NASA

Aeronautical Engineering
A Continuing Bibliography with Indexes

NASA SP-7037(163)
July 1983

National Aeronautics and Space Administration

25th Anniversary
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NASA SP-7037(163)

AERONAUTICAL ENGINEERING

A CONTINUING BIBLIOGRAPHY WITH INDEXES

(Supplement 163)

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 June 1983 in

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

NASA Scientific and Technical Information Branch 1983
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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 387 reports, journal articles, and other documents originally announced in June 1983 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, and abstracts when available, are reproduced exactly as they appeared originally in *IAA* and *STAR*, including the original accession numbers from the respective announcement journals. The *IAA* items will precede the *STAR* items within each category.

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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. A listing of public collections of NASA documents is included on the inside back cover.

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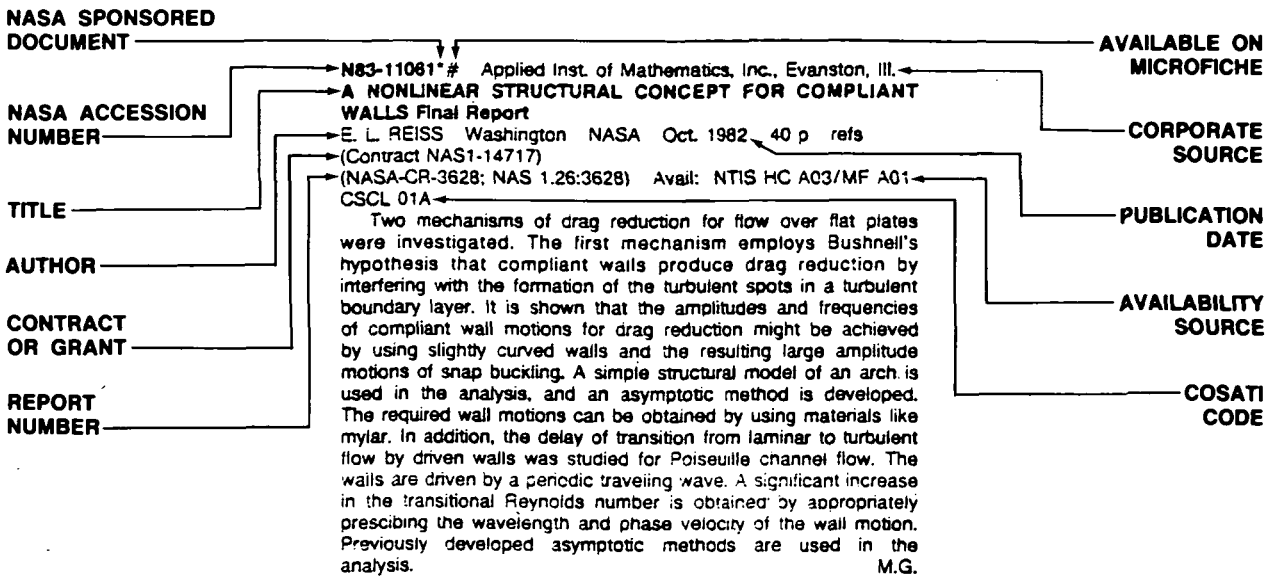

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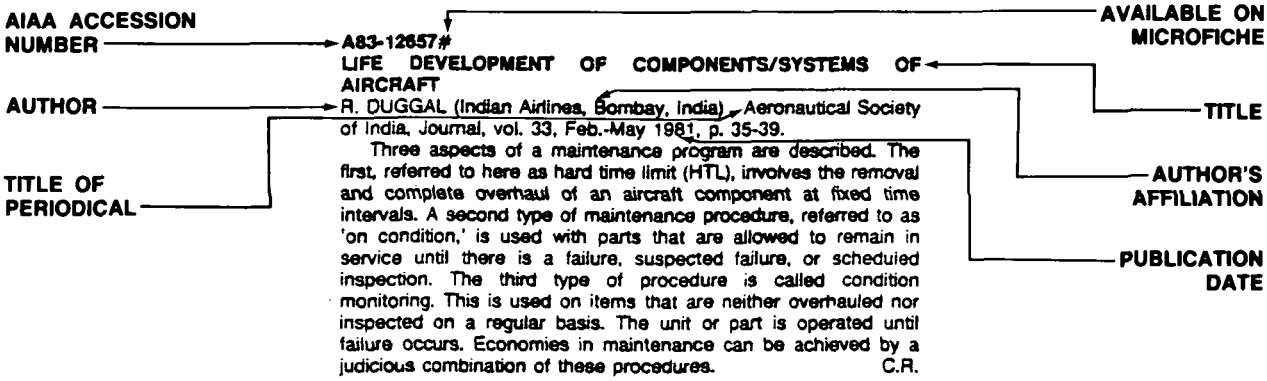

AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 163)

JULY 1983

01

AERONAUTICS (GENERAL)

N83-20907# Air Force Logistics Command, Wright-Patterson AFB, Ohio. Logistics Systems Laboratory Div.
F100 ENGINE BUILD POLICY FINDINGS Final Report
V. L. WILLIAMSON Nov. 1982 23 p
(AD-A122868; XRS-82-217A) Avail: NTIS HC A02/MF A01 CSCL 15E

The build policy study was pursued as a follow on study to the OMENS (Opportunistic Maintenance Engine Simulator) work. The engine studied is the F100 engine used in the F-15 aircraft. The OMENS model assumes that whenever a worn or used part is replaced, it is replaced with a new part. Some life limited parts, however, have had life limits extended, been refurbished or salvage, and are still useable. The part from a pool of used parts which would be the most cost effective to install, given no new parts are available is determined. Removal rates, NRTS rates, and all available costs studied in OMENS are considered. GRA

N83-20908# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics.
A QUALITATIVE ANALYSIS OF SAC AIRCRAFT MAINTENANCE M.S. Thesis
D. P. COOK and H. J. DEVAULT Sep. 1982 124 p refs
(AD-A122815; AFIT-LSSR-17-82) Avail: NTIS HC A06/MF A01 CSCL 15E

Past research efforts in SAC aircraft maintenance have addressed singular issues. Little attention has been given to examine the holistic environment that encompasses SAC aircraft maintenance. The purpose of this study was to examine and identify problems within the SAC aircraft environment from the perspective of its personnel. From interview data obtained from the Air Force Human Resources Laboratory, WPAFB OH, it was found that the SAC aircraft maintenance environment could be categorized as follows: Methods Support, Work Environment, Equipment Support, Personnel Policy, Motivation/Morale, and Technical Support. Further, it was found that the above-mentioned categories could be divided into unique areas for specific analysis. The data revealed that every area and category could be prioritized by the percentage of negative statements within each area and category. A negative statement indicated that a problem existed in a given area and category. The authors found that all areas and categories contained a highly significant number of problems. Finally, a suggested format was offered by the authors to help SAC units to identify problems within their respective units. GRA

N83-22091*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SIMULATION OF A WEATHER RADAR DISPLAY FOR OVER-WATER AIRBORNE RADAR APPROACHES
G. R. CLARY Feb. 1983 29 p refs
(NASA-TM-84315; A-9185; NAS 1.15:84315) Avail: NTIS HC A03/MF A01 CSCL 17I

Airborne radar approach (ARA) concepts are being investigated as a part of NASA's Rotorcraft All-Weather Operations Research Program on advanced guidance and navigation methods. This research is being conducted using both piloted simulations and flight test evaluations. For the piloted simulations, a mathematical model of the airborne radar was developed for over-water ARAs to offshore platforms. This simulated flight scenario requires radar simulation of point targets, such as oil rigs and ships, distributed sea clutter, and transponder beacon replies. Radar theory, weather radar characteristics, and empirical data derived from in-flight radar photographs are combined to model a civil weather/mapping radar typical of those used in offshore rotorcraft operations. The resulting radar simulation is realistic and provides the needed simulation capability for ongoing ARA research. Author

N83-22092*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NEW TEST TECHNIQUES AND ANALYTICAL PROCEDURES FOR UNDERSTANDING THE BEHAVIOR OF ADVANCED PROPELLERS
G. L. STEFKO, L. J. BOBER, and H. E. NEUMANN 1983 24 p refs Presented at the 1983 Business Aircraft Meeting and Exposition, Wichita, Kans., 12-15 Apr. 1983; sponsored by the Society of Automotive Engineers
(NASA-TM-83360; E-1622; NAS 1.15:83360; SAE-830729) Avail: NTIS HC A02/MF A01 CSCL 01B

Analytical procedures and experimental techniques were developed to improve the capability to design advanced high speed propellers. Some results from the propeller lifting line and lifting surface aerodynamic analysis codes are compared with propeller force data, probe data and laser velocimeter data. In general, the code comparisons with data indicate good qualitative agreement. A rotating propeller force balance demonstrated good accuracy and reduced test time by 50 percent. Results from three propeller flow visualization techniques are shown which illustrate some of the physical phenomena occurring on these propellers. S.L.

N83-22093# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
ADVANCES IN GUIDANCE AND CONTROL SYSTEMS
Jan. 1983 240 p refs Symp. held in Lisbon, 12-14 Oct. 1982 *In* ENGLISH and FRENCH
(AGARD-CP-321; ISBN-92-835-0324-4) Avail: NTIS HC A11/MF A01

Advances in optimal control theory, synthesis techniques and design methodology applicable to aircraft control are discussed. The rapidly developing technologies in computation, data distribution systems, computer aided design methods and data bases which permit application of theories and synthesis methods heretofore impractical are discussed. Aspects of these emerging technologies ranging from theory through applications including aircraft, missiles, space vehicles and unmanned vehicles are

discussed. Automatic flight control, airborne/spaceborne computers, and air navigation are emphasized.

02

AERODYNAMICS

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

A83-27714
ON THE SIMULATION OF THE HYPERVELOCITY REGIME OF FLOW PAST BODIES IN WIND TUNNELS [K VOPROSU MODELIROVANIIA GIPERSKOROSTNOGO REZHIMA OBTEKANIIA TEL V AERODINAMICHESKIKH TRUBAKH]
V. I. ALFEROV and O. N. VITKOVSKAIA Akademiia Nauk SSSR, *Izvestiia, Mekhanika Zhidkosti i Gaza, Jan.-Feb. 1983, p. 125-130.* In Russian. refs

The paper examines the principal features of the hypervelocity regime of flow past flight vehicles (e.g., spacecraft in the atmospheric reentry phase of their flight), which features are determined by the real properties of the air flow. Criteria for the simulation of this regime in various types of wind tunnels are examined. A comparative analysis shows the superiority of those facilities where air-flow velocities comparable to those in actual flight are achieved. Wind tunnels with MGD acceleration of the gas are an example of such facilities. B.J.

A83-27874
ON THE APPLICATION OF LINEARIZED THEORY TO MULTI-ELEMENT AEROFOILS. I - TANDEM FLAT PLATE AEROFOILS
G. D. WATT and G. V. PARKINSON (British Columbia, University, Vancouver, Canada) Aeronautical Quarterly, vol. 34, Feb. 1983, p. 46-60. Research supported by the Natural Sciences and Engineering Research Council of Canada. refs

A linearized two-dimensional incompressible potential flow theory for two-element uncambered tandem aerofoil sections is developed. It leads to formulas for lift and moment which can be calculated rapidly on a programmable hand calculator, and which reduce, when the two aerofoil elements come together, to the familiar thin-aerofoil formulas for an aerofoil with a simple flap. The theory is shown to give lift and moment predictions which are in good agreement with predictions of numerical potential flow theory. (Author)

A83-28951#
INSTANTANEOUS TURBULENCE PROFILES IN THE WAKE OF AN OSCILLATING AIRFOIL
J. DE RUYCK and C. HIRSCH (Brussel, Vrije Universiteit, Brussels, Belgium) AIAA Journal (ISSN 0001-1452), vol. 21, May 1983, p. 641, 642. Research supported by the Nationaal Fonds voor Wetenschappelijk Onderzoek. refs
(Contract DAJA37-80-C-0367)
Previously cited in issue 06, p. 800, Accession no. A82-17901

A83-28970#
INDUCED DRAG OF A SLENDER WING IN A NONUNIFORM STREAM
M. HANIN and A. BARSONY-NAGY (Technion - Israel Institute of Technology, Haifa, Israel) AIAA Journal (ISSN 0001-1452), vol. 21, May 1983, p. 781-783.

Hanin and Barsony-Nagy (1980) have developed a method for calculating the pressure distribution and lift of a slender wing in a nonuniform parallel stream whose velocity varies in the vertical direction. The induced drag was not considered in the reported study. The present investigation is concerned with an evaluation of the induced drag. In order to obtain the induced drag, the leading-edge suction forces are obtained and their resultant is subtracted from the streamwise component of the pressure force on the wing. Numerical results for several stream velocity profiles show the manner in which the induced drag varies with the velocity ratio of the stream and with the ratio of wing span to the vertical extent of stream nonuniformity. G.R.

A83-29012*# Lockheed-California Co., Burbank.
ZERO-LENGTH INLETS FOR SUBSONIC V/STOL AIRCRAFT
E. R. GLASGOW, W. E. BECK (Lockheed-California Co., Burbank, CA), and R. R. WOOLLETT (NASA, Lewis Research Center, Cleveland, OH) Journal of Aircraft (ISSN 0021-8669), vol. 20, May 1983, p. 397-403. refs
(Contract NAS3-21461)
Previously cited in issue 19, p. 3257, Accession no. A81-42186

A83-29018*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
INFLUENCE OF LEADING-EDGE THRUST ON TWISTED AND CAMBERED WING DESIGN FOR SUERSONIC CRUISE
H. W. CARLSON and D. S. MILLER (NASA, Langley Research Center, High-Speed Aerodynamics Div., Hampton, VA) Journal of Aircraft (ISSN 0021-8669), vol. 20, May 1983, p. 440-445.
Previously cited in issue 20, p. 3457, Accession no. A81-43146

A83-29020#
DEVELOPMENT AND VALIDATION OF THE V/STOL AERODYNAMICS AND STABILITY AND CONTROL MANUAL
M. M. WALTERS and C. HENDERSON (U.S. Naval Material Command, Naval Air Development Center, Warminster, PA) Journal of Aircraft (ISSN 0021-8669), vol. 20, May 1983, p. 450-455. refs
Previously cited in issue 05, p. 650, Accession no. A82-16903

A83-29021#
COMPUTATIONAL TREATMENT OF THREE-DIMENSIONAL TRANSONIC CANARD-WING INTERACTIONS
V. SHANKAR and N. MALMUTH (Rockwell International Science Center, Thousand Oaks, CA) Journal of Aircraft (ISSN 0021-8669), vol. 20, May 1983, p. 456-461. refs
(Contract F44620-81-C-0044)
Previously cited in issue 06, p. 797, Accession no. A82-17814

A83-29835*# 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 (Informatics General Corp., Palo Alto, Ca) and P. M. GOORJIAN (NASA, Ames Research Center, Moffett Field, CA) IN: Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 2 . New York, American Institute of Aeronautics and Astronautics, 1983, p. 253-265. refs
(AIAA 83-0888)

Studies were made to investigate the effects of viscosity on aerodynamic and aeroelastic characteristics of oscillating airfoils. The computer code LTRAN2 (viscous), which is based on a small disturbance aerodynamic theory, was used to make aerodynamic computations. Two viscous models, the viscous-ramp model and the lag-entrainment model were considered. The unsteady viscous effects were obtained by use of the quasi-steady assumptions. Two cases, a conventional airfoil, NACA 64A010, and a supercritical airfoil, MBB-A3, were studied at Mach numbers 0.796 and 0.7557, respectively. For both the airfoils, steady and unsteady aerodynamic computations were made by using inviscid and viscous theories. The steady and the unsteady results for the NACA 64A010 airfoil and the steady results for the MBB-A3 airfoil were compared with the available wind-tunnel results. Flutter speeds were computed for both airfoils by using the U-g method and the effects of viscosity on the airfoils were studied. Results from the viscous methods show improvements over the inviscid method. Author

A83-29836#
SUBSONIC DYNAMIC STALL IN PITCHING AND PLUNGING OSCILLATIONS INCLUDING LARGE GROUND INTERFERENCE EFFECTS
L. E. ERICSSON and J. P. REDING (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA) IN: Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 2 . New York, American Institute of Aeronautics and Astronautics, 1983, p. 266-276. refs
(AIAA 83-0889)

In the present paper an earlier developed analytic method for predicting dynamic stall is extended to high subsonic speeds to include both pitching and plunging oscillations in presence of ground plane interference. Theoretical relationships are derived for the interdependence of unsteady and steady aerodynamics providing the means for prediction of the dynamic characteristics using static experimental data. The method is shown to give predictions that are in good agreement with existing dynamic test results. It supplied the foundation for the computational method developed for the determination of the aeroelastic characteristics of the Space Shuttle cable trays. Author

A83-29849*# 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) IN: Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 2 . New York, American Institute of Aeronautics and Astronautics, 1983, p. 399-408. refs
(AIAA 83-0923)

Steady and unsteady aerodynamic data were measured on a rectangular wing with a 12 percent thick supercritical airfoil mounted in the NASA Langley Transonic Dynamics Tunnel. The wing was oscillated in pitch to generate the unsteady aerodynamic data. The purpose of the wind-tunnel test was to measure data for use in the development and assessment of transonic analytical codes. The effects on the wing pressure distributions of Mach number, mean angle of attack, and oscillation frequency and amplitude were measured. Results from the newly-developed XTRAN3S program (a nonlinear transonic small disturbance code) and from the RHOIV program (a linear lifting surface kernel function code) were compared to measured data for a Mach number of 0.7 and for oscillation frequencies ranging from 0 to 20 Hz. The XTRAN3S steady and unsteady results agreed fairly well with the measured results. The RHOIV unsteady-result agreement was fair but, of course, did not predict shock effects. Author

A83-29867#
A DISCRETIZED ASYMPTOTIC METHOD FOR UNSTEADY HELICOPTER ROTOR AIRLOADS
A. R. VAIDYANATHAN and G. A. PIERCE (Georgia Institute of Technology, Atlanta, GA) IN: Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 2 . New York, American Institute of Aeronautics and Astronautics, 1983, p. 558-563. refs
(AIAA 83-0989)

The computation required by Van Holten's asymptotic method for unsteady rotor airloads during forward flight can be significantly reduced by the use of piecewise continuous approximations for the unknown function in place of the continuous assumed mode expression. Piecewise constant and piecewise quadratic representations have been used and found to be acceptable except in cases involving strong blade/wake interactions, when smaller azimuth spacing must be used. Reductions in computation time of at least eighty percent are found to be possible. Author

A83-29883#
TRANSONIC INTERFERENCE EFFECTS IN TESTING OF OSCILLATING AIRFOILS
J. A. DAVIS (Rockwell International Corp., Rocketdyne Div., Canoga Park, CA) and S. L. PETRIE (Ohio State University, Columbus, OH) IN: Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 2 . New York, American Institute of Aeronautics and Astronautics, 1983, p. 714-727. refs
(AIAA 83-1032)

Experimental results are reported for fixed angle-of-attack and mid-chord pitch oscillation testing conducted in a 6 x 22 inch transonic airfoil tunnel. The results are compared with both steady-state and unsteady airfoil predictions. The validity of the experimental procedure is examined in the light of the unsteady interference effects at transonic speeds. The results indicate that oscillating airfoil tests at low-to-moderate reduced frequencies can be conducted at transonic speeds in a ventilated two-dimensional test facility with results relatively free of unsteady interference effects. N.B.

