

An experimental investigation is reported of the possible effects of adiabatic shear bands, caused by projectile impact, on the fatigue strength of a titanium alloy (Ti-6 pct Al-4 pct V). No significant reduction in fatigue strength due to the presence of adiabatic shear bands was found, nor did the fatigue cracks initiate from the bands. The results are relevant to the problem of foreign object impact damage to compressor blades in gas turbine aeroengines. Author

N84-31284*# San Jose State Univ., Calif. Dept. of Chemistry.
CHARACTERIZATION AND DEGRADATION STUDIES ON SYNTHETIC POLYMERS FOR AEROSPACE APPLICATION Final Report, 1 Oct. 1981 - 10 Dec. 1982
M. T. S. HSU Dec. 1982 53 p refs
(Contract NCC2-28)
(NASA-CR-166597; NAS 1.26:166597) Avail: NTIS HC A04/MF A01 CSCL 11B

The anti-misting additive for jet fuels known as FM-9 (proprietary polymer) was characterized by elemental analysis, solubility studies and molecular weight determination. Physical properties of surface tension, viscosity, specific gravity and other physical parameters were determined. These results are compared with properties of polyisobutylene and fuels modified with the same; the misting characteristics of polyisobutylene and FM-9 in Jet A fuel are included. Characterization and degradation of phthalocyanine and its derivatives were accomplished by use of a mass spectrometer and a pyroprobe solid pyrolyzer. Metal phthalocyanine tetracarboxylic acids and phthalocyanine-tetraamine cured epoxies were studied. Epoxy/graphite composite panels were exposed to a NASA-Ames radiant panel fire simulator in the flaming and non-flaming modes; toxic gases of HCN and HZS were measured along with oxygen, Co2, Co, and organic gases. Author

N84-31287*# Lockheed-California Co., Burbank.
FLIGHT SERVICE EVALUATION OF KEVLAR-49 EPOXY COMPOSITE PANELS IN WIDE-BODIED COMMERCIAL TRANSPORT AIRCRAFT Final Annual Flight Service Report
R. H. STONE Jun. 1984 50 p refs
(Contract NAS1-11621)
(NASA-CR-172344; NAS 1.26:172344; FAFSR-10) Avail: NTIS HC A03/MF A01 CSCL 11D

Kevlar-49 fairing panels, installed as flight service components on three L-1011s, were inspected after 10 years of service. There are six Kevlar-49 panels on each aircraft: a left-hand and right-hand set of a wing-body sandwich fairing; a solid laminate under-wing fillet panel; and a 422 K (300 F) service aft engine fairing. The three L-1011s include one each in service with Eastern, Air Canada, and TWA. The fairings have accumulated a total of 79,568 hours, with one ship set having nearly 28,000 hours service. The inspections were conducted at the airlines' major maintenance bases with the participation of Lockheed Engineering. The Kevlar-49 components were found to be performing satisfactorily in service with no major problems, or any condition requiring corrective action. The only defects noted were minor impact damage, a few minor disbonds and a minor degree of fastener hole fraying and elongation. These are for the most part comparable to damage noted on fiberglass fairings. The service history obtained in this program indicates that Kevlar-49 epoxy composite materials have satisfactory service characteristics for use in aircraft secondary structure. Author

N84-31300# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
COMPOSITE STRUCTURE REPAIR
L. G. KELLY (AFWAL) Feb. 1984 24 p refs Presented at the 57th Meeting of the Structures and Materials Panel, Vimeiro, Portugal, 9-14 Oct. 1983
(AD-A141456; AGARD-4-716; ISBN-92-835-1466-1) Avail: NTIS HC A02/MF A01 CSCL 11D

The technology for advanced composite structure repair is presently in a developing stage. The boundaries and limitations of bolted versus bonded repairs and precured patches versus cocured in place patches and their applicability to various types of hardware has yet to be clearly established. This paper does not discuss step by step repair procedures for specific aircraft components, such as defined in repair technical orders, but rather provides general guidelines for repair concepts and discusses two repair configurations that are generic in nature; an external patch and a near flush repair and the extent to which they have been verified in the U.S. These repairs are applicable to a wide variety of light to moderately bonded (up to 25,000 lb/inch) stiffened and honeycomb sandwich structure sustaining damage over a

reasonably large area (up to 100 sq. in.) Also provided are references to documents containing step by step procedures for these repair techniques and identification of organizations in the U.S. actively engaged in advanced composite structure repair.
GRA

N84-31343*# Boeing Commercial Airplane Co., Seattle, Wash.
FLIGHT SERVICE EVALUATION OF TWO ALUMINUM-BRAZED TITANIUM SPOILERS
R. R. BOYER Aug. 1984 48 p refs
(Contract NAS1-13897)
(NASA-CR-172371; NAS 1.26:172371; D6-52046) Avail: NTIS HC A03/MF A01 CSCL 11F

The long-term service evaluation of two aluminum-brazed titanium (ABTi) honeycomb flight spoilers was concluded. The two spoilers had about 7.5 years of commercial flight experience on All Nippon Airways Model 737 aircraft. All Nippon Airways was selected because Japan has one of the most severe marine-industrial environments in the world. The results indicated that both flight spoilers still had the same load-carrying capability as when they were originally installed. No direct evidence of any corrosion was observed on either spoiler. Another significant accomplishment of this effort was the development of a braze design for efficiently distributing point loads from the fittings and skin into the honeycomb core.
Author

N84-31363# Pratt and Whitney Aircraft Group, West Palm Beach, Fla. Government Products Div.
BEHAVIOR OF NI-CR-SI COATING ALLOYS IN NA2SO4, V2O5 AND MIXED SALT HOT CORROSION Final Report
R. G. COREY, A. S. KHAN, R. H. BARKALOW, and R. J. HECHT 1 Oct. 1983 52 p refs
(Contract DE-AC06-79ET-15322)
(DE84-012386; DOE/ET-15322/T6; FR-15738) Avail: NTIS HC A04/MF A01

This report describes the results of a program to select coating alloys that are resistant to vanadium- and sulfate-induced hot corrosion and solid particle erosion in the 700 to 900 C temperature range. Test materials, methods, and results are discussed. The principal alloy coatings that were tested were high-chromium, nickel-base alloys with additions of silicon, aluminum, and tantalum.
DOE

N84-31406# American Defense Preparedness Association, Washington, D. C.
ANNUAL MEETING OF THE PYROTECHNICS AND EXPLOSIVES APPLICATIONS SECTION ON THE AMERICAN DEFENSE PREPAREDNESS ASSOCIATION
29 Sep. 1983 289 p Meeting held at Fort Worth, Tex., 27-29 Sep. 1983
(AD-A143157; AD-E750921) Avail: NTIS HC A13/MF A01 CSCL 19A

Proceedings of the Annual Meeting of the Pyrotechnics and Explosives application section on the American Defense Preparedness association are presented. Topics of discussion include: Pod Separation System; Forward and Aft Separation Bolts for the NASA Shuttle Solid Rocket Separation System; Use of TLX Energy Transfer Lines on the F-16 Aircraft; The Mathematical Foundation for the 'Ridge-Cut' Technique Used in Explosive Bolts; Nonprimary-Explosive, Hot-Wire Detonator; Environmental Assessment of Smoke and Obscurant Pyrotechnic Materials; Visible Spectra of Standard Navy Colored Flares; A Low Energy Rocket Motor (LERM) for Use With Smoke Countermeasure Projectiles; Sprays and Submunitions - Two concepts for the 81 mm smoke cartridge; Electrostatic and Electromagnetic Resistant Blasting Caps, Squibs and Cartridges, Use of High Pressure Water Jets to Wash Out Explosives; A Scientific Method of Determining the Useful Life of Explosive Devices in Aircraft; U.S. Army Pyrotechnic Safety Enhancement Program - Pyrotechnic protective clothing; Controlled Fragmentation of Tapered Cylinders; and Development of a 35-Second Delay Cutter for the SRB Parachute.
GRA

N84-32434 Department of the Air Force, Washington, D.C.
LOW COST THERMAL PROTECTION SYSTEM PROCESSING Patent
R. V. KROMREY, inventor (to Air Force) 15 May 1984 7 p
Supersedes AD-D009573
(AD-D011142; US-PATENT-4,448,742; US-PATENT-APPL-SN-370233; US-PATENT-CLASS-264-270)
Avail: US Patent & Trademark Office CSCL 13H

A method and apparatus for spin casting a castable material into a cylindrical body. The method comprises the steps of rotating an elongated cylindrical body about its longitudinal axis, applying an extrudable uncured material as a continuous stram in helical fashion from one point in the body to another point, continuing to rotate the body until the material is leveled and at least partially curing the material while continuing to rotate the body. The apparatus comprises means for holding and spinning an elongated cylindrical body, and extruder means for providing a continuous stream of an extrudable uncured material in a desired fashion along the inside of the cylindrical body.
Author (GRA)

N84-32504*# United Technologies Corp., East Hartford, Conn. Engineering Div.
MATERIALS FOR ADVANCED TURBINE ENGINES (MATE): PROJECT 3: DESIGN, FABRICATION AND EVALUATION OF AN OXIDE DISPERSION STRENGTHENED SHEET ALLOY COMBUSTOR LINER Final Report
R. J. HENRICKS and K. D. SHEFFLER Feb. 1984 274 p refs
(Contract NAS3-20072)
(NASA-CR-174691; NAS 1.26:174691; PWA-5574-175) Avail: NTIS HC A12/MF A01 CSCL 11F

The suitability of wrought oxide dispersion strengthened (ODS) superalloy sheet for gas turbine engine combustor applications was evaluated. Incoloy MA 956 (FeCrAl base) and Haynes Developmental Alloy (HDA) 8077 (NiCrAl base) were evaluated. Preliminary tests showed both alloys to be potentially viable combustor materials, with neither alloy exhibiting a significant advantage over the other. Both alloys demonstrated a +167C (300 F) advantage of creep and oxidation resistance with no improvement in thermal fatigue capability compared to a current generation combustor alloy (Hastelloy X). MA956 alloy was selected for further demonstration because it exhibited better manufacturing reproducibility than HDA8077. Additional property tests were conducted on MA956. To accommodate the limited thermal fatigue capability of ODS alloys, two segmented, mechanically attached, low strain ODS combustor design concepts having predicted fatigue lives or = 10,000 engine cycles were identified. One of these was a relatively conventional louvered geometry, while the other involved a transpiration cooled configuration. A series of 10,000 cycle combustor rig tests on subscale MA956 and Hastelloy X combustor components showed no cracking, thereby confirming the beneficial effect of the segmented design on thermal fatigue capability. These tests also confirmed the superior oxidation and thermal distortion resistance of the ODS alloy. A hybrid PW2037 inner burner liner containing MA956 and Hastelloy X components was designed and constructed.
Author

N84-32529 Department of the Air Force, Washington, D.C.
PERFLUOROALKYLETHER SUBSTITUTED PHENYL PHOSPHINES Patent
C. TAMBORSKI, C. E. SNYDER, JR., and J. B. CHRISTIAN, inventors (to Air Force) 12 Jun. 1984 4 p
(AD-D011122; US-PATENT-4,454,349; US-PATENT-APPL-SN-418115; US-PATENT-CLASS-568-13)
Avail: US Patent & Trademark Office CSCL 07C

Fluorinated phosphines having the general formula wherein ROR is a perfluoroalkylether group containing at least one ether linkage are useful as antioxidation additives for perfluorinated fluids.
GRA

N84-32535*# Chem Tronics, Inc., El Cajon, Calif.
RIGID CLOSED-CELL POLYIMIDE FOAMS FOR AIRCRAFT APPLICATIONS AND FOAM-IN-PLACE TECHNOLOGY Final Report, 1 Jul. 1982 - 1 Jul. 1984
J. GAGLIANI, P. STRAUB, and J. GAGLIANI, JR. 1983 47 p refs
(Contract NAS9-16657)
(NASA-CR-171805; NAS 1.26:171805) Avail: NTIS HC A03/MF A01 CSCL 11B

Significant accomplishments generated are summarized. Testing of closed cell foams, which has resulted in the characterization of compositions which produce rigid foams for use in galley structure applications is reported. It is shown that the density, compressive strength and shear strength of the foams are directly related to the concentrations of the microballoons. The same properties are also directly related to the resin loading. Prototype samples of rigid closed cell foams meeting the requirements of the program were submitted. Investigation of the apparatus to produce polyimide foams using foam in place techniques, resulted in the selection of a spray gun apparatus, capable to deliver a mixture of microballoons and resin binder on substrates which cures to yield a closed cell foam. It is found that the adhesion of the foam on aluminum, titanium and steel substrates is satisfactory. It is concluded that the material meets the mechanical and thermal requirements of the program. E.A.K.

N84-32552*# Utah Univ., Salt Lake City.
CARBON-13 AND PROTON NUCLEAR MAGNETIC RESONANCE ANALYSIS OF SHALE-DERIVED REFINERY PRODUCTS AND JET FUELS AND OF EXPERIMENTAL REFEREE BROADENED-SPECIFICATION JET FUELS Final Report
D. K. DALLING, B. K. BAILEY, and R. J. PUGMIRE Sep. 1984 98 p refs
(Contract NAG3-27)
(NASA-CR-174761; NAS 1.26:174761) Avail: NTIS HC A05/MF A01 CSCL 21D

A proton and carbon-13 nuclear magnetic resonance (NMR) study was conducted of Ashland shale oil refinery products, experimental referee broadened-specification jet fuels, and of related isoprenoid model compounds. Supercritical fluid chromatography techniques using carbon dioxide were developed on a preparative scale, so that samples could be quantitatively separated into saturates and aromatic fractions for study by NMR. An optimized average parameter treatment was developed, and the NMR results were analyzed in terms of the resulting average parameters; formulation of model mixtures was demonstrated. Application of novel spectroscopic techniques to fuel samples was investigated. Author

N84-32553# Naval Research Lab., Washington, D. C.
LIQUID AND SOLID PHASE COMPOSITIONS IN A PARTIALLY FROZEN JP-5 FUEL LOW IN N-ALKANES Memorandum Report, Apr. 1983 - Jan. 1984
T. L. VANWINKLE, R. N. HAZLETT, E. J. BEAL, and G. W. MUSHRUSH 27 Jun. 1984 19 p
(Contract F65-571)
(AD-A143390; AD-E400961; NRL-MR-5357) Avail: NTIS HC A02/MF A01 CSCL 21D

A JP-5 low in n-alkanes was partially frozen at several temperatures 9 to 15 C below its normal freezing point of -53 C. In spite of their low concentrations in the starting fuel, the n-alkanes were the predominant components in the solid phase crystallizing from the fuel. In this respect, this JP-5 behaves in a fashion similar to other jet fuels which contain 3 to 5 times the amounts of n-alkanes. Author (GRA)

N84-33142# Joint Publications Research Service, Arlington, Va.
SWEDISH RESEARCH IN HIGH-TEMPERATURE CERAMICS, SUPERALLOYS
U. BERGMARK *In its* West Europe Rept.: Sci. and Technol. (JPRS-WST-84-030) p 1-5 7 Sep. 1984 Transl. into ENGLISH from NY Tek. (Stockholm), 26 Apr. 1984 p 34-35
Avail: NTIS HC A04/MF A01

Fuel-efficient and wear-resistant jet engines for aircraft are sought. In theory, it is easy to construct: just use higher pressure and temperatures in the engines. Unfortunately, the present knowledge of materials places certain temperature restrictions on the engines. Energy savings seem possible with the use of a thin layer of ceramic materials, such as zirconium dioxide. A method of adhesive bonding (plasma spraying of MCrAlY alloy to the turbine blade) is needed to make the ceramic stick. Also considered are jet engines made of heat resistant materials that need no coating. B.G.

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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.

A84-42757
THE ROLE OF MATERIALS AND PROCESSES IN HIGH DENSITY ELECTRONIC PACKAGING
P. R. JONES (P. R. Jones Engineering Co., Cedar Rapids, IA) IN: National Technical Conference, 15th, Cincinnati, OH, October 4-6, 1983, Proceedings . Azusa, CA, Society for the Advancement of Material and Process Engineering, 1983, p. 385-391.

Problems encountered by packaging engineers in applications of current miniaturized components and methods for electronics components are surveyed. Attention is focused on mass vapor phase soldering of pins into back planes. The process was ameliorated by the advent of CAD techniques as the layout per square inch increased. Location of components end-to-end simplified the process and improved circuit reliability. Tolerances were reduced to 0.03 in. separation, which required retooling the 0.1 in. standard test grids. Chip carriers with up to 64 leads were then devised and withstood 1000 cycles from -55 to 125 C without failure. The new process forced the integration of chip and board assembly operations. Studies are still required for quantifying the actual cost savings (if any) of the whole process. M.S.K.

A84-42761
WELDBOND PRODUCTION PROCESS TECHNOLOGY
S. G. LEE (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH), R. L. RUPP, A. SHAMES (Fairchild Republic Co., Farmingdale, NY), and T. CROUCHER IN: National Technical Conference, 15th, Cincinnati, OH, October 4-6, 1983, Proceedings . Azusa, CA, Society for the Advancement of Material and Process Engineering, 1983, p. 438-448. refs

Weldbonding consists of the chemical processing of structural elements to provide the most effective surface for subsequent adhesive bonding. Once the adhesive has been applied and the structural elements fixtured by computer-controlled spot welding, the assembly is cured. Five different fuel cell access panels fabricated by means of an optimized weldbond process are installed on A-10 aircraft, totalling 1500 assemblies in the course of aircraft production. These panels will be periodically inspected in order to assess their durability. To this end, an Aerospace Recommend Practice for weldbonding (number 1675) has been submitted to the SAE for approval. O.C.

A84-43574
MAGNETIC LEVITATION - THE TRACK CURRENTS
J. VAN BLADEL and D. DE ZUTTER (Gent, Rijksuniversiteit, Ghent, Belgium) Applied Physics B - Photophysics and Laser Chemistry (ISSN 0721-7269), vol. B34, Aug. 1984, p. 193-201. refs

An infinitely long wire carrying a direct current I moves parallel with a conducting plate of thickness d. The motion is at right angles to the current. A relativistic formulation is used to obtain the lift and drag forces on the primary current I, and the distribution of currents induced in the track. Extensive numerical data are provided, especially on the track currents. Author

A84-43615
POLYGONAL PLATE MODELING OF REALISTIC STRUCTURES
E. H. NEWMAN, P. ALEXANDROPOULOS, and E. K. WALTON (Ohio State University, Columbus, OH) IEEE Transactions on Antennas and Propagation (ISSN 0018-926X), vol. AP-32, July 1984, p. 742-747. Research supported by the Ohio State University Research Foundation. refs
(Contract N00014-78-C-0049)

The effectiveness of method of moments (MM) surface patch modeling for describing realistic structures is demonstrated, as is a technique for analyzing the intersection of several plates or patches. Surface patch MM models consider perfectly conducting surfaces, thus allowing computerized studies of hundreds of modes in terms of a small number of plates. An electric field formulation applicable to both closed and open surfaces is employed with a scale model or drawing of an aircraft structure. Plates intersecting along edges involve continuity of the normal component of current at the juncture. Overlap modes are defined that permit current to flow from one plate to another but do not permit linear dependencies between the modes. Examples are given for radar cross sections of the 747, the Concorde and a rocket and verified with reference to an available data base. M.S.K.

A84-43686#
HARMONIC RADAR CROSS-SECTION OF BISTATIC NONLINEAR RESPONDER
O. M. BUCCI, A. DE BONITATIBUS, and I. PINTO (Napoli, Universita; Istituto Universitario Navale, Naples, Italy) Alta Frequenza (ISSN 0002-6557), vol. 53, May-June 1984, p. 172-176. Research sponsored by the Consiglio Nazionale delle Ricerche. refs

Nonlinearly loaded antennas could be employed in a number of applications. Examples of such applications are related to anticollision aids in freeway traffic control and aircraft landing operations and ground station components in solar power satellite systems. The present investigation is concerned with the results of measurements regarding a microwave bistatic responder operating in the G-band (3.95-5.85 GHz). The receiving and transmitting horns of the responder form an angle of approximately 67 deg. The experimental results obtained with the responder are compared with theoretical values computed on the basis of a Volterra series solution considered by Franceschetti and Pinto (1980). The agreement between theory and experimental values demonstrates both the accuracy of the model and the efficiency of the mathematical method. G.R.

A84-43935
PRESSURE LOSSES IN GAS FLOWS IN CYLINDRICAL DUCTS WITH FRICTION AND HEATING [POTERI DAVLENIIA PRI TECHENII GAZA V TSILINDRICHESKOM KANALE S TRENIEM I PODOGREVOM]
V. E. REZNIK, V. P. DANILCHENKO, G. M. GORELOV, and A. A. ALEKSANDROV Energetika (ISSN 0579-2983), July 1984, p. 97-100. In Russian. refs

A simple but sufficiently accurate method of calculating pressure losses in ducts is required for the efficient design analysis of the heat-exchanges of gas turbine engines. An approximate solution to the problem of determining gas parameters is presented here for the general case of specific heat flux variation along the length of a duct. The results obtained using the approach proposed here are shown to be accurate to within 1-2 percent, which is sufficient for preliminary design studies. V.L.

A84-44046#
MUSHROOMING VULNERABILITY TO EMP
E. J. LERNER Aerospace America (ISSN 0740-722X), vol. 22, Aug. 1984, p. 74-78.

The electromagnetic pulse (EMP) generated by a single thermonuclear bomb detonated above the continental U.S. could set up electrical fields of 50 kV/m over nearly all of North America. Since the progressively microminiaturized integrated circuits of current military and civilian electronics become more vulnerable with decreasing circuit element size, even shield-protected chips can now be destroyed by the substantially shield-dampened EMP pulses. It is noted as a source of special concern that, as nuclear weapons have evolved, the EMP characteristically generated by them has shifted to increasingly shorter wavelengths, requiring significant redesign of EMP shields devised a decade or more ago. The surge arresters currently employed may not react sufficiently rapidly for existing weapons. O.C.

A84-44516#
IMPROVED DAMAGE-TOLERANCE ANALYSIS METHODOLOGY
J. B. CHANG (Rockwell International Corp., Los Angeles, CA) and R. M. ENGLE (USAF, Wright-Patterson AFB, OH) (Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Technical Papers. Part 1, p. 224-236) Journal of Aircraft (ISSN 0021-8669), vol. 21, Sept. 1984, p. 722-730. Previously cited in issue 12, p. 1738, Accession no. A83-29751. refs
(Contract F33615-77-C-3121)

A84-44650#
STEADY-STATE RESPONSE OF VIBRATING SYSTEMS TO PERIODIC PULSE EXCITATION
R. B. BHAT (Concordia University, Montreal, Canada) AIAA Journal (ISSN 0001-1452), vol. 22, Sept. 1984, p. 1340-1342. Sponsorship: National Research Council of Canada.
(Contract NRC A-1375)

A closed-form expression is derived for the steady-state response of systems subject to periodic pulse excitations, e. g., machines and structures. An equation of motion is formulated for a simple vibrating system and conditions are defined for the system response in a particular interval. The responses are then characterized for each term in a Fourier expansion of a force function. A convolution integral and a Laplace transformation are obtained for describing the responses, which contain decaying oscillations at the resonance frequency of the system, for a damped system, and at the natural frequency for an undamped system. M.S.K.

A84-45001#
NONDESTRUCTIVE TEST METHOD FOR DETERMINING THE CRITICAL PRESSURE ON THE INSIDE PANELS OF A FUSELAGE FUEL TANK
H. CHEN, W. LI, H. RONG, M. SONG, and S. FAN (Aircraft Strength Research Institute, People's Republic of China) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 665-668. refs

A nondestructive test method is presented for determining critical loads of actual shell structures under external pressure. It is a step-by-step method using the normal deflection of shell structures as a control variable. The nondestructive buckling tests on the inside panels of four fuel tank in an airplane fuselage were carried out by using the method presented by authors. The critical pressures for local buckling and general instability of the shells were exactly determined. The test results show that the nondestructive buckling test method is successful. Author

A84-45018#

CAD/CAM IN THE BRAZILIAN AERONAUTICAL INDUSTRY [LA CAO/FAO DANS L'INDUSTRIE AERONAUTIQUE BRESILIENNE]

L. H. LAMPI (Empresa Brasileira de Aeronautica, S.A., Sao Jose dos Campos, Sao Paulo, Brazil) and S. A. EMBRAER IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 811-814. In French.

Features, applications and progress in the usage of CAD/CAM since 1980 by an aircraft manufacturer in Brazil are described. The system comprises 34 graphics work stations dedicated to structural design, lofting, electrical cable routing, finite element modeling and quality control. Standardized work methods have been devised to enhance productivity. Programs have been defined for finite element stress analysis and generating wiring diagrams. The computerized design capabilities have increased productivity for hole boring accuracy through work on digitized controllers. Psychological testing has been initiated to identify users who can adapt more easily to CAD/CAM utilization. M.S.K.

A84-45048#

PRODUCTIVITY IMPROVEMENTS THROUGH THE USE OF CAD/CAM

M. D. WEHRMAN (Boeing Commercial Airplane Co., Seattle, WA) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 1079-1084.

This paper focuses on Computer Aided Design/Computer Aided Manufacturing (CAD/CAM) productivity improvements that occurred in the Boeing Commercial Airplane Company (BCAC) between 1979 and 1983, with a look at future direction. Since the introduction of numerically controlled machinery in the 1950s, a wide range of engineering and manufacturing applications has evolved. The main portion of this paper includes a summarized and illustrated cross-section of these applications, touching on benefits such as reduced tooling, shortened flow time, increased accuracy, and reduced labor hours. The current CAD/CAM integration activity, directed toward capitalizing on this productivity in the future, is addressed. Author

A84-45057#

STRUCTURAL OPTIMIZATION WITH NON LINEAR CONSTRAINTS

L. BARTHE, F. DIEU, PB. GIBERT (ONERA, Chatillon-sous-Bagneux, Hauts-de-Seine, France), R. LACOMBE, and J. LOCATELLI (Societe Nationale Industrielle Aerospatiale, Toulouse, France) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 1156-1171. refs

Analytical tools are presented for optimizing the structure of a commercial transport aircraft and configuring controls for the static and dynamic behavior. The techniques are intended for ensuring a lowest possible cost for the aircraft while the final configuration is still in formation. The structure is analyzed with pre-stressing models to identify appropriate components for stress testing. The components are modeled at both parts and sub-assembly levels, with inclusion of a 'no flutter' provision in the analyses. The problem is governed by technological, static and dynamic, eigenfrequency and aerodynamic constraints. State equations are defined for a finite element discretization. Sample calculations are performed for characterizing modal eigenfrequencies and a twin engine wing. M.S.K.