A83-29927* New York Univ., New York.
COMPUTATIONAL FLUID DYNAMICS OF AIRFOILS AND WINGS
P. GARABEDIAN and G. MCFADDEN (New York University, New York, NY) IN: Transonic, shock, and multidimensional flows: Advances in scientific computing; Proceedings of the Symposium, Madison, WI, May 13-15, 1981 . New York, Academic Press, 1982, p. 1-16. refs
(Contract NSG-1579; NGR-33-016-201; NGT-33-016-800)

It is pointed out that transonic flow is one of the fields where computational fluid dynamics turns out to be most effective. Codes for the design and analysis of supercritical airfoils and wings have become standard tools of the aircraft industry. The present investigation is concerned with mathematical models and theorems which account for some of the progress that has been made. The most successful aerodynamics codes are those for the analysis of flow at off-design conditions where weak shock waves appear. A major breakthrough was achieved by Murman and Cole (1971), who conceived of a retarded difference scheme which incorporates artificial viscosity to capture shocks in the supersonic zone. This concept has been used to develop codes for the analysis of transonic flow past a swept wing. Attention is given to the trailing edge and the boundary layer, entropy inequalities and wave drag, shockless airfoils, and the inverse swept wing code. G.R.

A83-29971
NUMERICAL SOLUTIONS FOR UNSTEADY AEROFOILS USING INTERNAL SINGULARITY DISTRIBUTIONS
G. BADNYOPADHYAY and B. C. BASU (Indian Institute of Technology, Kharagpur, India) Aeronautical Journal (ISSN 0001-9240), vol. 87, March 1983, p. 105-108.

In order to check the accuracy of the internal singularity approach to the solution of airfoils undergoing general unsteady motion, this method is applied to 8.4 percent VonMises and 4 percent Joukowski airfoils subjected to a sudden change of incidence, with attention to the time-dependent buildup of lift. Comparisons are made of the present results with those of Basu and Hancock (1978). The number of segments into which the airfoil surface has to be divided is reduced by the present method from 40 to 26, while yielding comparable numerical accuracy and reducing computing time. O.C.

N83-20895# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany).
INTRODUCTORY SURVEY OF AEROELASTIC PROBLEMS IN SEPARATED AND TRANSONIC FLOW
H. FOERSCHING *In* Von Karman Inst. for Fluid Dynamics Unsteady Airloads and Aeroelastic Probl. in Separated and Transonic Flow 26 p 1981 refs
Avail: NTIS HC A15/MF A01

A survey of aeroelastic problems in separated and transonic flow is presented. The problems of aircraft dynamic stalling and

buffeting, and on the aeroelastic problems peculiar to transonic flow are emphasized. The effects of these aeroelastic phenomena on aircraft design are discussed and illuminated through representative examples. E.A.K.

N83-20896*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THE PHENOMENON OF DYNAMIC STALL
W. J. MCCROSKEY *In* Von Karman Inst. for Fluid Dynamics Unsteady Airloads and Aeroelastic Probl. in Separated and Transonic Flow 28 p 1981 refs Original document was announced as N81-20029
Avail: NTIS HC A15/MF A01 CSCL 01A

Dynamic stall and its consequences which are important to aircraft design and operation are discussed. A certain degree of unsteadyness always accompanies the flow over streamlined bodies at high angle of attack, however, the stall of lifting surface undergoing unsteady motion is more complex than static stall. Dynamic stall remains a major unsolved problem with a variety of applications in aeronautics, hydrodynamics and wind engineering. E.A.K.

N83-20902# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
UNSTEADY AERODYNAMIC AND AEROELASTIC PROPERTIES ON CONTROL SURFACES IN TRANSONIC FLOW
N. C. LAMBOURNE *In its* Unsteady Airloads and Aeroelastic Probl. in Separated and Transonic Flow 15 p 1981 refs
Avail: NTIS HC A15/MF A01

The steady and unsteady aerodynamic properties of control surfaces are reviewed. The aerodynamic properties provide a background to understand the aeroelastic problems that affect controls in the transonic regime. Simple trailing edge control surfaces representing flaps, wings or airfoils are discussed. Flow regimes are described and the physical properties are emphasized. E.A.K.

N83-20903# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
COMPARISON OF COMPUTED AND MEASURED UNSTEADY PRESSURE FIELDS OF A SUPERCRITICAL WING
M. COUSTON, J. J. ANGELINI, and J. L. MEURZEC *In its* Unsteady Airloads and Aeroelastic Probl. in Separated and Transonic Flow 28 p 1981 refs
Avail: NTIS HC A15/MF A01

The prediction of unsteady flows over supercritical wings of modern transport aircrafts is discussed. The unsteady aerodynamic loads acting on the structure were studied. A provisional approach, based on asymptotic approximation for wings with large aspect ration and small sweepback, which allows the introduction of a three dimensional correction into the nonlinear, two dimensional calculation is proposed. The experimental and nonlinear two dimensional and approximate three dimensional calculations are compared. E.A.K.

N83-20904# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium). Fluid Dynamics Div.
AEROELASTIC PROBLEMS OF WINGS IN TRANSONIC FLOW
R. J. ZWAAN *In its* Unsteady Airloads and Aeroelastic Probl. in Separated and Transonic Flow 50 p 1981 refs
Avail: NTIS HC A15/MF A01

Transonic flutter characteristics of wings are discussed. The transonic dip in the flutter boundary are emphasized. The phenomenon is examined with 2-D wings as examples. Experimental work and prediction methods dealing with transonic flutter characteristics of 3-D wings are surveyed. E.A.K.

N83-20906# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany).
UNSTEADY AIRLOADS ON OSCILLATING WINGS IN POST-STALL CONDITION
P. BUBLITZ *In* Von Karman Inst. for Fluid Dynamics Unsteady Airloads and Aeroelastic Probl. in Separated and Transonic Flow 30 p 1981 refs
Avail: NTIS HC A15/MF A01

Wind tunnel tests were performed on two wing configurations. The first one is a basic trapezoidal half wing model, and the second one is the same basic wing equipped with a strake. The tests were executed under incompressible flow conditions in the low speed wind tunnel. The test installations are described and test results are discussed, especially with respect to the aeroelastic/dynamic response problem and the aeroelastic stability problem. E.A.K.

N83-20915*# National Aeronautics and Space Administration, Washington, D. C.
SOME CHARACTERISTIC QUANTITIES OF KARMAN-TREFFTZ PROFILES
J. J. H. BLOM Jan. 1983 35 p refs Transl. into ENGLISH of "Enige Karateristieke Grootheden Van Von Karman-Trefftz Profielen" rept. VTH-LR-323 Technische Hogeschool, Delft, Netherlands, Jun. 1981 40 p Original language document was announced as N82-19189
(Contract NASW-3542)
(NASA-TM-77013; NAS 1.15:77013) Avail: NTIS HC A03/MF A01 CSCL 01A

For von Karman-Trefftz profiles, the characteristics which determine profile shape (profile nose dimensions, maximum thickness and position: tail slope and curvature) are stated as a function of transformation variables using the Timman method. The profile is obtained by iterative deformation of a von Karman profile with known transformation, corresponding as well as possible to the desired profile. The figures and relations which enable a good choice of the required profile are given. Author (ESA)

N83-20916*# National Aeronautics and Space Administration, Washington, D. C.
A STUDY OF DIRIGIBLES FOR USE IN THE PERUVIAN SELVA CENTRAL REGION
N. J. MAYER Mar. 1982 144 p refs
(NASA-TM-85633; NAS 1.15:85633) Avail: NTIS HC A07/MF A01 CSCL 01C

The potential for dirigibles as transports in the Selva Central region of Peru was evaluated by means of a mission and economic analysis. A total requirement to transport over 19 million tons (t) of agricultural produce, lumber, and meat was projected by the year 2004. A primary route involving zones for loading and delivering this cargo was identified. Although dirigibles are capable of short field operation, all existing airfields must be enlarged in width to allow for all conditions of wind and weather and to provide space for overnight mooring. A maintenance base and operations headquarters, complete with hangar and other service facilities would be required. The quantities of cargo to be carried establish requirements for fleets of dirigibles of various sizes and capacities. Cargo capacities of 5 to 100 tons were identified. Fleet sizes up to 106 dirigibles (in 20 t capacities) would be required. Dirigibles were assumed to be of the nonrigid type except in the 100 t category for which rigid characteristics were assumed. A method of determining dirigible costs was developed. The values derived were then applied to an economic analysis to determine initial investment and operating costs. It was found that larger dirigibles of approximately 20 t capacities or higher could offer significant cost benefits over airplanes, provided cruise speeds were higher than 100 km/hr. M.G.

N83-20917*# National Aeronautics and Space Administration, Washington, D. C.
A STUDY OF DIRIGIBLES FOR USE IN THE PERUVIAN SELVA CENTRAL REGION [ESTUDIO DE DIRGIBLES PARA UTILIZACION EN LA REGION DE LA SELVA CENTRAL DEL PERU]
N. J. MAYER Mar. 1982 150 p refs In SPANISH
(NASA-TM-85634; NAS 1.15:85634) Avail: NTIS HC A07/MF A01 CSCL 01C

The potential for dirigibles as transports in the Selva Central region of Peru was evaluated by means of a mission and economic analysis. A total requirement to transport over 19 million tons (t) of agricultural produce, lumber and meat was projected by the year 2004. A primary route involving zones for loading and delivering this carbo was identified. Although dirigibles are capable of short field operation, all existing airfields must be enlarged in width to allow for all conditions of wind and weather and to provide space for overnight mooring. A maintenance base and operations headquarters, complete with hangar and other service facilities would be required. The quantities of cargo capacities of 5 to 100 tons were identified. Fleet sizes up to 106 dirigibles (in ~20 t capacities) would be required. Dirigibles were assumed to be of the nonrigid type except in the 100 t category for which rigid characteristics were assumed. A method of determining dirigible costs was developed. The values derived were then applied to an economic analysis to determine initial investment and operating costs. It was found that larger dirigibles of approximately 20 t capacities or higher could offer significant cost benefits over airplanes, provided cruise speeds were higher than 100km/hr. M.G.

N83-20918*# Bihrle Applied Research, Inc., Jericho, N. Y.
ROTARY BALANCE DATA FOR A TYPICAL SINGLE-ENGINE GENERAL AVIATION DESIGN FOR AN ANGLE-OF-ATTACK RANGE OF 8 DEG TO 90 DEG. 1: INFLUENCE OF AIRPLANE COMPONENTS FOR MODEL D
J. RALSTON Washington NASA Mar. 1983 316 p refs (Contract NAS1-16205)
(NASA-CR-3246; NAS 1.26:3246) Avail: NTIS HC A14/MF A01 CSCL 01A

The influence of airplane components, as well as wing location and tail length, on the rotational flow aerodynamics is discussed for a 1/6 scale general aviation airplane model. The airplane was tested in a built-up fashion (i.e., body, body-wing, body-wing-vertical, etc.) in the presence of two wing locations and two body lengths. Data were measured, using a rotary balance, over an angle-of-attack range of 8 deg to 90 deg, and for clockwise and counter-clockwise rotations covering an omega b/2V range of 0 to 0.9. Author

N83-20920# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugmechanik.
MEASUREMENT OF THE FLOW-FIELD BEHIND HARMONICALLY OSCILLATING GUST GENERATORS IN THE MODEL SUBSONIC WIND TUNNEL (MUK)
B. KRAG Aug. 1982 146 p refs *In* GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-806)
(DFVLR-FB-82-26; ESA-TT-806) Avail: NTIS HC A07/MF A01; DFVLR, Cologne DM 46,20

The German Netherland wind tunnel (DNW) considers the installation of a gust generator. Basic investigations in the model subsonic wind tunnel shows which parameters are influencing the propagation of the gust field and which type of gust generator is best suited for the DNW. Four different types of gust generators were investigated. The gust field was measured within the complete volume of the test section using dynamic flow direction probes. S.L.

N83-20923# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SURVEY OF TRANSONIC FLOW RESEARCH IN CHINA
Z. ZHENG 18 Oct. 1982 9 p Transl. into ENGLISH from Lixue yu Shijian (China), v. 4, no. 1, 1982 p 70-71
(AD-A122788; FTD-ID(RS)T-1077-82) Avail: NTIS HC A02/MF A01 CSCL 20D

Transonic flow research is surveyed. Calculations for steady state, inviscid external flow; nonstationary external flow; and internal flow are discussed. The finite difference method is used for the calculation of transonic flow fields for airfoils, bodies of rotation, intake ducts, cascades, and entire fuselages. S.L.

N83-22157*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AN AERODYNAMIC ASSESSMENT OF VARIOUS SUPERSONIC FIGHTER AIRPLANES BASED ON SOVIET DESIGN CONCEPTS
M. L. SPEARMAN Mar. 1983 25 p refs
(NASA-TM-84647; NAS 1.15:84647) Avail: NTIS HC A02/MF A01 CSCL 01A

The aerodynamic, stability, and control characteristics of several supersonic fighter airplane concepts were assessed. The configurations include fixed-wing airplanes having delta wings, swept wings, and trapezoidal wings, and variable wing-sweep airplanes. Each concept employs aft tail controls. The concepts vary from lightweight, single engine, air superiority, point interceptor, or ground attack types to larger twin-engine interceptor and reconnaissance designs. Results indicate that careful application of the transonic or supersonic area rule can provide nearly optimum shaping for minimum drag for a specified Mach number requirement. Through the proper location of components and the exploitation of interference flow fields, the concepts provide linear pitching moment characteristics, high control effectiveness, and reasonably small variations in aerodynamic center location with a resulting high potential for maneuvering capability. By careful attention to component shaping and location and through the exploitation of local flow fields, favorable roll-to-yaw ratios may result and a high degree of directional stability can be achieved. A.R.H.

N83-22159*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AUGMENTATION OF FIGHTER-AIRCRAFT PERFORMANCE BY SPANWISE BLOWING OVER THE WING LEADING EDGE
A. SEGINER and M. SALOMON (SAL Engineering, Haifa, Israel) Mar. 1983 29 p refs
(NASA-TM-84330; A-9243; NAS 1.15:84330) Avail: NTIS HC A03/MF A01 CSCL 01A

Spanwise blowing over the wing and canard of a 1:35 model of a close-coupled-canard fighter airplane configuration (similar to the Kfir-C2) was investigated experimentally in low-speed flow. Tests were conducted at airspeeds of 30 m/sec (Reynolds number of 1.8 x 10 to the 5th power based on mean aerodynamic chord) with angle-of-attack sweeps from -8 to 60 deg, and yaw-angle sweeps from -8 to 36 deg at fixed angles of attack 0, 10, 20, 25, 30, and 35 deg. Significant improvement in lift-curve slope, maximum lift, drag polar and lateral/directional stability was found, enlarging the flight envelope beyond its previous low-speed/maximum-lift limit. In spite of the highly swept (60 deg) leading edge, the efficiency of the lift augmentation by blowing was relatively high and was found to increase with increasing blowing momentum on the close-coupled-canard configuration. Interesting possibilities of obtaining much higher efficiencies with swirling jets were indicated. M.G.