A84-45058#

OPTIMIZATION OF HYBRID LAMINATED COMPOSITE PLATES

N. G. R. IYENGER and J. R. UMERATIYA (Indian Institute of Technology, Kanpur, India) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 1172-1178. refs

An attempt is made to obtain an optimum weight design of hybrid laminated composite plates made of boron/epoxy and Kevlar/epoxy laminae. The study is conducted on antisymmetric angle-ply laminated rectangular and skew plates with one pair of opposite edges clamped and the other two edges simply supported. The plate is analyzed using the Galerkin-Vlasov technique by approximating the displacements employing beam characteristic and trigonometric functions. For optimization studies a sequential augmented Lagrangian method which in turn uses a quasi-Newton method is employed. It is observed that the hybrid laminates have deflections which are in between that for a single material laminate. The optimum weight per unit area of the plate for differing aspect ratios increases for both uniform and varying loads. Author

A84-45059#

COMPOSITE ELEMENTS IN STRUCTURAL OPTIMIZATION-INVESTIGATIONS ON OPTIMALITY CRITERIA AND MATHEMATICAL METHODS

D. W. MATHIAS, G. HORNUNG, and H. ROEHRLE (Dornier GmbH, Friedrichshafen, West Germany) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 1179-1187.

A fully stressed design and a gradient method are discussed for optimizing a fiber-reinforced wing. The goal of the analyses is to identify a minimum weight component which satisfies failure criteria. Attention is given to a quasi-isotropic composite with a fixed layer ratio and an anisotropic composite involving single layer optimization. The fully stressed method is a function of the stress/design variable ratio and converges quickly for a statically determinate structure. The gradient technique features piecewise linearization with account taken of reserve factors and the structural weight. Both techniques can allow for constraints in terms of stresses, acceleration forces, flutter, stiffness, etc. M.S.K.

A84-45060#

WEIGHT MINIMIZATION OF ORTHOTROPIC RECTANGULAR FLAT PANELS SUBJECTED TO A FLUTTER SPEED CONSTRAINT

L. LIBRESCU and L. BEINER (Tel Aviv University, Tel Aviv, Israel) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 1188-1196. refs

A theoretical model for minimizing the weight of orthotropic, rectangular outer panels on a supersonic aircraft is presented. The panels are assumed to have a flutter speed constraint and be subject to in-plane loadings. The theory of optimal control of distributed parameter systems is used to configure the optimality equations in conjunction with the Plaut instability condition (1972), which serves to characterize the optimal flutter frequency parameter. The Galerkin method is employed to solve the equations to obtain rough estimates of the optimal panel designs. Sample calculations show, e.g., that the mass ratio of optimal panels is independent of spanwise in-plane loads, clamping streamwise edges saves weight and critical flutter parameters increase with the orthotropy ratio, tensile in-plane loads and inverse aspect ratio. M.S.K.

A84-45202#

A SUB-DOMAIN APPROACH FOR THE COMPUTATION OF COMPRESSIBLE INVISCID FLOWS

J.-P. VEUILLOT and L. CAMBIER (ONERA, Chatillon-sous-Bagneux, Hauts-de-Seine, France) (Institut National de Recherche en Informatique et en Automatique, Journee sur les Methodes Numeriques pour les Equations d'Euler pour les Fluides Compressibles non Visqueux, Rocquencourt, Yvelines, France, Dec. 7-9, 1983) ONERA, TP, no. 1984-61, 1984, 21 p. refs

(ONERA, TP NO. 1984-61)

A sub-domain approach for the computation of inviscid flows is proposed within the framework of pseudo-unsteady methods. A general matching technique of two perfect fluid sub-domains is presented in the case where the systems of equations solved in each sub-domain are hyperbolic with respect to time. This technique is based on the interpretation of selected compatibility relations as transport equations. The proposed method provides a solution to the problem of fitting discontinuities (shocks and wakes). Numerical applications are presented for realistic 2D problems. Author

A84-45208#

INHOMOGENEOUS FLOW CALCULATIONS BY SPECTRAL METHODS MONO-DOMAIN AND MULTI-DOMAIN TECHNIQUES

Y. MORCHOISNE (ONERA, Chatillon-sous-Bagneux, Hauts-de-Seine, France) (Workshop on Spectral Methods, Hampton, VA, Aug. 16-18, 1984) ONERA, TP, no. 1984-67, 1984, 29 p. refs

(ONERA, TP NO. 1984-67)

Geometric complexity ant time scheme accuracy are important factors in spectral methods for inhomogeneous flow calculations. A spectral expansion in time is presently proposed for time scheme accuracy improvements, together with monodomain and multidomain mapping techniques for complex geometries. Four cases are treated: (1) a square domain with stream function formulation and spectral time derivatives; (2) a cubic or square domain with velocity-pressure formulation and spectral time derivatives; (3) a square duct with velocity-pressure formulation and finite difference time derivatives; and (4) an airfoil with velocity-pressure formulation, finite difference time derivatives, and a multidomain technique. O.C.

A84-45491

HIGH SPEED INTERFEROMETRIC METHOD FOR DENSITY FIELD INVESTIGATION IN A BOUNDARY LAYER BEHIND THE SHOCK WAVE

A. A. KONKOV, E. A. KOZIUKOV, and V. I. BUMBLIS (Akademiia Nauk SSSR, Institut Vysokikh Temperatur, Moscow, USSR) IN: International Congress on High Speed Photography and Photonics, 15th, San Diego, CA, August 21-27, 1982, Proceedings. Part 1 . Bellingham, WA, SPIE The International Society for Optical Engineering, 1983, p. 539-543. refs

An interferometric method for measuring the density profile in the hypervelocity flow behind a shock wave is presented and applied. The experimental apparatus comprises a Mach-Zehnder interferometer; a spectrometer equipped with a high-speed rotating-mirror camera providing up to 300 frames at exposure times 0.5-2.0 microsec, corresponding to 100,000 to 4 million frames/sec; a 4000-K-blackbody 200-microsec-pulse light source; and an Ar-laser calibration source. The operating principle and interferogram processing techniques are explained, and results are shown for the boundary layer behind a 10-km/sec shock wave produced by a 22-m-long 100-mm-diameter explosion shock tube and incident on a sharp flat plate. The error in the Delta rho (y) determination is found to be less than 8 percent. T.K.

A84-45497

APPLICATION OF PULSED LASER HOLOGRAPHY TO NONDESTRUCTIVE TESTING OF AIRCRAFT STRUCTURES

H. FAGOT, P. SMIGIELSKI (Saint-Louis, Institut Franco-Allemand de Recherches, Saint-Louis, Haut-Rhin, France), and J.-L. ARNAUD (*SocieteNationale Industrielle Aerospatiale, Laboratoire Central*, Suresnes, Hauts-de-Seine, France) IN: International Congress on High Speed Photography and Photonics, 15th, San Diego, CA, August 21-27, 1982, Proceedings. Part 2 . Bellingham, WA, SPIE The International Society for Optical Engineering, 1983, p. 602-607. Research supported by the Direction des Recherches, Etudes et Techniques. refs

Subsequent to laboratory tests, experiments were conducted on an aircraft undergoing maintenance in order to assess the possible uses of holographic interferometry for nondestructive testing of large aircraft structures. A double ruby laser was used, delivering two pulses with a duration of 20 ns each. The two pulses are separated by an arbitrary time interval Delta-t which is determined as a function of both the amplitude and frequency of the surface displacement. Shocks of the order of 100 mJ cause the structure under investigation to vibrate, the time interval Delta-t thereby ranging from 10 to 100 microsec for a delay of a few millisec after shock initiation. The method used is relatively insensitive to environmental disturbances. Although the laser delivers pulses of light of less than 100 mJ in energy, it is possible to visualize a field of 0.5 x 1 m. Some results will be reported which have been obtained at the lower surface of an airfoil, on a wheel well, and on an air-brake. Finally, a brief review will be made on the improvements envisaged on both the laser and the recording method in order to obtain an operational system for holographic nondestructive testing. Author

A84-45517

MEASURING THE FLUTTER OF PLANE MODEL WITH DYNAMIC SHADOW MOIRE TOPOGRAPHY

M. WU and S. NI (Zhejiang University, Hangzhou, People's Republic of China) IN: International Congress on High Speed Photography and Photonics, 15th, San Diego, CA, August 21-27, 1982, Proceedings. Part 2 . Bellingham, WA, SPIE The International Society for Optical Engineering, 1983, p. 924-930.

This paper describes an optical method for measuring the flutter of a plane model with a dynamic shadow moire topography. Computational formulas are proposed, their errors are discussed, and the method of the test device are also presented. Position-amplitude and the test time-amplitude curves are shown. The results of the measurements are compared in accuracy with the contact measurement using acceleration sensors. Both are very approximate. Author

A84-45584#

INSTABILITIES OF A GYROSCOPE PRODUCED BY RAPIDLY ROTATING, HIGHLY VISCOUS LIQUIDS

W. P. DAMICO, JR. (U.S. Army, Ballistics Research Laboratory, Aberdeen Proving Ground, MD) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 7, July-Aug. 1984, p. 443-449. Previously cited in issue 07, p. 1074, Accession no. A81-20687. refs

A84-45698#

A METHOD FOR MACHINING METAL AIRSCREWS ON A LATHE [ZASTOSOWANIE TOKARKI DO OBROBKI METALOWYCH SMIGIEL LOTNICZYCH]

J. KAPCIA and R. ROWINSKI Instytut Lotnictwa, Prace (ISSN 0509-6669), no. 95, 1983, p. 3-15. In Polish. refs

The present state of Polish production methods for propeller blades is discussed, and the history of propeller production techniques in Poland is reviewed. An elliptical approximation for machining an airfoil section is proposed. The possibility of using a machine tool normally used for convex profiles of steam turbine blades is also considered. An electromechanical method for finishing aircraft propellers is also proposed, and is described in a series of drawings and black and white photographs. I.H.

A84-45700#
A QUASI-PHASE TORQUE METER [MOMENTOMIERZ QUASI-FAZOWY]
M. MLYNARCZYK, Z. SZYMANSKI, and S. WASKO Instytut Lotnictwa, Prace (ISSN 0509-6669), no. 95, 1983, p. 25-43. In Polish. refs

Operational principles are described and the results of laboratory tests of a quasi-phase torque meter for continuous measurement driveshaft torque in helicopters are reported. The device is based on a pulse position modulated electric pulsating process and is composed of two MF-100 torque transducers and an electronic measuring block. Laboratory tests showed that the accuracy of the device under typical operating conditions is high and that for some loss of accuracy it is possible to measure torque within a wide range of rotational speeds and temperatures. The meter can also be used for several high-power industrial applications as a device for measuring and limiting the torque transmitted by a shaft. I.H.

A84-45707
CERTAIN CASES OF WING PLANFORM OPTIMIZATION ON THE BASIS OF STRENGTH CONDITIONS [O NEKOTORYKH SLUCHAIAKH OPTIMIZATSII FORMY KRYLA V PLANE PO USLOVIIAM PROCHNOSTI]
G. V. UKRAINTSEV and V. M. FROLOV TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 14, no. 1, 1983, p. 57-65. In Russian. refs

The possibility of minimizing the weight of a wing through an optimization of its planform with respect to the static strength is investigated. An optimization procedure suitable for the initial stage of design is proposed and illustrated by examples. The approach proposed here provides simple analytical expressions for determining the principal design parameters corresponding to a specified static strength. Two optimized wing geometries are presented. V.L.

A84-45708
AN APPLICATION OF THE FINITE ELEMENT METHOD TO THE LOCAL STRENGTH ANALYSIS OF THE STRUCTURAL ELEMENTS OF AIRCRAFT [PRIMENENIE METODA KONECHNYKH ELEMENTOV K ISSLEDOVANIIU MESTNOI PROCHNOSTI ELEMENTOV AVIATSIONNYKH KONSTRUKTSII]
V. I. BARYSHNIKOV, V. I. GRISHIN, V. IU. DONCHENKO, and IU. V. TIKHONOV TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 14, no. 1, 1983, p. 66-73. In Russian. refs

A unified approach has been developed for the analysis of the local strength of structural elements including stress-strain analysis, determination of plastic strain, and calculation of stress intensity factors at crack tips. The approach proposed here has been implemented in a set of application software for the strength analysis of aircraft structures with service-related damage. Results obtained for a spar attachment fitting, a ribbed panel, and a bolted joint are presented. V.L.

A84-45710
AN APPROXIMATE CALCULATION OF STRESS INTENSITY FACTORS IN THE JOINTS OF AIRCRAFT STRUCTURES [PRIBLIZHENNYI RASCHET KOEFFITSIENTA KONTSENTRATSII NAPRIAZHENII V SOEDINENIIAKH AVIATSIONNYKH KONSTRUKTSII]
N. S. GALKINA and V. I. GRISHIN TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 14, no. 1, 1983, p. 85-93. In Russian. refs

A method based on the principle of superposed solutions is proposed for calculating stress intensity factors in structural joints, particularly, around loaded holes. The method employs a finite element algorithm in displacements based on two- and three-dimensional elasticity equations. The effect of geometrical parameters and static boundary conditions on stress intensity factors around holes is examined. An analysis is made of stress distribution in the joints of wing panels. V.L.

A84-45717
AN AUTOMATION OF THE TOPOLOGICAL DESCRIPTION OF THE SCHEMATIC ARRANGEMENTS OF LOAD-BEARING STRUCTURES [AVTOMATIZATSIIA TOPOLOGICHESKOGO OPISANIIA RASCHETNYKH SKHEM SILOVYKH KONSTRUKTSII]
V. N. SEMENOV TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 14, no. 1, 1983, p. 121-127. In Russian. refs

A method for the compact topological description of the schematic arrangements of load-bearing structures has been developed and implemented in computer software. Algorithms for the development of compact initial information and its conversion to a set of topological data for a finite-element design analysis are presented. The efficiency of the program is demonstrated by using it to design a bulkhead substructure containing surface membranes, longitudinal bars, and transverse beam elements. V.L.

A84-45718
DETERMINATION OF CREEP DEFORMATIONS UNDER UNSTEADY HEATING AND LOADING [OPREDELENIE DEFORMATSII POLZUCHESTI V USLOVIIAKH NESTATSIONARNOGO NAGREVA I NAGRUZHENIIA]
N. V. BIRIUKOV, S. N. IVANOV, and E. L. SANKOVICH TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 14, no. 1, 1983, p. 128-132. In Russian.

A procedure for calculating creep deformations in materials under unsteady heating and loading has been developed in which experimental creep curves are input in a computer in the form of a table and interpolated using cubic splines. The analysis is based on the theory of strain hardening. The procedure is applied to 12Kh18N10T steel, and the results obtained are found to be in good agreement with experimental data. V.L.

A84-45725
THE USE OF THE PERTURBATION METHOD FOR DETERMINING THE OPTIMUM DISTRIBUTION OF THE LOAD-BEARING MATERIAL IN SWEPT WINGS [PRIMENENIE METODA VOZMUSHCHENII DLIA OTYSKANIIA OPTIMAL'NOGO RASPREDELENIIA SILOVOGO MATERIALA V STRELOVIDNYKH KRYL'IAKH]
A. V. ALBUL, N. V. BANICHUK, V. I. BIRIUK, and I. I. KOANDE TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 14, no. 2, 1983, p. 86-94. In Russian.

The problem of minimizing the weight of swept wings, with constraints on the load-bearing capacity, is analyzed, and an approximate analytical solution is obtained using the perturbation method. The solutions obtained to zero and first approximations are compared with an exact numerical solution to the problem. The dependence of the minimum wing weight on the permissible lifting force loss due to aeroelastic deformations and on the angle of sweep is examined. V.L.

A84-45726
A STUDY OF CRACK GROWTH RATE IN A NOTCHED STRIP UNDER BIHARMONIC LOADING [ISSLEDOVANIE SKOROSTI RAZVITIIA TRESHCHIN V POLOSE S NADREZOM PRI BIGARMONICHESKOM NAGRUZHENII]
G. G. ZAVERIUKHA TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 14, no. 2, 1983, p. 95-104. In Russian. refs

Experiments have been carried out on notched specimens cut from rolled sheets of AK4-1AT1 and D16AT alloys in order to investigate the kinetics of crack growth under biharmonic loading. Plots are presented which show the effect of the parameters of biharmonic loading on crack propagation rate. A procedure for calculating crack growth rate under biharmonic loading is proposed which is applicable to aircraft structures subjected to biharmonic loading with frequency ratios of 2-10 and 80-500. V.L.

A84-45727
A METHOD FOR CALCULATING STRESS INTENSITY FACTORS IN STRUCTURAL ELEMENTS WITH CURVILINEAR CRACKS [METOD RASCHETA KOEFFITSIENTOV INTENSIVNOSTI NAPRIAZHENII V ELEMENTAKH KONSTRUKTSII S KRIVOLINEINYMI TRESHCHINAMI]
V. I. GRISHIN and V. IU. DONCHENKO TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 14, no. 2, 1983, p. 105-112. In Russian. refs

An energy method has been developed for determining stress intensity factors in thin-walled structures with multiple-nucleus curvilinear cracks. The procedure has been implemented in a set of specialized software, FITTING, designed for the local strength analysis of aircraft structures. The accuracy of the procedure is evaluated, and examples of stress intensity and crack path computations are presented. V.L.

A84-45742
DETERMINATION OF AERODYNAMIC LOADS IN SUPERSONIC FLOW FOR THE ANALYSIS OF AIRCRAFT FLUTTER AT LOW STROUHAL NUMBERS [OPREDELENIE AERODINAMICHESKIKH NAGRUZOK V SVERKHZVUKOVOM POTOKE DLIA RASCHETA NA FLATTER LETATEL'NOGO APPARATA PRI MALYKH CHISLAKH STRUKHALIA]
E. N. NABIULLIN and A. A. RYBAKOV TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 14, no. 3, 1983, p. 86-93. In Russian.

A method is presented for calculating unsteady aerodynamic forces in supersonic flow acting on the lifting surfaces of an aircraft located in one plane. The method is based on the well-known acceleration potential approach. To determine the aerodynamic loads, a lifting surface is divided into a certain number of trapeziform panels, with the distributed dipole (pressure difference) intensity assumed to be constant for each panel. In the case of steady flow, the method proposed here is reduced to the theory of Woodward (1968). The approach is illustrated by an example. V.L.

A84-45748
IMPROVING THE ACCURACY OF A SHEAR FINITE ELEMENT USED IN THE NASTRAN PROGRAM [UTOCHNENIE RABOTY SDVIGOVOGO KONECHNOGO ELEMENTA, PRIMENIAEMOGO V PROGRAMME NASTRAN]
V. A. BELOUS TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 14, no. 3, 1983, p. 125-128. In Russian. refs

An analysis of skewed panels by means of the shear element used in the NASTRAN program has demonstrated the inadequate accuracy of the element in this particular application. Here, the operating principle of the shear element is examined in detail with a view to determining the factors responsible for its low accuracy. Ways to improve the accuracy of the shear element are suggested. V.L.

A84-45821
THE EFFECT OF SECONDARY FLOW TAPS ON THE CHARACTERISTICS OF A TWO-STAGE SECTION WITH PARTIAL STAGES [VLIIANIE OTVODOV VTORICHNOGO POTOKA NA KHARAKTERISTIKI DVUKHSTUPENCHATOGO OTSEKA S PARTSIAL'NYMI STUPENIAMI]
I. I. KIRILLOV (Leningradskii Politekhnicheskii Institut, Leningrad, USSR) and I. G. GOGOLEV (Brianskii Institut Transportnogo Mashinostroeniia, Bryansk, USSR) Promyshlennaia Teplotekhnika (ISSN 0204-3602), vol. 6, no. 4, 1984, p. 59-64. In Russian.

Experiments on partial turbine stages indicate that stem leakage from the primary flow and the merging of the secondary and the primary flow result in energy losses. In order to reduce the detrimental effect of the secondary flow, turbine stages with secondary flow taps have been designed and tested. Here, test results for a single-shaft experimental air turbine whose partial stages have been equipped with secondary flow taps are examined. V.L.

A84-45822
AN EXPERIMENTAL STUDY OF THE THERMAL STATE OF THE WALLS OF A COMBUSTION CHAMBER WITH FLAME TUBES UNDER SERVICE CONDITIONS [EKSPERIMENTAL'NOE ISSLEDOVANIE TEPLOVOGO SOSTOIANIIA STENOK KAMERY SGORANIIA S ZHAROVYMI TRUBAMI V USLOVIIAKH EKSPLUATATSII]
V. N. KOROLEV, K. F. OTT, V. V. STARTSEV, and E. M. TOLMACHEV (Ural'skii Politekhnicheskii Institut, Sverdlovsk, USSR) Promyshlennaia Teplotekhnika (ISSN 0204-3602), vol. 6, no. 4, 1984, p. 64-67. In Russian. refs

An experimental study of the thermal state of the walls of a flame tube shows that a substantial inhomogeneity of the temperature field along the flame tube results from a stepped feed of the cooling air. A modified cooling system is proposed which employs film and impact cooling. It is shown that the cooling system proposed here makes it possible to reduce the temperature gradient over the length of the flame tube by a factor of 1.5. V.L.

A84-45965*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FEASIBILITY ANALYSIS OF A SPIRAL GROOVE RING SEAL FOR COUNTER-ROTATING SHAFTS
E. DIRUSSO (NASA, Lewis Research Center, Cleveland, OH) Journal of Aircraft (ISSN 0021-8669), vol. 21, Aug. 1984, p. 618-622. Previously cited in issue 16, p. 2361, Accession no. A83-36239.

A84-45983
SIMILARITY CRITERIA FOR THE SPECTRA OF WALL PRESSURE FLUCTUATIONS IN A TURBULENT BOUNDARY LAYER
B. M. EFIMTSOV Soviet Physics - Acoustics (ISSN 0038-562X), vol. 30, Jan.-Feb. 1984, p. 33-35. Translation. refs

Experimental data on the spectra of wall pressure fluctuations in a turbulent boundary layer are presented in order to establish a generalized law governing wall pressure for determining aerodynamic parameters in wind tunnel tests. The wall pressure fluctuation spectra are presented over a wide range of Mach numbers ($M = 0.015$-4), Reynolds numbers ($Re = 600$ to 150,000), and Strouhal numbers ($S = 0.2$ to 1000) which are determined by means of a unified measurement procedure and a system of sensors with high spatial resolution. It is found that the calculations of pressure fluctuations in the audio frequency range are in good agreement with measurements of pressure fluctuations on the surface of a passenger aircraft fuselage in a wind tunnel test. I.H.

A84-46129*# Old Dominion Univ., Norfolk, Va.
MEASUREMENT OF CONVECTIVE HEAT TRANSFER TO SOLID CYLINDERS INSIDE VENTILATED SHROUDS
K. DARYABEIGI, E. F. GERMAIN (Old Dominion University, Norfolk, VA), and R. L. ASH (NASA, Langley Research Center, Hampton, VA) American Institute of Aeronautics and Astronautics, Thermophysics Conference, 19th, Snowmass, CO, June 25-28, 1984. 7 p. NASA-supported research. refs
(AIAA PAPER 84-1725)

The influence of ventilated cylindrical shrouds on the convective heat transfer to circular cylinders has been studied experimentally. Geometries studied were similar to those used in commercially available platinum resistance thermometers. Experiments showed that thermal response (convection) was enhanced when the shroud ventilation factor was approximately 20 percent (80 percent solid), and that maximum enhancement occurred when the ventilation holes were located symmetrically on either side of the stagnation lines. Author

A84-46138#
PERFORMANCE MONITORING ON GNOME ENGINES ON CANADIAN COAST GUARD AIR CUSHION VEHICLES
H. I. H. SARAVANAMUTTOO (Carleton University, Ottawa, Canada) Canadian Aeronautics and Space Journal (ISSN 0008-2821), vol. 29, Dec. 1983, p. 327-335. Research supported by the Natural Sciences and Engineering Research Council of Canada.

An extremely low cost performance monitoring system has been developed for use on Gnome powered air cushion vehicles. The system is based on an already available programmable calculator used in conjunction with the existing instrumentation. Despite its extreme simplicity the system has already shown the capability of detecting both instrumentation problems and engine deterioration. A simple procedure for minimizing the scatter of manually collected data is offered. Author

A84-46190
THE BUCKLING OF HONEYCOMB SANDWICH CIRCULAR RINGS
A. K. EL-SENUSSI and J. P. H. WEBBER (Bristol, University, Bristol, England) Aeronautical Journal (ISSN 0001-9240), vol. 88, June-July 1984, p. 249-256. refs

A theoretical solution is given for the overall buckling and wrinkling of sandwich circular rings when subjected to a uniform radial pressure loading. The core is in the form of a honeycomb material, and the faces can be made from laminated fibre reinforced plastics, which exhibit coupling between bending and stretching. The elasticity equations for both the orthotropic core and faces are satisfied, and it is found that the problem is governed by four simultaneous differential equations for the displacements of the faces. A solution is obtained by assuming simple sine and cosine functions for these displacements. Minimum critical pressures are found numerically and results are given which show the dependence on face thickness, core thickness and mean radius. A procedure is suggested for finding approximate solutions for sandwich rings subjected to more general loading conditions. Author

A84-46236
HEAT TRANSFER IN A LAMINAR BOUNDARY LAYER OF AN ABSORBING, EMITTING, AND SCATTERING MEDIUM ON A PERMEABLE PLATE [TEPLOOBMEN V LAMINARNOM POGRANICHNOM SLOE POGLOSHCHAIUSHCHEI, IZLUCHAIUSHCHEI I RASSEIVAIUSHCHEI SREDY NA PRONITSAEMOI PLASTINE]
N. A. RUBTSOV and N. N. PONOMAREV (Akademiia Nauk SSSR, Institut Teplofiziki, Novosibirsk, USSR) Akademiia Nauk SSSR, Sibirskoe Otdelenie, Izvestiia, Seriia Tekhnicheskikh Nauk (ISSN 0002-3434), June 1984, p. 65-73. In Russian. refs

A numerical solution is presented for a system of nonlinear equations describing radiation-convection heat transfer in a laminar boundary layer on a permeable plate. The effect of viscous dissipation is neglected; the anisotropy of scattering is allowed for by considering two types of indicatrices with different degrees of extension. The influence of scattering effects on the interaction of convection and radiation in the boundary layer is analyzed. V.L.