N83-22161*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AEROPROPULSIVE CHARACTERISTICS OF TWIN SINGLE-EXPANSION-RAMP VECTORING NOZZLES INSTALLED WITH FORWARD-SWEPT WINGS AND CANARDS
M. L. MASON and F. J. CAPONE Mar. 1983 76 p refs
(NASA-TP-2133; L-15555; NAS 1.60:2133) Avail: NTIS HC A05/MF A01 CSCL 01A

The Langley 16 foot transonic tunnel was used to determine the aeropropulsive characteristics of twin single-expansion-ramp vectoring nozzles installed in a wing-body configuration with forward-swept wings. The configuration was tested with and without fixed canards. The test conditions included free-stream Mach numbers of 0.60, 0.90, and 1.20. The model angle of attack ranged from -2 deg to 14 deg; the nozzle pressure ratio ranged from 1.0 (jet off) to 9.0. The Reynolds number based on the wing mean aerodynamic chord varied from 3.0 x 10 to the 6th power to 4.8 x 10 to the 6th power, depending on Mach number. Aerodynamic characteristics were analyzed to determine the effects of thrust vectoring and the canard effects on the wing-afterbody-nozzle and the wing-afterbody portions of the model. Thrust vectoring had no effect on the angle of attack for the onset of flow separation on the wing but resulted in reduced drag at angle-of-attack values above that required for wing flow separation. The canard was found to have little effect on the thrust-induced lift resulting from vectoring, since canard effects occurred primarily on the wing. Author

N83-22162*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
EXPERIMENTAL STUDY OF WING LEADING-EDGE DEVICES FOR IMPROVED MANEUVER PERFORMANCE OF A SUPERCRITICAL MANEUVERING FIGHTER CONFIGURATION
M. J. MANN, J. K. HUFFMAN, C. H. FOX, JR., and R. L. CAMPBELL Mar. 1983 84 p refs
(NASA-TP-2125; L-15539; NAS 1.60:2125) Avail: NTIS HC A05/MF A01 CSCL 01A

Wind tunnel tests were conducted to examine the use of wing leading-edge devices for improved subsonic and transonic maneuver performance. These devices were tested on a fighter configuration which utilized supercritical-wing technology. The configuration had a leading-edge sweep of 45 deg and an aspect ratio of 3.28. The tests were conducted at Mach numbers of 0.60 and 0.85 with angles of attack from -0.5 deg to 22 deg. At both Mach numbers, sharp leading-edge flaps produced vortices which greatly altered the flow pattern on the wing and resulted in substantial reductions in drag at high lift. Underwing or pylon-type vortex generators also reduced drag at high lift. The vortex generators worked better at a Mach number of 0.60. The vortex generators gave the best overall results with zero toe-in angle and when mounted on either the outboard part of the wing or at both an outboard location and halfway out the semispan. Both the flaps and the vortex generators had a minor effect on the pitching moment. Fluorescent minitufts were found to be useful for flow visualization at transonic maneuver conditions. Author

N83-22163*# Boeing Commercial Airplane Co., Seattle, Wash.
AEROELASTIC LOADS PREDICTION FOR AN ARROW WING. TASK 1: EVALUATION OF R. P. WHITE'S METHOD Final Report
C. J. BORLAND and M. E. MANRO Washington NASA Mar. 1983 93 p refs
(Contract NAS1-15678)
(NASA-CR-3640; NAS 1.26:3640; D6-51762-1) Avail: NTIS HC A05/MF A01 CSCL 01A

The separated flow method is evaluated. This method was developed for moderately swept wings with multiple, constant strength vortex systems. The flow on the highly swept wing used in this evaluation is characterized by a single vortex system of continuously varying strength. S.L.

N83-22164*# Boeing Commercial Airplane Co., Seattle, Wash.
AEROELASTIC LOADS PREDICTION FOR AN ARROW WING. TASK 2: EVALUATION OF SEMI-EMPIRICAL METHODS Final Report
A. C. WERY, R. M. KULFAN, and M. E. MANRO Washington NASA Mar. 1983 123 p refs
(Contract NAS1-15678)
(NASA-CR-3641; NAS 1.26:3641) Avail: NTIS HC A06/MF A01 CSCL 01A

The development and evaluation of a semi empirical method to predict pressure distributions on a deformed wing by using an experimental data base in addition to a linear potential flow solution is described. The experimental data accounts for the effects of aeroelasticity by relating the pressures to a parameter which is influenced by the deflected shape. Several parameters were examined before the net leading edge suction coefficient was selected as the best. S.L.

N83-22165*# United Technologies Corp., East Hartford, Conn. Research Center.
ANALYSIS OF UNSWEPT AND SWEPT WING CHORDWISE PRESSURE DATA FROM AN OSCILLATING NACA 0012 AIRFOIL EXPERIMENT. VOLUME 1: TECHNICAL REPORT Final Contractor Report
A. O. ST.HILAIRE and F. O. CARTA Washington Mar. 1983 101 p refs
(Contract NAS1-16041; DA PROJ. 1L1-61102-AH-45)
(NASA-CR-3567; NAS 1.26:3567) Avail: NTIS HC A06/MF A01 CSCL 01A

The unsteady chordwise force response on the airfoil surface was investigated and its sensitivity to the various system parameters was examined. A further examination of unsteady aerodynamic data on a tunnel spanning wing (both swept and unswept), obtained in a wind tunnel, was performed. The main body of this data analysis was carried out by analyzing the propagation speed of pressure disturbances along the chord and by studying the behavior of the unsteady part of the chordwise pressure distribution at various points of the airfoil pitching cycle. It was found that Mach number effects dominate the approach to and the inception of both static and dynamic stall. The stall angle decreases as the Mach number increases. However, sweep dominates the load behavior within the stall regime. Large phase differences between unswept and swept responses, that do not exist at low lift coefficient, appear once the stall boundary is penetrated. It was also found that reduced frequency is not a reliable indicator of the unsteady aerodynamic response in the high angle of attack regime. S.L.

N83-22166*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A COMMON GEOMETRIC DATA-BASE APPROACH FOR COMPUTER-AIDED MANUFACTURING OF WIND-TUNNEL MODELS AND THEORETICAL AERODYNAMIC ANALYSIS
M. J. SEE (Kansas Univ., Lawrence) and J. V. COZZOLONGO Apr. 1983 27 p refs
(NASA-TP-2151; A-9169; NAS 1.60:2151) Avail: NTIS HC A03/MF A01 CSCL 01A

A more automated process to produce wind tunnel models using existing facilities is discussed. A process was sought to more rapidly determine the aerodynamic characteristics of advanced aircraft configurations. Such aerodynamic characteristics are determined from theoretical analyses and wind tunnel tests of the configurations. Computers are used to perform the theoretical analyses, and a computer aided manufacturing system is used to fabricate the wind tunnel models. In the past a separate set of input data describing the aircraft geometry had to be generated for each process. This process establishes a common data base by enabling the computer aided manufacturing system to use, via a software interface, the geometric input data generated for the theoretical analysis. Thus, only one set of geometric data needs to be generated. Tests reveal that the process can reduce by several weeks the time needed to produce a wind tunnel model component. In addition, this process increases the similarity of

the wind tunnel model to the mathematical model used by the theoretical aerodynamic analysis programs. Specifically, the wind tunnel model can be machined to within 0.008 in. of the original mathematical model. However, the software interface is highly complex and cumbersome to operate, making it unsuitable for routine use. The procurement of an independent computer aided design/computer aided manufacturing system with the capability to support both the theoretical analysis and the manufacturing tasks was recommended. S.L.

N83-22167*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
LOW-SPEED AERODYNAMIC CHARACTERISTICS OF A 14-PERCENT-THICK NASA PHASE 2 SUPERCRITICAL AIRFOIL DESIGNED FOR A LIFT COEFFICIENT OF 0.7
C. D. HARRIS, R. J. MCGHEE, and D. O. ALLISON Dec. 1980 104 p refs
(NASA-TM-81912; L-13891; NAS 1.15:81912) Avail: NTIS HC A06/MF A01 CSCL 01A

The low speed aerodynamic characteristics of a 14 percent thick supercritical airfoil are documented. The wind tunnel test was conducted in the Low Turbulence Pressure Tunnel. The effects of varying chord Reynolds number from 2,000,000 to 18,000,000 at a Mach number of 0.15 and the effects of varying Mach number from 0.10 to 0.32 at a Reynolds number of 6,000,000 are included. S.L.

03

AIR TRANSPORTATION AND SAFETY

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

A83-28194#
INVESTIGATION OF POSSIBLE LTA CRAFT APPLICATION TO SOLVE NATIONAL ECONOMY PROBLEMS
P. P. DEMENTEV, V. I. MAVRITSKII, M. M. KULIK, and P. V. PIATISHEV (Ministerstvo Aviatsionnoi Promyshlennosti SSSR, Moscow, USSR) Airship, Dec. 1982, p. 19-22.

The use of LTA craft which employ aerostatic and aerodynamic lift generation in the exploitation of remote regions of the northeastern USSR is assessed, with a view to the demands of resource prospecting and exploitation. Three airship designs are considered, of which one is of conventional, all-aerostatic lift type while the others incorporate tilt fan rotors or helicopter rotors for the augmentation of lift. Projected cruise speeds are in all cases 120 km/hr, and payloads are of 10 tons. O.C.

A83-28899*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
NASA AERIAL APPLICATIONS WAKE INTERACTION RESEARCH
D. J. MORRIS, C. C. CROOM, B. J. HOLMES (NASA, Langley Research Center, Hampton, VA), and C. P. VAN DAM (Kansas, University, Wichita, KS) American Society of Agricultural Engineers and National Agricultural Aviation Association, Joint Technical Session, Las Vegas, NV, Dec. 6, 1982, Paper. 24 p. refs

A computer code has been developed for predicting trajectories of particles released in the wakes of airplanes or helicopters. The code accounts for effects of turbulence, crosswind, propeller slipstream, terrain variations, and plant canopy density on particle trajectories. Comparisons are given between experiments and theory. Applications of the code for spray pattern improvement are illustrated. Author

A83-29203#
C-141 OPERATIONS IN OPERATION BRIGHT STAR 82
R. E. BROOKS (USAF, Charleston AFB, SC) IN: Institute of Navigation, Annual Meeting, 38th, Colorado Springs, CO, June 14-17, 1982, Proceedings . Washington, DC, Institute of Navigation, 1982, p. 6-8.

The role of the C-141 aircraft during Operation Bright Star 82, a testing exercise for the U.S. Rapid Deployment Force, is examined. A personal account is presented of how six C-141 aircraft flew from Pope Air Force Base, North Carolina, to Cairo West, Egypt, dropped 600 paratroopers and proceeded to Rhein-Main Air Base, West Germany, nonstop in 19:12 hours of flying time. The inflight refueling procedures are discussed as well as some of the problems involved with large formation air refueling. Also examined are the force rendezvous of 18 C-141 and 6 C-130 aircraft and the mass airdrop at Cairo West. N.B.

A83-29204#
B-52 OPERATIONS IN THE BRIGHT STAR 82 EXERCISE
D. A. DICK (USAF, Standardization/Evaluation Div., Grand Forks AFB, ND) IN: Institute of Navigation, Annual Meeting, 38th, Colorado Springs, CO, June 14-17, 1982, Proceedings . Washington, DC, Institute of Navigation, 1982, p. 9-13.

The B-52 bombing mission during Operation Bright Star 82, the longest nonstop B-52 bombing mission in the history of the Strategic Air Command, is discussed. Various aspects of the preparation for this mission of interest to navigators are examined, including the operational planning, tactics design, and weapon certification. A method to visually enhance weapon accuracy, the BUSY BULLSEYE tactic, was developed. The development and testing of the MK-82SE high drag munition for the Strategic Protection Force role are considered. In addition, the full scale practice mission, DIM STAR, flown on the White Sands missile range ten days prior to the flight is discussed. N.B.

A83-29371
STUDIES OF DAMAGE INVOLVING AIRCRAFT COMPONENTS [SCHADENSUNTERSUCHUNGEN AN LUFTFAHRZEUGTEILEN]
G. LANGE (Braunschweig, Technische Universitaet, Brunswick, West Germany) Metall (ISSN 0026-0746), vol. 37, April 1983, p. 365-371. In German. refs

In West Germany, the causes of aircraft accidents and operational disturbances have been systematically evaluated since 1973. Since that time, a total of 5216 cases have been studied. The percentage of accidents and operational disturbances attributable to human, technological, and other causes are listed in a table for the various classes of aircraft. Human error represents with a total of 62 percent of all cases the most frequent cause for accidents, while only 9 percent are related to technical defects. Of all accidents traceable to technological causes, only a small percentage is related to the fracture of mechanical structural components. In a study of 160 cases involving accidents caused by technological factors, 57 percent of all cases were identified as fatigue fractures, 38 percent as overload fractures, and 4 percent as due to corrosion. The reasons for the fractures are discussed in detail, giving attention to various examples. G.R.

A83-29372
AUTOMATION OF PREPLANNING AS A MEANS FOR IMPROVING QUALITY IN CONNECTION WITH FLIGHT OPERATIONAL CONTROL. I [AUTOMATISIERUNG DER VORPLANUNG ALS MITTEL ZUR QUALITAETSSTEIGERUNG BEI DER OPERATIVEN FLUGLEITUNG. I]
W. KUNERT (Interflug Gesellschaft fuer Internationalen Flugverkehr mbH, Berlin, East Germany) Technisch-oekonomische Information der zivilen Luftfahrt (ISSN 0232-5012), no. 5, 1982, p. 163-172. In German.

Steadily increasing air traffic control requirements make it necessary to take suitable steps which can ensure a safe, fluid, and economic conduction of air traffic operations. Such steps are needed because air traffic control systems are for economic reasons frequently not dimensioned for the satisfaction of the maximum demands occurring only at certain times. An

enhancement of the quality of planning with respect to the air traffic control processes is, therefore, a necessary condition for quality improvement with respect to process implementation.An understanding of this relation led to the further development of the process 'preplanning' as integral part of the air traffic control system. The project 'Automation of Preplanning' represents the first step taken in connection with this development. This project was introduced into the civil air traffic control service of the German Democratic Republic in 1981. The project forms a component of the automated system of flight operational control of the GDR.
G.R.

A83-29393#
ENERGY CONSERVATION IN AIR TRANSPORTATION - THE CANADIAN AIR TRAFFIC CONTROL EFFORT
R. E. CHAFE (Transport Canada, Ottawa, Canada) Canadian Aeronautics and Space Journal (ISSN 0008-2821), vol. 28, Dec. 1982, p. 339-345.

Air Traffic Services, an element of the Canadian Air Transport Administration, has taken steps to satisfy requirements for a service which will yield energy and cost efficiency improvements for prospective users. Considerations influencing the formulation of policy have included data on the North Atlantic airspace at and above Flight Level 270, together with its transition area over eastern Canada, the demands of military airspace, standard profile aircraft descents to minimize radar vectoring requirements, the possibilities for the automation of air traffic control, and an air traffic flow management program currently under development. O.C.

A83-29855#
APPLICATION OF THE NONLINEAR FINITE ELEMENT METHOD TO CRASHWORTHINESS ANALYSIS OF AIRCRAFT SEATS
A. O. BOLUKBASI and D. H. LAANANEN (Simula Inc., Tempe, AZ) IN: Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 2 . New York, American Institute of Aeronautics and Astronautics, 1983, p. 448-456. *Sponsorship: U.S. Department of* Transportation. refs
(Contract DOT-FA03-80-C-00098)
(AIAA 83-0929)

A three-dimensional mathematical model of an aircraft seat, occupant, and restraint system has been developed for use in analysis of light aircraft crashworthiness. Because of the significant role played by the seat in overall system crashworthiness, a detailed finite element model of the seat structure is included. The seat model can accommodate large displacements, nonlinear material behavior, and local buckling. The occupant model consists of twelve rigid mass segments whose dimensions and inertial properties have been determined from studies of human body anthropometry and kinematics and from measurements of anthropomorphic test dummies. Model predictions are compared with measured data from dynamic tests of a simple seat. Author

A83-29966
FORECASTING IN AIR TRANSPORT - A CRITICAL REVIEW OF THE TECHNIQUES AVAILABLE
A. N. HOFTON (Cranfield Institute of Technology, Cranfield, Beds., England) (Royal Aeronautical Society, Symposium on Planning Airline Fleet Composition, London, England, Jan. 19, 1983) Aeronautical Journal (ISSN 0001-9240), vol. 87, March 1983, p. 85-87.

Air transport forecasting is aimed at the provision of a qualitative and quantitative measure of likely levels of future market demand, with such components as marketing opportunities, company efforts, performance control, the determination and influence of business environment, and contingency planning. Forecasting methods employ market research, expert assessments, the projection of scenarios, mathematical 'curve fitting' projections, econometric and demographic models, and simulation techniques. Time scales for forecasting are divided in the present lecture into the categories of 'short term', or one to 18 months, 'medium term', of 18 months to five years, and 'long term', of from five to 15 years. O.C.

A83-29967
FLEET PLANNING MODELS
J. C. TREVETT (Cranfield Institute of Technology, Cranfield, Bed., England) (Royal Aeronautical Society, Symposium on Planning Airline Fleet Composition, London, England, Jan. 19, 1983) Aeronautical Journal (ISSN 0001-9240), vol. 87, March 1983, p. 88-94. refs

Attention is given to the method by which fleet planning procedures can be undertaken, after conducting the requisite analyses of markets, aircraft types, and cost and revenue structures. The objective of these efforts is the selection of a plan offering the best overall business potential for an airline over a number of years of operation. Note is taken of the application of mathematical programming techniques to these problems, and attention is given to fleet planning models currently being used by manufacturers and airlines. The most prominent factors in the selection of a fleet of aircraft for a given route system are capacity requirements, maximum airport use frequency, maximum frequency of routes limited by bilateral treaty, and aircraft type availability for a given planning period. Attention is also given to aircraft cost and size relations, best route combinations, and optimal fleet combinations. Extensive comparative data are presented in tabular form. O.C.

A83-29968
CHOICE OF OPTIMAL CABIN CAPACITY
D. G. YEOMANS (Cranfield Institute of Technology, Cranfield, Beds., England) (Royal Aeronautical Society, Symposium on Planning Airline Fleet Composition, London, England, Jan. 19, 1983) Aeronautical Journal (ISSN 0001-9240), vol. 87, March 1983, p. 95-98.

Considerations of cabin capacity, which may be briefly characterized as the number of passenger seats available on a given flight, seek to establish a balance between situations in which passengers must be turned away for lack of seats, and the high overhead costs in relationship to revenue resulting from an excess of seating capacity. Although cabin capacity is only a general consideration during aircraft procurement, small adjustments may make the difference between profit and loss once the aircraft is in service. One such adjustment is cabin apportionment to different passenger classes. Optimal seat number is frequently computed by means of the Normal distribution, although Elle (1967) has shown that the Negative Binomial distribution is more correct. Attention is given to the difference between results obtained by means of these two distributions.
O.C.

A83-29969
MILITARY POTENTIAL OF TILTROTOR AIRCRAFT
T. THOMASON (Bell Helicopter Textron, Fort Worth, TX) Aeronautical Journal (ISSN 0001-9240), vol. 87, March 1983, p. 99-103.

The TiltRotor concept, as exemplified by the U.S. Army/NASA XV-15 research aircraft, combines the wing of an aircraft with the large diameter rotors of a helicopter to achieve VTOL operation without compromise of fuel efficiency in either cruise or hover. The XV-15 has demonstrated twice the speed and range in cruise of helicopters currently in operation, suggesting significant advantages over helicopters in military operations. Attention is given to the suitability of TiltRotor aircraft for land, carrier-based naval and amphibious operations, including Marine assault, Assault escort, combat rescue, commando operations, utility transport, antisubmarine warfare, reconn{issance, and airborne early warning. The Joint Services Advanced Vertical Lift Aircraft Development Program has been instituted for the further study of these capabilities. O.C.

N83-22168*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
FLIGHT ASSESSMENT OF A DATA-LINK-BASED NAVIGATION-GUIDANCE CONCEPT
T. S. ABBOTT Apr. 1983 32 p refs
(NASA-TM-84493; L-15436; NAS 1.15:84493) Avail: NTIS HC A03/MF A01 CSCL 01C

With the proposed introduction of a data-link provision into the Air-Traffic-control (ATC) system, the capability will exist to supplement the ground-air, voice (radio) link with digital, data-link information. Additionally, ATC computers could provide, via the data link guidance and navigation information to the pilot which could then be presented in much the same manner as conventional navigation information. The primary objective of this study was to assess the feasibility and acceptability of using 4-sec and 12-sec information updating to drive conventional cockpit-navigation-instrument formats for path-tracking guidance. A flight test, consisting of 19 tracking tasks, was conducted and, through the use of pilot questionnaires and performance data, the following results were obtained. From a performance standpoint, the 4-sec and 12-sec updating led to a slight degradation in path-tracking performance, relative to continuous updating. From the pilot's viewpoint, the 12-sec data interval was suitable for long path segments (greater than 2 min of flight time), but it was difficult to use on shorter segments because of higher work load and insufficient stabilization time. Overall, it was determined that the utilization of noncontinuous data for navigation was both feasible and acceptable for the prescribed task. Author

N83-22169# Committee on Commerce, Science, and Transportation (U. S. Senate).
NATIONAL AIRSPACE SYSTEM PLAN
Washington GPO 1982 93 p Hearing before the Subcomm. on Aviation of the Comm. on Com., Sci. and Transportation, 97th Congr., 2d Session, 24 Jun. 1982
(GPO-98-029) Avail: Subcommittee on Aviation

Four pertinent issues were addressed: the adequacy of the National Airspace System (NAS) as a planning document, FAA's management capability, the mode S data link and transponder, and replacement of the en route computer replacement. B.G.

N83-22170# Notre Dame Univ., Ind. Fire Research Group.
NUMERICAL CALCULATIONS OF TURBULENT BUOYANT FLOW IN AIRCRAFT CABINS Final Report
K. T. YANG, J. R. LOYD, A. M. KANURY, and K. SATOH Atlantic City FAA Mar. 1983 52 p refs
(Contract NB81-NADA-2000)
(FAA-CT-82-61) Avail: NTIS HC A04/MF A01

The UNDSAFE computer code is utilized to study the spread of fire and smoke in aircraft cabins due to fires located in the cabin floor. A simulation study is first made based on expected data to establish the equivalence between two dimensional and three dimensional parameters including fire distribution and shape, the doorway height, and level of turbulence and also the effects of these parameters on the fire and smoke spread. The computer code is then used to simulate the spread of fire and smoke in a wide body aircraft cabin with and without seats for two different scenarios of the fire location. The results show the dramatic effects of the seats on the flow, temperature, and smoke concentration behaviors inside the cabin. Important parameters have been identified such as the seat back height and the configuration of the seat bottom, closed or open. Author

N83-22171# Simula, Inc., Tempe, Ariz. Technical Center.
COMPUTER SIMULATION OF AN AIRCRAFT SEAT AND OCCUPANT IN A CRASH ENVIRONMENT, VOLUME 1 Final Report, Sep. 1980 - Sep. 1982
D. H. LAANANEN, A. O. BOLUKBASI, and J. W. COLTMAN Mar. 1983 200 p refs
(Contract DTFA03-80-C-00098)
(FAA-CT-82-33-1-VOL-1; TR-82401) Avail: NTIS HC A09/MF A01

A mathematical model of an aircraft seat, occupant, and restraint system was developed for use in analysis of light aircraft crashworthiness. Because of the significant role played by the seat in overall system crashworthiness, a finite element model of the seat structure was included. The seat model can accommodate large plastic deformations and includes the capability for simulation of local buckling of bending members. Because the program was written for use primarily by engineers concerned with the design and analysis of seat and restraint systems, an effort was made to minimize the input data required to describe the occupant. The development of the mathematical model of the occupant, the finite element seat analysis, validation, and organization of the computer program are discussed. M.G.

N83-22172# Simula, Inc., Tempe, Ariz. Technical Center.
COMPUTER SIMULATION OF AN AIRCRAFT SEAT AND OCCUPANT IN A CRASH ENVIRONMENT. VOLUME 2: PROGRAM SOM-LA USER MANUAL Final Report, Sep. 1980 - Sep. 1982
D. H. LAANANEN, J. W. COLTMAN, and A. O. BOLUKBASI Mar. 1983 235 p refs
(Contract DTFA03-80-C-00098)
(FAA-CT-82-33-2-VOL-2; TR-81415) Avail: NTIS HC A11/MF A01

A mathematical model of an aircraft seat, occupant, and restraint system was developed for use in analysis of light aircraft crashworthiness. Instructions for preparing input data and operating the program are presented and supported by detailed examples. Sample material properties and modeling parameters are also included. M.G.

N83-22173# Federal Aviation Administration, Atlantic City, N.J. Technical Center.
A STUDY OF BIRD INGESTIONS INTO LARGE HIGH BYPASS RATIO TURBINE AIRCRAFT ENGINES Interim Report, May 1981 - Apr. 1982
G. FRINGS Mar. 1983 60 p
(Contract FAA PROJ. 182-320-100)
(FAA-CT-82-144) Avail: NTIS HC A04/MF A01

A 1 year study has been conducted to document the numbers, weights, and species of birds being ingested into large high bypass ratio aircraft turbine engines. This study will continue into a second year. This interim presents the findings to date. Author

N83-22174# Factory Mutual Research Corp., Norwood, Mass.
COMPUTER MODELING OF AIRCRAFT CABIN FIRE PHENOMENA
M. A. DELICHATSIOS, R. L. ALPERT, L. ORLOFF, and M. K. MATHEWS Oct. 1982 65 p refs
(Contract NB81-NADA-2007)
(PB83-119891; NBS-GCR-82-404) Avail: NTIS HC A04/MF A01 CSCL 01C

A two layer integral model is presented for the calculation of turbulent wall flows on a vertical wall including a burning wall. The turbulent flow is divided into inner and outer turbulent regimes. These regimes are matched on a dividing streamline after appropriate wall laws for the turbulent flow have been developed. Wall laws, which depend on the specific boundary conditions, are proposed for an adiabatic wall plume, with addition of an inert material at the wall and a burning wall. The present methodology could be used also to develop wall flow laws for a constant temperature or constant heat flux wall and the overfire region above a burning wall. Numerical results are presented for an

adiabatic wall flow with constant buoyancy flux and a burning wall without appreciable radiation. GRA

N83-22180# KLM Royal Dutch Airlines, Amsterdam (Netherlands). Aircraft Performance Dept.
THE AIRLINE FACING THE PRESENT CRISIS
J. H. WAGENMAKERS *In* AGARD Air Traffic Control in Face of Users' Demand and Econ. Constraints 7 p Feb. 1983
Avail: NTIS HC A06/MF A01

The impact of the drastic fuel price increase on airline operations is briefly discussed. Some measures that are being taken to contain the economic effect are reviewed. In particular air traffic control (ATC) criteria and military constraints are highlighted, which are known to have a direct influence on fuel burn. This is illustrated with examples and furthermore a specific comment is made in relation to the Portuguese ATC environment. Author

N83-23210# Supreme Court of South Africa, Pretoria. Commission of Inquiry into Civil Aviation in South Africa.
CO-ORDINATION IN AVIATION IN SOUTHERN AFRICA
C. S. MARGO *In* CSIR Ann. Transportation Conv., Vol. 1 13 p 1982
Avail: NTIS HC A16/MF A01

The principles and economics of transport in the context of an adequate and efficient network of air services in Southern Africa are discussed. Probable future developments in the demand for transport are examined. The advantages of air transport and the use thereof in Southern Africa are analyzed. The economics of air transport in the region are examined and solutions are offered for the effective coordination of a suitable transport network, and for the provision and maintenance of the necessary infrastructure. E.A.K.

N83-23234# Department of Transport, Pretoria (South Africa).
HUMAN FACTORS IN AIR SAFETY
J. J. S. GERMISHUYS *In* CSIR Ann. Transportation Conv., Vol. 4 8 p 1982 refs
Avail: NTIS HC A20/MF A01

The human factor in aviation safety, and the relationship between aircraft accidents and man's involvement were discussed. The emphasis is on educating pilots in a process of self analysis, whereby they recognize their limitations and take positive steps to ensure that such limitations do not impede air safety. Safety in general could be improved in this way. Author

04

AIRCRAFT COMMUNICATIONS AND NAVIGATION

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

A83-27124
DATA TRANSMISSION IN THE CASE OF SECONDARY RADAR /MODE S/ [DATENUEBERTRAGUNG BEIM SEKUNDAERRADAR /MODE-S/]
P. PLUMEYER (Braunschweig, Technische Universitaet, Brunswick, West Germany) Ortung und Navigation, no. 3, 1982, p. 414-427. In German.

In the U.S. it is planned to replace the current secondary radar system ATC RBS by the Mode S radar, which was developed during the last few years. The Mode S provides a number of improvements related to the area of measurement technology, and, in addition, it has the capability to address each aircraft on an individual basis. In connection with the latter ability, the Mode S radar can deal with a greater number of aircraft and a higher traffic density than the SSR. Attention is given to signal formats in the SSR and Model S systems, the data formats of the replies, and questions regarding the significance and the employment of the formats, taking into account aspects of standard surveillance and data communications. G.R.

A83-27913
PERTURBATION ADAPTIVE ARRAY PROCESSOR FOR AIRBORNE APPLICATION
J. KILVINGTON (Royal Aircraft Establishment, Radio and Navigation Dept., Farnborough, Hants., England) IEE Proceedings, Part F - Communications, Radar and Signal Processing, vol. 130, pt. F, no. 1, Feb. 1983, p. 84-90.

An adaptive processor which utilizes a perturbation algorithm in a microprocessor is developed for use with a four-element array in aircraft radionavigation and communications systems. It is found that the resulting system is of the same form as that of an LMS algorithm for small perturbations and a simulation is presented which shows the deviations from this form for larger perturbations. The simulation is also used to study the behavior of the processor and to determine several design parameters. It is demonstrated that the use of a microprocessor allows more complicated features to be used than is possible with dedicated hardware, such as the weight rescaling process which takes the place of the clamped weight or reference signal. The word length used for weight control is kept to a minimum by the good linearity of this system which is essential to the weight rescaling process. N.B.

A83-27919
ADAPTIVE CLUTTER SUPPRESSION FOR AIRBORNE PHASED ARRAY RADARS
R. KLEMM (Forschungsgesellschaft fuer angewandte Naturwissenschaften, Forschungsinstitut fuer Funk und Mathematik, Wachtberg-Werthhoven, West Germany) IEE Proceedings, Part F - Communications, Radar and Signal Processing, vol. 130, pt. F, no. 1, Feb. 1983, p. 125-132. refs

Noting that the two-dimensional filter has to be adaptive, new results are presented on optimum adaptive clutter suppression. A suboptimum approach (beamformer plus adaptive temporal filter) is presented for purposes of comparison. It is shown that it is nearly impossible to achieve the favorable properties of the optimum space-time clutter filter with a suboptimum substitute. There are four other conclusions. The first is that the optimum space-time clutter filter is insensitive to any kind of sidelobe clutter. The second is that the performance of the optimum space-time processor is independent of the aperture of the transmit antenna. The third it is that, for proper operation, the echo field must be sampled in space and time according to the Nyquist condition. The fourth is that even through suboptimum approaches, such as a beamformer canscaded with an adaptive temporal filter, may reach the maximum gain far from the main-beam clutter region, they show much broader stop bands and are sensitive to strong sidelobe clutter. C.R.

A83-27969
OPERATION OF ILS DURING SNOW AND ICE CONDITIONS
J. A. STENSTADVOLDEN (Norwegian Telecommunications Administration, Norway) The Controller, vol. 22, Mar. 1983, p. 10-13.

Weather conditions with precipitation of snow and rain introduce various problems to civil aviation, and aircraft operations are impeded by difficulties, such as reduced visibility and reduced friction coefficient on runways. The present investigation is concerned with the operation of the Instrument Landing System (ILS) under snow conditions and the employment of suitable approaches for reducing the susceptibility of ILS to weather effects. The glide slope part of ILS is particularly susceptible to accumulations of snow. The ILS localizer is far less susceptible, while the ILS Marker Beacons are rarely disturbed by weather effects. Attention is given to snow effects on ILS glide slopes, the effects produced by snow with different characteristics, protective and preventive actions, corrective action in the case of snow accumulation on ILS localizers, and the accumulation of snow on antennas. G.R.

A83-28164
TERRAIN PROFILE MATCHING FOR MISSILE GUIDANCE
R. S. DALE (British Aerospace Dynamics Group, Bristol, England) Aerospace Dynamics, June 1981, p. 17-19.

Attention is given to the goals and methods of terrain profile matching, and to the system deriving from such considerations which is known as TERPROM. The system incorporates dead reckoning navigation instruments, usually in the form of an inertial measuring unit, whose errors are continually predicted and corrected by a Kalman filter which observes the measurement of the missile's height above the ground. Although systems are already in existence which use terrain matching over several kilometers of flight to obtain a single position fix, TERPROM processes each height measurement as it is obtained, yielding a virtually continuous updating of the error estimates and allowing the use of lower grade sensors despite the achievement of a superior terrain-following capability. O.C.

A83-28178
ALGORITHM DEVELOPMENT FOR INFRA-RED AIR-TO-AIR GUIDANCE SYSTEMS - HOW TO SEPARATE THE WHEAT FROM THE CHAFF: A SIMPLE APPROACH TO TARGET DETECTION
P. D. ALLEN and J. NORTHFIELD (British Aerospace, Dynamics Group, Stevenage, Herts., England) Aerospace Dynamics, May 1982, p. 16-23.

Criteria for algorithms used for processing IR data in missile homing devices are discussed, with emphasis on the target acquisition stage. High speed, sometimes mechanically activated search patterns are used to identify and lock on a target. The target must be retained in the field of view of the optics, and the tracking phase is initiated. The guidance optics must continually discriminate between the target and the background and remained lock-on target through maneuvers which may decrease the signature intensity. The choice of algorithms is influenced by the detector sensitivity, the waveband, spatial resolution, and the scanning system used. Constraints are experienced from the electronic packaging volume, power consumption, cost, and available processing time. Attention is given to basic, Prewitt, and Laplacian scene generation, and clustering logic involving connectivity, original scene, and convolved scene operators, as well as spatial filters. M.S.K.

A83-28594
TECHNICAL AND OPERATIONAL EVALUATION OF WIDE-AREA COVERAGE NAVIGATION SYSTEMS IN THE CONTINENTAL UNITED STATES
D. W. RICHARDSON (Systems Control Technology, Inc., West Palm Beach, FL) Navigation, vol. 29, Winter 1982-1983, p. 261-270.

The technical and operational considerations involved in the FAA sponsored evaluation of wide-area coverage navigation systems suitable for replacing or supplementing the existing VOR systems of airborne navigation are discussed. A database is being developed which considers such issues as data quantifying flight technical error as one element in an overall navigation system use error budget, and signal coverage and accuracy data throughout the continental US for Loran-C, Omega, and Omega/VLF. Also addressed are detailed data regarding propagating errors, signal-to-noise ratios, bias errors, etc. and operational use data such as piolot workload, blunders, pilot-controller communications. Attention is focused on the establishment of the lateral and vertical accuracy criteria of the wide-area coverage navigation systems. N.B.