A84-46320
THERMOFLUIDDYNAMIC EXPERIMENTS WITH A HEATED AND ROTATING CIRCULAR CYLINDER IN CROSSFLOW
H. PELLER, V. LIPPIG, D. STRAUB, and R. WAIBEL (Muenchen, Hochschule der Bundeswehr, Neubiberg, West Germanyu) Experiments in Fluids (ISSN 0723-4864), vol. 2, 1984, p. 113-120. Research sponsored by the Thermosystem GmbH. refs

Heat transfer measurements were conducted on a heated rotating circular cylinder in air crossflow in the free-stream Re range 8,300-71,000 for Nusselt numbers up to 300. It is found that forced-convection heat transfer can be readily manipulated by varying the following parameters: surface roughness, aspect ratio, temperature, turbulence level of incoming flow, and blockage ratio. For velocity ratios above 0.5, the Nusselt number behavior is shown to be consistent with that reported in the literature. However, for velocity ratios less than 0.5, significant deviations from the heat transfer coefficients previously believed to be constant are observed. V.L.

A84-46337#
DEVELOPMENT OF A STOCHASTIC MODEL FOR FATIGUE CRACKS IN AIRCRAFT STRUCTURES
B. UPPALURI and L. MARCHINSKI (Boeing Vertol Co., Philadelphia, PA) IN: American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 119-129. refs

One of the causes responsible for the deterioration of the reliability of aircraft structures with use is fatigue damage. It is pointed out that the present state-of-the-art does not provide any reliable techniques for estimating the fatigue crack behavior of the full-scale structures at the design stage. The present investigation is concerned with the development of a probabilistic model for fatigue behavior. This model can incorporate the information on varying sizes of cracks at selected inspection times on the aircraft structure. The fatigue process is described as an evolutionary stochastic process, taking into account assumptions, crack initiation, and the solution of the governing differential equations. Attention is given to the merits of the discrete growth model, the solution for exponential distribution, the solution for Weibull distribution, and several numerical examples. G.R.

A84-46338#
A PROCEDURE FOR THE ADJUSTMENT OF THE ENDURANCE LIMIT OF A COMPONENT TO ACCOUNT FOR A REDUCTION IN THE NUMBER OF FATIGUE TEST SPECIMENS
W. D. HARRIS (Hughes Helicopters, Inc., Mesa, AZ) IN: American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 130-139. refs

The general procedure used for deriving fatigue strength values in the case of military helicopters is briefly considered. In the development of a test plan for helicopters, the assumption is made that the testing of the specified number of specimens will provide the required 50 percent confidence level. However, often an interim fatigue strength value is required prior to completion of the planned test program. In such a case adjustments must be made in the determination of the interim values, if the required confidence level and probability of survival are to be preserved. The present investigation is concerned with the derivation of these adjustments for both a normal and log normal distribution for the typical 50 percent confidence level and 99.87 percent (three Sigma) probability of survival. G.R.

A84-46345#
THE INTEGRATED BLADE INSPECTION SYSTEM (IBIS) - PROGRAM REVIEW AND STATUS
L. D. MEYER and R. A. EKVALL (General Electric Co., Cincinnati, OH) IN: American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 206-212. Navy-Army-supported research.
(Contract F33615-78-C-5095; F33615-80-C-5106)

It has been found that automation of key inspection processes for aircraft turbine engine blades and vanes can increase inspection reliability, repeatability, and thoroughness. In addition, automation reduces quality assurance costs. For these reasons steps have been taken to establish the Integrated Blade Inspection System (IBIS), a computer-based, automated system for the precision inspection of individual airfoil parts. IBIS includes automated inspection modules, interconnected through a computerized data management network. IBIS is discussed, taking into account the Visual Inspection Module, the Fluorescent Penetrant Inspection Module, the Automated Fluorescent Penetrant Preprocessing Module, the X-ray Inspection Module, the Infrared Inspection Module, and the Information Computer System. G.R.

A84-46346#

T-700 BLISK/IMPELLER CUTTER LIFE IMPROVEMENT PROGRAM

N. SINGH (U.S. Army, Troop Support and Aviation Material Readiness Command, St. Louis, MO) IN: American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 213-226. Army-supported research. refs

Inconel 718 (high-temperature nickel-base alloy) and AM355 (precipitation-hardening steel) are very popular in the aircraft industry. However, problems arise because these materials are very difficult to machine. The present investigation is concerned with an indepth study which was conducted by an American aerospace company with the aim to optimize cutter design and machining parameters for an extension of the life of the tools used in machining the considered materials. The areas studied are related to modes of tool failure, tool materials, tool geometry, machining parameters, cutting fluids, and surface treatment of tool materials. It was found that thermal cracking/chipping was a primary mode of tool failure when machining (milling) Inconel 718 with tungsten carbide cutters, while flank wear was a primary mode of tool failure when machining (milling) AM 355 material with tungsten carbide cutters. G.R.

A84-46347#

AUTOMATED COORDINATE MEASURING MACHINE TO MEASURE TWIST AND CONTOUR OF MAIN ROTOR BLADES AT BELL HELICOPTER TEXTRON

M. G. HUFFMAN (Bell Helicopter Textron, Fort Worth, TX) IN: American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 227-233.

The employment of the computer-controlled three-dimensional coordinate measuring machine (CMM) makes it possible to avoid tedious and cumbersome procedures which formerly had to be performed in measuring twist and contour of the main rotor blade of a helicopter. The present investigation has the objective to discuss the coordinate measuring machine recently installed by an American helicopter manufacturer. In May of 1982, the manufacturer purchased a three-axis cantilever-type coordinate measuring machine. This machine measures the twist and contour of composite main rotor blades produced by the company. Attention is given to details regarding the procedures employed in the tests conducted with the CMM, the software, blade terminology, the computer and peripherals, the actual blade measurement, and possibilities for using the CMM for other tasks. G.R.

A84-46355*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

NASA TRANSMISSION RESEARCH AND ITS PROBABLE EFFECTS ON HELICOPTER TRANSMISSION DESIGN

E. V. ZARETSKY, J. J. COY, and D. P. TOWNSEND (NASA, Lewis Research Center, Cleveland, OH) IN: American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 303-320. Previously announced in STAR as N83-24858. refs

Transmissions studied for application to helicopters in addition to the more conventional geared transmissions include hybrid (traction/gear), bearingless planetary, and split torque transmissions. Research is being performed to establish the validity of analysis and computer codes developed to predict the performance, efficiency, life, and reliability of these transmissions. Results of this research should provide the transmission designer with analytical tools to design for minimum weight and noise with maximum life and efficiency. In addition, the advantages and limitations of drive systems as well as the more conventional systems will be defined. S.L.

A84-46377*# Connecticut Univ., Storrs.

THE IMPORTANCE OF NONLINEARITY ON THE HIGHER HARMONIC CONTROL OF HELICOPTER VIBRATION

J. A. MOLUSIS (Connecticut, University, Storrs, CT) IN: American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 624-647. Army-NASA-supported research. refs

The effect of nonlinearity on the higher harmonic control (HHC) of helicopter vibration is investigated using a nonlinear aeroelastic simulation. A nonlinear solution is proposed which relates the HHC inputs to vibration outputs on the basis of a Volterra functional series. The Volterra series solution is shown to reduce to a vector polynomial equation relating HHC inputs to vibration outputs at any harmonic frequency. The nonlinear transfer relationship is identified from a nonlinear vibration analysis computer program, and the identification model is examined in detail. Improvements to current HHC algorithms are presented, and several Kalman filter divergence problems are quantified. V.L.

A84-46413

A COMPARATIVE STUDY OF THE INFLUENCE OF DIFFERENT MEANS OF TURBINE COOLING ON GAS TURBINE PERFORMANCE

J. F. LOUIS, K. HIRAOKA, and M. A. EL-MASRI (MIT, Cambridge, MA) International Journal of Turbo and Jet-Engines, vol. 1, no. 2, 1984, p. 123-137. refs

(Contract E(49-18)-2295)

A common general model for simple, open cycle gas turbines is used to compare the performance of engines using different types of cooling, in order to establish the influence of such methods on the thermodynamic efficiency and specific work of powerplants. The model evaluates these factors in view of the influence of mixing losses incurred by coolant and combustion gases, coolant pumping, and heat transfer from the expanding gas. Dimensionless variables are used to achieve generality and provide useful design guidelines and insights. Sample calculations give the optimum turbine inlet temperature of thermodynamic efficiency and specific work for different pressure ratios and typical dimensionless numbers. Attention is given to the sensitivity of efficiency and specific work to each key parameter. O.C.

A84-46484#

METAL BONDING SLOWLY WINNING OVER RELUCTANT DESIGNERS

V. WIGOTSKY Aerospace America (ISSN 0740-722X), vol. 22, Sept. 1984, p. 82-84, 86.

In recent years, aircraft designers have come to rely more on metal-metal bonding as a primary structure construction alternative to rivets. Aircraft employing this technique now include the F-27 and F-28 commuter airliners, and the Trident IIIB airliner. Nevertheless, resistance to expanded use of metal bonding techniques appears to stem from the poor durability performance of first-generation bonding techniques, which were not sufficiently resistant to moisture penetration and corrosion. In addition to developing better surface preparation and sealing, adhesive bonding has been improved by better adhesives, during whose curing extensive crosslinking improves plastic deformation resistance. This yields superior long term loading performance. Higher cure temperature adhesives are under development for supersonic fighter structures that are exposed to more severe aero-thermodynamic regimes than subsonic aircraft. O.C.

N84-31131# Vought Corp., Dallas, Tex.

AIRCRAFT-STORE ELECTRICAL INTERCONNECTION SYSTEM (AEIS) FUNCTIONAL REQUIREMENTS

J. R. PERKINS and D. E. LAUTNER *In* ASD Proc. Papers of the 2nd AFSC Avionics Standardization Conf., Vol. 1 p 111-122 Nov. 1982

(AD-P003527) Avail: NTIS HC A25/MF A01 CSCL 09C

This paper provides a summary of the work performed under an A2I2 (Aircraft Armament Interoperable Interface) contract sponsored by the Naval Weapon Center and Air Force Armament Laboratory for developing the aircraft-store electrical functional

requirements which will be principally implemented by MIL-STD-1760. The paper provides an overview of the overall requirement drivers and then focuses on three principal electrical areas of the AEIS: The power interface, high bandwidth signaling, and digital data transfer. The paper provides insight on derivation of these requirements and supporting rationale in terms of drivers from existing store requirements, developmental store and technology trends, and traditional engineering approaches.
Author (GRA)

N84-31132# Vought Corp., Dallas, Tex.
SIGNAL SET STANDARDIZATION FOR THE AIRCRAFT-STORE ELECTRICAL INTERCONNECTION SYSTEM
D. E. LAUTNER and J. R. PERKINS *In* ASD Proc. Papers of the 2nd AFSC Avionics Standardization Conf., Vol. 1 p 123-138 Nov. 1982
(AD-P003528) Avail: NTIS HC A25/MF A01 CSCL 09C
The Air Force and Navy are conducting a joint program (Aircraft Armament Interoperable Interface A2I2) to standardize interfaces between aircraft and stores. One product of this joint A2I2 program is a military standard for the Aircraft-Store Electrical Interconnection System (AEIS). This standard, released in July 1981 as MIL-STD-1760, defines the electrical interface between aircraft and stores. As mentioned in the MIL-STD-1760 foreword, the complete AEIS is comprised of electrical, logical, and physical elements. The present MIL-STD-1760 issue addresses only the electrical signal set element. This paper provides an overview on the background for the selected MIL-STD-1760 electrical signal set. Following this overview, application restrictions, application guidelines and various technical issues are discussed for each of the power, digital, high bandwidth and discrete signals of MIL-STD-1760. The discussion covers the electrical signal set characteristics presently defined in MIL-STD-1760 plus clarifications and more rigorous definitions of the electrical signal characteristics expected in a future revision to MIL-STD-1760. Author (GRA)

N84-31142# Circuit Technology, Inc., Farmingdale, N.Y.
MIL-STD-1553B MARCONI LSI CHIP SET IN A REMOTE TERMINAL APPLICATION
A. DIMARINO *In* ASD Proc. Papers of the 2nd AFSC Avionics Standardization Conf., Vol. 1 p 269-275 Nov. 1982
(AD-P003538) Avail: NTIS HC A25/MF A01 CSCL 09C
Marconi Avionics is utilizing the MIL-STD-1553B LSI Chip Set in the SCADC Air Data Computer application to perform all of the required remote terminal MIL-STD-1553B protocol functions. Basic components of the RTU are the dual redundant chip set, CT3231 Transceivers, 256 x 16 RAM and a Z8002 microprocessor. Basic transfers are to/from the RAM command of the bus controller or Z8002 processor. During transfers from the processor to the RAM, the chip set busy bit is set for a period not exceeding 250 microseconds. When the transfer is complete, the busy bit is released and transfers to the data bus occur on command. The LSI Chip Set word count lines are used to locate each data word in the local memory and 4 mode codes are used in the application: reset remote terminal, transmit status word, transmitter shut-down, and override transmitter shutdown. Author (GRA)

N84-31146# Marconi Avionics Ltd., Rochester (England).
THIRD GENERATION MIL-STD-1553B LSI CHIP SET
R. D. BEASLEY *In* ASD Proc. Papers of the 2nd AFSC Avionics Standardization Conf., Vol. 1 p 315-325 Nov. 1982
(AD-P003542) Avail: NTIS HC A25/MF A01 CSCL 09C
Marconi Avionics Limited's experience with MIL-STD-1553 commenced with the implementation of an a standard remote terminal in the Head Up Display for the General Dynamics F16 by our Airborne Displays Division. The Flight Automation Research Laboratory (FARL) has subsequently completed a circuit design for the digital section of a MIL-STD-1553B terminal with the LSI implementation carried out by Marconi Electronic Devices Ltd. These LSI devices are currently available through Circuit Technology Inc. of New York. This paper will review the current LSI terminal activity undertaken by FARL. This activity has used experience gained during the previous five-element 1553B LSI development as the foundation for a third generation two-element 1553 LSI terminal design. The subsequent semiconductor implementation is a collaborative exercise between the GEC Hirst Research Centre and FARL. Author (GRA)

N84-31148# Aeronautical Systems Div., Wright-Patterson AFB, Ohio.
MIL-STD-1553B VALIDATION TESTING
D. J. THORPE and K. V. VAKKALANKA *In its* Proc. Papers of the 2nd AFSC Avionics Standardization Conf., Vol. 1 p 337-347 Nov. 1982
(AD-P003544) Avail: NTIS HC A25/MF A01 CSCL 09C
One of the major responsibilities of the Systems Engineering Avionics Facility (SEAFAC) is to act as the Air Force Office of Primary Responsibility (OPR) for MIL-STD-1553 applications. Since its inception in 1974, this organization played a vital role in promoting and enforcing the standard. In the area testing, SEAFAC set the pace by developing the Test Plan and specialized test equipment. Our advanced validation test facility allows us to test a wide variety of MIL-STD-1553B interfaces, such as Remote Terminals, transceivers and, of particular interest, the Large Scale Integrated circuit chips, to ensure their conformity to MIL-STD-1553B. This paper outlines our present validation testing as well as planned automation of our test facility. A summary of our experiences is presented. The paper concludes with SEAFAC's role in future testing. Author (GRA)

N84-31169# Naval Avionics Center, Indianapolis, Ind.
NAVY PACKAGING STANDARDIZATION THRUSTS
J. R. KIDWELL *In* ASD Proc. Papers of the 2nd AFSC Avionics Std. Conf., Vol. 2 p 617-632 Nov. 1982 Proc. held in Dayton, Ohio, 30 Nov. - 2 Dec. 1982
(AD-P003564) Avail: NTIS HC A25/MF A01 CSCL 09C
Standardization is a concept that is basic to our world today. The idea of reducing costs through the economics of mass production is an easy one to grasp. Henry Ford started the process of large scale standardization in this country with the Detroit production lines for his automobiles. In the process additional benefits accrued, such as improved reliability through design maturity, off-the-shelf repair parts, faster repair time, and a resultant lower cost of ownership (lower life-cycle cost). The need to attain standardization benefits with military equipments exists now. Defense budgets, although recently increased, are not going to permit us to continue the tremendous investment required to maintain even the status quo and develop new hardware at the same time. Needed are more reliable, maintainable, testable hardware in the Fleet. It is imperative to recognize the obsolescence problems created by the use of high technology devices in our equipments, and find ways to combat these shortfalls. The Navy has two packaging standardization programs that will be addressed in this paper; the Standard Electronic Modules and the Modular Avionics Packaging programs. Following a brief overview of the salient features of each program, the packaging technology aspects of the program will be addressed, and developmental areas currently being investigated will be identified. Author (GRA)

N84-31177# Westinghouse Defense and Electronic Systems Center, Baltimore, Md.
WESTINGHOUSE USES USAF-DEVELOPED STANDARDS
C. S. SHYMAN *In* ASD Proc. Papers of the 2nd AFSC Avionics Std. Conf., Vol. 2 p 753-765 Nov. 1982 Proc. held in Dayton, Ohio, 30 Nov. - 2 Dec. 1982
(AD-P003572) Avail: NTIS HC A25/MF A01 CSCL 09C
Westinghouse has applied digital standards advantageously for the U.S. Air Force on its latest weapon systems. At present Westinghouse is applying MIL-STD-1750A (ISA), MIL-STD-1589B (JOVIAL 73 HOL), and MIL-STD-1553B (multiplex busing) to three major programs: B-1B Offensive Radar System, Improved AN/APG-66 Radar for the F-16, and AFTI F-16 Electro-Optical Sensor/Tracker. Westinghouse has gone one step further than the digital standards. With U.S. Air Force encouragement Westinghouse has a program for maximum radar commonality among the B-1B ORS, F-16C, and the U.S. Army Sgt. York DIVAD

Gun System. This paper will cover Westinghouse's approach toward managing the application of the military standards across multiple programs with different prime contractors and services. Additionally, the method by which configuration control of standard module hardware (i.e., rational standardization) maintained at Westinghouse will be discussed. Author (GRA)

N84-31182# Marconi Avionics Ltd., Rochester (England).
OPTIONS AND OPPORTUNITIES FOR STANDARDS: A NATO/AGARD VIEWPOINT
J. T. SHEPHERD and L. J. URBAN *In* ASD Proc. Papers of the 2nd AFSC Avionics Std. Conf., Vol. 2 p 843-859 Nov. 1982 Proc. held in Dayton, Ohio, 30 Nov. - 2 Dec. 1982
(AD-P003577) Avail: NTIS HC A25/MF A01 CSCL 09C

This paper presents a summary of the findings of AGARD Working Group 06. This working group was established to consider Distributed Micro Processor Application to Guidance & Control Systems. The results of this study are presented in AGARD AR-178. One of the areas considered by the working group was option and opportunities for standards and it is this area that is being considered in this paper. It should be emphasized that this document is not intended to suggest definitive standards or even to state categorically that any given standard should be developed. Rather its intention is to focus attention upon the need for standards and to point out areas where opportunities exist for standardization. As will be seen from the previous sections in this report there is a vast proliferation in hardware and software. When systems are developed they often produce unique hardware and software, such as operating systems, executives, high level languages, etc. Since the life cycle of aircraft systems is at least twenty years from conception, it could be as much as thirty years after the initial design before the systems are finally phased out. This makes it almost impossible to maintain avionic systems in the later parts of their life cycle. Author (GRA)

N84-31444# Joint Publications Research Service, Arlington, Va.
REGULATION OF MECHANICAL CHARACTERISTIC OF IRON-POWDER ELECTROMAGNETIC BRAKE Abstract only
I. K. KHAYRULLIN, V. S. SYROMYATNIKOV, S. G. ISMAGILOV, and R. N. SULTANGALEYEV *In its* USSR Rept.: Electron. and Elec. Engr. (JPRA-UEE-84-008) p 39 11 Jun. 1984 Transl. into ENGLISH from Elektrotekhn. (Moscow), no. 12, Dec. 1983 p 35-36
Avail: NTIS HC A04

Electromagnetic clutches and brakes operating with iron powder are used in aircraft instrumentation and automation systems because of their favorable performance indicators, particularly high ratio of braking torque to moment of inertia. The braking torque, also the running torque during slipage, can be treated as the sum of a magnetomechanical component (speed-independent interaction of iron particles with one another and with the rotor surface) and an electromagnetic component (speed-dependent interaction of magnetic field crossing the air gap to the rotor with eddy currents induced in the rotor). It is feasible to regulate the corresponding mechanical (speed-torque) characteristic in order to achieve the optimum curve for a given drive system. The regulation system consists of an inductive transducer, a linear rectifier, a function regulator, a voltage divider, and a pulse-width modulator with the output pulse duration controllable by the ratio of pulse duration to switching period. Such a regulation system has been designed at the Institute of Aviation for a brake with variable poles and cylindrical low-inertia rotor mixing iron powder in the air gap. Performance calculations indicate a linearly increasing parabolic speed-torque curve with a linearization error not exceeding 5%. Author

N84-31467# Rome Air Development Center, Griffiss AFB, N.Y.
PROCEEDINGS OF THE ANTENNA APPLICATIONS SYMP., VOLUME 2
Mar. 1984 397 p Symp. held in Urbana, Ill., 21-23 Sep. 1983
(AD-A142754; RADC-TR-84-52-VOL-2) Avail: NTIS HC A17/MF A01 CSCL 09E

The Proceedings of the 1983 Antenna Applications Symposium are a collection of the State-of-the-Art papers relating to Phased Array Antennas, Millimeter Wave Antennas, Microstrip and Conformal Antennas and Reflector Antennas.

N84-31477# Ball Aerospace Systems Div., Boulder, Colo.
A CONFORMAL SHF PHASED ARRAY FOR AIRCRAFT SATELLITE COMMUNICATION
R. CUMMINGS and K. KUDRNA *In* RADC Proc. of the Antenna Appl. Symp., Vol. 2 p 179-192 Mar. 1984
(AD-P003509) Avail: NTIS HC A17/MF A01 CSCL 09E

A receive-only 7.5 GHz microstrip phased array has been developed by Ball Aerospace Systems Division (BASD). This 256 radiating element array provides a gain of 20 dBic over a conical scan region of 120 deg. Two arrays with one on either side of an aircraft would provide near hemispherical coverage. The array consists of four subarrays and can be expanded to achieve higher gain when required. The array is left-hand circularly polarized and has three-bit digital PIN diode phase shifters for steering the beam. A microprocessor-based beam steering controller is used for calculating the phase shifter settings for each beam position. Each subarray includes radiating elements, quadrature hybrids, phase shifters, corporate feed, R.F. chokes in microstrip medium and hybrid PIN diode drivers. The array is approximately 1.5 inches thick and is conformal to the aircraft skin. It is a bolt on assembly only requiring aircraft skin entries for the R.F. output and for control lines. Transmit capability can be provided by merely changing the artwork to go to 8.5 GHz. Author (GRA)

N84-31518# General Dynamics Corp., Fort Worth, Tex. Fort Worth Div.
EMBEDDED INFORMATION TRANSFER TECHNOLOGY ASSESSMENT Final Report, 30 Sep. 1982 - 17 Nov. 1983
L. A. HUFF, J. MORELAND, R. ALLISON, J. ELIA, and B. JERDEE Wright-Patterson AFB, Ohio AFWAL 16 Apr. 1984 85 p
(Contract F33615-82-C-1842)
(AD-A142649; FZM-7151; AFWAL-TR-84-1021) Avail: NTIS HC A05/MF A01 CSCL 09E

The objective of this study is to develop approaches for improved Line Replaceable Unit (LRU) internal communications, utilizing state-of-the-art techniques and technology, in order to reduce the growing number of interconnects with LRU's. Worst-case LRU data transfer requirements were established by analyzing internal signal routing, data rates, and duty cycles of the F-16 Fire Control Computer (FCC) and the Programmable Signal Processor (PSP). It was determined that 25/Mword/second is adequate for card-to-backplane (serial) transfers. Candidate designs for meeting these requirements were developed and then subjected to an extensive trade-off analysis. This analysis ultimately yielded the selection of Switched Network Electro-Optical (serial) and Electro-Optical Air-Gap (parallel) as the preferred approaches. The interface pin-count per module of the recommended designs has been reduced to approximately 40. This is substantially lower that the average of 250 connections per module in most conventional approaches and fulfills the primary objective of this program. Further, the zero insertion-force air-gap interfaces directly support modular architectures and enhance the prospects of making two-level maintenance concepts a practical reality. Author (GRA)

N84-31554*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
CALCULATION OF BOUNDARY LAYERS OF OSCILLATING AIRFOILS
T. CEBECI and L. W. CARR (California State Univ., Long Beach) May 1984 28 p refs Prepared in cooperation with Army Research and Technology Labs., St. Louis
(NASA-TM-85943; A-9599; NAS 1.15:85943; USAAVSCOM-TR-84-A-1) Avail: NTIS HC A03/MF A01 CSCL 20D

A two-point finite difference unsteady laminar and turbulent boundary layer computational method was used to investigate the properties of the flow around an airfoil (NACA 0012) oscillating through angles of attack up to 18 degrees, for reduced frequencies of 0.01 and 0.20. The unsteady potential flow was determined using the unsteady potential flow method of Geissler. The influence of transition location on stal behavior was investigated, using both experimentally determined transition information, and transition located at the pressure peak; the results show the need for viscous-inviscid interaction in future computation of such flows. Author

N84-31557# Cranfield Inst. of Tech., Bedfordshire (England). Dept. of Aerodynamics.
SPLASH AND SPRAY FROM ROAD VEHICLES AND ASSOCIATED TOPICS: A BIBLIOGRAPHY
N. A. COWPERTHWAITE Jun. 1984 16 p Sponsored by Dept. of Transport
(CAR-8425; ISBN-0-947767-10-X) Avail: NTIS HC A02/MF A01

Approximately 113 citations are given on some aerodynamic characteristics of motor vehicles on various road surfaces and under varying conditions. Some topics covered include: wet road friction at high speeds; water spray generated by road vehicles; effects of visibility on driver performance; spray patterns and suppression; highway and vehicular safety; drag and spray produced by pneumatic wheels moving through water layers; spray reducing devices for vehicles; surfaces laid to reduce splash and spray; water surface depth measurement; and pneumatic tire hydroplaning. E.R.