A83-28595
A MULTIFUNCTION INTEGRATED APPROACH TO PROVIDING AIRCRAFT INERTIAL DATA
G. J. ROBINETTE and R. E. WITTERS (USAF, Avionics Laboratory, Wright-Patterson AFB, OH) Navigation, vol. 29, Winter 1982-1983, p. 271-278. refs

An approach is developed for providing all the inertial information required by an advanced fighter aircraft from a single set of inertial sensors (gyros and accelerometers). Avionics subsystems such as navigation, reference, flight control, autopilot, cockpit displays, mission avionics, and weapon delivery all require inertial data from a dedicated set of inertial sensors. The conventional approach is to provide a redundancy of interial sensors and a duplication of inertial data. By providing all required inertial data from a common set of inertial sensors, duplication can be eliminated and the advantages of redundancy achieved. The Integrated Inertial Reference Assembly (IIRA) program is being conducted in order to produce a cost effective integrated system architecture that can satisfy all inertial requirements and meet aircraft safety-of-flight and survivability constraints. The IIRA concept has direct application to advanced fighter aircraft, as well as to advanced transports, trainers, cruise missiles, and bombers. N.B.

A83-28596
THE INTEGRATED INERTIAL NAVIGATION SYSTEM AN/ASN-132
J. NIEMELA (U.S. Army, Avionics Research and Development Activity, Fort Monmouth, NJ) Navigation, vol. 29, Winter 1982-1983, p. 279-288.

The navigation system architecture developed in the Integrated Inertial Navigation System (IINS) program in order to meet the requirement of the US Army for a highly accurate inertial/TACAN hybrid navigation system is discussed. The design trade-offs made as well as the hardware selections are examined. The MIL-STD-1553 was selected as the appropriate data bus interface standard, which facilitates configuration control during system development and also allows rapid integration with future aircraft systems that will use it as a primary means of data transmittal. The signal interface between the subsystem element, onboard mission equipment, and flight instruments are examined in detail. The federated processing structure which allows great flexibility in the insertion of future technology is discussed with particular attention to the inertial/TACAN updata algorithm and data bus control functions. N.B.

A83-28597
VOR/DME AUTOMATED STATION SELECTION ALGORITHM
W. B. RUHNOW and M. L. GOEMAAT (Rockwell International Corp., Cedar Rapids, IA) Navigation, vol. 29, Winter 1982-1983, p. 289-299.

An Automated Station Selection Algorithm is developed for selecting stations which well-qualified flight crews would probably select if given adequate time and motivation to do so, and which is suitable for a new VOR/DME geographically oriented navigation system. It is shown that this method tends to pick stations which are ahead of the aircraft, are usable for about 50 nm, and provide acceptable dual DME geometry whenever such station pairs exist. A standby pair station pair is also selected which may be utilized when an unexpected loss of station signal occurs. Aircraft altitude information is found to be able to improve the station selection performance considerably. The initialization problem of what to do immediately after takeoff and the problem of selecting stations during complex maneuvers are not considered. N.B.

A83-28649#
ANALYSIS OF THE PRECISION OF INERTIAL NAVIGATION SYSTEMS [GENAUIGKEITSANALYSE VON TRAEGHEITSNAVIGATIONSSYSTEMEN]
N. LOHL Braunschweig, Technische Universitaet, Fakultaet fuer Maschinenbau und Elektrotechnik, Dr.-Ing. Dissertation, 1982. 154 p. In German. refs

The present investigation is concerned with a study of the dynamic environment of strapdown sensors, which are directly exposed to the unsteady environmental conditions on board an aircraft. Environmental effects, such as angular vibrations and linear vibrations, have generally a detrimental effect on the navigational accuracy of the strapdown inertial system. The investigation has, therefore, the objective to use flight test data with a strapdown system as a basis for a characterization of the noise observed in the case of the gyroscope and the acceleration-measuring device

of the strapdown system. Statistical analysis methods are used in connection with the data evaluation. The problem of the time dependence of the average value of the sensor signals made it necessary to employ a trend filter for the separation of the measured data into a low-frequency unsteady trend component and a high-frequency steady noise component. G.R.

A83-28700
INTEGRATED SYSTEMS EVALUATED ON F-15
R. R. ROPELEWSKI Aviation Week and Space Technology, vol. 118, Apr. 11, 1983, p. 47-50, 55-57.

The performance characteristics and design features of the F-15 integrated flight/fire control (IFFC) system are reported. The system was built to combine conventional pilot inputs with automatic controls generated by an aircraft fire control system. Flight tests conducted without the Atlis 2 electro-optical sensor/tracker, and the APG-63 radar tracker was found to function well in air-to-air gunnery situations. The IFFC provides an extra display in the HUD as a director fire control solution. Additionally, several switch functions on the throttles have been changed. Manual flight is permitted, as is automatic control in the terminal attack phase. The results of several flight trials are reviewed, and the benefits of relinquishing manual control in close situations are stressed. Deficiencies in system reliability are discussed. M.S.K.

A83-28776
NATIONAL AEROSPACE MEETING, MOFFETT FIELD, CA, MARCH 24, 25, 1982, PROCEEDINGS
Meeting sponsored by the Institute of Navigation. Washington, DC, Institute of Navigation, 1982. 143 p
$30

The present conference topics include Space Shuttle inertial upper stage attitude initialization and update, the evaluation of inertial upper stage navigation algorithms, helicopter guidance and flight control demonstration by means of a laser gyro inertial navigation system, the Nova-1 drag-free navigation satellite, the Conex gyroscope, the performance of a helicopter strapdown ring laser gyro tetrad inertial navigation system, improved accelerometers for high accuracy strapdown inertial navigation systems, and the radar detection of low level wind shear. Also discussed are the timing of a Loran-C navigation system chain, flight demonstrations of the integrated inertial sensor assembly, a trapped readout for an electrostatically supported superconducting gyro, the fault/maneuver tolerance of aided Global Positioning System (GPS) demodulation/navigation processors, and the computer simulation of a differential GPS for civil applications. O.C.

A83-28779*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
GUIDANCE AND FLIGHT CONTROL DEMONSTRATION IN A HELICOPTER FLIGHT ENVIRONMENT USING A LASER-GYRO INERTIAL NAVIGATION SYSTEM
S. F. SCHMIDT (NASA, Ames Research Center, Moffett Field, CA; Analytical Mechanics Associates, Inc., Jericho, NY), R. A. CARESTIA (NASA, Ames Research Center, Moffett Field, CA; Southern Colorado, University, Pueblo, CO), R. J. HRUBY, G. XENAKIS (NASA, Ames Research Center, Moffett Field, CA), and L. D. CORLISS (NASA, Ames Research Center; U.S. Army, Army Aeromechanics Laboratory, Moffett Field, CA) In: National Aerospace Meeting, Moffett Field, CA, March 24, 25, 1982, Proceedings. Washington, DC, Institute of Navigation, 1982, p. 20-25. refs

The present flight test program results indicate that an all-digital inertial sensing system can be used in helicopter flight guidance and control, provided that the rotor rotation-induced motions are filtered from body rate and accelerometer signals before they are used in the feedback control system. Attention is given to the problem posed by the different repetition rates used by each of the manufacturers involved in the procurement of such all-digital subsystems. Autopilot designers must accordingly predict the need for filters and install them where called for in the sensor software. Two alternatives to this method are explored. Recent technological developments indicate that strapped down inertial systems will replace vertical and direction gyros as well as body rate accelerometers in future aircraft systems. O.C.

A83-28781*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PERFORMANCE OF A STRAPDOWN RING LASER GYRO TETRAD INERTIAL NAVIGATION SYSTEM IN A HELICOPTER FLIGHT ENVIRONMENT
R. A. CARESTIA (NASA, Ames Research Center, Moffett Field, CA; Southern Colorado, University, Pueblo, CO), R. J. HRUBY (NASA, Ames Research Center, Moffett Field, CA), and W. S. BJORKMAN (NASA, Ames Research Center, Moffett Field; Analytical Mechanics Associates, Inc., Mountain View, CA) In: National Aerospace Meeting, Moffett Field, CA, March 24, 25, 1982, Proceedings. Washington, DC, Institute of Navigation, 1982, p. 32-40. refs

Results are presented for the first flight demonstration test of a strapdown laser inertial navigation system in a helicopter environment. It is noted that acceptable navigation accuracies were obtained with system alignment times as short as 5 min or less, and that the use of all four available sensors in the navigation algorithm did not significantly improve performance over that achievable by means of only three orthogonal sensors. Failure detection by means of the parity residual from four axes proved successful for failure levels far below the noise threshold of flight control sensing requirements. Summing the gyro parity residual for a period of 13-20 min can yield step-shifted laser gyro sensor bias error detection comparable to the gyro random shift specification. O.C.

A83-28784#
RADAR DETECTION OF LOW LEVEL WIND SHEAR AFFECTING AIRCRAFT TERMINAL NAVIGATION
P. R. MAHAPATRA, R. J. DOVIAK, and D. S. ZRNIC (NOAA, National Severe Storms Laboratory, Norman, OK) In: National Aerospace Meeting, Moffett Field, CA, March 24, 25, 1982, Proceedings. Washington, DC, Institute of Navigation, 1982, p. 52-59. refs

Consideration is given to the suitability of Doppler radar as a reliable detection and warning system for the low level wind shear that has been responsible for aircraft accidents and other incidents in the recent past. In light of what is known about the nature of low level wind shear, three types of radar are considered as possible remote sensors: modified airport surveillance radar, coherent FM-CW radar, and pulsed Doppler radar, which is the type closest to operational implementation. It is concluded that a successful shear warning system could be based on Doppler radar sensing of shear along approach paths, together with the estimation of trajectory degradation on the basis of wind perturbations. O.C.

A83-28785#
INTEGRATION AND FLIGHT DEMONSTRATIONS OF THE INTEGRATED INERTIAL SENSOR ASSEMBLY /IISA/
C. N. SHEN and D. J. SAURINA (U.S. Naval Material Command, Naval Air Development Center, Warminster, PA) In: National Aerospace Meeting, Moffett Field, CA, March 24, 25, 1982, Proceedings. Washington, DC, Institute of Navigation, 1982, p. 65-74.

The Integrated Inertial Sensor Assembly (IISA) employs a dual triad of strapdown ring laser gyros and accelerometers in skewed configuration, together with high speed microprocessors, in order to provide all the inertial sensor data required by advanced military aircraft. U.S. Navy efforts toward the integration and flight demonstration of the Advanced Development Model IISA on an advanced naval aircraft are presently discussed, and results of analytical studies performed for the assessment of the feasibility of the IISA's integration with the candidate F/A-18A aircraft are presented. Results of a preliminary flight control stability analysis are also given. O.C.

A83-28787#
FAULT/MANEUVER TOLERANCE OF AIDED GPS DEMODULATION/NAVIGATION PROCESSORS IN THE NON-PRECISION APPROACH ENVIRONMENT
J. W. SENNOTT (Bradley University, Peoria, IL) In: National Aerospace Meeting, Moffett Field, CA, March 24, 25, 1982, Proceedings. Washington, DC, Institute of Navigation, 1982, p. 80-87. Research supported by the U.S. Department of Transportation. refs

The potential performance of a Global Positioning System (GPS) processor, with and without altimeter, airspeed and heading inputs, is predicted by means of a demodulator error model which accounts for the integrated processor structure and signal amplitude adaptation that are relevant to the software most likely to be used during prospective GPS operations. Attention is given to conditions of normal signals with flight turbulence, and of turbulence in combination with randomly distributed turn rate maneuvers. Full performance is recovered within several seconds after signal restoration in the former case, and in the latter, errors are found to be almost identical with those of the turbulence-alone case. O.C.

A83-28788#
FAA HELICOPTER NAVSTAR GPS FLIGHT TESTING
R. D. TILL (FAA, Technical Center, Atlantic City, NJ) In: National Aerospace Meeting, Moffett Field, CA, March 24, 25, 1982, Proceedings. Washington, DC, Institute of Navigation, 1982, p. 88-93.

The radionavigation system or mix of systems suitable for post-1990 requirements is being investigated by the Federal Aviation Administration (FAA) for the case of helicopters, with a view to the use of the NAVSTAR Global Positioning System (GPS). Flight test and ground test data were analyzed to determine the perturbation effect of multipath operations, satellite shielding conditions, user satellite geometry, vehicle dynamics, natural and man-made interference, and helicopter rotor modulation. The flight test data was obtained over 15 hours of radar-tracked and nonprecision approach flying under GPS-derived guidance. O.C.

A83-28789#
SYNERGISTIC INTEGRATION OF JTIDS/GPS TECHNOLOGY
J. D. REISS and J. W. FRISINA (Singer Co., Kearfott Div., Little Falls, NJ) In: National Aerospace Meeting, Moffett Field, CA, March 24, 25, 1982, Proceedings. Washington, DC, Institute of Navigation, 1982, p. 94-102. refs

A hybrid navigation system capable of reliable, jam-resistant operation in severe vehicle acceleration and electromagnetic signal environments is envisioned, through an integration of JTIDS and GPS navigation processing that is predicted on the significant degree of state estimation processing commonality of these systems. A relatively small addition to the existing JTIDS software may be all that is required to support both JTIDS relative navigation and the optimal rate carding of the GPS receiver's critical code-tracking loop. It is noted that the distributed nature of the JTIDS community allows the real time interchange of pseudorange data among GPS participants in jamming environments. Recent advances in distributed software and embedded host process design applicable to the combined signal processing environment are explored in detail. O.C.

A83-28790#
COMPUTER SIMULATION OF A DIFFERENTIAL GPS FOR CIVIL APPLICATIONS
K. Y. PARK (Magnavox Data Systems, Inc., Falls Church, VA) In: National Aerospace Meeting, Moffett Field, CA, March 24, 25, 1982, Proceedings. Washington, DC, Institute of Navigation, 1982, p. 103-110. refs

A computer simulation program has been developed for the performance analysis of the GPS under various modes of operation in general and a differential GPS in particular. By running this simulation program, the differential concept is verified and problem areas are identified. Improvement in position accuracy and system limitations are also discussed. Since the differential GPS concept herein focuses on general aviation, GPS signal availability and intentional signal degradation are also discussed. (Author)

A83-28791#
RELIABILITY OF NAVSTAR GPS FOR CIVIL AVIATION
C. A. SHIVELY (Mitre Corp., McLean, VA) In: National Aerospace Meeting, Moffett Field, CA, March 24, 25, 1982, Proceedings. Washington, DC, Institute of Navigation, 1982, p. 111-122. U.S. Department of Transportation refs
(Contract DOT-FA01-82-C-10003)

Attention is given to two methods for the prediction of NAVSTAR GPS satellite navigation coverage of a given geographical area, the weighed average and the critical satellite methods, which have been used to evaluate the proposed 18-, 21- and 24-satellite constellations from the standpoint of civil aviation. The more conservative critical satellite method identifies those satellites that must all be working to avoid the cessation of coverage at a given location. Only the 24-satellite constellation provides enough redundant satellites to eliminate critical satellites and their associated coverage's vulnerability. The weighed average method, by contrast, yields more optimistic results on the basis of a weighing of the reliability of a number of satellites in view by the fraction of time that particular visibility conditions exist at the chosen location. O.C.

A83-29201
INSTITUTE OF NAVIGATION, ANNUAL MEETING, 38TH, U.S. AIR FORCE ACADEMY, COLORADO SPRINGS, CO, JUNE 14-17, 1982, PROCEEDINGS
Washington, DC, Institute of Navigation, 1982, 137 p.

Topics examined include current U.S. Air Force navigator training, C-141 operations in Operation Bright Star 82, an advanced day/night sight reduction electronic sextant, techniques of VOR area navigation, a STS-1 orbital trajectory reconstruction using unmodeled acceleration estimation, and automated nautical charts. Also discussed are submarine hazard avoidance and piloting equipment, NAVSTAR-GPS at sea, Space Shuttle onboard IMU redundancy managment design, the laser gyro as a self-contained inertial navigation aid, and a reverse velocity rocket sled test bed for inertial guidance systems. In addition, other topics considered include the flight testing of a low cost inertial guidance system, a lab test to find the major error sources in a laser strapdown inertial navigator, and advanced single-channel NAVSTAR-GPS multiplex receiver with up to eight pseudochannels, and the benefits of integrating GPS and inertial navigation systems. For individual items see A83-29202 to A83-29214 N.B.

A83-29205*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
VOR AREA NAVIGATION - TECHNIQUES AND RESULTS
W. A. RAGSDALE (NASA Johnson Space Center; Intermetrics, Inc., Houston, TX) IN: Institute of Navigation, Annual Meeting, 38th, Colorado Springs, CO, June 14-17, 1982, Proceedings Washington, DC, Institute of Navigation, 1982, p. 21-24. refs

Several methods for deriving position from VOR (without DME) have been developed and evaluated in this study. These methods permit navigation to arbitrary waypoints using either two VOR's or one VOR and a clock. These algorithms have been tested in computer simulations and in flight tests. The single VOR method appears to be the most practical and is a candidate for an automated light plane area navigation system, called VORNAV. Author

A83-29207#
NAVSTAR-GPS AT SEA
J. M. LIGON (U.S. Coast Guard, Office of Research and Development, Washington, DC), P. S. NOE, and V. T. RHYNE (Texas A & M University, College Station, TX) IN: Institute of Navigation, Annual Meeting, 38th, Colorado Springs, CO, June 14-17, 1982, Proceedings . Washington, DC, Institute of Navigation, 1982, p. 57-66. refs

Results of tests conducted using one of the six NAVSTAR-GPS Z-SET receivers for marine navigation are presented. The

performance of the Z-SET is compared with other radionavigation systems, including Transit, Loran-C, and Omega. Among other results, it is found that the average accuracy of the Z-SET is probably better than 15 meters, and that the Z-SET ground tracks are comparable to those of Loran-C in areas of favorable signal strength and geometry under certain conditions. Over longer periods of time, systematic temporal variations appear in Z-SET tracks which are manifested by an oriented wander in stationary scatter plots and as rot{tion in linear at-sea tracks. The Z-SET was able to cope with the dynamics encountered by the ship housing the receiver. N.B.

A83-29210#
FLIGHT TESTING THE LOW COST INERTIAL GUIDANCE SYSTEM
J. M. HOFFMAN (USAF, Guidance Div., Holloman AFB, NM) IN: Institute of Navigation, Annual Meeting, 38th, Colorado Springs, CO, June 14-17, 1982, Proceedings . Washington, DC, Institute of Navigation, 1982, p. 85-92.

Results are presented for flight tests of the Low Cost Inertial Guidance System (LCIGS), which was developed to provide flight control, guidance, navigation, and vehicle stabilization for tactical stand-off missiles. Tests of one prototype system, the LCIGS-CSDL brassboard system, showed a highly erratic performance, as terminal position errors ranged from 175 to 9282 feet, while the circular error probable (CEP) was 2126 feet. The other prototype system, the LCIGS-LSI system, demonstrated a CEP of 969 feet for CST alignment maneuvers and 1163 feet for A/D alignment maneuvers. N.B.

A83-29212#
INTEGRATED GPS, DLMS, AND RADAR ALTIMETER MEASUREMENTS FOR IMPROVED TERRAIN DETERMINATION
D. R. KATT, M. J. WENDL, and G. D. YOUNG IN: Institute of Navigation, Annual Meeting, 38th, Colorado Springs, CO, June 14-17, 1982, Proceedings . Washington, DC, Institute of Navigation, 1982, p. 101-104.
(Contract F33615-80-C-3617)

Results are presented for an investigation of an integrated navigation system which combines measurements from the Global Positioning System, the Digital Landmass System (DLMS). Data Base, and a Radar Altimeter in a Kalman statistical filter mechanization to provide an improved terrain data base. Performance results are obtained analytically in a closed-form solution which obviates the need for extensive simulations. Parametric results are presented for various measurement accuracies and for various DLMS error correlation distances. N.B.

A83-29213#
AN ADVANCED SINGLE-CHANNEL NAVSTAR GPS MULTIPLEX RECEIVER WITH UP TO EIGHT PSEUDOCHANNELS
P. WARD (Texas Instruments, Inc., Lewisville, TX) IN: Institute of Navigation, Annual Meeting, 38th, Colorado Springs, CO, June 14-17, 1982, Proceedings . Washington, DC, Institute of Navigation, 1982, p. 105-111.

The operational and performance characteristics are evaluated for an advanced NAVSTAR GPS digital multiplex receiver front-end design that time-shares one code generator and one carrier synthesizer. Multiplexing is demonstrated with this single-channel receiver front-end in a manner that creates up to eight pseudo-channels, which provide simultaneous tracking of four GPS transmitters in P-code of both the L1 and L2 signals. In addition, space vehicle 50 Hz navigation message data are read continuously from all four GPS transmitters. These eight pseudochannels emulate a multichannel set that is virtually free of interchannel bias and interchannel phase drift error since all GPS signals of the same frequency travel the same hardware path. The receiver error characteristics are examined and actual tracking error plots for 16 simultaneous observables from four real GPS satellites are shown. N.B.

A83-29214#
BENEFITS OF INTEGRATING GPS AND INERTIAL NAVIGATION SYSTEMS
T. N. UPADHYAY, B. A. KRIEGSMAN, and D. B. COX, JR. (Charles Stark Draper Laboratory, Inc., Cambridge, MA) IN: Institute of Navigation, Annual Meeting, 38th, Colorado Springs, CO, June 14-17, 1982, Proceedings . Washington, DC, Institute of Navigation, 1982, p. 120-132. refs
(Contract F04704-81-C-0015)

The underlying synergism inherent in the integration of GPS and Inertial Navigation System (INS) technology is discussed, and the stand-alone performances and limitations of these systems and the means to improve their performances are examined. The integration design issues of these systems along with the merits of system integration are considered. Different levels of system integration are examined and their performance advantages and complexities are evaluated. Specific mission-related benefits of an integrated GPS-INS system, such as precision navigation, better anti-jam performance, increased standoff capability, lower cost, and improved reliability, are assessed. It is concluded that enough synergism between GPS and INS technology exists to make the integration an effective means of providing additional military capability. Numerical simulation results are presented in order to demonstrate the improved performance of the integrated system in both favorable and adverse environments. N.B.

N83-20927# Bendix Corp., Baltimore, Md. Communications Div.
FRANGIBLE MICROWAVE LANDING SYSTEM (INVERTED AZIMUTH WAVEGUIDE ARRAY CONFIGURATION) Final Report
P. D. WIENHOLD and E. F. KOLB Washington FAA Dec. 1982 82 p
(Contract DTFA01-81-C-10068)
(DOT/FAA/RD-82/88; BCD-FR-82-002) Avail: NTIS HC A05/MF A01

A feasibility study of the increased frangibility of Microwave Landing System equipment mounted on the extended runway centerline and an assessment of the FAA requirements in regard to frangibility was presented. A conceptual design known as the inverted AZ array was developed and fabricated as a mechanical prototype. The primary structural components of the antenna are vertical cantilever waveguides and frangible joints incorporated into their base. Impact and static load tests proved that several joint designs meet the FAA requirements for frangibility. B.G.

N83-20930# Federal Aviation Agency, Atlantic City, N.J.
OPERATIONAL AND TECHNICAL EVALUATION OF THE FULL DIGITAL AUTOMATED RADAR TERMINAL SYSTEMS (ARTS) DISPLAY (FDAD) Final Report
R. CLARK and S. RODITI Oct. 1982 42 p
(AD-A122269; FAA-RD-82-51; FAA-CT-82-87) Avail: NTIS HC A03/MF A01 CSCL 17I

This report discusses the operational and technical evaluation of the Full Digital Automated Radar Terminal Systems (ARTS) Display (FDAD). The FDAD was capable of providing data entry, data display, data refresh, and input/output functions of either ARTS II, ARTS III, or ARTS IIIA computer. Three different cathode-ray tube phosphors, including color, were evaluated. Data were displayed either in a full-digital mode or a time-share mode. During the time-share mode, the display of digital data was time shared with analog radar/beacon target reports. Modifications to software, hardware, and display firmware would be required to make the FDAD's operationally suitable. The technical evaluation conditionally accepts the displays, as tested, and it recommends their use as field displays, provided certain modifications are made. Author (GRA)

N83-22175# Radio Technical Commission for Aeronautics, Washington, D. C.
MINIMUM OPERATIONAL PERFORMANCE STANDARDS FOR AIRBORNE AREA NAVIGATION EQUIPMENT USING VOR/DME REFERENCE FACILITY SENSOR INPUTS
17 Sep. 1982 164 p refs Supersedes RTCA/DO-140 (RTCA/DO-180; RTCA/DO-140) Avail: NTIS HC A08/MF A01

Minimum Operational Performance Standards for Airborne Area Navigation Equipment (2D and 3D) using VOR/DME reference facility sensor inputs are described. Incorporated within these standards are equipment characteristics that should be useful to users of the system as well as designers, manufacturers and installers. Functions and features for two types of systems are defined: A 2D system which provides only lateral guidance and a 3D system which provides both lateral and vertical guidance. Even though both 2D and 3D equipments are covered in this specification, the equipment manufacturer or installer may choose to build and test the equipment to only the 2D requirements.
Author

N83-22176# Federal Aviation Agency, Atlantic City, N.J. Technical Center.
TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM (TCAS) EVALUATION. VOLUME 2: EQUIPPED THREAT PHASE AND AN ASSESSMENT IN AN ERROR-DEGRADED ENVIRONMENT Final Report, Nov. 1981 - Jan. 1982
B. R. BILLMANN Apr. 1983 66 p refs
(Contract FAA PROJ. 052-243-340)
(FAA/CT-82-52-2-VOL-2) Avail: NTIS HC A04/MF A01

The results of certain aspects of Traffic Alert and Collision Avoidance System (TCAS) logic testing are presented. The TCAS logic significantly improved the resulting separation during encounters with TCAS equipped threats. Simplified command coordination procedures have increased command coordination reliability. Some minor logic modifications were identified to further enhance TCAS logic performance for TCAS equipped threats. The performance of the logic in the presence of reduced surveillance link reliability was also analyzed. The link reliability level required to affect adequate resolution and separation was identified. This analysis was conducted in a measurement error degraded environment. Review of flight test results indicate surveillance link reliability exceeds that required to affect adequate separation performance.
S.L.

N83-22177# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
AIR TRAFFIC CONTROL IN FACE OF USERS' DEMAND AND ECONOMY CONSTRAINTS
Feb. 1983 111 p refs Conf. held in Lisbon, 15 Oct. 1982 *In* ENGLISH and FRENCH
(AGARD-CP-340; ISBN-92-835-0326) Avail: NTIS HC A06/MF A01

The role of air traffic control in reduction of operating costs for aircraft is addressed, including fuel conservation, economic constraints, civilian military coordination aspects, management, and planning concepts.

N83-22178# Civil Aviation Authority, London (England).
A UK NATS VIEW OF THE AIR TRAFFIC MANAGEMENT REQUIREMENTS IN THE NEXT DECADE
P. H. HEMMING *In* AGARD Air Traffic Control in Face of Users' demand and Econ. Constraints 5 p Feb. 1983
Avail: NTIS HC A06/MF A01

The main categories of user demand in United Kingdom airspace at present and the Air Traffic Management infrastructure currently provided are discussed. Aspects of NATS plans for improvement and modernization of air traffic control and the relationship of these plans to improved economy and fuel conservation are outlined. The main focus of these plans is related to development of ATC capability in the London and South East England area, therefore the redevelopment of the London Air Traffic Control Centre is described in the context of the theme of the Special Session. The relationship applicable to the United Kingdom between financial policy, implementation plans and the cost to system user is discussed in view of the constraints it places on the ability of the ATC system to meet commercial demand for the most economic service.
Author

N83-22181# Allied Air Forces Central Europe, Ramstein AFB (West Germany).
MILITARY REQUIREMENTS [LES BESOINS MILITAIRES]
J. DEDONCKER *In* AGARD Air Traffic Control in Face of Users' Demand and Econ. Constraints 7 p Feb. 1983 In FRENCH
Avail: NTIS HC A06/MF A01

In view of the constraints affecting the military user, it is beneficial to question how much traffic control can contribute to solving actual problems which border largely on the matter of fuel costs. An outline of progress related to approval of the defense budget in member countries of the Atlantic Alliance illustrates how difficult it is in western demoncracies to obtain, in this crisis period, the credits needed to carry out the collective defense programs which were elaborated by NATO in consultation with member countries of the Alliance and approved by governmental authorities. Concrete results, obtained in recent years through the coordination of civilian and military partners responsible for space management provide a glimpse of models of action capable of contributing to a form of economy of costly fuel. These gains seem ridiculous when the question of means needed to realize a deliberately agreed upon policy is raised in all its seriousness.
A.R.H.

N83-22182# Aeroportos e Navegacao Aerea E.P., Lisbon (Portugal).
AIR TRAFFIC SERVICES IN PORTUGAL
J. F. CARVALHO *In* AGARD Air Traffic Control in Face of Users' Demand and Econ. Constraints 3 p Feb. 1983
Avail: NTIS HC A06/MF A01

The Portuguese area of responsibility for the provision of Air Traffic Services; and the organization of services and authorities are described. An overview is given of development projects, for the Lisboa and Santa Maria FIR's, their objectives basic concepts, and implementation dates.
Author

N83-22183# Portuguese Air Force, Alfragide.
AIR TRAFFIC SERVICES IN PORTUGAL: CIVIL-MILITARY COORDINATION ASPECTS
L. G. ROCHA *In* AGARD Air Traffic Control in Face of Users' Demand and Econ. Constraints 7 p Feb. 1983
Avail: NTIS HC A06/MF A01

The provision in Portugal of Air Traffic Services in civil and military aircraft and concurrent procedures is discussed. This assessment is based on a strictly military point of view having in account either its requirements or national and international involvements. All over the world the users of the airspace as well of the Air Traffic Control Systems are basically the General Aviation, Air Carriers with their trunk, regional and short haul categories and the military aviation. The effect that military activity has on ATC Systems is extremely inconstant depending on either air space structure or Air Traffic Services organization at each country.
Author

N83-22184# Federal Aviation Administration, Washington, D.C.
OVERVIEW OF UNITED STATES PROGRAM FOR MODERNIZING AIR TRAFFIC CONTROL AND AIRWAY FACILITIES
R. W. WEDAN and P. R. DROUILHET (Lincoln Lab., Lexington, Mass.) *In* AGARD Air Traffic Control in Face of Users' Demand and Econ. Constraints 14 p Feb. 1983
Avail: NTIS HC A06/MF A01

The Federal Aviation Administration (FAA) recently completed a comprehensive plan for moderning the United States (U.S.) Air Traffic Control and Airways Facilities over the period from now to the year 2000. An overview of this plan is provided and description of some of the recent technological developments that provide the foundation for significant improvements to the system are discussed. These improvements include a new discrete address surveillance and data communications system, an airborne collision

avoidance system that operates independently from the ground based air traffic control system, the replacement of the air traffic control computer facilities with modern equipment, the inclusion of a higher level of automation to aid the controllers and to provide greater freedom of severe precision landing aids using microwave equipment, and enhanced dissemination of severe weather information to controllers and pilots. Other innovations are also planned in order to meet an increasing demand for air traffic control services but without incurring a proportionate increase in the cost of providing these services. Author

N83-22185# Ratcliffe (S.), Malvern (England).
MANAGEMENT AND PLANNING CONCEPTS
S. RATCLIFFE *In* AGARD Air Traffic Control in Face of Users' Demand and Econ. Constraints 6 p Feb. 1983
Avail: NTIS HC A06/MF A01

The processes used for management and control of air traffic are outlined. Some congestion in airspace or at airports is inevitable, the further ahead this congestion is foreseen, the more economically it can be resolved. A limit is set by the accuracy with which the future can be predicted. Existing ATC systems necessarily use human controllers, who often significantly outnumber the aircraft under their control. It is not easy to see how this situation might be improved. Control tasks must be divided up between numerous controllers who, at busy times, cannot discuss each others problems in any detail. Controllers therefore solve only subsets of the total problem, and their solutions are significantly less efficient than theory indicates is possible. The extent to which 'automation' might make possible cheaper or more efficient ATC is safety considerations and difficult 'human factors' problems. Author

N83-22186# Eurocontrol Agency, Brussels (Belgium).
DYNAMIC CONTROL OF INBOUND FLIGHTS FOR MINIMUM COST OPERATION
A. BENOIT and S. SWIERSTRA *In* AGARD Air Traffic Control in Face of Users' Demand and Econ. Constraints 32 p Feb. 1983 refs
Avail: NTIS HC A06/MF A01

The Zone of Convergence (ZOC) concept is proposed as an essential short term Air Traffic Control contribution to the economics of air transport. It is established that, when considering traffic inbound to a medium to high density terminal, this approach could reduce fuel consumption by some ten to thirty percent, this value being referred to the total fuel burn in an extended area including and surrounding main terminal and extending over some 100, ideally 300, nautical miles. The selection of profiles tailored to the operators' criteria, whether constrained by ATC or not, is discussed in some detail. The compatibility of the techniques proposed with online operations is found to be satisfactory. This conclusion results from test conducted using ATC simulation facilities, airline flight simulators, and online exercises involving regular scheduled flights. Author

N83-22187# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany).
INVESTIGATIONS ON FOUR-DIMENSIONAL GUIDANCE IN THE TMA
V. ADAM and W. LECHNER *In* AGARD Air Traffic Control in Face of Users' Demand and Econ. Constraints 11 p Feb. 1983 refs
Avail: NTIS HC A06/MF A01

The four dimensional (4D) guidance of aircraft in the terminal area (TMA) allows for precise control of the minimum separation and thus efficient use of the available approach capacity of the respective airport. A concept for the 4D guidance of transport aircraft was developed and a corresponding control mode was integrated in an automatic flight control system for transport aircraft. The 4D mode is based on usual radar vector guidance technique of air traffic control and, therefore, is characterized by a succession of flight sections with constant values for indicated airspeed, heading and descent rate. The time of arrival is controlled by altering the path via a delay fan. The algorithm for the calculation of the commanded 4D flightpath takes into account suitable wind models updated by actual wind data. The 4D mode is described and first flight test results are discussed. Author

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AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

A83-27499*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ADVANCED TECHNOLOGY FOR FUTURE REGIONAL TRANSPORT AIRCRAFT
L. J. WILLIAMS (NASA, Langley Research Center, General Aviation and Commuter Technology Office, Hampton, VA) Society of Automotive Engineers, Commuter Aircraft and Airline Operations Meeting, Savannah, GA, May 24-26, 1982, Paper. 18 p. refs

In connection with a request for a report coming from a U.S. Senate committee, NASA formed a Small Transport Aircraft Technology (STAT) team in 1978. STAT was to obtain information concerning the technical improvements in commuter aircraft that would likely increase their public acceptance. Another area of study was related to questions regarding the help which could be provided by NASA's aeronautical research and development program to commuter aircraft manufacturers with respect to the solution of technical problems. Attention is given to commuter airline growth, current commuter/region aircraft and new aircraft in development, prospects for advanced technology commuter/regional transports, and potential benefits of advanced technology. A list is provided of a number of particular advances appropriate to small transport aircraft, taking into account small gas turbine engine component technology, propeller technology, three-dimensional wing-design technology, airframe aerodynamics/propulsion integration, and composite structure materials. G.R.