N84-31558*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DEPOSITION OF NA2SO4 FROM SALT-SEEDED COMBUSTION GASES OF A HIGH VELOCITY BURNER RIG
G. J. SANTORO, S. A. GOEKOGLU (Analex Corp.), F. J. KOHL, C. A. STEARNS, and D. A. ROSNER (Yale Univ.) 1984 24 p refs Proposed for presentation at the TMS-AIME Fall Meeting, Detroit, 17-19 Sep. 1984
(NASA-TM-83751; E-2237; NAS 1.15:83751) Avail: NTIS HC A02/MF A01 CSCL 20D

The mechanism of deposition of Na2SO4 was studied under controlled laboratory conditions and the results have been compared to a recently developed comprehensive theory of vapor deposition. Thus Na2SO4, NaCl, NaNO3 and simulated sea salt solutions were injected into the combustor of a nominal Mach 0.3 burner rig burning jet fuel at constant fuel/air ratios. The deposits formed on inert collectors, rotation in the cross flow of the combustion gases, were weighed and analyzed. Collector temperature was uniform and could be varied over a large range by internal air cooling. Deposition rates and dew point temperatures were determined. Supplemental testing included droplet size measurements of the atomized salt solutions. These tests along with thermodynamic and transport calculations were utilized in the interpretation of the deposition results. Author

N84-31597*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
NIGHTTIME OBSERVATIONS OF THUNDERSTORM ELECTRICAL ACTIVITY FROM A HIGH ALTITUDE AIRPLANE
M. BROOK (New Mexico Inst. of Mining and Technology), C. RHODES (New Mexico Inst. of Mining and Technology), O. H. VAUGHAN, JR., R. E. ORVILLE (State Univ. of New York, Albany), and B. VONNEGUT (State Univ. of New York, Albany) Sep. 1984 32 p refs
(NASA-TM-86455; NAS 1.15:86455) Avail: NTIS HC A03/MF A01 CSCL 14B

Photographs from a NASA U-2 airplane flying over nocturnal thunderstorms show frequent lightning activity in the upper part of the cloud. In some cases, unobscured segments of lightning channels 1 km or longer are visible in clear air around and above the cloud. Multiple images of lightning channels indicate multiple discharges in the same channel. Photographs taken through a diffraction grating show that the lightning has a spectrum similar to that observed in the lower troposphere. Lightning spectra obtained with a slitless line-scan spectrometer show strong singly ionized nitrogen emissions at 463.0 and 500.5 nm. Field changes measured with an electric field-change meter correlate with pulses measured with a photocell optical system. Optical signals corresponding to dart leader, return stroke, and continuing current events are readily distinguished in the scattered light emerging from the cloud surface. The variation of light intensity with time in lightning events is consistent with predicted modification of optical lightning signals by clouds. It appears that satellite based optical sensor measurements cannot provide reliable information on current rise times in return strokes. On the other hand, discrimination between cloud-to-ground and intracloud flashes and the counting of ground strokes is possible using the optical pulse pairs which have been identified with leader, return-stroke events in the cloud-to-ground flashes studied. A.R.H.

N84-31641*# Cummins Engine Co., Inc., Columbus, Ind.
POSITIVE DISPLACEMENT COMPOUNDING OF A HEAVY DUTY DIESEL ENGINE Contractor Final Report
R. SEKAR and R. KAMO Nov. 1983 104 p refs Sponsored in cooperation with NASA. Lewis Research Center
(Contract DE-AC02-78CS-54936)
(NASA-CR-168286; DOE/NASA-4936/3; NAS 1.26:168286; CTR-0748-84003) Avail: NTIS HC A06/MF A01 CSCL 20A

A helical screw type positive displacement (PD) compressor and expander was considered as an alternative to the turbocharger and the power turbine in the Cummins advanced turbocompound engine. The Institute of Gas Technology (IGT) completed the design, layout, and performance prediction of the PD machines. The results indicate that a screw compressor-expander system is feasible up to at least 750 HP, dry operation of the rotors is feasible, cost and producibility are uncertain, and the system will yield about 4% improvement in brake specific fuel consumption (BSFC) over the advanced turbocompound engine. Author

N84-31679# Shock and Vibration Information Center (Defense), Washington, D. C.
THE SHOCK AND VIBRATION DIGEST, VOLUME 16, NO. 7 Monthly Report
J. NAGLE-ESHLEMAN, ed. Jul. 1984 96 p refs
(AD-A143958) Avail: SVIC, Code 5804, Naval Research Lab., Washington, D.C. 20375 CSCL 20K

The dynamic and static operating characteristics of journal bearings and the stability and vibrations of mechanical systems are reviewed. Book reviews, previews of meetings, and educational course descriptions which relate to mechanics are presented. Abstracts of literature on the following topics are given: mechanical systems, structural systems, vehicle systems, biological systems, mechanical components, structural components, dynamic environment, mechanical properties, experimentation, and analysis and design.

N84-31683*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NONLINEAR DISPLACEMENT ANALYSIS OF ADVANCED PROPELLER STRUCTURES USING NASTRAN
C. LAWRENCE and R. E. KIELB Aug. 1984 12 p refs
(NASA-TM-83737; E-2222; NAS 1.15:83737) Avail: NTIS HC A02/MF A01 CSCL 20K

The steady state displacements of a rotating advanced turboprop are computed using the geometrically nonlinear capabilities of COSMIC NASTRAN Rigid Format 4 and MSC NASTRAN Solution 64. A description of the modified Newton-Raphson algorithm used by Solution 64 and the iterative scheme used by Rigid Format 4 is provided. A representative advanced turboprop, SR3, was used for the study. Displacements for SR3 are computed for rotational speeds up to 10,000 rpm. The results show Solution 64 to be superior for computating displacements of flexible rotating structures. This is attributed to its ability to update the displacement dependent centrifugal force during the solution process. Author

N84-31684*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ACTIVE CONTROLS: A LOOK AT ANALYTICAL METHODS AND ASSOCIATED TOOLS
J. R. NEWSOM, W. M. ADAMS, JR., V. MUKHOPADHYAY, S. H. TIFFANY, and I. ABEL Jul. 1984 15 p refs Presented at 14th Congr. of the Intern. Council of the Aeron. Sci., Toulouse, 10-14 Sep. 1984
(NASA-TM-86269; NAS 1.15:86269) Avail: NTIS HC A02/MF A01 CSCL 20K

A review of analytical methods and associated tools for active controls analysis and design problems is presented. Approaches employed to develop mathematical models suitable for control system analysis and/or design are discussed. Significant efforts have been expended to develop tools to generate the models from the standpoint of control system designers' needs and develop the tools necessary to analyze and design active control systems. Representative examples of these tools are discussed. Examples where results from the methods and tools have been compared with experimental data are also presented. Finally, a perspective on future trends in analysis and design methods is presented. Author

N84-31688*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NONLINEAR STRUCTURAL ANALYSIS
Washington Jun. 1984 168 p Workshop held in Cleveland, 19-20 Apr. 1983
(NASA-CP-2297; E-1903; NAS 1.55:2297) Avail: NTIS HC A08/MF A01 CSCL 20K

Nonlinear structural analysis techniques for engine structures and components are addressed. The finite element method and boundary element method are discussed in terms of stress and structural analyses of shells, plates, and laminates.

N84-31698*# Case Western Reserve Univ., Cleveland, Ohio. NsG-3283
INTERACTIVE FINITE ELEMENTS FOR GENERAL ENGINE DYNAMICS ANALYSIS
M. L. ADAMS, J. PADOVAN (Akron Univ.), and D. G. FERTIS (Akron Univ.) *In* NASA. Lewis Research Center Nonlinear Struct. Anal. p 119-130 Jun. 1984 refs
Avail: NTIS HC A08/MF A01 CSCL 20K

General nonlinear finite element codes were adapted for the purpose of analyzing the dynamics of gas turbine engines. In particular, this adaptation required the development of a squeeze-film damper element software package and its implantation into a representative current generation code. The ADINA code was selected because of prior use of it and familiarity with its internal structure and logic. This objective was met and the results indicate that such use of general purpose codes is viable alternative to specialized codes for general dynamics analysis of engines. Author

N84-31699*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NONLINEAR ANALYSIS FOR HIGH-TEMPERATURE COMPOSITES: TURBINE BLADES/VANES
D. A. HOPKINS and C. C. CHAMIS *In its* Nonlinear Struct. Anal. p 131-147 Jun. 1984 refs
Avail: NTIS HC A08/MF A01 CSCL 20K

An integrated approach to nonlinear analysis of high-temperature composites in turbine blade/vane applications is presented. The overall strategy of this approach and the key elements comprising this approach are summarized. Preliminary results for a tungsten-fiber-reinforced superalloy (TFRS) composite are discussed. Author

N84-31700*# Pratt and Whitney Aircraft, East Hartford, Conn.
THREE-DIMENSIONAL STRESS ANALYSIS USING THE BOUNDARY ELEMENT METHOD
R. B. WILSON and P. K. BANERJEE (State Univ. of New York, Buffalo) *In* NASA. Lewis Research Center Nonlinear Struct. Anal. p 149-160 Jun. 1984 refs
(Contract NAS3-23697)
Avail: NTIS HC A08/MF A01 CSCL 20K

The boundary element method is to be extended (as part of the NASA Inelastic Analysis Methods program) to the three-dimensional stress analysis of gas turbine engine hot section components. The analytical basis of the method (as developed in elasticity) is outlined, its numerical implementation is summarized, and the approaches to be followed in extending the method to include inelastic material response indicated. Author

N84-31701# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
RESPONSE OF A PLASTER-WOOD ROOM SUBJECTED TO SIMULATED SONIC BOOMS
N. N. WAHBA Jul. 1984 402 p refs Sponsored in part by National Research Council of Canada and the Ministry of Transport, Transportation Development Centre
(UTIAS-276; ISSN-0082-5255) Avail: NTIS HC A18/MF A01

The response of a room of plaster-wood construction with an open window subjected to sonic-boom loading was investigated both analytically and experimentally. The pressure variations inside the room were predicted analytically by viewing the room as a Helmholtz resonator. The UTIAS Travelling-Wave, Horn-Type, Sonic-Boom Simulator was used to generate sonic booms in order to check the analysis. The structural response of the room walls due to the pressure loading was also predicted analytically using a series solution and a finite element technique incorporating the normal-mode method. Stresses produced due to sonic-boom loading are below the ultimate stresses of the materials that constitute the walls. The statics and dynamics of a cracked plaster-wood wall were investigated using a finite-element method and checked experimentally. The measured strains in the vicinity of a crack-tip are in agreement with the predicted values. It is unlikely that propagation of a crack in a wall can occur due to sonic booms obtained from supersonic transports (SST), except in extraordinary circumstances. For a plaster-wood wall the crack will propagate if the overpressure of the incident sonic boom exceeds 265 N/sq m. For an N-wave having an overpressure of 100 N/sq m, crack propagation may occur if the crack length is larger than 0.7 of the wall width. Author

N84-32246# Singer Co., Sunnyvale, Calif. Link Flight Simulation Div.
SYNTHETIC APERTURE RADAR SIMULATION
N. SZABO *In* American Defense Preparedness Association Proc. of the 5th Interservice/Ind. Training Equipment Conf., Vol. 1 p 205-210 16 Nov. 1983
(AD-P003474) Avail: NTIS HC A17/MF A01 CSCL 17I

During the 1980's, a new generation of airborne radar systems will become operational. These radars will have a number of new capabilities, but their synthetic apertures will have the greatest impact on simulation of the system since they provide a tenfold increase in resolution. Increased radar landmass simulator resolution is not the only problem implied by this increase. In particular, the sparsity of the DMA data bases presents a challenge in the generation of realistic images. Other new requirements include the simulation of anomalies caused by the Doppler mapping. For the last two years, Link has conducted an R&D program to explore the requirements of these new generation radars. This paper reports on the results. Author (GRA)

N84-32248# Singer Co., Binghamton, N.Y. Link Flight Simulation Div.
A LASER IMAGE GENERATION SYSTEM FOR HELICOPTER NAP-OF-THE-EARTH (NOE) FLIGHT TRAINING
H. M. TONG *In* American Defense Preparedness Association Proc. of the 5th Interservice/Ind. Training Equipment Conf., Vol. 1 p 253-261 16 Nov. 1983
(AD-P003481) Avail: NTIS HC A17/MF A01 CSCL 05I

The training effectiveness of the camera-modelboard visual system for low-altitude, nap-of-the-earth (NOE) flights, particularly for helicopters, is well established. Traditional camera-modelboard technology, however, has a number of inherent limitations which have been overcome by using a laser image generator instead of a TV camera as in the current generation of camera-modelboard systems. The first full-scale Laser Image Generation (LIG) visual system, developed by Singer-Link under the AH-IS Cobra Helicopter Flight Weapons Simulator contract, will be delivered to the U.S. Army in the near future. This new visual system offers improvements in many areas, some of which are discussed in this paper, together with the visual system technology involved and performance parameters achieved on the AH-IS simulator. Author (GRA)

N84-32561 Council for Scientific and Industrial Research, Pretoria (South Africa).
ECONOMIC USE OF CBN GRINDING TOOLS IN THE PRODUCTION OF JET TURBINE COMPONENTS
R. GEISLER and D. HALLEN 1983 9 p Transl. into ENGLISH from Ind. Diamanten Rundschau (West Germany), v. 15, no. 4, 1981 p 247-249
(CSIR-TRANS-1736) Avail: NTIS HC A02/MF A01

The use of cubical boron nitride (CBN) grinding wheels in the production of jet turbine components of superalloys such as Inconel 100, Nimonic 90 or Rene 120 with the acid of an example of guide vane machining for low pressure turbines is described. Cost savings achieved by the use of CBN wheels as compared with conventional grinding wheels and spark erosion are presented in tabular form. R.J.F.

N84-32658# Sperry Gyroscope Co., Clearwater, Fla.
RADIO FREQUENCY DISTRIBUTION ASSEMBLY
K. M. CULLEY 1984 32 p
(Contract N00014-82-C-2147)
(AD-A143575) Avail: NTIS HC A03/MF A01 CSCL 09E

The Naval Research Laboratory (NRL) Radio Frequency Distribution Assembly (RFDA) is an interface between the Sperry four-channel, fast-switching synthesizer and the EF-111 jamming system antenna ports. The RFDS is a sophisticated, high-speed RF interface designed to convert the banded outputs of the four-channel synthesizer (16 ports) to 36 ports which represent six ordinal directions of arrival (DOA) for the EF-111 jamming system. The RFDS will distribute the RF signals while providing controlled RF amplitudes to simulate the antenna patterns of the EF-111 Electronic Warfare (EW) system. The simulation of the arrival angles which appear between the ordinal directions is performed by controlling the amplitude of the RF signal from the DOA channels. The RFDA is capable of operating over the frequency range of 500MHz to 18GHz, and can rapidly switch between varying frequencies and attenuation levels. GRA

N84-32664# California Univ., Livermore. Lawrence Livermore Lab.
HIGH-POWER RF COMPRESSOR
C. W. HARTMAN, J. H. HAMMER, and D. MEEKER 30 Mar. 1984 11 p refs
(Contract W-7405-ENG-48)
(DE84-013118; UCID-20054) Avail: NTIS HC A02/MF A01

Rapid compression of resonant RF fields in a coaxial cavity with a moving, magnetically confined plasma ring is discussed. The ring velocity can be a high, compression to high energy density and high power can be achieved before significant resistive loss or vaporization of the cavity walls occurs. An example is given of compressing 10(5) J of lambda = 15 cm stored energy to 2 x 10(6) J of lambda = 1.0 cm RF energy with the energy released in 3 nsec for a maximum power of 6 x 10(14) W. It is suggested that a proof of principle plasma ring accelerator experiment can provide a test by compressing 125 joules of 14 cm RF to 1.25 kJ of 1.4 cm radiation, released in 5 nsec for a peak power of 2.5 x 10(11) W. DOE

N84-32707*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Coll. of Engineering.
ANALYSIS, TESTING, AND EVALUATION OF FAULTED AND UNFAULTED WYE, DELTA, AND OPEN DELTA CONNECTED ELECTROMECHANICAL ACTUATORS Final Report
T. W. NEHL and N. A. DEMERDASH Jul. 1983 235 p refs
(Contract NAS9-16281)
(NASA-CR-171808; NAS 1.26:171808) Avail: NTIS HC A11/MF A01 CSCL 09A

Mathematical models capable of simulating the transient, steady state, and faulted performance characteristics of various brushless dc machine-PSA (power switching assembly) configurations were developed. These systems are intended for possible future use as primemovers in EMAs (electromechanical actuators) for flight control applications. These machine-PSA configurations include wye, delta, and open-delta connected systems. The research performed under this contract was initially broken down into the following six tasks: development of mathematical models for various machine-PSA configurations; experimental validation of the model for failure modes; experimental validation of the mathematical model for shorted turn-failure modes; tradeoff study; and documentation of results and methodology. DOE

N84-32714# General Electric Co., Cincinnati, Ohio. Aircraft Engine Business Group.
HIGH TEMPERATURE ELECTRONICS TECHNOLOGY Final Report, Apr. 1980 - Sep. 1983
J. C. DENING and D. E. HURTLE Mar. 1984 227 p
(Contract N00173-79-C-0010)
(AD-A143571; R83AEB637) Avail: NTIS HC A11/MF A01 CSCL 09A

This report summarizes the barrier metallization developments accomplished in a program intended to develop 300 C electronic controls capability for potential on-engine aircraft engine application. In addition, this report documents preliminary life test results at 300 C and above and discusses improved design practices required for high temperature integrated injection logic semiconductors. Previous Phase 1 activities focused on determining the viability of operating silicon semiconductor devices over the -55 C to +300 C temperature range. This feasibility was substantiated but the need for additional design work and process development was indicated. Phase 2 emphasized the development of a high temperature metallization system as the primary development need for high temperature silicon semiconductor applications. GRA

N84-32749*# Bjorksten Research Labs., Inc., Madison, Wis.
DEVELOPMENT OF THE SONIC PUMP LEVITATION Interim Summary Report
S. A. DUNN (Sedun, Inc., Madison, Wisc.) Aug. 1984 95 p
(Contract NAS8-33513)
(NASA-CR-161963; NAS 1.26:161963) Avail: NTIS HC A05/MF A01 CSCL 20D

A prototype levitating/positioning device termed the Sonic Pump Levitator was designed, built and successfully tested in full gravity and in the reduced gravity of the parabolic flight regime of the KC-135. Positioning is achieved by timely and appropriate application of gas momentum from one or more of six sonic pumps. The sonic pumps, which are arranged orthogonally in opposed pairs about the levitation region, are activated by an electro-optical, computer controlled, feedback system. The sonic pump is a transducer which is capable of converting sound energy into a directed flow of gas. It consists of a loudspeaker whose face is sealed by a closure perforated by one or more orifices. The diaphragm of the loudspeaker is the only moving part of the sonic pump, no valves being needed. This very low inertia electromechanical device was developed to provide the short response time necessary to keep pace with the demands of computerized position keeping. B.W.

N84-32771# Argonne National Lab., Ill.
HEAT TRANSFER WITH PHASE CHANGE IN PLATE-FIN HEAT EXCHANGERS
C. B. PANCHAL 1984 15 p refs Presented at 22nd Natl. Heat Transfer Conf., Niagara Falls, N.Y., 5 Aug. 1984
(Contract W-31-109-ENG-38)
(DE84-006405; CONF-840816-4) Avail: NTIS HC A02/MF A01

A theoretical and experimental study was conducted for convective evaporation and condensation in plate-fin compact heat exchangers. The overall performance of a brazed-aluminum heat exchanger in the evaporation mode with ammonia and in the condensation mode with both ammonia and refrigerant R-22 as working fluids. The heat exchanger has straight perforated fins on the working-fluid side and extruded rectangular channels on the single-phase (water) side. The two-phase flow in narrow channels of the heat exchanger is modeled using a triangular relationship between pressure gradient, liquid film flow rate, and film thickness. The overall performance of the heat exchanger is calculated by employing local heat-transfer analysis and integrating mass- and heat-balance equations along the heat-exchanger length. Theoretical predictions are found to agree favorably with experimental results for a prototypical heat exchanger unit. DOE

N84-32782*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PIEZOELECTRIC DEICING DEVICE Patent Application
R. FINKE and B. BANKS, inventors (to NASA) 7 Aug. 1984 9 p Continuation of US-Patent-Appl-SN-469867, filed 25 Feb. 1983
(NASA-CASE-LEW-13773-2; NAS 1.71:LEW-13773-2; US-PATENT-APPL-SN-638541) Avail: NTIS HC A02/MF A01 CSCL 14B

A fast voltage pulse is applied to a transducer which comprises a composite of multiple layers of alternately polarized piezoelectric material. These layers are bonded together and positioned over the curved leading edge of an aircraft wing structure. Each layer is relatively thin and metallized on both sides. The strain produced in the transducer causes the composite to push forward resulting in detachment and breakup of ice on the leading edge of the aircraft wing. NASA

N84-32790*# Pratt and Whitney Aircraft, East Hartford, Conn. Engineering Div.
TURBINE BLADE AND VANE HEAT FLUX SENSOR DEVELOPMENT, PHASE 1 Final Report
W. H. ATKINSON, M. A. CYR, and R. R. STRANGE Aug. 1984 88 p refs
(Contract NAS3-23529)
(NASA-CR-168297; NAS 1.26:168297; PWA-5914-21) Avail: NTIS HC A05/MF A01 CSCL 14B

Heat flux sensors available for installation in the hot section airfoils of advanced aircraft gas turbine engines were developed. Two heat flux sensors were designed, fabricated, calibrated, and tested. Measurement techniques are compared in an atmospheric pressure combustor rig test. Sensors, embedded thermocouple and the Gordon gauge, were fabricated that met the geometric and fabricability requirements and could withstand the hot section environmental conditions. Calibration data indicate that these sensors yielded repeatable results and have the potential to meet the accuracy goal of measuring local heat flux to within 5%. Thermal cycle tests and thermal soak tests indicated that the sensors are capable of surviving extended periods of exposure to the environment conditions in the turbine. Problems in calibration of the sensors caused by severe non-one dimensional heat flow were encountered. Modifications to the calibration techniques are needed to minimize this problem and proof testing of the sensors in an engine is needed to verify the designs. Author

N84-32792# Naval Research Lab., Washington, D. C.
PASSIVE LINE-OF-SIGHT STABILIZATION FOR AN INFRARED SENSOR Final Report, Sep. 1982 - Aug. 1983
R. L. LUCKE 28 Jun. 1984 15 p
(Contract F12-152)
(AD-A143305; NRL-8828) Avail: NTIS HC A02/MF A01 CSCL 17G

The use of passive gyroscopic stabilization in the vibrational environment of a P-3 aircraft is described theoretically. The conclusion is reached that even a fairly heavy instrument (30 kg) can have its line of sight stabilized to a precision of 100 microradions or better. Author (GRA)

N84-32793# Naval Biodynamics Lab., New Orleans, La.
PHOTODIGITIZING PROCEDURES
P. D. KILGORE and J. H. GOTTBRATH Feb. 1984 33 p
(Contract M00-97-PN)
(AD-A143589; AD-E800972; NBDL-84R002) Avail: NTIS HC A03/MF A01 CSCL 14E

This report documents procedures and programs for efficiently running the Photo Digitizing System at the Naval Biodynamics Laboratory. Procedures have been tested and have been found to be effective. Any future acquisitions of programs or changes to current programs should be incorporated in these procedures. On-going research programs use high speed instrumentation cameras to record the motion of test subjects during biodynamic experiments. The films are digitized and the 3-dimensional motion is reconstructed and analyzed. Experimental research is performed to determine the effects of aircraft crashes, ship motion, vibration, aircraft ejection and parachute opening forces on the health and performance of Navy personnel. Author (GRA)

N84-32811# Department of the Air Force, Washington, D.C.
LASER BEAM DUCT PRESSURE CONTROLLER SYSTEM Patent Application
A. J. LADERMAN, inventor (to Air Force) 6 Oct. 1983 13 p
(AD-D011102; US-PATENT-APPL-SN-539352) Avail: NTIS HC A02/MF A01 CSCL 20D

Document describes a laser beam duct pressure controller system for maintaining a spatially uniform pressure in a flowing gas volume which is subjected to temporal pressure variations. This desired result is accomplished, with cooperating structural components (and gases therein) which eliminate the axial flow of a conditioning gas within the laser beam duct, by matching the time rate of change of the pressure of the flowing conditioning gas to the time rate of change of the pressure in the cavity of an operably associated laser beam turret. Author (GRA)

N84-32824*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THERMAL ANALYSIS OF A PLANETARY TRANSMISSION WITH SPHERICAL ROLLER BEARINGS OPERATING AFTER COMPLETE LOSS OF OIL
H. H. COE Sep. 1984 14 p refs
(NASA-TP-2367; E-2008; NAS 1.60:2367) Avail: NTIS HC A02/MF A01 CSCL 13I

Planetsys and Spherbean, two computer programs developed for the analysis of rolling element bearings, were used to simulate the thermal performance of an OH-58 helicopter main rotor transmission. A steady state and a transient thermal analysis were made and temperatures thus calculated were compared with experimental data obtained from a transmission that was operated to destruction, which occurred about 30 min after all the oil was drained from the transmission. Temperatures predicted by Spherbean were within 3% of the corresponding measured values at 15 min elapsed time and within 9% at 25 min. Spherbean also indicates a potential for high bearing cage temperatures with misalignment and outer ring rotation. E.A.K.