A83-28013#
SYNCHROPHASING FOR CABIN NOISE REDUCTION OF PROPELLER-DRIVEN AIRPLANES
B. MAGLIOZZI (United Technologies Corp., Hamilton Standard Div., Windsor Locks, CT) American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 8th, Atlanta, GA, Apr. 11-13, 1983, 8 p.
(AIAA PAPER 83-0717)

An analysis to identify the acoustic noise and vibration signatures of the individual propellers of propeller-driven airplanes was developed and implemented as a computer program. The purpose of this analysis was to investigate the potential for noise and vibration reduction of a synchrophaser and to identify the relative phase angles required to achieve the noise and vibration reductions. The results from applying the analysis to existing measurements made on a Lockheed P-3 airplane are discussed. It is concluded that significant noise reduction, in the order of 8 to 14 dB, can be realized using a synchrophaser with the selected relative phase angles. (Author)

A83-28180
DEVELOPMENT OF A MINI RPV - STABILEYE
R. STEPHENSON (British Aerospace, Bristol, England) Aerospace Dynamics, May 1982, p. 30-36. refs

Remotely piloted vehicles are described, with particular note given to features of the Stabileye twin-broom pusher propeller vehicle. The Jindivik was built in 1952 and eventually led to the currently operative Viper MK, which has a 2500 lb thrust turbojet, a 6.32 m wing span, and a maximum take-off weight of 1655 kg. The Stabileye has gone through three evolutionary changes, finally resulting in a box-like fuselage, a rectangular planform airfoil with square section graphite reinforced plastic (grp) tubes for booms, and a single fin and rudder assembly. The fuselage is cut from a

grp honeycomb core material and bonded. A NACA 4415 wing profile has a high lift coefficient at low Re, good stall characteristics, good tolerance of surface roughness in regards to lift and stall performance, and easy access to components for maintenance. A flight control system is featured with pilot control, autopilot, roll stabilization height lock, height offset adjustment, and failsafe systems. It can be launched conventionally, by parachute, by net, or by wire engagement. A TV sensor gives real time flight imagery to the remote controller. M.S.K.

A83-28185* Purdue Univ., Lafayette, Ind.
DIRECT MEASUREMENT OF TRANSMISSION LOSS OF AIRCRAFT STRUCTURES USING THE ACOUSTIC INTENSITY APPROACH
Y. S. WANG and M. J. CROCKER (Purdue University, West Lafayette, IN) Noise Control Engineering Journal, vol. 19, Nov.-Dec. 1982, p. 80-85. refs
(Contract NAG1-58)

A measurement technique is developed in order to obtain the sound transmission loss of an aircraft fuselage which obviates the need for the two-room transmission suite. The sound transmission paths were determined in tests on a light aircraft fuselage using a two-microphone acoustic intensity method for measuring the acoustic intensity transmitted to the interior when the fuselage was exposed to an external random incidence sound-field. The intensity transmitted through different sections of the fuselage can be estimated accurately using this new technique. Results of these tests show that the plexiglass window is the major transmission path in the high frequency range. In addition, the transmission losses through a single and a double layer window were predicted theoretically by using the Statistical Energy Analysis Model. Very good agreement is found between the predictions and the measurements. N.B.

A83-28191#
DEVELOPMENT AND TESTING OF SKYSHIP 500
N. BENNETT Airship, Dec. 1982, p. 5, 6.

The Full Transport Category Certificate of Airworthiness development and testing of the Skyship 500 is related, with attention to the balancing of control surfaces to reduce loads and increase response, and to the propeller pitch/power relationship. Also discussed are the propulsion system strain gaging, air intake, fan, and blowoff valve development, and the evaluation of the fuel and ignition systems. The Skyship 500 has in the course of the demonstration flight period been fitted with radar, Omega/VLF navigation, a TV system with radio downlink, and a microwave downklink. O.C.

A83-28192#
SOME EFFECTS OF SIZE ON NON-RIGID AIRSHIPS
J. WEBB (Cranfield Institute of Technology, Cranfield, Beds., England) Airship, Dec. 1982, p. 6-11. refs

A discussion is presented of the implications of Section 'Q' of the British Civil Airworthiness Requirements, in light of airship design studies conducted for nonrigid airships in the 10-20 ton payload class. Attention is given to the influence of maneuver, gust loading and mooring loads on envelope structure weights and materials that can be chosen by contemporary designers, as well as hull wrinkling effects in bending and the strengths that may be projected for envelope seams. O.C.

A83-28193#
PRELIMINARY REPORT ON THE ENGINEERING DEVELOPMENT OF THE MAGNUS AEROSPACE CORP LTA 20-1 HEAVY-LIFT AIRCRAFT
J. D. DELAURIER (Toronto, University, Toronto, Canada), W. D. MCKINNEY, W. L. KUNG, G. M. GREEN, and H. S. B. SCHOLAERT Airship, Dec. 1982, p. 12-18. refs

The LTA 20-1 employs helium lifting gas buoyancy, vectored thrust from side-mounted engines, and Magnus-effect lift from a large, horizontal axis rotating sphere, in order to fulfill heavy payload missions. The LTA 20-1 is currently in the engineering definition stage of its development, whose purpose is to complete the details of craft configuration and provide accurate estimates of performance capabilities, including stability and controllability. Wind tunnel tests have been conducted on a model of the craft with a 30.5-cm rotating sphere. The buoyant and Magnus-effect lift of the full-sized vehicle will be provided by a helium-filled sphere 61 m in diameter. Attention is given to the structural design features of the gondola, as well as weight estimates for the airframe and propulsion groups of components. O.C.

A83-28813
AVIATION FILTERS FOR FUELS, OILS, HYDRAULIC FLUIDS, AND AIR [AVIATSIONNYE FIL'TRY DLIA TOPLIV MASEL, GIDRAVLICHESKIKH ZHIDKOSTEI I VOZDUKHA]
K. V. RYBAKOV, IU. I. DMITRIEV, and A. S. POLIAKOV Moscow, Izdatel'stvo Mashinostroenie , 1982, 104 p. In Russian. refs

The theory underlying the filtration of working fluids used in aviation is examined, along with methods for testing filters and rules of filter maintenance. Consideration is given to the characteristics of various filter materials, characteristics of suspensions, criteria used in estimating the efficiency of filters, methods used for calculating the performance characteristics of filters, and principles governing the contamination of working fluids in filtering systems. The discussion covers both aircraft filters and filters used in the ground-support systems. V.L.

A83-29015#
DESIGN AND DEVELPMENT OF THE RF-5E AIRCRAFT
R. M. GIBB (Northrop Corp., Aircraft Div., Hawthorne, CA) Journal of Aircraft (ISSN 0021-8669), vol. 20, May 1983, p. 418-424.

Previously cited in issue 20, p. 3464, Accession no. A81-43150

A83-29241
ON THE ROUTES - BOEING 757 WITH BRITISH AIRWAYS
T. E. FORD Aircraft Engineering (ISSN 0002-2667), vol. 55, April 1983, p. 2-6.

The planned use of Boeing 757s by British Airways is briefly described, and aspects of the aircraft are discussed. The automatic flight controls are addressed, including the functional interrelationship of the autopilot flight director system, the single channel thrust management system, and other sub systems. The components and functions of the flight management system are considered, and the capabilities of the electronic flight instrument system are described. The engine indication and crew alerting system, which provides the flight crew with primary engine parameters for the whole time and with secondary engine parameters and caution advisory alert messages, is covered. The control surfaces and their functioning are addressed, and the fuel system and powerplants are discussed, indicating some of the parameters. C.D.

A83-29281
MOTION OF THE SKI RUNNERS OF AN AIRCRAFT ON SOIL. I [DVIZHENIE LYZHNYKH OPOR SAMOLETA PO GRUNTU. I]
G. S. GURA Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 4, 1982, p. 39-43. In Russian. refs

The friction characteristics of the skin runners of an aircraft on a soil runway are examined. A computational scheme is proposed for determining the resistance to sliding of ski runners on soil, with division of the resistance into two components, friction and deformation. The proposed scheme makes it possible to carry out calculations using known constants without the need for cumbersome experiments to determine the generalized resistance coefficients. B.J.

A83-29391#
HELICOPTER FLIGHT TESTING, SIMULATION AND REAL-TIME ANALYSIS
K. LUNN (Boeing Vertol Co., Philadelphia, PA) (Flight Test Symposium, Dorval, Quebec, Canada, Mar. 16, 1982) Canadian Aeronautics and Space Journal (ISSN 0008-2821), vol. 28, Dec. 1982, p. 307-326.

This paper notes briefly the factors that are of prime concern for the flight testing of helicopters, and compares these factors to fixed wing aircraft concerns. The degree of success attained in predicting flight test results based on pre-flight simulation is reviewed, together with the simulation techniques. The value of these pre-flight test predictions during the actual flight test, combined with the benefits of on-line analysis, are discussed. A real-time analysis system for helicopter flight testing is described and the gains achieved in flight rate and data turnaround are noted. A data bank, resident on the flight test data system, which can be accessed for analyses such as component fatigue damage and component life, is included. Author

A83-29394#
ADVANCED DESIGN STRUCTURAL CONSIDERATIONS WHEN INTRODUCING NEW MATERIALS AND CONSTRUCTION METHODS
J. E. FISCHLER (Douglas Aircraft Co., Long Beach, CA) (Canadian Symposium on Aerospace Structures and Materials, 1st, Toronto, Canada, June 14, 1982) Canadian Aeronautics and Space Journal (ISSN 0008-2821), vol. 28, Dec. 1982, p. 346-358. refs

After presenting the results of a 1975 study concerning the use of boron-epoxy and graphite-epoxy composites to reinforce the aluminum-brazed titanium alloy honeycomb sandwich structures of a supersonic (Mach 2.2 cruise speed) transport design, a comparison is made between this technology and a recently developed proprietary process. The novel process, which involves the welding and superplastic forming/diffusion bonding of four titanium alloy sheets at a time to form structural sandwich structures, yields many advantages with respect to wing weight and cost. Attention is given to the criteria for novel material and construction method evaluation used in the comparison. O.C.

A83-29395#
THE APPLICATION OF A SUB-SCALE FLIGHT DEMONSTRATOR AS A COST EFFECTIVE APPROACH TO AIRCRAFT DEVELOPMENT
G. ROSENTHAL (Fairchild Republic Co., Farmingdale, NY) (Canadian Symposium on Advanced Technology Light and General Aviation Aircraft, 4th, Ottawa, Canada, Oct. 6, 1982) Canadian Aeronautics and Space Journal (ISSN 0008-2821), vol. 28, Dec. 1982, p. 359-370.

The availability of small and reliable turbojet units, polymer composite primary structures, and compact and powerful flight test instrumentation allows early, low cost flight test programs to be run with a subscale demonstrator aircraft. Attention is given to the application of this methodology to a Next Generation Trainer candidate design's evaluation, where it has yielded impressive schedule, cost and test data advantages. It is judged that the overall program required a schedule and expense comparable to that of a wind tunnel test program employing a complex powered model. In addition, comprehensive results were obtained under representative dynamic flight conditions that would not have been accurately simulated in wind tunnel tests. Natural stall warning and excellent stall and post-stall characteristics were exhibited. O.C.

A83-29675
DASH 8 - CANADA'S NEW COMMUTER
J. MOXON Flight International (ISSN 0015-3710), vol. 123, April 9, 1983, p. 1005-1010.

A description is presented of a new commuter aircraft built by a Canadian aerospace company. Conceived from the start as a commuter, the Dash 8 is designed primarily as an aircraft capable of delivering 36 passengers to a major airport with enough baggage for international travel. The Dash 8 will vie with four other new competitors to capture a slice of a market for possibly as many as 2000 aircraft. Preliminary details regarding the new aircraft were released informally in June 1979. The first two production Dash 8s will be delivered in July 1984. The aircraft will cost $5.1 million, fully equipped. Flight testing involves four preproduction Dash 8s and 1600 flight hours. Certification is expected in September 1984. Avionics on the Dash 8 can be tailored to suit the customer. The manufacturer hopes to offer microwave landing system equipment before long. The aircraft is to have a cruising speed of 270 kt. On a standard day, it needs just under 3000 ft of runway to land. G.R.

A83-29772#
SIMULATION OF T-38 AIRCRAFT STUDENT CANOPY RESPONSE TO COCKPIT PRESSURE AND THERMAL LOADS USING MAGMA
R. E. MCCARTY and R. A. SMITH (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, OH) IN: Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 1 . New York, American Institute of Aeronautics and Astronautics, 1983, p. 432-444. refs
(AIAA 83-0942)

The linear and nonlinear static response to cockpit pressure and (cold) thermal loads of the forward canopy for the T-38 aircraft has been predicted using the MAGNA (Materially and Geometrically Nonlinear Analysis) finite element computer program. The results obtained are compared to those of earlier analyses and full scale tests. It is concluded that the current canopy design when properly rigged can withstand more than 20 psig pressure, that thermal loads are more critical than cockpit pressure loads, and that providing more attachment fixity at both forward and aft arches would relieve stress concentrations which occur at the canopy corners. Author

A83-29780*# Lockheed-California Co., Burbank.
STATIC AND DAMAGE TOLERANCE TESTS OF AN ADVANCED COMPOSITE VERTICAL FIN FOR L-1011 AIRCRAFT
F. DORWARD and R. N. KETOLA (Lockheed-California Co., Burbank, CA) IN: Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 1 . New York, American Institute of Aeronautics and Astronautics, 1983, p. 516-527.
(Contract NAS1-1400)
(AIAA 83-0970)

This paper recounts the significant events which took place during the structural verification testing of two graphite/epoxy material, full-size vertical stabilizers. The ground test articles were tested to a high bending dynamic lateral gust condition. The first unit failed during static testing at 98 percent Design Ultimate Load. Failure began within the front spar cap. A detailed review of the failure was performed to identify all possible modes. This review resulted in a 'production line' type fix being designed for incorporation in the second ground test article prior to installation in the test fixture. The modified second unit sustained 106 percent of Design Ultimate Load without incident. One lifetime (36,000 flights) of damage tolerance testing was accomplished with the specimen purposely damaged at five locations. A fail-safe loading was performed successfully after simulating lightning strike damage to the fin box cover. A large area repair was substantiated by completing a second lifetime of spectrum loadings. The residual static strength was determined to be 119.7 percent of Design Ultimate Load. Author

A83-29782*# Kansas Univ., Lawrence.
DESIGN FOR PREVENTION OF ACOUSTIC FATIGUE
H. W. SMITH (Kansas, University, Lawrence, KS) IN: Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 1 . New York, American Institute of Aeronautics and Astronautics, 1983, p. 534-540. NASA-sponsored research. refs
(AIAA 83-0973)

It is pointed out that new noise prediction methods and acoustic life estimation methods have matured to the point where they can be combined into a unified engineering procedure. 'Life derivatives' can be extracted from parametric charts to furnish design data for preventing acoustic fatigue. The acoustic fatigue life is shown to be sensitive to the damping ratio through the use of life derivatives. The localized nature of propeller noise can be quantified with an 'isodecibel' contour diagram.Even though the peak sound pressure level may be high, the directional derivatives show the noise decay rates with distance. Acoustic fatigue design is discussed from the overall design methodology and is shown to be similar to other structural design problems. While nonlinearities present a formidable design engineering problem, they are manageable by proven semi-empirical techniques. For new design problems, it is imperative to determine whether the data base completely spans the design variables. C.R.

A83-29806*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AN ANALYTICAL COMPARISON OF TWO WING STRUCTURES FOR MACH 5 CRUISE AIRPLANES
A. H. TAYLOR, L. R. JACKSON (NASA, Langley Research Center, Hampton, VA), J. A. CERRO, and S. J. SCOTTI (Kentron Technical Center, Hampton, VA) IN: Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 1 . New York, American Institute of Aeronautics and Astronautics, 1983, p. 738-744. refs
(AIAA 83-0974)

Mach 5 cruise research conducted by NASA is related to aerodynamics, propulsion, and structures. The study of structures includes the propulsion system, fuselage, and wings. Various studies have shown that the achievement of adequate range is largely dependent on a low structural mass fraction. The present investigation is concerned with a study of two wing structure configurations for Mach 5 aircraft. An uprated version (Ti-6242 replacing B-120 titanium) of the YF-12/SR-71 wing structure is considered. The B-120 titanium structure represents the current art of high speed aircraft wing structures. The YF-12 wing structure was designed about 20 years ago when the analytical methods for calculating thermal stresses were limited. The second wing structural configuration studied in the present investigation also used Ti-6242 materials but replaced the corrugated-beaded panels with diffusion bonded honeycomb-core sandwich panels, and replaced the z-stifened shear webs with sine-wave stiffened shear webs. G.R.