N84-32827*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AIRCRAFT LANDING DYNAMICS FACILITY CARRIAGE WELD TEST PROGRAM
A. G. LAWSON Sep. 1984 70 p refs
(NASA-TM-85802; NAS 1.15:85802) Avail: NTIS HC A04/MF A01 CSCL 13I

A welded tubular structure constructed of low alloy high strength quenched and tempered steel was tested. The consistency of the mechanical strengths and chemical composition and the degree of difficulty of obtaining full strength welds with these steels is characterized. The results of constructing and testing two typical connections which are used in the structure design are reported. E.A.K.

N84-32832# Naval Postgraduate School, Monterey, Calif.
REPORT OF TESTS OF A COMPRESSOR CONFIGURATION OF CD (CONTROLLED DIFFUSION) BLADING M.S. Thesis
Y. KOYUNCU Mar. 1984 198 p
(AD-A143499) Avail: NTIS HC A09/MF A01 CSCL 13G

Results of 14 tests in a subsonic cascade are reported in which the air inlet angle and Reynolds number were varied. The cascade contained 20 Controlled Diffusion (CD) blades, with 5.01 inches chord, aspect ratio of 2.0 and solidity of 1.67. Pneumatic probe surveys and surface pressure measurements were used to obtain blade performance and flow quality data. There was no measurable influence of the Reynolds number on the blade losses in the range of Re. = 474000 to Re. = 690000. Fourteen tests, using seven different inlet air angles over a range of 24 to 46 degrees generated generally well behaved blade performance parameters. The results were compared with previous results from a corresponding cascade of DCA blades. Author (GRA)

N84-32842# GA Technologies, Inc., San Diego, Calif.
AN IMPROVED METHOD FOR THE PREDICTION OF CENTRIFUGAL COMPRESSOR ROTATIONAL-TONE NOISE
R. G. ADAMS and B. H. BICKERS (National Nuclear Corp., Ltd.) Apr. 1984 9 p refs Presented at the Intersoc. Energy Conversion Eng. Conf., San Francisco, 19 Aug. 1984
(Contract DE-AT03-84SF-11963)
(DE84-013345; GA-A-17545; CONF-840804-22) Avail: NTIS HC A02/MF A01

This paper presents a method of calculating the sound power produced by the action of the impeller vanes from the design parameters of the compressor and the calculated flow loss coefficients. This method develops relationships between the non-dimensional wake width, ratio between the jet and wake velocities and the impeller loss coefficient. Fourier analysis of the resulting square wave gives an expression for the fluctuating pressure force at the impeller exit surface. This is then applied to the acoustic dipole source term derived in an earlier paper to calculate the sound power produced by the rotating impeller. DOE

N84-32852# Ames Lab., Iowa.
APPLICATION OF ELASTIC WAVE SCATTERING THEORY TO THE DETECTION AND CHARACTERIZATION OF FLAWS IN STRUCTURAL MATERIALS
R. B. THOMPSON 1984 14 p refs Presented at ASME Pressure Vessel and Piping Conf., San Antonio, 17 Jun. 1984
(Contract W-7405-ENG-82)
(DE84-013729; IS-M-488; CONF-840647-20) Avail: NTIS HC A02/MF A01

The uses of elastic wave scattering theory in ultrasonic nondestructive evaluation are reviewed. The present understanding of the scattering from stress free, elliptical cracks in unbounded media is first summarized. This is followed by a discussion of additional problems imposed by the topography of real cracks and part surfaces. The increasing use of models in engineering applications is illustrated by examples taken from the inspection of nuclear power plant piping and pressure vessel welds and aircraft turbine engine rotor components. DOE

N84-32864*# Computer Software Management and Information Center, Athens, Ga.
TWELFTH NASTRAN USERS' COLLOQUIUM
Washington Aug. 1984 261 p refs Colloq. held in Orlando, Fla., 7-11 May 1984 Prepared in cooperation with Georgia Univ., Athens
(NASA-CP-2328; NAS 1.55:2328) Avail: NTIS HC A12/MF A01 CSCL 20K

NASTRAN is a large, comprehensive, nonproprietary, general purpose finite element computer code for structural analysis. The Twelfth Users' Colloquim provides some comprehensive papers on the application of finite element methods in engineering, comparisons with other approaches, unique applications, pre and post processing or auxiliary programs, and new methods of analysis with NASTRAN.

N84-32869*# Gates Learjet Corp., Wichita, Kans.
COMPUTER AIDED MODELING AND POST PROCESSING WITH NASTRAN ANALYSIS
R. R. BOROUGHS *In* Computer Software Management and Information Center Twelfth NASTRAN Users' Colloq. p 54-77 Aug. 1984 refs
Avail: NTIS HC A12/MF A01 CSCL 20K

Computer aided engineering systems are invaluable tools in performing NASTRAN finite element analysis. These techniques are implemented in both the pre-processing and post-processing phases of the NASTRAN analysis. The finite element model development, or pre-processing phase, was automated with a computer aided modeling program called Supertabl, and the review and interpretation of the results of the NASTRAN analysis, or post-processing phase, was automated with a computer aided plotting program called Output Display. An intermediate program, Nasplot, which was developed in-house, has also helped to cut down on the model checkout time and reduce errors in the model. An interface has been established between the finite element computer aided engineering system and the Learjet computer aided design system whereby data can be transferred back and forth between the two. These systems have significantly improved productivity and the ability to perform NASTRAN analysis in response to product development requests. Author

N84-32873*# Tennessee Eastman Corp., Oak Ridge.
STRUCTURAL ANALYSIS OF THE SUPPORT SYSTEM FOR A LARGE COMPRESSOR DRIVEN BY A SYNCHRONOUS ELECTRIC MOTOR
J. R. WINTER *In* Computer Software Management and Information Center Twelfth NASTRAN Users' Colloq. p 161-191 Aug. 1984 refs
Avail: NTIS HC A12/MF A01 CSCL 20K

For economic reasons, the steam drive for a large compressor was replaced by a large synchronous electric motor. Due to the resulting large increase in mass and because the unit was mounted on a steel frame approximately 18 feet above ground level, it was deemed necessary to determine if a steady state or transient vibration problem existed. There was a definite possibility that a resonant or near resonant condition could be encountered. The ensuing analysis, which led to some structural changes as the analysis proceeded, did not reveal any major steady state vibration problems. However, the analysis did indicate that the system would go through several natural frequencies of the support structure during start-up and shutdown. This led to the development of special start-up and shutdown procedures to minimize the possibility of exciting any of the major structural modes. A coast-down could result in significant support structure and/or equipment damage, especially under certain circumstances. In any event, dynamic field tests verified the major analytical results. The unit has now been operating for over three years without any major vibration problems. Author

N84-32876*# Aerostructures, Inc., Arlington, Va.
FOUR NEW CAPABILITIES IN NASTRAN FOR DYNAMIC AND AEROELASTIC ANALYSES OF ROTATING CYCLIC STRUCTURES
V. ELCHURI and A. M. GALLO (Bell Aerospace Textron) *In* Computer Software Management and Information Center Twelfth NASTRAN Users' Colloq. p 237-256 Aug. 1984 refs
Avail: NTIS HC A12/MF A01 CSCL 20K

Static aerothermoelastic design/analysis of axial-flow compressors, modal flutter analysis of axial-flow turbomachines, forced vibration analysis of rotating cyclic structures and modal flutter analysis of advanced turbopropellers with highly swept blades are four new capabilities developed and implemented in NASTRAN Level 17.7. The contents, applicability and usefulness of these capabilities which were developed and documented under the sponsorship of NASA's Lewis Research Center are discussed. Overall flowcharts and selected examples are presented. R.J.F.

N84-32878# Aeronautical Research Labs., Melbourne (Australia).
THE NEED FOR BIAXIAL FATIGUE TESTING AT A.R.L.
J. M. FINNEY and P. W. BEAVER May 1984 21 p
(AD-A143203; ARL/STRUC-TM-380) Avail: NTIS HC A02/MF A01 CSCL 14B

The need for biaxial fatigue testing at ARL (Aeronautical Research Laboratories) is discussed. The acquisition of a facility is based on the grounds of improving fatigue and fracture prediction in aircraft, and enhancing ARL's capability of responding to service problems. Partial Contents: Regions of Multidirectional Stress in Aircraft; Multiaxial Fatigue and Fiber Composite Materials; Current Tasks for Which a Biaxial Test Facility is Essential or Desirable; and Proposed Biaxial Fatigue Machine. GRA

N84-32881# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DYNAMICS OF ANGULAR MOVEMENTS OF A SOLID SUPPORTING A ROTATING ROTOR WITH CONSIDERATION OF ENERGY DISSIPATION
V. A. GROBOV and I. I. KANTEMIR 6 Jul. 1984 12 p Transl. into ENGLISH from Mat. Fiz. (USSR), no. 11, 1972 p 8-14
(AD-A143349; FTD-ID(RS)T-0296-84) Avail: NTIS HC A02/MF A01 CSCL 20K

This report discusses the dynamics of angular movements of a solid supporting a rotating rotor. The motion of a system is analyzed consisting of a solid B with mass M, rotor B' with mass M' and two passive dampers B and B', each which consists of a spring and mass placed into a tube filled with a viscous fluid. Equations of motion are formulated for this system. The schematic of this system is illustrated. B.W.

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GEOSCIENCES

Includes geosciences (general); earth resources; energy production and conversion; environment pollution; geophysics; meteorology and climatology; and oceanography.

A84-43431#
GRAVITY FIELD PRODUCTS FROM OCEAN ALTIMETER DATA
R. H. RAPP (Ohio State University, Columbus, OH) IN: Guidance and Control Conference, Seattle, WA, August 20-22, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 270-278. Research supported by the Ohio State University Research Foundation. refs
(Contract F19628-81-K-0002)
(AIAA PAPER 84-1875)

GEOS-3 and Seasat altimeter data acquired over the 1975-1978 period, after correction for tides, orbital errors, meteorological effects, and sea surface topography, should yield the geoid equipotential surface. The initial, gravity field-related information obtained is that for the geoid undulations, which can be processed to yield point and mean gravity anomalies as well as deflections of the vertical. Such values are obtainable at the surface of the ocean and above it by means of upward continuation techniques. Attention is given to computations with existing altimeter data for these gravity field products, with a view to the data that should be acquired in the future. O.C.

A84-43653#
AIR FORCE AIR WEATHER SERVICE'S REQUIREMENTS FOR GLOBAL METEOROLOGICAL DATA
D. A. MOORE and R. E. PETERSON (USAF, Air Weather Service, Scott AFB, IL) Applied Optics (ISSN 0003-6935), vol. 23, Aug. 1, 1984, p. 2474-2476.

The activities of the Air Weather Service in building a central environmental data base and providing the Air Force, Army, and the Department of Defense with weather analysis and forecasts are reviewed. In particular, the requirements for cloud imagery, precipitation measurements, surface characteristics, and profiles of winds, temperature, moisture, and aerosols are discussed. The role of numerical models in building a comprehensive global data base is examined. It is emphasized that weather support can be enhanced by using advanced remote-sensing methods (e.g., coherent lidar methods) to measure some of the environmental elements that affect military operations. V.L.

A84-43908* National Center for Atmospheric Research, Boulder, Colo.
THE MICROBURST - HAZARD TO AIRCRAFT
J. MCCARTHY and R. SERAFIN (National Center for Atmospheric Research, Boulder, CO) Weatherwise (ISSN 0043-1672), vol. 37, June 1984, p. 120-127. NOAA-supported research; U.S. Department of Transportation.
(Contract DOT-FA01-82-Y-10513; NASA ORDER H-59314-B)

In encounters with microbursts, low altitude aircraft first encounter a strong headwind which increases their wing lift and altitude; this phenomenon is followed in short succession by a decreasing headwind component, a downdraft, and finally a strong tailwind that catastrophically reduces wing lift and precipitates a crash dive. It is noted that the potentially lethal low altitude wind shear of a microburst may lie in apparently harmless, rain-free air beneath a cloud base. Occasionally, such tell-tale signs as localized blowing of ground dust may be sighted in time. Microbursts may, however, occur in the heavy rain of a thunderstorm, where they will be totally obscured from view. Wind shear may be detected by an array of six anemometers and vanes situated in the vicinity of an airport, and by Doppler radar equipment at the airport or aboard aircraft. O.C.

A84-44000

VORTEX SHEDDING BY A SAVONIUS ROTOR [SYSTEME TOURBILLONNAIRE ENGENDRE PAR UNE EOLIENNE SAVONIUS]

M. BOTRINI, C. BEGUIER, A. CHAUVIN, and R. BRUN (Marseille II, Universite, Marseille, France) Academie des Sciences (Paris), Comptes Rendus, Serie II - Mecanique, Physique, Chimie, Sciences de l'Univers, Sciences de la Terre (ISSN 0249-6305), vol. 298, no. 20, May 28, 1984, p. 861-864. In French.

A series of flow visualizations was performed to characterize the wake vortices of a Savonius rotor. The trials were undertaken in an attempt to account for discrepancies between theoretical and experimentally-derived power coefficients. The Savonius examined was two-bladed with a center offset. All tests were made in a water tunnel. Dye injection provided the visualization, and average velocities and velocity fluctuations were measured using a laser Doppler anemometer. A system of three vortices was found to be periodically shed by the rotor. Flow velocity fluctuation intensity peaked as a vortex was shed. The vortex shedding alternated from blade to blade, so that one was shed from a blade moving upstream. M.S.K.

A84-44150

THE ROLE OF NEXRAD IN AIRCRAFT NAVIGATION AND FLIGHT SAFETY ENHANCEMENT

P. R. MAHAPATRA (Indian Institute of Science, Bangalore, India) and J. T. LEE (NOAA, National Severe Storms Laboratory, Norman, OK) Navigation (ISSN 0028-1522), vol. 31, Spring 1984, p. 21-37. refs

Up to now, the Air Traffic Control (ATC) system has been mainly concerned with keeping aircraft in the air at safe distances from each other to eliminate collision hazards. In recent years, it has been recognized that weather is an important factor in a large number of aircraft accidents and flight delays. The integrated and automated ATC system, which is currently being planned, will, therefore, also have the task to reroute traffic around storm areas. This function will depend on highly reliable sensors for weather monitoring. The required meteorological data would be partly provided by the Next Generation Weather Radar (Nexrad) system which is currently being developed. The present investigation is concerned with the characteristics of the Nexrad system, taking into account the role of weather information and, in particular, the role of the Nexrad system in enhancing flight safety. G.R.

A84-44429#

PREDICTIONS OF AIR POLLUTION FROM AN OFFSHORE AIRPORT. III ANALYSIS OF DISPERSION PROCESS IN INTERNAL BOUNDARY LAYER

M. OHKURA and A. NISHI (Miyazaki University, Miyazaki, Japan) Japan Society of Air Pollution, Journal (ISSN 0386-7064), vol. 19, no. 3, 1984, p. 194-202. In Japanese, with abstract in English. refs

A84-45065#

AN ON-LINE REALIZATION FOR PRECISE WIND VECTOR MEASUREMENTS ON BOARD THE DO 28 RESEARCH AIRCRAFT

P. VOERSMANN (Braunschweig, Technische Universitaet, Brunswick, West Germany) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 1226-1234. Research supported by the Deutsche Forschungsgemeinschaft. refs

On board the DO 28 research aircraft of the Technische Universitaet Braunschweig an on-line wind measuring system has been implemented. It calculates all three components of the wind vector in real time at a sampling rate of 23 Hz. The theoretical principle for determining the wind vector is stated. A summary of the installed computer and sensor hardware is presented and the effects of sensor errors on wind accuracy are discussed. Flight test results show that there is little influence of aircraft maneuvers on system accuracy. The high precision of the winds measured on board the aircraft was verified in a tower fly-by with data collected from a tower of 300 m height. Author

A84-45663

VARIATION WITH DISTANCE OF AIRCRAFT NOISE IMPACT PARAMETERS

K. W. YEOW (Malaya, University, Kuala Lumpur, Malaysia) Journal of Sound and Vibration (ISSN 0022-460X), vol. 95, July 8, 1984, p. 127-130. refs

The measurements and computation methods used to predict aircraft-noise levels in the vicinity of airports are discussed. A distinction is drawn between time-integrated noise parameters such as effective perceived noise level (LEPN) or noise exposure forecast (NEF) and non-time-integrated parameters such as maximum perceived noise level (LPNmax). While directionality and convection-Mach-number effects can be ignored for all parameters, the inverse square law (with respect to the distance r0) applies only to the non-time-integrated parameters; computations with NEF and LEPN follow a simple 1/r0 law. The results of sample calculations are presented in graphs. T.K.

N84-31768# Army Engineer Topographic Labs., Fort Belvoir, Va.

TERRAIN ANALYSIS PROCEDURAL GUIDE FOR BUILT-UP AREAS (REPORT NO. 13 IN THE ETL (ENGINEER TOPOGRAPHIC LABORATORIES) SERIES ON GUIDES FOR ARMY TERRAIN ANALYSTS)

R. J. FRODIGH Apr. 1984 218 p

(AD-A142918; ETL-0354) Avail: NTIS HC A10/MF A01 CSCL 08B

This procedural guide provides the Army Terrain Analyst with the methods and procedures to generate thematic, or factor, overlays, with supportive tables, for portraying approximately 20 built-up area elements. Retrieval of information from three basic sources (topographic maps, photography, and literature) is considered, and applied techniques for development of factor overlays are documented in a step-by-step sequence. Author (GRA)

N84-31786# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

USING GAS-TURBINE POWER STATIONS WITH AIRCRAFT ENGINES FOR POWER-AND-HEAT GENERATION

A. A. MARGARYAN 1 Jun. 1984 9 p Transl. into ENGLISH from Prom. Arm. (USSR), no. 6, 1972 p 13-15

(AD-A142084; FTD-ID(RS)T-0072-84) Avail: NTIS HC A02/MF A01 CSCL 10B

The purpose is to determine certain power engineering indices of gas turbine engines used to generate electricity and heat. The RD-3M-500 engine is discussed. It is concluded that the engine would be useful for the generation of heat and electricity in regions located far from large power sources when these regions had limited water and fuel supplies. R.J.F.

N84-31787# Department of Energy, Washington, D. C.

JET SPOILER ARRANGEMENT FOR WIND TURBINE Patent Application

J. D. CYRUS, E. G. KABLEC, and P. C. KLIMAS, inventors (to DOE) 15 Sep. 1983 13 p

(Contract DE-AC04-76DP-00789)

(DE84-011303; US-PATENT-APPL-SN-532430) Avail: NTIS HC A02/MF A01

An air jet spoiler arrangement is provided for a Darrieus-type vertical axis wind-powered turbine. Air is drawn into hollow turbine blades through air inlets at the end thereof and is ejected in the form of air jets through small holes or openings provided along the lengths of the blades. The air jets create flow separation at the surfaces of the turbine blades, thereby including stal conditions and reducing the output power. A feedback control unit senses the power output of the turbine and controls the amount of air drawn into the air inlets accordingly. DOE

N84-31848# Manchester Univ. (England). Dept. of Physics.
A LABORATORY STUDY OF AIRCRAFT PRECIPITATION STATIC CHARGING Final Scientific Report, 1 Aug. 1982 - 31 Jul. 1983
A. J. ILLINGWORTH May 1984 50 p
(Contract AF-AFOSR-0323-82)
(AD-A142561; AFOSR-84-0540TR) Avail: NTIS HC A03/MF A01 CSCL 04A

Laboratory experiments show that when small ice particles collide with targets at speeds of up to 80m/s then the charge transfer is dependent upon the work function of the target material. Most common materials charge negatively, in agreement with observed aircraft charging in ice clouds, but magnesium which has a low work function charges positively. These results enable the charging of materials to be predicted before flight, and also suggest that alloys of magnesium should minimize aircraft charging. The laboratory apparatus could be used to characterize the charging of the new composite materials for aircraft surfaces. GRA

N84-31865*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CLIMATOLOGY OF OZONE AT ALTITUDES FROM 19,000 AT 59,000 FEET BASED ON COMBINED GASP AND OZONESONDE DATA
W. H. JASPERSON (Control Data Corp.), G. D. NASTROM (Control Data Corp.), and J. D. HOLDEMAN Aug. 1984 363 p refs
(Contract DOT-FA78WAI-893)
(NASA-TP-2303; E-1626; NAS 1.60:2303) Avail: NTIS HC A16/MF A01 CSCL 04B

A climatology of ozone for altitudes from FL190 to FL590 (19,000 to 59,000 ft) is presented. Climatological tables are given in two appendixes: one with d deg latitude resolution on a monthly basis, and one with 10 deg latitude resolution on a seasonal basis. Data were taken from 11,472 balloon-borne ozonesondes launched at 60 stations from 1963 to 1980 and from over 160,000 observations made by the Global Atmospheric Sampling Program on 4417 commercial airliner flights from 1975 to 1979. Case study and statistical comparisons of results from these two data sets showed that they are compatible and can be combined. Several examples of analyses that can be made by using the tabulated data are given and discussed. Author

N84-32919*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
SURVEY OF MANUFACTURERS OF HIGH-PERFORMANCE HEAT ENGINES ADAPTABLE TO SOLAR APPLICATIONS
W. B. STINE 15 Jun. 1984 39 p
(Contract DE-AM04-80AL-13137)
(NASA-CR-173911; JPL-PUB-84-46; DOE/JPL-1060/75; NAS 1.26:173911) Avail: NTIS HC A03/MF A01 CSCL 10B

The results of an industry survey made during the summer of 1983 are summarized. The survey was initiated in order to develop an information base on advanced engines that could be used in the solar thermal dish-electric program. Questionnaires inviting responses were sent to 39 companies known to manufacture or integrate externally heated engines. Follow-up telephone communication ensured uniformity of response. It appears from the survey that the technology exists to produce external-heat-addition engines of appropriate size with thermal efficiencies of over 40%. Problem areas are materials and sealing. R.J.F.

N84-32969# Weapons Systems Research Lab., Adelaide (Australia).
INVESTIGATION INTO THE INTERNAL AERODYNAMIC DESIGN AND ASSOCIATED ERRORS IN A FAST DESCENT DUCTED SONDE FOR THE MEASUREMENT OF ATMOSPHERIC PRESSURE AND TEMPERATURE (AMPARS PHASE 2)
P. H. O. PEARSON Nov. 1983 28 p
(AD-A143189; WSRL-0343-TR) Avail: NTIS HC A03/MF A01 CSCL 04B

This report investigates aspects of the atmospheric pressure and temperature measuring technique for a fast descent sonde. The sonde, which is drogue stabilized, is released from a rocket vehicle in the vicinity of the apogee which is 20 km. Low speed wind tunnel tests have been conducted to check any errors in the measurement of atmospheric pressure resulting from the positioning of the static tube mounted inside an internally ducted sonde. It shows that no errors occur for the chosen position up to an external airflow incidence of 30 deg. Errors owing to heat transfer into a centrally mounted thermistor are examined for various thermistor positions and incidence angles and the thermistor response time has been measured and compared with theoretical results. Overall it is shown that the duct design is suitable for a fast descent sonde with errors well below those specified by the Bureau of Meteorology for standard ascending meteorological sondes. Author (GRA)

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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.

A84-43401
GUIDANCE AND CONTROL CONFERENCE, SEATTLE, WA, AUGUST 20-22, 1984, TECHNICAL PAPERS
Conference sponsored by the American Institute of Aeronautics and Astronautics. New York, American Institute of Aeronautics and Astronautics, 1984, 780 p. For individual items see A84-43402 to A84-43486.

Among the guidance and control topics discussed are autonomous spacecraft navigation, aeroassisted orbital plane change, spacecraft applications of inertial energy storage wheels, miss distance dynamics in homing missiles, robust missile autopilot design, the Space Telescope Alternate Fine Guidance Sensor, instrument failure detection and isolation in a system with variable plant parameters, the control of forward swept wing configurations dominated by flight dynamic-aeroelastic interactions, Global Positioning System applications to geodesy, airborne gravity measurement with an astroinertial system, discrete optimal control solutions applicable to missile guidance, and maximum information guidance for homing missiles. Also considered are the analysis of a control concept for ejection seats, large flexible structure controllability improvements, multivariable control for the F-100 engine, allowable response delay for large aircraft, airborne wind shear detection, robust compensator synthesis by frequency-shaped estimation, digital flight mode control systems for high performance aircraft with flight propulsion control coupling, a model-following control system for helicopters, the maneuvering of distributed spacecraft, roll/yaw control of flexible spacecraft, and the evolution of the Pershing II missile system. O.C.

A84-43406#
MULTIVARIABLE PREFILTER DESIGN FOR COMMAND SHAPING
N. A. LEHTOMAKI, G. STEIN, and J. E. WALL, JR. (Honeywell Systems and Research Center, Minneapolis, MN) IN: Guidance and Control Conference, Seattle, WA, August 20-22, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 38-43. refs
(AIAA PAPER 84-1829)

A state space computational approach for the design for prefilters to realize desired multivariable closed-loop transfer matrices is presented and related to LQG loopshaping techniques for multivariable feedback design and the problem of perfect regulation. The procedure works for ,nonsquare as well as square systems under some mild restrictions and can be interpreted quite easily in terms of high gain state feedback control with integral action to set the bandwidth of the prefiltering action. Author

A84-43420*# Washington Univ., Seattle.
INSTRUMENT FAILURE DETECTION AND ISOLATION IN A SYSTEM WITH VARIABLE PLANT PARAMETERS
F. J. ALEXANDRO, JR. (Washington, University, Seattle, WA) and J. TSOU IN: Guidance and Control Conference, Seattle, WA, August 20-22, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 176-181. refs
(Contract NCA2-OR-850-301)
(AIAA PAPER 84-1856)

This paper considers the problem of detecting instrument failures in a system in which there are plant parameter variations. The method described is based on the use of Kalman filters to provide a detection comparison in a manner similar to Clark's dedicated observer method. To improve the sensitivity to sensor variation and reduce the sensitivity to plant parameter variation the Kalman filters are designed to be sub-optimal. A procedure is described to design the sub-optimal filters so as to improve a measure of the ratio of sensor to plant sensitivity. Author

A84-43466#
NONCONSERVATIVE EVALUATION OF UNIFORM STABILITY MARGINS OF MULTIVARIABLE FEEDBACK SYSTEMS
D. B. RIDGELY, S. S. BANDA (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, OH), and H.-H. YEH IN: Guidance and Control Conference, Seattle, WA, August 20-22, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 581-591. refs
(AIAA PAPER 84-1939)

This paper discusses concepts of stability margins of multivariable feedback systems. Independent and uniform stability margins are defined. A previous conjecture that the uniform margins may be computed by using the eigenvalue magnitudes instead of the singular values in the robust stability criteria is theorized. The nonconservatism provided by this theory in the evaluation of uniform margins is discussed, along with limitations of the uniform margins. Also presented is a method of using the uniform margins to extend the region of stability beyond what can be specified by singular values. Results are demonstrated numerically in an example of a lateral attitude control system for a drone aircraft. Author

A84-43467*# Drexel Univ., Philadelphia, Pa.
DESIGN OF AN OPTIMAL OUTPUT FEEDBACK CONTROL SYSTEM WITH MODAL INSENSITIVITY
K. V. RAMAN and A. J. CALISE (Drexel University, Philadelphia, PA) IN: Guidance and Control Conference, Seattle, WA, August 20-22, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 592-600. refs
(Contract N00014-77-C-0642; NAG1-243)
(AIAA PAPER 84-1940)

This paper deals with the design of an output feedback controller which results in selected modal insensitivity, and at the same time optimizes a quadratic performance index representative of desired system performance for nominal plant parameter values. The approach taken here is to characterize the class of attainable eigenvectors for a given set of eigenvalues (distinct or non-distinct) which lie in a subspace called the 'Modal Insensitivity Subspace'. A constraint is established on the feedback matrix which results in modal insensitivity. Necessary conditions for optimality subject to the constraint on the feedback matrix are given. This forms the basis for a numerical algorithm to compute the optimal feedback gain which analyzed for convergence. To illustrate the procedure, a design is carried out using the lateral dynamics of an L-1011 aircraft. Author

A84-43469#
CONFIGURATION CONTROL METHODOLOGY FOR SYSTEM PERFORMANCE ENHANCEMENT
M. N. WAGDI (Suez Canal University, Port Said, Egypt) IN: Guidance and Control Conference, Seattle, WA, August 20-22, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 618-623. refs
(AIAA PAPER 84-1942)

A new methodology is introduced where the variation of the system configuration parameters are considered as contributions to the control effort. Such consideration results into a more effective and robust controllers that enhance the system performance. A relation between the desired shift in the eigen values and the variation in the system configuration parameters is established. Also a direct relation between the control gain matrix and the variation in the eigen values is established. As an application to the present methodology the configuration control of an aircraft performing a lateral maneuver is worked out. Author

A84-43479*# Calspan Corp., Buffalo, N. Y.
OPTIMAL STATE-RATE FEEDBACK EXPLICIT MODEL-FOLLOWING
S. BUETHE (Calspan Corp., Buffalo, NY) and J. V. LEBACQZ (NASA, Ames Research Center, Moffett Field, CA) IN: Guidance and Control Conference, Seattle, WA, August 20-22, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 710-714. refs
(Contract NCC2-142)
(AIAA PAPER 84-1857)

The development of optimal explicit model-following control laws which include the use of state-rate signals is described. By formulating the control problem to consider both state and state-rate errors, some generalization of previous results is obtained. For special cases in which 'perfect' model-following is possible, the form of the resulting control law is particularly simple and leads to clear understanding of the direct influences of the weighting matrices used in the problem formulation. In addition the use of state-rate feedback permits the solution to be expressed in terms of gains on state an state-rate errors between model and controlled element, thereby obviating any requirement that perturbation signals be used for feedback. Author

A84-43481*# California Univ., Davis.
AUTOMATION EFFECTS IN A STEREOTYPICAL MULTILOOP MANUAL CONTROL SYSTEM
R. A. HESS (California, University, Davis, CA) and B. D. MCNALLY IN: Guidance and Control Conference, Seattle, WA, August 20-22, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 723-730. NASA-supported research. refs
(AIAA PAPER 84-1896)

The increasing reliance of state-of-the art, high performance aircraft on high authority stability and command augmentation systems, in order to obtain satisfactory performance and handling qualities, has made critical the achievement of a better understanding of human capabilities, limitations, and preferences during interactions with complex dynamic systems that involve task allocation between man and machine. An analytical and experimental study has been undertaken to investigate human interaction with a simple, multiloop dynamic system in which human activity was systematically varied by changing the levels of automation. Task definition has led to a control loop structure which parallels that for any multiloop manual control system, and may therefore be considered a stereotype. O.C.

A84-44745

HIGH SPEED TRANSPARENT SYSTEM RECONFIGURATION FOR FAILSAFE COMPUTER NETWORKS

D. E. ARNOLD and J. W. ALBERS (Sperry Corp., Sperry Univac Defense Systems Div., St. Paul, MN) IN: Air Traffic Control Association, Annual Fall Conference, 27th, Atlantic City, NJ, October 18-21, 1982, Proceedings. Arlington, VA, Air Traffic Control Association, 1982, p. 257-263.

An alternative distributed architecture approach for failsafe Air Traffic Control (ATC) computers is described. The approach is based on a concept developed for the Canadian navy in which ATC system tasks are distributed to a number of independent, loosely coupled processors according to their function in the display, communications, or interface subsystems. Several of the advantages of such a system are discussed. Consideration is also given to the development of a Serial Data Bus (SDB) and its network control software which provide error free data transfer and high survivability in military applications. The design characteristics of the SDB network are discussed in detail, and its applications to a local medium-sized ATC computer system are pointed out. Schematic diagrams are provided of the system architecture and of the SDB interface format. I.H.

A84-44793

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) IEEE Transactions on Automatic Control (ISSN 0018-9286), vol. AC-29, Sept. 1984, p. 827-829. 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

A84-44940#

EVALUATION OF SINGULARLY PERTURBED PURSUIT-EVASION GAMES

B. S. A. JARMARK (Saab-Scania AB, Linkoping, Sweden), C. HILLBERG (Chalmers Tekniska Hogskola, Goteborg, Sweden), and J. SHINAR (Israel Institute of Technology, Haifa, Israel) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 111-117. refs

A horizontal interception problem, formulated as a pursuit-evasion game, is studied in order to evaluate the accuracy of suboptimal feedback strategies obtained by singular perturbation technique. The exact solution of the problem is generated by an algorithm based on differential dynamic programming. The aircraft models used in the study are of realistic aerodynamical and propulsion characteristics. Results indicate that for initial ranges larger than 8-10 turning radii the suboptimal strategies provide a reasonable accuracy. Author

A84-44941#

TIME-DELAY COMPENSATION IN ACTIVE CONTROL ALGORITHMS

A. BRADSHAW and M. A. WOODHEAD (Salford, University, Salford, Lancs., England) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 118-125. refs

A control algorithm which accounts for multiple period delays in a discrete tracking system is presented. The modification was sought to compensate for computational delays being large relative to the sampling periods. Attention is focused on multi-input multi-output linear systems. It is shown that adequate tracking is obtained if the slow and fast modes of the pole values are a subset of the open unit disk. Conditions are defined for both full time delay compensation and stability of the fast modes. Applications are numerically illustrated for vertical translation and fuselage pitch pointing maneuvers on the YF-16 aircraft and confirmed by the results of laboratory simulations. M.S.K.

A84-45017#

UHSH1 - AN EFFICIENT THREE DIMENSIONAL SHAPE OPTIMAL DESIGN PROGRAM

L. YINGWEI and H. JIARMIN (Nanchang Aircraft Co., Nanchang, People's Republic of China) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 802-810. refs

Features of a three-dimensional shape optimization program (UHSH1) for designing elastic solid aircraft components are described. The structures are expected to experience multiple loadings. UHSH1 can be used to find a minimal weight and the minimum maximum stress. Calculations are guided by stress, displacement, frequency and upper and lower bound constraints. The designs are modeled in terms of triangular finite elements, in association with a sensitivity analysis for the three-dimensional parameteric elements. Shapes are generated through super curve and shape superposition techniques. Sample solutions are found for optimal tapering of a cantilever beam and lug optimization. M.S.K.

A84-45606*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

A MULTILOOP SYSTEM STABILITY MARGIN STUDY USING MATRIX SINGULAR VALUES

V. MUKHOPADHYAY (NASA, Langley Research Center; Joint Institute for Advancement of Flight Sciences, Hampton, VA) and J. R. NEWSOM (NASA, Langley Research Center, Hampton, VA) (Guidance and Control Conference, San Diego, CA, August 9-11, 1982, Collection of Technical Papers, p. 420-428) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 7, Sept.-Oct. 1984, p. 582-587. Previously cited in issue 02, p. 230, Accession no. A83-12457. refs

A84-45647

SYSTEMS OF TERMINAL CONTROL [SISTEMY TERMINAL'NOGO UPRAVLENIIA]

A. P. BATENKO Moscow, Izdatel'stvo Radio i Sviaz', 1984, 161 p. In Russian. refs

Consideration is given to the problem of combining optimal and nonoptimal systems of terminal control. Methods are presented for applying the principles of automatic control of objects with nonlinear motion which is described in a series of linear and nonlinear differential equations. Several example computer subroutines in FORTRAN for realizing the procedure are provided. I.H.

A84-46122#
THE DESIGN OF COMPUTER GENERATED IMAGES
D. SMART (General Dynamics Corp., Avionic Systems Dept., Fort Worth, TX) and A. C. CHIRIELEISON (General Dynamics Corp., Simulation Animation Services, Weatherford, TX) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 22nd, Reno, NV, Jan. 9-12, 1984. 4 p.
(AIAA PAPER 84-0556)

The present investigation is concerned with the problems involved in providing visual flight simulation with the aid of a Computer Generated Image System (CGI), and the approaches employed to solve these problems. It is pointed out that in visual flight simulation each scenario requires several thousand different viewpoints for a very few minutes of simulated flight. A satisfaction of unrealistic requirements becomes impossible or prohibitively expensive, and compromises must usually be made. For a suitable implementation of the needed features, it is important to have a complete understanding of the proposed visual system's data base software and hardware capabilities. Attention is given to requirements and specifications, the designing of proposals, and the construction and management of data bases. Artistic people must be hired to produce the initial concepts, and draftsmen are needed, when creating three-dimensional objects. G.R.

A84-46499
EVALUATION OF 3-D GRAPHICS SOFTWARE - A CASE STUDY
M. E. LORES, S. H. CHASEN, and J. M. GARNER (Lockheed-Georgia Co., Marietta, GA) IEEE Computer Graphics and Applications (ISSN 0272-1716), vol. 3, Nov. 1983, p. 73-77.

The principal output of the engineering process in an aircraft manufacturing organization is geometry and the associated manufacturing, assembly, and maintenance specifications. Conventional ways to communicate geometric information were inefficient and time-consuming. Modern digital computers with high-quality interactive graphics devices offer now a means for a significant improvement of the efficiency with which geometric data are created, manipulated, and maintained. They also permit all engineering disciplines to operate from a common geometric database. The present investigation is concerned with developments which occurred at an American aerospace company once the need for a commercial three-dimensional (3-D) computer-aided capability had been established. The first step in selecting a software system was a self-appraisal to identify current capabilities within the company. Subsequent steps involved an evaluation of individual systems. G.R.

N84-31123# Proprietary Software, Inc., Los Angeles, Calif.
MANAGEMENT OVERVIEW OF THE BENEFITS OF EFFICIENT JOVIAL J73/1750A SOFTWARE TOOLS
J. FLEISS *In* ASD Proc. Papers of the 2nd AFSC Avionics Standardization Conf., Vol. 1 p 15-18 Nov. 1982
(AD-P003519) Avail: NTIS HC A25/MF A01 CSCL 09B

The Air Force has invested a significant amount of funds in providing a set of standards for avionics applications. Support software tools for MIL-STD 1750A and MIL-STD 1589B are of critical importance to numerous avionics applications. This article discusses the tools being provided by PSS in support of MIL-STD 1750A and MIL-STD 1589B. Author (GRA)

N84-31126# Aeronautical Systems Div., Wright-Patterson AFB, Ohio.
JOVIAL LANGUAGE CONTROL PROCEDURES WITH A VIEW TOWARD ADA (TRADEMARK)
P. A. KNOOP and B. R. EVANS *In* ASD Proc. Papers of the 2nd AFSC Avionics Standardization Conf., Vol. 1 p 49-63 Nov. 1982
(AD-P003522) Avail: NTIS HC A25/MF A01 CSCL 09B

JOVIAL is the interim standard language for Air Force avionics embedded computer until Ada becomes available. The JOVIAL Language Control Facility (LCF) has developed and fine-tuned the procedures of language control and defined them using a formal modeling technique. The resulting models promote tight administration of the control function by exposing the details of all tasks and forcing attention to their interrelationships. They also provide a basis for reconfiguring proven Air Force language control functions for Ada, and the LCF has identified some important considerations in accomplishing this. The Air Force's transition to Ada has a high probability of success because of their experience with JOVIAL, their systematic evolution and fine-tuning of language control procedures, and the extensibility of these procedures to encompass Ada. Author (GRA)

N84-31152# Fairchild Camera and Instrument Corp., Palo Alto, Calif. Advanced Research and Development Lab.
MIL-STD-1750A MICROPROCESSOR CHIP SET DEVELOPMENT
T. A. LONGO and D. WILNAI *In* ASD Proc. Papers of the 2nd AFSC Avionics Standardization Conf., Vol. 1 p 395-404 Nov. 1982
(AD-P003548) Avail: NTIS HC A25/MF A01 CSCL 05A

Fairchild ARDL, under contract with General Dynamics/Fort Worth, is developing a high performance MIL-STD-1750A microprocessor chip set for use in embedded computer applications in U.S. Air Force avionic systems. This paper describes the development program, the design methodology and the process technology. Fairchild MIL-STD-1750A Microprocessor chip set is centered around the F9450A a 20-MHz 64 pin microprocessor with 200ns cycle time that implements all 1750A instructions including floating point. Two support devices under development are the F9451, a 1750A Memory Management Unit, and the F9452, a 1750A Block Protect RAM device. In addition to the microprocessor chip set, Fairchild is developing an Engineering Test and Evaluation Equipment based on the FS-1 Microprocessor Development system. The paper discusses current trends in processing technologies and their effects on system performance. Author (GRA)

N84-31166# Martin Marietta Aerospace, Orlando, Fla.
STANDARDS AND INTEGRATED AVIONIC DIGITAL SYSTEM ARCHITECTURE
E. L. GRIFFIN *In* ASD Proc. Papers of the 2nd AFSC Avionics Std. Conf., Vol. 2 p 563-581 Nov. 1982 Proc. held in Dayton, Ohio, 30 Nov. - 2 Dec. 1982
(AD-P003561) Avail: NTIS HC A25/MF A01 CSCL 09B

Integrated digital system design and development of the hardware, software, and interfaces that integrate the avionic flight control, fire control, and man-machine display and control must emphasize the man-rated weapon system's availability and survivability. The scope of tasks including detailed trade studies such as CMOS/SOS versus ECL semiconductor use, and parallel pipelining versus multi-microprocessor architecture usually requires an engineering team with backgrounds from requirements and integration, electronics hardware, packaging, and software. System attributes of fault tolerance, fail safe, and fail soft operation requires total team adherence to a set of design, documentation, implementation, and test standards of which few have complete familiarity. Since use of these standards has prevented costly errors and overruns in procurement, and decreased maintenance costs over the life cycle, this paper shows how to make each effective contributor on the team understand the standards controlling performance and product specifications, change and configuration control, test planning, and test procedure generation for the other areas of expertise. Author (GRA)

N84-31172# Teledyne Systems Co., Northridge, Calif.
THE APPLICATION OF STANDARDS TO THE TDY-750 (TIGERSHARK) MISSION COMPUTER
D. W. GEYER *In* ASD Proc. Papers of the 2nd AFSC Avionics Std. Conf., Vol. 2 p 659-674 Nov. 1982 Proc. held in Dayton, Ohio, 30 Nov. - 2 Dec. 1982
(AD-P003567) Avail: NTIS HC A25/MF A01 CSCL 09C

The design objective of the Teledyne TDY-750 computer series was to be completely compliant with the three Air Force Standards applying to aircraft mission computers: MIL-STD-1750A, MIL-STD-1553B, and MIL-STD-1589B (JOVIAL J73). A secondary design objective was to build a machine substantially lighter and faster than its competition while using standard discrete parts available from multiple sources. All objectives were met and, on 8/31/82, the first production prototype machine completed acceptance testing ahead of schedule. The 15 pound machine includes 64K memory, housing, power supply, and a microprogrammable 1553B Bus Controller/Remote Terminal. Formal SEAFAC testing to Change Notice 1 was successfully completed 8/25/82. A powerful software development system, including a real time JOVIAL Symbolic Debugger, complete the total hardware/software system. Author (GRA)

N84-31175# IBM Federal Systems Div., Bethesda, Md.
DEFENSE INDUSTRY ATTITUDES ABOUT AF INTERFACE STANDARDS REPORT OF AN ELECTRONICS INDUSTRIES ASSOCIATION SURVEY
P. N. POCALYKO and C. E. SWALLOW, JR. *In* ASD Proc. Papers of the 2nd AFSC Avionics Std. Conf., Vol. 2 p 721-727 Nov. 1982 Proc. held in Dayton, Ohio, 30 Nov. - 2 Dec. 1982
(AD-P003570) Avail: NTIS HC A25/MF A01 CSCL 09C

Major General Welch USAF, Asst. Deputy Chief of Staff for Research, Development and Acquisition, has asked the Electronic Industries Association for policy level participation in the Air Force's avionics standards program. This paper reports on the initial step of the response of industry. It analyzes a survey made under the sponsorship of the EIA. Defense industry managers and senior engineers experienced in the development and production of mission-critical avionics and software were questioned about their experiences and opinions concerning the Air Force standards for J-73 (JOVIAL), Ada, 1553 Data Bus, and 1750 Instruction Set Architecture. The responses are cross-correlated with experience levels and nature of the respondent's field of expertise. Results are presented as a summary of current attitudes which can serve as data base for focusing issues for further discussion with industry. Author (GRA)

N84-31187# Arinc Research Corp., Annapolis, Md.
STANDARD AVIONICS SOFTWARE: THE FUTURE STRATEGY FOR COST-EFFECTIVE AVIONICS
E. C. STRAUB *In* ASD Proc. Papers of the 2nd AFSC Avionics Std. Conf., Vol. 2 p 927-945 Nov. 1982 Proc. held in Dayton, Ohio, 30 Nov. - 2 Dec. 1982
(AD-P003582) Avail: NTIS HC A25/MF A01 CSCL 09B

This paper reports an ARINC Research Corporation's work in developing and evaluating software acquisition alternatives for the USAF's Multi-Mode Radar program (since renamed the Multi-Role Radar (MRR) Program). Although the paper reflects work accomplished for that program, the approach taken could be used for any software-intensive avionics program where several aircraft are involved and for which most of the software and hardware might be common. The work was sponsored by Air Force Systems Command's Deputy for Reconnaissance and Electronic Warfare, Aeronautical Systems Division (ASD/RW). The paper assesses the applicability of current radar technology and production programs to an MRR; discusses guidance provided by existing and proposed policies, Directives and Standards; examines the operational, cost, schedule, risk, supportability, and management aspects of three software development alternatives and addresses the use of the ASD/ACCX software cost estimating model to analyze software development costs. Software acquisition alternative results are presented. Author (GRA)

N84-31955*# SoHaR, Inc., Los Angeles, Calif.
FAULT TOLERANT SOFTWARE MODULES FOR SIFT
M. HECHT and H. HECHT Jul. 1982 78 p refs
(Contract NAS1-15428)
(NASA-CR-165874; NAS 1.26:165874) Avail: NTIS HC A05/MF A01 CSCL 09B

The implementation of software fault tolerance is investigated for critical modules of the Software Implemented Fault Tolerance (SIFT) operating system to support the computational and reliability requirements of advanced fly by wire transport aircraft. Fault tolerant designs generated for the error reported and global executive are examined. A description of the alternate routines, implementation requirements, and software validation are included. M.A.C.

N84-31973# Softech, Inc., Waltham, Mass.
INTEGRATED COMPUTER-AIDED MANUFACTURING (ICAM) ARCHITECTURE. PART 3, VOLUME 6: COMPOSITE INFORMATION MODEL OF 'MANUFACTURE PRODUCT' (MFG1) Final Report, Sep. 1980 - Oct. 1982
C. MARTIN, A. NOWLIN, W. ST.JOHN, S. SMITH, and T. RUEGSEGGER Wright-Patterson AFB, Ohio AFWAL Sep. 1983 899 p 8 Vol.
(Contract F33615-80-C-5109)
(AD-A143072; REPT-1080-35; AFWAL-TR-82-4063-VOL-6) Avail: NTIS HC A99/MF A01 CSCL 09B

The Integrated Computer Aided Manufacturing (ICAM) Architecture Part III was initiated to maintain and update the existing manufacturing architecture as well as develop training courses to assist in the transition of IDEF (ICAM definition) applications, concepts and procedures to other Air Force programs. This volume, Volume VI, presents the composite view depicting manufacturing as it exists today in the form of an AS IS Information Model of Manufacturing. Author (GRA)

N84-31984# National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.
THE INFLUENCE OF COMPUTER AIDED DESIGN (CAD) ON RESEARCH
W. LOEVE and R. F. VANDENDAM 5 Jun. 1983 17 p refs In DUTCH; ENGLISH summary Presented at Symp. on de Betekenis van CAD/CAM voor de Neder. vliegtuigbouw, Delft, 6 May 1983
(NLR-MP-83026-U; AD-B084828) Avail: NTIS HC A02/MF A01

The effects of CAD on cooperation aspects within the National Aerospace Laboratory (NLR) and between NLR and the aircraft industry are discussed. An infrastructure of hardware and software to support the aerodynamic design of aircraft is described. Organizational and technical aspects of this development are described. The CAD techniques make it possible to program NLR knowledge in such a way that it can directly be used for design in the industry by means of a dialogue between computer and designer. Author (ESA)

N84-31993*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
FLUX-VECTOR SPLITTING AND RUNGE-KUTTA METHODS FOR THE EULER EQUATIONS Final Report
E. TURKEL and B. VANLEER Jun. 1984 12 p refs
(Contract NAS1-16394; NAS1-17070; NAS1-17130)
(NASA-CR-172415; ICASE-84-27; NAS 1.26:172415) Avail: NTIS HC A02/MF A01 CSCL 12A

Runge-Kutta schemes have been used as a method of solving the Euler equations exterior to an airfoil. In the past this has been coupled with central differences and an artificial vesocity in space. In this study the Runge-Kutta time-stepping scheme is coupled with an upwinded space approximation based on flux-vector splitting. Several acceleration techniques are also considered including a local time step, residual smoothing and multigrid. B.W.

N84-32018# Mathematisch Centrum, Amsterdam (Netherlands).
MULTIPLE GRID METHODS FOR EQUATIONS OF THE SECOND KIND WITH APPLICATIONS IN FLUID MECHANICS Ph.D. Thesis
H. SCHIPPERS 1983 21148 p refs
(MATH-CENTRE-TRACTS-163; B8402121; ISBN-90-6196-260-9) Avail: NTIS HC A07/MF A01

Multiple grid methods for solving the algebraic systems that occur in numerical methods for the Fredholm equations of the second kind were studied. Iterative schemes of Brakkage's and Atkinson's method were extended. Multiple grid methods can be utilized in the programming language ALGOL 68 and in fluid mechanics. Potential flow around airfoils and oscillating disk flow were considered. Author (ESA)

N84-33058# Aeronautical Research Labs., Melbourne (Australia).
ARRAY PROCESSOR UTILIZATION IN THE COMPUTATION OF REAL-TIME IMAGES
L. N. LESTER Aug. 1984 22 p refs
(ARL-SYS-TM-73; AR-003-953) Avail: NTIS HC A02/MF A01

The application of an array processor to the real time generation of aircraft images in Air Traffic Control tower simulation is described. Particular emphasis is placed upon the problems which arises in achieving efficient utilization of the array processor. The time required to transfer data from the host to the array processor is a serious consideration in the partitioning of the algorithm between the two processors. Array processor execution speed is about ten times faster than a host FORTRAN routine, provided that the array processor code is written to maximize the number of parallel computing elements used and to minimize loop lengths by pipelining of operations. These requirements result in a considerable software development effort. A timing analysis of the resultant array processor code is also presented. Author

N84-33072# Aeronautical Research Labs., Melbourne (Australia).
FLIGHT SYSTEMS RASTER GRAPHICS SOFTWARE REFERENCE MANUAL
L. N. LESTER Jul. 1984 57 p refs
(ARL-SYS-TM-72; AR-003-939) Avail: NTIS HC A04/MF A01

Flight simulation work at Aeronautical Research Laboratories employs raster graphics for both the presentation of visual scenes with limited dynamic content and for the replication of both flight instruments and sensor displays. The raster graphics system consists of an LSI-11/23 microprocessor (functioning as host) and three A.R.L. designed controller units coupled to RGBS monitors, and is connected through the LSI-11/23 to the Flight Simulation Group VAX-11/780 computer. This Memorandum describes the raster graphic system, and four software packages which are available to enable a VAX user to create a manipulate pictures. These packages are: RJRLSI which runs in the LSI-11/23 for communication; LSILOAD, for loading and executing LSI programs; FLISGRAPH, a set of subroutines for creating and manipulating pictures; and MANPIX, a utility program which provides a versatile range of picture manipulation capabilities through a simple set of commands. Author

N84-33112*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
NUMERICAL SOLUTIONS OF ACOUSTIC WAVE PROPAGATION PROBLEMS USING EULER COMPUTATIONS Final Report
S. HARIHARAN (Tennessee Univ. Space Inst.) Aug. 1984 31 p refs
(Contract NAS1-17070)
(NASA-CR-172434; ICASE-84-39; NAS 1.26:172434) Avail: NTIS HC A03/MF A01 CSCL 12A

This paper reports solution procedures for problems arising from the study of engine inlet wave propagation. The first problem is the study of sound waves radiated from cylindrical inlets. The second one is a quasi-one-dimensional problem to study the effect of nonlinearities and the third one is the study of nonlinearities in two dimensions. In all three problems Euler computations are done with a fourth-order explicit scheme. For the first problem results are shown in agreement with experimental data and for the second problem comparisons are made with an existing asymptotic theory. The third problem is part of an ongoing work and preliminary results are presented for this case. Author

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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.

A84-43693#
DISCRETE FREQUENCY NOISE GENERATED FROM A FLAT PLATE IN PARALLEL WITH A UNIFORM ONCOMING FLOW
T. FUKANO, Y. TAKAMATSU (Kyushu University, Fukuoka, Japan), T. KOZU (Hitachi, Ltd., Tokyo, Japan), and A. A. TALUKDER Kyushu University, Faculty of Engineering, Memoirs (ISSN 0023-6160), vol. 44, March 1984, p. 19-39. refs

A discrete frequency noise generated from a flat plate in parallel with a uniform oncoming flow was investigated both analytically and experimentally. With an assumption that the generation of this noise is due to the vortex shedding from the trailing edge of a plate, a flow model was introduced to derive a working formula for the evaluation of the sound pressure level of the radiated discrete frequency noise. The time varying characteristics of turbulence in the near wake of the plate trailing edge were also measured by a hot wire anemometer, and correlations for different parameters, which are included in the working formula, were obtained. It was made clear that the predicted SPL obtained by this working formula and by the correlations agreed well with the measurements. The complicated change of the SPL with the scraping length at the trailing edge of a thick flat plate was also discussed. Author

A84-44508*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LOW FLIGHT SPEED FAN NOISE FROM A SUPERSONIC INLET
R. P. WOODWARD, F. W. GLASER, and J. G. LUCAS (NASA, Lewis Research Center, Cleveland, OH) Journal of Aircraft (ISSN 0021-8669), vol. 21, Sept. 1984, p. 665-672. Previously cited in issue 21, p. 3201, Accession no. A83-45517. refs

A84-44628*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ACOUSTIC NEAR-FIELD PROPERTIES ASSOCIATED WITH BROADBAND SHOCK NOISE
J. SEINER and J. C. YU (NASA, Langley Research Center, Acoustic and Noise Reduction Div., Hampton, VA) AIAA Journal (ISSN 0001-1452), vol. 22, Sept. 1984, p. 1207-1215. Previously cited in issue 24, p. 4249, Accession no. A81-49744. refs

A84-44631*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AN ACOUSTIC EVALUATION OF CIRCUMFERENTIALLY SEGMENTED DUCT LINERS
W. R. WATSON (NASA, Langley Research Center, Noise Propagation and Suppression Branch, Hampton, VA) AIAA Journal (ISSN 0001-1452), vol. 22, Sept. 1984, p. 1229-1233. Previously cited in issue 10, p. 1475, Accession no. A83-25939. refs

A84-45021#
COMMERCIAL AIRCRAFT NOISE
M. J. SMITH (Rolls-Royce, Ltd., Derby, England) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 841-848. refs

The history of aircraft noise control development is traced with an eye to forecasting the future. Noise control became imperative with the advent of the first generation of commercial jet aircraft, which were extremely loud. The steady increases in the size of turbofans have nearly matched the progress in noise reduction capabilities in recent years. Only 5 dB of reduction in fleet noise has been achieved since early standards were met. Current engine design is concentrated on increasing fuel efficiency rather than lowering noise emissions. Further difficulties exist because of continued flights with older aircraft. Gains in noise reduction have been made mainly by decreasing exhaust velocities from 600-700 m/sec to 300-400 m/sec. New techniques being explored comprise mixing the core and bypass flows, interaction tone control, reduction of broadband sources, development of acoustic liner technology and alterations in the number of fan blades and stage spacing. M.S.K.

A84-45034#
ON THE PROPAGATION OF SOUND IN NOZZLES OF STRONGLY VARYING CROSS-SECTION
L. M. B. C. CAMPOS (Instituto Superior Tecnico, Lisbon, Portugal; Cambridge University, Cambridge, England) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 967-981. Research supported by the Calouste Gulbenkian Foundation. refs

The propagation of sound in nozzles of substantially varying cross-section is considered, taking into account reflections from the tapering walls, and non-uniform convection by the axially accelerated or decelerated mean flow. Exact solutions of the acoustic equations are obtained for the simplest case of the fundamental longitudinal mode in quasi-one-dimensional, low Mach number nozzle flow. The effects of non-uniform mean flow on sound are demonstrated by comparing horns and nozzles, and 15 properties are proved or quoted concerning: (1) relations between acoustic pressure and velocity; (2) equipartition or biasing of kinetic and compression energies; (3) conservation or evolution of wave action; (4) existence of elementary or special solutions; (5) cut-off frequencies, and amplitude and phase laws. It is concluded with a simple formula for the approximate calculation of the acoustic fields; the formula can be made more accurate by using a correction factor for amplitude and phase, which is plotted against area ratio for propagation upstream or downstream diffusers and convergents. Author

A84-45035#
AEROACOUSTIC RESEARCH IN THE NETHERLANDS RELATED TO AIRCRAFT DEVELOPMENT
W. B. DE WOLF (Nationaal Lucht- en Ruimtevaartlaboratorium, Amsterdam, Netherlands) and S. L. SARIN (Fokker, Schiphol, Netherlands) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 982-988. Research supported by the Nederlands Instituut voor Vliegtuigontwikkeling en Ruimtevaart. refs

Noise reduction efforts undertaken with the RB 183-555-15H turbofan on the new F28 aircraft are described. Experiments were performed with jet noise suppressors and acoustic liner designs. Vibration absorbers were installed in the cabin walls. The suppressors were examined with a H_2O_2-fuelled model in a test facility, leading to selection of an 8-lobed exhaust nozzle. A new acoustic liner was devised which reduced nonlinearities by a factor of five when compared with wire mesh on perforated plate liners. The tests yielded designs for a system of dynamic vibration absorbers which were subsequently installed in the cabin walls of the F27 and produced a 7 dB noise reduction. M.S.K.

A84-45050#
DESIGN OF A FLIGHT TRACK AND AIRCRAFT NOISE MONITORING SYSTEM
G. BEKEBREDE and T. H. M. HAGENBERG (Nationaal Lucht- en Ruimtevaartlaboratorium, Amsterdam, Netherlands) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 1096-1105.

Design, functional and performance features of the FANOMOS (flight track and aircraft noise monitoring system) for assessing aircraft flight path fidelity to a prescribed flight track are described. FANOMOS acquires real time radar data and makes comparisons with a prerecorded flight plan. Up to 50 flight tracks can be processed simultaneously and plotted on maps with the respective flight plans. The information may be selectively retrieved on an x-y plotter with an accuracy comparable to a radar track, i.e., 100 m at 10 n. mi. from the radar antenna. The system is adaptable in terms of radar equipment and data rates, and can be implemented for detecting flight path deviations which cause noise complaints in areas surrounding airports. M.S.K.

A84-45068#
ACOUSTICAL DESIGN ECONOMIC TRADE OFF FOR TRANSPORT AIRCRAFT
A. BENITO (Madrid, Universidad Politecnica, Madrid, Spain) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 1247-1255. Research sponsored by the Iberia - Lineas Aereas de Espana. refs

The effects of ICAO fixed certification limits and local ordinances on acoustic emissions from jets on commercial transport aircraft and costs of operations are explored. The regulations effectively ban some aircraft from operation over populated areas, impose curfews on airports and, in conjunction with local civil aviation rules, levy extra taxes and quotas on noisier equipment. Jet engine manufacturers have attempted to increase the flow laminarity, decrease the exhaust speed and develop acoustic liners for selected duct areas. Retrofits are, however, not usually cost effective due to increased operational costs, e.g., fuel consumption can increase after engine modification because of increased weight. Finally, an attempt is made to assess, monetarily, the costs of noise pollution, wherein fines are levied for noisy aircraft and the money is spent insulating homes from noise. M.S.K.

A84-45292
HALL EFFECTS ON MHD FREE-CONVECTION FLOW PAST AN ACCELERATED VERTICAL POROUS PLATE
A. K. SINGH (Banaras Hindu University, Varanasi, India) Astrophysics and Space Science (ISSN 0004-640X), vol. 102, no. 2, July 1984, p. 213-221. refs

The effect of Hall currents on the hydromagnetic free-convection flow of an electrically conducting and incompressible viscous fluid past a uniformly accelerated infinite vertical porous plate is discussed. The magnetic Reynolds number is assumed to be small so that the induced magnetic field can be neglected. The governing equations of the flow are solved by defining a complex velocity with the help of the Laplace transform method when the Prandtl number is equal to unity. The influence of the various parameters on the unsteady flow field is presented for both the cases, cooling and heating of the porous plate by free-convection currents. Author

A84-45661* Boston Univ., Mass.
SELF-SUSTAINED OSCILLATIONS OF A SHOCK WAVE INTERACTING WITH A BOUNDARY LAYER ON A SUPERCRITICAL AIRFOIL
C. S. VENTRES (Boston University, Boston, MA) and M. S. HOWE (Bolt Beranek and Newman Inc., Cambridge, MA; Southampton, University, Southampton, England) Journal of Sound and Vibration (ISSN 0022-460X), vol. 95, July 8, 1984, p. 97-115. Previously announced in STAR as N84-16131. refs
(Contract NAG2-179)

A theory is proposed of the self-sustaining oscillations of a weak shock on an airfoi in steady, transonic flow. The interaction of the shock with the boundary layer on the airfoil produces displacement thickness fluctuations which convect downstream and generate sound by interaction with the trailing edge. A feedback loop is established when this sound impinges on the shock wave, resulting in the production of further fluctuations in the displacement thickness. The details are worked out for an idealized mean boundary layer velocity profile, but strong support for the basic hypotheses of the theory is provided by a comparison with recent experiments involving the generation of acoustic 'tone bursts' by a supercritical airfoil section. Author

A84-45664* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

SOLUTION OF THE WAVE EQUATION FOR OPEN SURFACES INVOLVING A LINE INTEGRAL OVER THE EDGE

F. FARASSAT (NASA, Langley Research Center, Hampton, VA) Journal of Sound and Vibration (ISSN 0022-460X), vol. 95, July 8, 1984, p. 136-141.

A simple mathematical model of a stationary source distribution for the supersonic-propeller noise-prediction formula of Farassat (1983) is developed to test the validity of the formula solutions. The conventional thickness source term is used in place of the Isom thickness formula; the relative importance of the line and surface integrals in the solutions is evaluated; and the numerical results are compared with those obtained with a conventional retarded-time solution in tables. Good agreement is obtained over elevation angles from 10 to 90 deg, and the line-integral contribution is found to be significant at all elevation angles and of the same order of magnitude as the surface-integral contribution at angles less than 30 deg. The amplitude-normalized directivity patterns for the four cases computed ($x = 1.5$ or 10; $k = 5.0$ or 50) are presented graphically. T.K.

A84-45960*# Cornell Univ., Ithaca, N.Y.

COMPARISON OF BROADBAND NOISE MECHANISMS, ANALYSES, AND EXPERIMENTS ON ROTORS

A. R. GEORGE and S.-T. CHOU (Cornell University, Ithaca, NY) Journal of Aircraft (ISSN 0021-8669), vol. 21, Aug. 1984, p. 583-592. NASA-supported research. Previously cited in issue 11, p. 1651, Accession no. A83-28009. refs

A84-46013

AERODYNAMIC SOUND DUE TO A POINT SOURCE NEAR A HALF-PLANE

R. BALASUBRAMANYAM (Dundee, University, Dundee, Scotland) IMA Journal of Applied Mathematics (ISSN 0272-4960), vol. 33, July 1984, p. 71-81. Research supported by the Science and Engineering Research Council. refs

In this paper Jones's analysis is extended to the diffraction of sound in three dimensions by a semi-infinite plane with a plane vortex sheet attached in the two cases when the wave equation is in the form for still air and when convection is present. It is found that in so far as the moving medium is concerned the imposition or otherwise of the Kutta-Joukowski condition does not have much influence on the scattered field away from the diffracting plane; when the source is near the edge the field has the same directionality and order of magnitude. On the other hand, near the wake the Kutta-Joukowski condition produces a much stronger field than elsewhere even when the source is not near the edge. It is also concluded that the same phenomenon occurs for arbitrary sources and not just for the line source discussed by Jones. Author

A84-46364#

THE AERODYNAMICS AND AEROACOUSTICS OF ROTATING TRANSONIC FLOW FIELDS

J. W. RUTHERFORD (U.S. Military Academy, West Point, NY) IN: American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 431-437. refs

A computational model of the problem of radiative shocks from a subsonically rotating disturbance for a two-dimensional flow field is developed and applied to a study of the propagation of shock waves into the far field. The model is based on the similarity between the rotating cylinder model and the rotor blade mechanisms for the propagation of a shock wave. The delocalization is simulated in the model through a sequence of increasing rotational Mach numbers. Computational results obtained from the potential transonic small disturbance equation are graphically displayed showing delocalization occurring. Geometric design parameters of the rotor blade which may affect the helicopter noise are studied. Results indicate that thinning the blade and increasing the aspect ratio near the tip of the blade would delay the onset of the delocalization. I.R.

A84-46365*# Massachusetts Inst. of Tech., Cambridge.

A PARAMETRIC STUDY OF BLADE VORTEX INTERACTION NOISE FOR TWO, THREE, AND FOUR-BLADED MODEL ROTORS AT MODERATE TIP SPEEDS THEORY AND EXPERIMENT

K. P. LEIGHTON and W. L. HARRIS (MIT, Cambridge, MA) IN: American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 438-444. refs
(Contract NSG-1583)

An investigation of blade slap due to blade vortex interaction (BVI) has been conducted. This investigation consisted of an examination of BVI blade slap for two, three, and four-bladed model rotors at tip Mach numbers ranging from 0.20 to 0.50. Blade slap contours have been obtained for each configuration tested. Differences in blade slap contours, peak sound pressure level, and directivity for each configuration tested are noted. Additional fundamental differences, such as multiple interaction BVI, are observed and occur for only specific rotor blade configurations. The effect of increasing the Mach number on the BVI blade slap for various rotor blade combinations has been quantified. A peak blade slap Mach number scaling law is proposed. Comparison of measured BVI blade slap with theory is made. Author

A84-46366#

TOWARDS A BETTER UNDERSTANDING OF HELICOPTER EXTERNAL NOISE

A. DAMONGEOT, F. DAMBRA, and B. MASURE (Aerospatiale, Marignane, Boushes-du-Rhone, France) IN: American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 445-457. refs

The problem of helicopter external noise generation is studied taking into consideration simultaneously the multiple noise sources: rotor rotational-, rotor broadband -, and engine noise. The main data are obtained during flight tests of the rather quiet AS 332 Super Puma. The flight procedures settled by ICAO for noise regulations are used: horizontal flyover at 90 percent of the maximum speed, approach at minimum power velocity, take-off at best rate of climb. Noise source levels are assessed through narrow band analysis of ground microphone recordings, ground measurements of engine noise and theoretical means. With the perceived noise level unit used throughout the study, relative magnitude of noise sources is shown to be different from that obtained with linear noise unit. A parametric study of the influence of some helicopter parameters on external noise has shown that thickness-tapered, chord-tapered, and swept-back blade tips are good means to reduce the overall noise level in flyover and approach. I.R.

A84-46383#

MODEL ROTOR HIGH-SPEED IMPULSIVE NOISE - PARAMETRIC VARIATIONS AND FULL-SCALE COMPARISONS

W. R. SPLETTSTOESSER, K. J. SCHULTZ (Deutsche Forschungs- und Versuchstalt fuer Luft- und Raumfahrt, Brunswick, West Germany), F. H. SCHMITZ, and D. A. BOXWELL (U.S. Army, Research and Technology Laboratories, Moffett Field, CA) American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Paper. 25 p. refs

The results of a 1/7-scale model of the AH-1 series helicopter main rotor test in the German-Dutch anechoic wind tunnel are discussed, with emphasis given on exploring the important scaling parameters of helicopter-rotor high-speed impulsive noise. Nondimensional parameters are derived from the governing equations and employed to compare the model rotor measurements with full-scale investigations, using an equivalent in-flight technique. The peak acoustic pressure, impulsive noise directivity, and acoustic waveform of the model are found to scale well in shape and in amplitude with full-scale results. Parametric variations of the model-rotor acoustic measurements, such as the change of the high-speed impulsive noise level over a range of advancing-tip Mach numbers at constant advance ratio or constant velocity, are presented. It is concluded that model-scale rotors can be used to explore potential acoustic design innovations on full-scale helicopters. I.R.

N84-32081# Joint Publications Research Service, Arlington, Va.
USSR REPORT: PHYSICS AND MATHEMATICS
15 Aug. 1984 110 p refs Transl. into ENGLISH from various Russian articles
(JPRS-UPM-84-005) Avail: NTIS HC A06/MF A01

Topics in the following categories are discussed: acoustics, crystals, semiconductors, electricity, magnetism, fluid dynamics, lasers, masers, optics, spectroscopy, molecular physics, opto-electronics, plasma physics, theoretical physics, and mathematics.

N84-32115*# Purdue Univ., Lafayette, Ind.
MEASUREMENT OF THE ABSORPTION COEFFICIENT USING THE SOUND-INTENSITY TECHNIQUE
M. ATWAL and R. BERNHARD May 1984 12 p refs
(Contract NAG1-58)
(NASA-CR-173848; NAS 1.26:173848; REPT-0226-9; HL84-12)
Avail: NTIS HC A02/MF A01 CSCL 20A

The possibility of using the sound intensity technique to measure the absorption coefficient of a material is investigated. This technique measures the absorption coefficient by measuring the intensity incident on the sample and the net intensity reflected by the sample. Results obtained by this technique are compared with the standard techniques of measuring the change in the reverberation time and the standing wave ratio in a tube, thereby, calculating the random incident and the normal incident adsorption coefficient. E.R.

N84-32116*# Purdue Univ., Lafayette, Ind.
STUDY OF DOUBLE WALL PANELS FOR USE IN PROPELLER DRIVEN AIRCRAFT
M. ATWAL and R. BERNHARD May 1984 24 p refs
(Contract NAG1-58)
(NASA-CR-173847; NAS 1.26:173847; REPT-0226-10; HL84-13)
Avail: NTIS HC A02/MF A01 CSCL 20A

Propeller driven aircraft have exhibited high levels of interior noise. Most absorption materials are not effective at low frequencies where maximum noise levels occur. Two panels separated by an air gap are suggested as an alternative means of noise attenuation. This design produces an impedance mismatch where a sound wave travels backwards to the source. The higher the impedance, the higher the reflected soundwave intensity. Two aluminum panels with helium in between and two panels with one being perforated were investigated. Helium increases the transmission loss because of a greater impedance mismatch than air. The transmission loss of the unperforated panel is higher throughout the frequency range tested. DOE

N84-32117*# Purdue Univ., Lafayette, Ind. School of Mechanical Engineering.
PREDICTION OF LIGHT AIRCRAFT INTERIOR SOUND PRESSURE LEVEL USING THE ROOM EQUATION
M. ATWAL and R. BERNHARD May 1984 25 p refs
(Contract NAG1-58)
(NASA-CR-173840; NAS 1.26:173840; REPT-0226-12; HL-84-15)
Avail: NTIS HC A02/MF A01 CSCL 20A

The room equation is investigated for predicting interior sound level. The method makes use of an acoustic power balance, by equating net power flow into the cabin volume to power dissipated within the cabin using the room equation. The sound power level transmitted through the panels was calculated by multiplying the measured space averaged transmitted intensity for each panel by its surface area. The sound pressure level was obtained by summing the mean square sound pressures radiated from each panel. The data obtained supported the room equation model in predicting the cabin interior sound pressure level. S.B.

N84-32119*# Cambridge Acoustical Associates, Inc., Mass.
ANALYTICAL MODEL OF THE STRUCTUREBORNE INTERIOR NOISE INDUCED BY A PROPELLER WAKE Final Report
M. C. JUNGER, J. M. GARRELICK, R. MARTINEZ, and J. E. COLE, III May 1984 98 p refs
(Contract NAS1-17570)
(NASA-CR-172381; NAS 1.26:172381) Avail: NTIS HC A05/MF A01 CSCL 20A

The structure-borne contribution to the interior noise that is induced by the propeller wake acting on the wing was studied. Analytical models were developed to describe each aspect of this path including the excitation loads, the wing and fuselage structures, and the interior acoustic space. The emphasis is on examining a variety of parameters, and as a result different models were developed to examine specific parameters. The excitation loading on the wing by the propeller wake is modeled by a distribution of rotating potential vortices whose strength is related to the thrust per blade. The response of the wing to this loading is examined using beam models. A model of a beam structurally connected to a cylindrical shell with an internal acoustic fluid was developed to examine the coupling of energy from the wing to the interior space. The model of the acoustic space allows for arbitrary end conditions (e.g., rigid or vibrating end caps). Calculations are presented using these models to compare with a laboratory test configuration as well as for parameters of a prop-fan aircraft. A.R.H.

N84-32122*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ANALYSIS OF THE EFFECT ON COMBUSTOR NOISE MEASUREMENTS OF ACOUSTIC WAVES REFLECTED BY THE TURBINE AND COMBUSTOR INLET
R. G. HUFF 1984 14 p refs Presented at the 9th Aeroacoustics Conf., Williamsburg, Va., 15-17 Oct. 1984; sponsored by NASA and AIAA
(NASA-TM-83760; E-2250; NAS 1.15:83760) Avail: NTIS HC A02/MF A01 CSCL 20A

Spectral analyses of static pressure fluctuations measured in turbine engine combustors at low engine speed show good agreement with theory. At idle speed the high pressure turbine is unchoked. Above idle speed the turbine chokes and a significant change in the shape of the measured combustor pressure spectrum is observed. A simplified theoretical model of the acoustic pressure generated in the combustor due to the turbulence-flame front interaction did not account for acoustic waves reflected from the turbine. By retaining this simplified combustion noise source model and adding a partial reflecting plane at the turbine and combustor inlet, a simple theoretical model was developed that reproduces the undulations in the combustor fluctuating pressure spectra. Plots of the theoretical combustor fluctuating pressure spectra are compared to the measured pressure spectra obtained from the CF6-50 turbofan engine over a range of engine operating speeds. The simplified combustion noise theory when modified by a simple turbine reflecting plane adequately accounts for the changes in measured combustor pressure spectra. It is further concluded that the shape of the pressure spectra downstream of the turbine, neglecting noise generated by the turbine itself, will be the combustion noise spectra unchanged except for the level reduction due to the energy blocked by the turbine. Author

N84-32123*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Mechanical Engineering.
ANALYTICAL INVESTIGATION OF SYNCHROPHASING AS A MEANS OF REDUCING AIRCRAFT INTERIOR NOISE Final Report
C. R. FULLER Washington NASA Aug. 1984 42 p refs
(Contract NAG1-390)
(NASA-CR-3823; NAS 1.26:3823) Avail: NTIS HC A03/MF A01 CSCL 20A

The noise control characteristics of synchrophasing are investigated using a simplified model of an aircraft fuselage. The analysis presented here includes directivity effects of the noise sources and solves in closed form the coupled motion between the interior and exterior acoustic fields and the shell vibrational response. The variation in sound pressure level at various locations inside the shell is studied for various synchrophase angles as well as the shell vibrational response and input power flow in order to uncover the principal mechanisms behind the transmission phenomena. Author

N84-32124*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ANNOYANCE CAUSED BY PROPELLER AIRPLANE FLYOVER NOISE
D. A. MCCURDY and C. A. POWELL Aug. 1984 52 p refs
(NASA-TP-2356; L-15796; NAS 1.60:2356) Avail: NTIS HC A04/MF A01 CSCL 20A

Laboratory experiments were conducted to provide information on quantifying the annoyance response of people to propeller airplane noise. The items of interest were current noise metrics, tone corrections, duration corrections, critical band corrections, and the effects of engine type, operation type, maximum takeoff weight, blade passage frequency, and blade tip speed. In each experiment, 64 subjects judged the annoyance of recordings of propeller and jet airplane operations presented at d-weighted sound pressure levels of 70, 80, and 90 dB in a testing room which simulates the outdoor acoustic environment. The first experiment examined 11 propeller airplanes with maximum takeoff weights greater than or equal to 5700 kg. The second experiment examined 14 propeller airplanes weighting 5700 kg or less. Five jet airplanes were included in each experiment. For both the heavy and light propeller airplanes, perceived noise level and perceived level (Stevens Mark VII procedure) predicted annoyance better than other current noise metrics. Author

N84-33147*# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
APPLICATION OF STIFFENED CYLINDER ANALYSIS TO ATP INTERIOR NOISE STUDIES Final Report
E. G. WILBY and J. F. WILBY Aug. 1983 132 p refs
(Contract NAS1-16521)
(NASA-CR-172384; L-5552; NAS 1.26:172384) Avail: NTIS HC A07/MF A01 CSCL 20A

An analytical model developed to predict the interior noise of propeller driven aircraft was applied to experimental configurations for a Fairchild Swearingen Metro II fuselage exposed to simulated propeller excitation. The floor structure of the test fuselage was of unusual construction - mounted on air springs. As a consequence, the analytical model was extended to include a floor treatment transmission coefficient which could be used to describe vibration attenuation through the mounts. Good agreement was obtained between measured and predicted noise reductions when the foor treatment transmission loss was about 20 dB - a value which is consistent with the vibration attenuation provided by the mounts. The analytical model was also adapted to allow the prediction of noise reductions associated with boundary layer excitation as well as propeller and reverberant noise. Author

N84-33148*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
EXPERIMENTAL INVESTIGATION OF SHOCK-CELL NOISE REDUCTION FOR SINGLE-STREAM NOZZLES IN SIMULATED FLIGHT, COMPREHENSIVE DATA REPORT. VOLUME 1: TEST NOZZLES AND ACOUSTIC DATA
K. YAMAMOTO, J. F. BRAUSCH, B. A. JANARDAN, D. J. HOERST, A. O. PRICE, and P. R. KNOTT May 1984 600 p refs 3 Vol.
(Contract NAS3-22514)
(NASA-CR-168234-VOL-1; NAS 1.26:168234-VOL-1; R82AEB491-VOL-1) Avail: NTIS HC A25/MF A01 CSCL 20A

The model nozzle configurations, acoustic test conditions, and detailed test results from the hot static and simulated flight acoustic tests at the General Electric Anechoc Chamber are described. B.G.

N84-33149*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
EXPERIMENTAL INVESTIGATION OF SHOCK-CELL NOISE REDUCTION FOR SINGLE-STREAM NOZZLES IN SIMULATED FLIGHT, COMPREHENSIVE DATA REPORT. VOLUME 2: LASER VELOCIMETER DATA
K. YAMAMOTO, J. F. BRAUSCH, B. A. JANARDAN, D. J. HOERST, A. O. PRICE, and P. R. KNOTT May 1984 780 p refs 3 Vol.
(Contract NAS3-22514)
(NASA-CR-168234-VOL-2; NAS 1.26:168234-VOL-2; R82AEB491-VOL-2) Avail: NTIS HC A99/MF A01 CSCL 20A

Mean velocity (axial component) and turbulent velocity (axial component) measurements for thirty one selected flow conditions of six models were performed employing the Laser Doppler Velocimeter Aerodynamic conditions which define the test points are given. Tabulations which explain the scope of mean velocity traverses and turbulence histogram measurements are also presented. The actual LV position, the type of traverse, and measured mean and turbulent velocities along copies of the LV mean velocity traces are contained. Author

N84-33150*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
EXPERIMENTAL INVESTIGATION OF SHOCK-CELL NOISE REDUCTION FOR SINGLE-STREAM NOZZLES IN SIMULATED FLIGHT, COMPREHENSIVE DATA REPORT. VOLUME 3: SHADOWGRAPH PHOTOS AND FACILITY DESCRIPTION
K. YAMAMOTO, J. F. BRAUSCH, B. A. JANARDAN, D. J. HOERST, A. O. PRICE, and P. R. KNOTT May 1984 208 p refs 3 Vol.
(Contract NAS3-22514)
(NASA-CR-168234-VOL-3; NAS 1.26:168234-VOL-3; R82AEB491-VOL-3) Avail: NTIS HC A10/MF A01 CSCL 20A

A total of 142 shadowgraph photographs were taken on 43 different plumes that were distributed over the six nozzle configurations using the 9.5 inch diameter collimated light beam of the shadowgraph setup. Aerodynamic flow conditions of the shadowgraph test points, the location and identification of each of the photographs, and copies of the pictures are presented. Author

N84-33151# Federal Aviation Administration, Washington, D.C. Noise Technology Branch.
NOISE MEASUREMENT FLIGHT TEST: DATA-ANALYSES AEROSPATIALE SA-365N DAUPHIN 2 HELICOPTER
J. S. NEWMAN (DOT, Cambridge, Mass), E. J. RICKELY, S. A. DABOIN, and K. R. BEATTIE Apr. 1984 167 p
(AD-A143229; FAA-EE-84-2) Avail: NTIS HC A08/MF A01 CSCL 20A

This report documents the results of a Federal Aviation Administration (FAA) noise measurement flight test program with the Dauphin twin-jet helicopter. 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 second in a series of seven documenting the FAA helicopter noise measurement program conducted at Dulles International Airport during the summer of 1983. The Dauphin 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 environment 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 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. Author (GRA)

N84-33166# Pacific Northwest Lab., Richland, Wash.
AIRCRAFT, SHIPS, SPACECRAFT, NUCLEAR PLANTS AND QUALITY
M. G. PATRICK May 1984 16 p Presented at the American Society of Quality Control, Richland Sect. Meeting, Richland, Wash., 17 May 1982
(Contract DE-AC06-76RL-01830)
(DE84-013262; PNL-SA-12287; CONF-8205268-1) Avail: NTIS HC A02/MF A01

A few quality assurance programs outside the purview of the Nuclear Regulatory Commission were studied to identify features or practices which the NRC could use to enhance its program for assuring quality in the design and construction of nuclear power plants. The programs selected were: the manufacture of large commercial transport aircraft, regulated by the Federal aviation Administration; US Navy shipbuilding; commercial shipbuilding regulated by the Maritime Administration and the US Coast Guard; Government-owned nuclear plants under the Department of Energy; spacecraft under the National Aeronautics and Space Administration; and the construction of nuclear power plants in Canada, West Germany, France, Japan, Sweden, and the United Kingdom. DOE

N84-33181*# Hughes Research Labs., Malibu, Calif.
DEFINITION, ANALYSIS AND DEVELOPMENT OF AN OPTICAL DATA DISTRIBUTION NETWORK FOR INTEGRATED AVIONICS AND CONTROL SYSTEMS. PART 2: COMPONENT DEVELOPMENT AND SYSTEM INTEGRATION Final Report, 1 May 1979 - 31 Mar. 1984
H. W. YEN and R. J. MORRISON Jun. 1984 80 p refs
(Contract NAS1-15829)
(NASA-CR-172429; NAS 1.26:172429) Avail: NTIS HC A05/MF A01 CSCL 20F

Fiber optic transmission is emerging as an attractive concept in data distribution onboard civil aircraft. Development of an Optical Data Distribution Network for Integrated Avionics and Control Systems for commercial aircraft will provide a data distribution network that gives freedom from EMI-RFI and ground loop problems, eliminates crosstalk and short circuits, provides protection and immunity from lightning induced transients and give a large bandwidth data transmission capability. In addition there is a potential for significantly reducing the weight and increasing the reliability over conventional data distribution networks. Wavelength Division Multiplexing (WDM) is a candidate method for data communication between the various avionic subsystems. With WDM all systems could conceptually communicate with each other without time sharing and requiring complicated coding schemes for each computer and subsystem to recognize a message. However, the state of the art of optical technology limits the application of fiber optics in advanced integrated avionics and control systems. Therefore, it is necessary to address the architecture for a fiber optics data distribution system for integrated avionics and control systems as well as develop prototype components and systems. 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.

A84-43421#
OPTIMAL SELECTION OF COST INDEX FOR AIRLINE FLEET HUB OPERATION
A. CHAKRAVARTY (Boeing Commercial Airplane Co., Seattle, WA) IN: Guidance and Control Conference, Seattle, WA, August 20-22, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 182-187.
(AIAA PAPER 84-1859)

The introduction of time-based control in an onboard system creates new opportunities to meet the requirements and goals of the airlines. A 1,000-nautical-mile route is chosen, and the optimal cost index is determined for different wind conditions and schedule policies. The policy speed is allowed to vary between maximum-range cruise (MRC) speed and Mach 0.8. The effects of crew overtime, hubbing and passenger satisfaction costs on the selection of an optimal cost index are analyzed. It is assumed that the takeoff takes place either at the scheduled takeoff time or later. So the expiration of the scheduled flight time coincides with the scheduled landing time or is a little behind. Finally, the effect of the delayed takeoff on the optimal cost index is delineated. Author

A84-43897#
TRAINING AERONAUTICAL AND ASTRONAUTICAL ENGINEERS IN FRANCE
I. DUVAUX (Matra, S.A., Velizy-Villacoublay, Yvelines, France) AIAA Student Journal (ISSN 0001-1460), vol. 21, Winter 1983/84, p. 10-13.

The engineering education system (EES) in France is described and compared with the American EES, with special attention given to those studies which lead to a degree in aeronautics and astronautics. It is noted that high-school graduates who want to work in industry usually choose an engineering school (ES) which requires two or three years of special preparatory classes. Study in the ES lasts three years with the third year of the ES corresponding to an American masters degree program. French ESs differ from American schools in the following aspects: French ESs require several training periods in industry, and industrial research organizations with industrialists participating in the education process by teaching. There are two types of schools in France which lead to a degree in aeronautics and astronautics: generalized and specialized. In the generalized schools the engineering subjects are studied the first two years and during the third year, students can choose among different majors including aeronautical and astronautical ones. In the specialized schools the first year of study, and the second are devoted to general scientific subjects, plus some specialized courses. During the third year, students major only in aeronautics and astronautics. I.R.

A84-44854
THE WARSAW CONVENTION - A DISCUSSION OF THE PRESENT POSITION
A. KEAN (International Civil Aviation Organization, Montreal, Canada) CIDA, vol. 7, 1982, p. 61-67.

The Warsaw Convention was adopted in 1929. The present investigation is concerned with the objectives of this convention and its position in 1982. The Warsaw Convention involved a deal by which protection was given to infant airlines in the form of limitation of liability in exchange for the passenger, or his dependents, or the shipper of cargo, being given the benefit of the reversal of the burden of proof of negligence. A second purpose of the Convention was related to the desire to achieve some international uniformity. A study is conducted regarding the need for a protection of airlines by limited liability, taking into account current conditions in the U.S., the developing countries, the Soviet block countries, and the other countries. Attention is given to the incentive provided by the percentage free system, the Hague Protocol of 1955, the Montreal Agreement, developments in Europe, and the Guatemala City Protocol. G.R.

A84-46348#
AN INNOVATIVE APPROACH TO SUPPLIER COST CONTROL
J. M. ROSEN (Sikorsky Aircraft, Stratford, CT) IN: American Helicopter Society, Annual Forum, 39th, St. Louis, MO, May 9-11, 1983, Proceedings . Alexandria, VA, American Helicopter Society, 1984, p. 234-239. refs

Important management concerns of today can be described by the concepts of productivity and affordability. The present investigation is concerned with an innovative approach which is being used by an American aircraft manufacturer to improve affordability of its products by stimulating productivity improvements via cost reductions in product materials obtained from suppliers. The analysis of 54 supplier visits, and over 1000 proposed cost savings ideas, provides a reasonable base of data for the formulation of conclusions regarding a 'Producibility/Should Cost' program. It is found that supplier's personnel do have a wealth of cost savings ideas which can be tapped by an affirmative program. G.R.

N84-32220*# Old Dominion Univ., Norfolk, Va. Dept. of Mechanical Engineering and Mechanics.
GRADUATE ENGINEERING RESEARCH PARTICIPATION IN AERONAUTICS Annual Progress Report, 1 Sep. 1983 - 31 Aug. 1984
A. S. ROBERTS, JR. Aug. 1984 18 p
(Contract NGR-47-003-052)
(NASA-CR-173849; NAS 1.26:173849) Avail: NTIS HC A02/MF A01 CSCL 05I

Graduate student engineering research in aeronautics at Old Dominion University is surveyed. Student participation was facilitated through a NASA sponsored university program which enabled the students to complete degrees. Research summaries are provided and plans for the termination of the grant program are outlined. Project topics include: Failure modes for mechanically fastened joints in composite materials; The dynamic stability of an earth orbiting satellite deploying hinged appendages; The analysis of the Losipescu shear test for composite materials; and the effect of boundary layer structure on wing tip vortex formation and decay. S.B.

N84-32230# Singer Co., Binghamton, N.Y. Link Flight Simulation Div.
A COMPARISON OF SIMULATOR PROCUREMENT/PROGRAM PRACTICES: MILITARY VERSUS COMMERCIAL
J. S. HUSSAR *In* American Defense Preparedness Association Proc. of the 5th Interservice/Ind. Training Equipment Conf., Vol. 1 p 47-59 16 Nov. 1983
(AD-P003453) Avail: NTIS HC A17/MF A01 CSCL 05A

The costs of complex military flight simulators have been steadily rising, causing all concerned to carefully evaluate procurement and life-cycle costs of these devices. In making these evaluations, the issue is often raised that commercial airline simulators of comparable quality can be procured for less money and with shorter schedules. This paper provides a comparison of military and commercial procurement methods, concentrating on the major differences between them. It analyzes the key discriminators between military and commercial contract requirements which collectively cause simulator procurement and program practices to be so different, and costs to vary so widely, when the resultant flight simulators procured by both methods are highly regarded for their training capabilities. Recognizing that some of the military requirements are unique and necessary, this paper takes the position that military simulator procurement can utilize some of the methods employed in commercial procurements to reduce life-cycle costs. Author (GRA)

N84-32240# Aeronautical Systems Div., Wright-Patterson AFB, Ohio.
MANAGING AIRCRAFT/SIMULATOR CONCURRENCY
R. W. BECK and J. C. CLARK *In* American Defense Preparedness Association Proc. of the 5th Interservice/Ind. Training Equipment Conf., Vol. 1 p 118-122 16 Nov. 1983
(AD-P003463) Avail: NTIS HC A17/MF A01 CSCL 15E

Concurrency is the word being used to describe the situation when a simulator or other aircrew training devices are required for delivery at the same time as the new aircraft it will support. If traditional acquisition approaches are applied to concurrent aircraft and simulation programs, it is practically impossible, in many cases, to deliver a fully capable aircrew training device anywhere near the Initial Operational Capability (IOC) of the aircraft. This is especially true when dealing with aircrew trainers for a complex tactical or strategic weapon system. Using the B-1B Simulator System program as an example, this paper discusses the risks and management challenges involved with concurrency and an innovative acquisition strategy designed to ensure the availability of aircrew training devices at or before the aircraft IOC. Included in this strategy are: (1) a new approach to preparation of the request for proposals documentation, (2) a competitive preliminary design effort, (3) methods for dealing with the acquisition of simulator design data, (4) the concept of providing the user a limited (interim) training capability early in the program, (5) management of a configuration baseline which evolves along with the simulator design, and (6) retrofit/update of all delivered devices to the final aircraft configuration. GRA

N84-32243# Singer Co., Sunnyvale, Calif. Link Flight Simulation Div.
LOW-ALTITUDE DATABASE DEVELOPMENT EVALUATION AND RESEARCH (LADDER)
D. MCCORMICK, T. SMITH, F. LEWANDOWSKI, W. PRESKAR, and E. MARTIN (AFHRL, Williams AFB, Ariz.) *In* American Defense Preparedness Association Proc. of the 5th Interservice/Ind. Training Equipment Conf., Vol. 1 p 150-155 16 Nov. 1983
(AD-P003468) Avail: NTIS HC A17/MF A01 CSCL 09B

Singer-Link and the Air Force Human Resources Laboratory (AFHRL), Williams Air Force Base, combined efforts to investigate specific visual requirements during low-level, high-speed flight. Visual information requirements were hypothesized, and an experiment was designed to systematically test the effects of various visual cues upon flight performance. The experiment tested the effects of visual scene elements in supporting simulator flight tasks of experienced Air Force fighter pilots. Specific visual factors studied were: (1) the importance of surface texture, (2) the importance of 3-D objects and object type, and (3) the effect of turning and bank angle upon flight performance. Pilot subjects were able to control flight at a mean altitude of 198 feet and at an airspeed of 480 knots. Test results indicate that both 3-D objects and 2-D terrain surface texture aid controlled low-altitude flight. Author (GRA)

N84-32245# Air Force Human Resources Lab., Williams AFB, Ariz. Operations Training Div.
DATA BASE GENERATION: IMPROVING THE STATE-OF-THE-ART
P. A. WIDDER and C. W. STEPHENS *In* American Defense Preparedness Association Proc. of the 5th Interservice/Ind. Training Equipment Conf., Vol. 1 p 164-170 16 Nov. 1983
(AD-P003470) Avail: NTIS HC A17/MF A01 CSCL 09B

The development of data bases for computer image generation systems is a time consuming, labor intensive process. While the last ten years have seen tremendous advances in the capabilities and capacities of computer image generation, comparable advances have not occurred in the area of data base management. As visual systems can output more scene detail, they require data bases which contain more information and so, take longer to build. If some effort is not made to develop methods to build data base more efficiently, the limiting factor for the amount of detail contained in an environment will be the data base development time. This paper will discuss two projects currently underway at the Air Force Human Resource Laboratory (AFHRL), Williams Air Force Base, AZ, which enable data bases to be developed much quicker by allowing the modelers to utilize work which has been done in the past by AFHRL or other organizations. The first project is the development of software to convert data bases formatted for one visual system to the format required for another visual system. The second project is the development of a library of models. GRA

N84-33254# General Accounting Office, Washington, D. C. National Security and International Affairs Div.
ANALYSIS OF BENEFITS REALIZED FROM MULTIYEAR CONTRACTING FOR THE BLACK HAWK HELICOPTER
9 May 1984 17 p
(AD-A143485; GAO/NSIAD-84-74) Avail: NTIS HC A02/MF A01 CSCL 05A

In 1982, the Congress authorized a $950 million 3-year multiyear contract for 294 Black Hawk helicopters. The Army estimated that such an arrangement would save about $8.1 million, or 7.9 percent, compared with three successive annual contracts for the same number of helicopters. GAO's analysis indicated an estimated budgetary savings to the Army of $73.9 million, with a net discounted savings to the government of about $46.6 million, or about 4.6 percent. GAO's estimate of net savings takes into account the cost of providing funds earlier under the multiyear contract. In addition, revenue to the U.S. Treasury may be reduced because of the tax implications of a multiyear contract. Neither the Army nor the contractor had evidence that the Black Hawk multiyear contract significantly enhanced the defense industrial base, another anticipated benefit of multiyear contracting. Author (GRA)

N84-33301# Committee on Science and Technology (U. S. House).
THE 1985 NASA AUTHORIZATION, VOLUME 2
Washington GPO 1984 1168 p Hearings before the Subcomm. on Space Sci. and Appl. of the Comm. on Sci. and Technol., 98th Congr., 2d Sess., no. 84, 1, 2, 7, 8, 9, 22, 23, 28, 29 Feb. and 1 Mar. 1984
(GPO-34-202) Avail: Subcommittee on Space Science And Applications

Of the 7.5 billion in the President's budget for NASA, $2.4 billion is allocated for research and development; $160 billion for space flight, control, and data communication; $160 million for construction of facilities; and $1.3 million for research and program management. Space station concepts and capabilities are explored and efforts to improve the shuttle main engine and assure cost effectiveness of the operational space shuttle are examined. Planning for the upper atmosphere research satellite mission, the Mars geoscience/climatology orbiter, and the advanced communications technology satellite is highlighted. The space commercialization, stabilization of number of civil service employees working for NASA, and the agency-wide productivity improvement and quality enhancement program are also discussed. A.R.H.

N84-33302# Committee on Science and Technology (U. S. House).
OVERSIGHT ON THE FEDERAL AVIATION ADMINISTRATION FISCAL YEAR 1985 RESEARCH, ENGINEERING AND DEVELOPMENT BUDGET REQUEST
Washington GPO 1984 183 p Hearings before the Subcomm. on Transportation, Aviation and Mater. of the Comm. on Sci. and Technol., 98th Congr., 2d Sess., no 79, 26, 28, 29 Mar. 1984
(GPO-34-924) Avail: Subcommittee on Transportation, Aviation and Materials

An analysis of the Federal Aviation Administration (FAA) budget for fiscal year 1985 is presented. A review of the research and development, and engineering programs necessary for the modernization of the air traffic control system is included. The status of the Systems Engineering Integration (SEI) contract to oversee implementation of the National Airspace System Plan is discussed. M.A.C.

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SPACE SCIENCES

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

N84-33318 Harvard Univ., Cambridge, Mass.
THE NATURE AND ORIGIN OF REFRACTORY INCLUSIONS IN THE ALLENDE METEORITE Ph.D. Thesis
A. S. KORNACKI 1984 241 p
Avail: Univ. Microfilms Order No. DA8410919

A detailed, systematic petrographic study of all (a(189)a)Al-rich and olivine-rich inclusions larger than aproxmately 0.2 mm in diameter in 17 thin sections of the Allende CV3 chondrite was performed by optical and scanning electron microscopy; the mineral chemistry of representative examples of each type of inclusion was also determined by electron probe microanalysis. Most Allende inclusions are aggregates containing varying proportions of three distinct constituents, termed concentric objects, chaotic materials, and inclusion matrix. A new classification system for Allende inclusions is proposed. The two textual varieties of olivine-rich incusions (rimmed and unrimmed olivine aggregates) consist primarily of inclusion matrix, which differ from opaque meteorite matrix by being relatively depleted in sulfides, metal grains, and (perhaps) carbonaceous material. Dissert. Abstr.

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GENERAL

A84-44707
FLIGHT IN AMERICA 1900-1983: FROM THE WRIGHTS TO THE ASTRONAUTS
R. E. BILSTEIN (Houston, University, Clear Lake City, TX) Baltimore, MD, Johns Hopkins University Press, 1984, 368 p. refs

The history of aeronautics in America, and the way in which American culture has affected and been affected by the development of flight technology is described. The growth of new aviation-related professions and the revolutions in industry and commerce ushered in by the age of flight are addressed. The military buildup before and after World War II is considered, and the role of American aeronautics in the World Wars, the Korean War, and the Vietnam War is described. The role of flight technology in the U.S. space program is discussed. C.D.

N84-32341# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
CALENDAR OF SELECTED AERONAUTICAL AND SPACE MEETINGS
Jul. 1984 127 p In FRENCH and ENGLISH
(AGARD-CAL-84/1; ISBN-92-835-0356-2) Avail: NTIS HC A07/MF A01

The dates, locations, times, and sponsors are provided for technical meetings, conferences, and symposia to be held, in all parts of the world, in the field of aerospace research and development as well as in other directly related fields such as energy, geophysics, and acoustics. Exhibitions (technical displays) and educational courses given by specialized institutions are included. Topics of interest include: aerospace medicine and biology; electronics, optics, and metrology; flight mechanics; fluid dynamics and acoustics; navigation, guidance, and control; thermodynamics, combustion, propulsion, and energetics; structures, materials, and applied mechanics; atmospheric physics and Earth environment; information, documentation, and data processing; and interdisciplinary aspects. A.R.H.

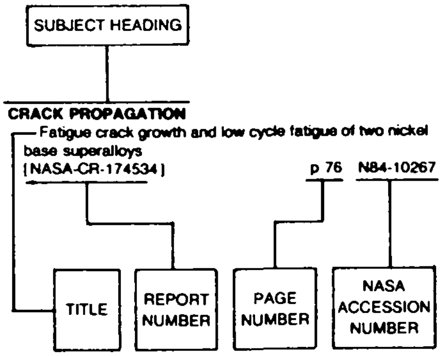
N84-33364*# National Aeronautics and Space Administration, Washington, D. C.
AERONAUTICS AND SPACE REPORT OF THE PRESIDENT, 1983 ACTIVITIES
1984 101 p
(NASA-TM-85538; NAS 1.15:85538) Avail: NTIS HC A06/MF A01 CSCL 05A

Achievements in communication; space science; space transportation; aeronautics; and Earth resources and environment are summarized. Activities of the various Federal agencies and cooperation with NASA in these areas are described. The Presidential policy announcement on the endorsement of commercial operation of expendable launch vehicles is included. Tables show, the space activities budget; a historical budget summary, U.S. space launch vehicles; U.S. and Soviet manned spaceflights, 1961 to 1983; U.S. launched space probes, 1975 to 1983; U.S. launched scientific and applications satellites, 1978 to 1983; the U.S. spacecraft record; the world record of space launches successful in attaining Earth orbit or beyond; and successful U.S. launchings for 1983. A.R.H.

N84-33365*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
NASA AMES SUMMARY HIGH SCHOOL APPRENTICESHIP RESEARCH PROGRAM, 1983 RESEARCH PAPERS Report, 13 Jun. - 19 Aug. 1983
P. POWELL Aug. 1984 141 p refs
(NASA-TM-85931; A-9689; NAS 1.15:85931) Avail: NTIS HC A07/MF A01 CSCL 05I

Engineering enrollments are rising in universities; however, the graduate engineer shortage continues. Particularly, women and minorities will be underrepresented for years to come. As one means of solving this shortage, Federal agencies facing future scientific and technological challenges were asked to participate in the Summer High School Apprenticeship Research Program (SHARP). This program was created 4 years ago to provide an engineering experience for gifted female and minority high school students at an age when they could still make career and education decisions. The SHARP Program is designed for high school juniors (women and minorities) who are U.S. citizens, are 16 years old, and who have unusually high promise in mathematics and science through outstanding academic performance in high school. Students who are accepted into this summer program will earn as they learn by working 8 hours a day in a 5-day work week. This work-study program features weekly field trips, lectures and written reports, and job experience related to the student's career interests. Author

Typical Subject Index Listing



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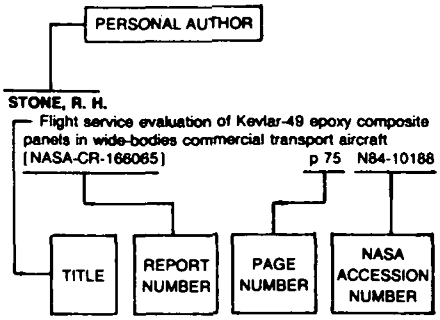

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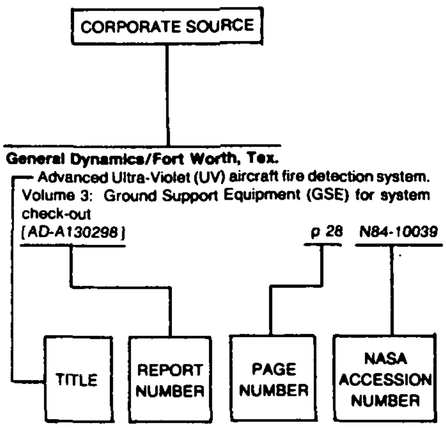

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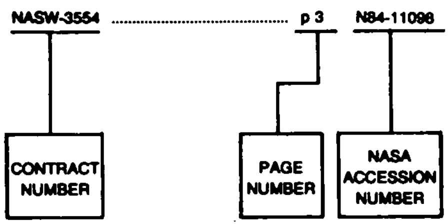

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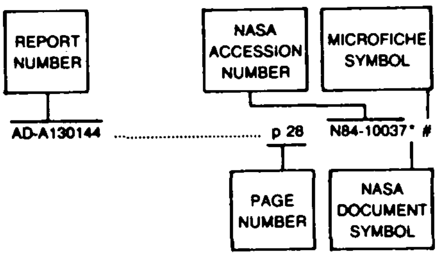

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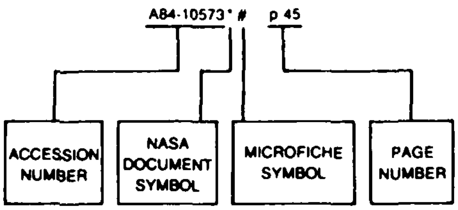

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