A83-29844*# California Univ., Los Angeles.
AEROELASTIC TAILORING OF ROTOR BLADES FOR VIBRATION REDUCTION IN FORWARD FLIGHT
P. P. FRIEDMANN and P. SHANTHAKUMARAN (California, University, Los Angeles, CA) IN: Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 2 . New York, American Institute of Aeronautics and Astronautics, 1983, p. 344-359. Army-supported research. refs
(Contract NSG-1578)
(AIAA 83-0916)

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. The vertical hub shears and rolling moments used as the objective function are obtained by appropriate integration of the loads acting along the span of the blade combined with a transformation to a hub fixed coordinate system, and a summation over the total number of blades. Numerical results for both a stiff-in-plane and a soft-in-plane configuration are presented, indicating that structural optimization yields the highest benefits when applied to soft-in-plane blade configuration. The results indicate substantial (15-40 percent) reduction in vibration levels, as well as a blade which is 20 percent lighter than the initial design. Author

A83-29850*# North Carolina State Univ., Raleigh.
AEROELASTIC CONSIDERATIONS FOR CONTINUOUS PATROL/HIGH ALTITUDE SURVEILLANCE PLATFORMS
C. D. TURNER (North Carolina State University, Raleigh, NC) and R. H. ROCKETTS (NASA, Langley Research Center, Hampton, VA) IN: Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 2 . New York, American Institute of Aeronautics and Astronautics, 1983, p. 409-417. refs
(AIAA 83-0924)

For the last several years, an investigation has been conducted regarding the feasibility of unmanned, airborne, High-Altitude Powered Platforms (HAPP), and High Surveillance Platforms for Over-the-Horizon Targeting (HI-SPOT). These airborne platforms have been proposed as a means of achieving a continuous regional communication-relay or for continuous regional surveillance for use in agricultural research or military applications, i.e., fleet support. These platforms would offer improvements over existing orbiting satellites. These improvements are related to better resolution and increased mission flexibility. The required mission endurance up to six months, would be obtained through the use of either solar power, a cryogenically fueled engine, or microwave-power. Attention is given to airborne platform configuration, structure, structural and aerodynamic modeling, modal analysis, and flutter analysis. G.R.

A83-29853#
TRANSIENT RESPONSE OF TAXIING AIRCRAFT
L. MINNETYAN (Clarkson College of Technology, Potsdam, NY) and T. G. GERARDI (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) IN: Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 2 . New York, American Institute of Aeronautics and Astronautics, 1983, p. 436-442. refs
(Contract AF-AFOSR-82-0216)
(AIAA 83-0927)

A hybrid method based on standard nonlinear and linear numerical procedures is developed for the complete simulation of structural response for aircraft taxiing over an irregular runway. The method uses time history integrations of the equations of motion to determine the nonlinear suspension forces on the basis of a small number of modal coordinates. The time-history results are used as inputs to a second stage linear analysis by which means the more detailed structural response is computed. The current capabilities of the method are demonstrated by its application to the simulation of a typical fighter aircraft taxiing over an irregular runway. The results are compared with test data and direct time-history analysis. Author

A83-29860*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AIRFOIL SHAPE AND THICKNESS EFFECTS ON TRANSONIC AIRLOADS AND FLUTTER
S. R. BLAND and J. W. EDWARDS (NASA, Langley Research Center, Hampton, VA) IN: Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 2 . New York, American Institute of Aeronautics and Astronautics, 1983, p. 490-497. refs
(AIAA 83-0959)

A transient pulse technique is used to obtain harmonic forces from a time-marching solution of the complete unsteady transonic

small perturbation potential evaluation. The unsteady pressures and forces acting on a model of the NACA 64A010 conventional airfoil and the MBB A-3 supercritical airfoil over a range of Mach numbers are examined in detail. Flutter calculations at constant angle of attack show a similar flutter behavior for both airfoils, except for a boundary shift in Mach number associated with a corresponding Mach number shift in the unsteady aerodynamic forces. Differences in the static aeroelastic twist behavior for the two airfoils are significant. Author

A83-29864#
A CLOSED-FORM ANALYSIS OF ROTOR BLADE FLAP-LAG STABILITY IN HOVER AND LOW-SPEED FORWARD FLIGHT IN TURBULENT FLOW
J. E. PRUSSING and Y. K. LIN (Illinois, University, Urbana, IL) IN: Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 2 . New York, American Institute of Aeronautics and Astronautics, 1983, p. 529-535. refs
(Contract DAAG29-81-K-0072)
(AIAA 83-0986)

An approximate, closed-form analysis is conducted for the stability of the coupled flap-lag motion of a helicopter rotor blade in the presence of turbulence. The longitudinal, lateral, and vertical components of turbulence are modelled as uncorrelated physical white moise processes and the equations governing the first moments of the stochastic averaging method. Approximations based on realistic rms values of turbulence velocities are used to obtain a closed-form first moment stochastic stability criterion. Results show that in hover the turbulence increases the stability of the coupled flap-lag motion. It is suggested that the turbulence increase the damping in the least-stable, lead-lag mode by providing the same stabilizing effect as an increase in the profile drag coefficient in both hover and low-speed forward flight. The vertical turbulence is found to have the dominant effect on this increase in stability. Numerical results for the hover case are compared with the more stringent case of second moment stability. N.B.

A83-29865*# Bell Helicopter Co., Fort Worth, Tex.
MEASURED INPLANE STABILITY CHARACTERISTICS IN HOVER FOR AN ADVANCED BEARINGLESS ROTOR
W. H. WELLER (Bell Helicopter Textron, Fort Worth, TX) and W. WARMBRODT (NASA, Ames Research Center, Moffett Field, CA) IN: Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers, Part 2 . New York, American Institute of Aeronautics and Astronautics, 1983, p. 536-546. refs
(AIAA 83-0987)

A study was made of the inplane stability characteristics of a model of an advanced bearingless main rotor. The four-bladed rotor system was tested for aeroelastic stability in hover for both isolated and body-free conditions. Variations in several hub design parameters were tested, including blade coning and sweep angles, blade inplane structural damping, pitch-link location (delta-free effect), and fuselage structural damping. An analysis of the experimental results shows that parametric stability trends observed from isolated-rotor studies may yield incorrect conclusions regarding coupled rotor-body characteristics. For body-free conditions, the baseline rotor configuration resulted in the best stability margins at 1-g thrust as well as at the nominal design rotor speed. Blade built-in coning had little effect on the body-free damping levels at the inplane/body resonance points. Introducing blade sweep destabilized the rotor at the inplane/body pitch resonance. V.L.

A83-29866*# Connecticut Univ., Storrs.
IDENTIFICATION OF HELICOPTER ROTOR DYNAMIC MODELS
J. A. MOLUSIS, Y. BAR-SHALOM (Connecticut, University, Storrs, CT), and W. WARMBRODT IN: Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers, Part 2 . New York, American Institute of Aeronautics and Astronautics, 1983, p. 547--557. refs
(AIAA 83-0988)

A recursive, extended Kalman-filter approach is applied to the identifiction of rotor damping levels of representative helicopter dynamic systems. The general formulation of the approach is presented in the context of a typically posed stochastic estimation problem, and the method is analytically applied to determining the damping levels of a coupled rotor-body system. The identified damping covergence characteristics are studied for sensitivity to both constant-coefficient and periodic-coefficient measurement models, process-noise covariance levels, and specified initial estimates of the rotor-system damping. A second application of the method to identifying the plant model for a highly damped, isolated flapping blade with a constant-coefficient state model (hover) and a periodic-coefficient state model (forward flight) is also investigated. The parameter-identification capability is evaluated for the effect of periodicity on the plant model coefficients and the influence of different measurement noise levels. V.L.

A83-29868*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
DESIGN OF THE FLUTTER SUPPRESSION SYSTEM FOR DAST ARW-1R - A STATUS REPORT
J. R. NEWSOM, I. ABELT (NASA, Langley Research Center, Hampton, VA), and A. S. POTOTZKY (Kentron International, Inc., Hampton, VA) IN: Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 2 . New York, American Institute of Aeronautics and Astronautics, 1983, p. 564-576. refs
(AIAA 83-0990)

This paper describes the design of the flutter suppression system for a remotely-piloted research vehicle. The modeling of the aeroelastic system, the methodology used to synthesize the control law, the analytical results used to evaluate the control law performance, and ground testing of the flutter suppression system onboard the aircraft are discussed. The major emphasis is on the use of optimal control techniques employed during the synthesis of the control law. Author

A83-29876*# General Dynamics Corp., Fort Worth, Tex.
THE DESIGN, TESTING AND ANALYSIS OF AEROELASTICALLY TAILORED TRANSONIC FLUTTER MODEL WINGS
A. C. MURPHY, W. A. ROGERS (General Dynamics Corp., Fort Worth, TX), M. H. SHIRK (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH), and C. L. RUHLIN (NASA, Langley Research Center, Loads and Aeroelasticity Div., Hampton, VA) IN: Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 2 . New York, American Institute of Aeronautics and Astronautics, 1983, p. 648-657.
(AIAA 83-1027)

An investigation of both the static aeroelastic and flutter characteristics of an aft swept wing, aeroelastically tailored to washout in one design and to washin in another, has been performed using two one-fourth-scale cantilever models representing the two designs. The models have been designed using an MSC/NASTRAN finite element model to preserve the full-scale airplane washout and washin characteristics. Test results show that the effect of the skin-to-core adhesive on model stiffness must be considered in the design cycle. Flutter analyses correlate fairly well with test results. Consideration is also given to F-16 metal and washout wing flutter speeds and mass ratio effects. V.L.

A83-29877#
WIND TUNNEL CORRELATION STUDY OF AERODYNAMIC MODELING FOR F/A-18 WING-STORE TIP-MISSILE FLUTTER
W. E. TRIPLET (McDonnell Aircraft Co., St. Louis, MO) IN: Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 2 . New York, American Institute of Aeronautics and Astronautics, 1983, p. 658-663. refs
(AIAA 83-1028)

Wind tunnel testing of the F/A-18 wing with underwing stores and tip missile discovered several cases of flutter for which acceptable correlation was not obtained by typical analytical adjustment of stiffness and mass. Studies were conducted to evaluate the effect of aerodynamic modeling on three of the uncorrelated cases using the doublet lattice theory. Results are presented showing the effect of individual system components on flutter. Acceptable correlation is shown for total models of the wing-rack-store-missile configuration, although models with air acting on the misile but not on the underwing store are also satisfactory. Author

A83-29878#
ON MEASURING TRANSONIC DIPS IN THE FLUTTER BOUNDARIES OF A SUPERCRITICAL WING IN THE WIND TUNNEL
A. J. PERSOON, J. J. HORSTEN, and J. J. MEIJER (National Lucht- en Ruimtevaartlaboratorium Amsterdam, Netherlands) IN: Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 2 . New York, American Institute of Aeronautics and Astronautics, 1983, p. 664-675. Research supported by the Nederlands Institut voor Vliegtuigontwikkeling en Ruimtevaart. refs
(AIAA 83-1031)

Flutter experiments were performed on a supercritical transport-type wing with the aim to investigate the transonic dip in the flutter boundaries and to obtain data for verification of a calculation method for unsteady aerodynamic loads. Complete transonic dips were measured at three wing angles of attack. At the highest wing angle of attack even a second dip was found. Simultaneously, the mean pressure distribution was measured in one chordwise section which could be used to explain the flutter characteristics. Using a flutter damper device, flutter onset could be measured accurately and in a rapid way. This paper deals with the experimental test setup and describes the on-line data reduction and presentation of results which were experienced to be valuable at this type of experiments. Author

N83-20931*# National Aeronautics and Space Administration, Washington, D. C.
SMALL TRANSPORT AIRCRAFT TECHNOLOGY
L. J. WILLIAMS 1983 118 p refs
(NASA-SP-460; NAS 1.21:460; LC-82-600387) Avail: NTIS HC A06/MF A01 CSCL 01C

Information on commuter airline trends and aircraft developments is provided to upgrade the preliminary findings of a NASA-formed small transport aircraft technology (STAT) team, established to determine whether the agency's research and development programs could help commuter aircraft manufacturers solve technical problems related to passenger acceptance and use of 19- to 50-passenger aircraft. The results and conclusions of the full set of completed STAT studies are presented. These studies were performed by five airplane manufacturers, five engine manufacturers, and two propeller manufacturers. Those portions of NASA's overall aeronautics research and development programs which are applicable to commuter aircraft design are summarized. Areas of technology that might beneficially be expanded or initiated to aid the US commuter aircraft manufacturers in the evolution of improved aircraft for the market are suggested. A.R.H.

N83-20933*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A COMPUTER PROGRAM FOR OBTAINING AIRPLANE CONFIGURATION PLOTS FROM DIGITAL DATCOM INPUT DATA
M. L. ROY (Kentron Technical Center, Hampton, Va.) and S. M. SLIWA Mar. 1983 61 p refs
(NASA-TM-84639; NAS 1.15:84639) Avail: NTIS HC A04/MF A01 CSCL 01C

A computer program is described which reads the input file for the Stability and Control Digital Datcom program and generates plots from the aircraft configuration data. These plots can be used to verify the geometric input data to the Digital Datcom program. The program described interfaces with utilities available for plotting aircraft configurations by creating a file from the Digital Datcom input data. S.L.

N83-20934# Douglas Aircraft Co., Inc., Long Beach, Calif.
SERVICE EVALUATION OF AIRBORNE TIRE PRESSURE INDICATING SYSTEMS Final Report, Jan. 1980 - May 1982
W. W. KWONG Atlantic City, N.J. FAA Dec. 1982 166 p
(Contract DTFA03-81-C-00044)
(DOT/FAA/RD-82/89; DOT/FAA/CT-82/90) Avail: NTIS HC A08/MF A01

Results of the in-service evaluation on tire pressure indicating systems are reported in this document. Two systems, one made by Goodyear and the other by Fairchild, were evaluated on two McDonnell Douglas DC-10's from March of 1980 to May of 1981. The Goodyear system employs the copper-graphite-copper journal bearing technique while the Fairchild system uses the inductive coupling (air gap transformer) method. A detailed test evaluation is included for each of the systems tested. Based on the in-service performance, the Fairchild system was selected as the production system. The first installation was completed at Long Beach in early 1982. FAA certification of Fairchild system was completed also in early 1982 with FAA Type Design approval granted for use on the DC-10-30 on February 22, 1982. Author

N83-20935# Office of Air Force History, Washington, D. C.
DEVELOPMENT AND EMPLOYMENT OF FIXED-WING GUNSHIPS, 1962 - 1972
J. S. BALLARD 1982 342 p refs
(AD-A122538) Avail: NTIS MF A01; SOD HC $15.00 CSCL 01C

The development of the concept of fixed-wing assault gunships is discussed. The tactics and deployment of these gunships in Southeast Asia are discussed. The importance of input from combat personnel is discussed. R.J.F.

N83-20936# Center for Naval Analyses, Alexandria, Va. Operations Evaluation Group.
METHODS FOR GENERATING AIRCRAFT TRAJECTORIES
D. B. QUANBECK Sep. 1982 58 p refs
(Contract N00014-76-C-0001)
(AD-A122386; CNA-PP-361) Avail: NTIS HC A04/MF A01 CSCL 19D

Methods for generating three dimensional aircraft trajectories necessary for quantitatively assessing aircraft tactics are documented in this report. Elements conventionally used in modeling aircraft motion are assembled to form a model governing aircraft translation, fuel use, and attitude. Assumptions on the functional dependence of the aircraft external forces and specific fuel consumption result in a system of seven equations and eleven variables governing aircraft trajectories. To provide flexibility in prescribing aircraft trajectories, the problem of solving the equations is formulated for five separate sets of known variables. These sets include variables defining aircraft controls, velocity attitude, and velocity magnitude. Extensions to the problem formulations allow flight path normal acceleration to be prescribed, also. A method to prescribe known variables is presented that ensures continuous aircraft acceleration and angular velocity. Numerical integration, finding roots of equations, and interpolation of function values are required to solve the trajectory generation problems.

Application of selected algorithms for numerical solution of the equations is discussed. Author (GRA)

N83-20937# Defence and Civil Inst. of Environmental Medicine, Downsview (Ontario). Health Sciences Section.

AN OPERATIONAL HYGIENE STUDY FOR OZONE IN THE CABIN OF THE CANADIAN FORCES (CC137) BOEING 707 AIRCRAFT

B. J. GILL Aug. 1982 21 p refs

(AD-A121749; DCIEM-82-R-37) Avail: NTIS HC A02/MF A01 CSCL 01C

A study was carried out to determine the concentration of ozone in the cabin of the Boeing 707 (CC137) at altitude on a cross-Canada flight during a seasonal period of high atmospheric ozone. An ozone monitor manufactured by Columbia Scientific Industries (CSI), Austin, Texas was used to measure O3 levels during the study. Prior to actual flight monitoring the analytical measuring equipment was calibrated at ground level and under simulated altitude conditions. Since ideal gas law corrections were not applicable at altitude it was necessary to prepare a correction factor for the CSI ozone meter under hypobaric conditions. In the flight trials, the maximum O3 value obtained during the westerly segment of the flight at an altitude of 39,000 feet, was 135 parts per billion (ppb) and 106 ppb on the return easterly portion of the flight. These values slightly exceed the Threshold Limit Value (TLV) for ozone of 100 ppb. However, they are below the Short Term Exposure Limit (STEL) of 300 ppb. During a similar time period, Atmospheric Environment Services (AES), Environment Canada, measured an ozone concentration of 1670 ppb in the atmosphere at an altitude of 39,370 feet in the Edmonton, Alberta area. A comparison of the maximum cabin concentration obtained during this study with that found externally by AES indicates that the engines of the Boeing 707 were removing greater than 90% of the atmosphere ozone prior to its entry into the aircraft cabin. The findings of this study indicate that ancillary ozone removing equipment need not be added to the aircraft. Author (GRA)

N83-20938# Tennessee Univ., Tullahoma.

A FLIGHT TEST EVALUATION AND ANALYTICAL STUDY OF THE BALL-BARTOE JETWING PROPULSIVE LIFT CONCEPT WITHOUT EJECTOR

R. D. KIMBERLIN, U. P. SOLIES, and A. K. SINHA 1 Oct. 1982 141 p refs

(Contract N00019-81-C-0506)

(AD-A121733; UTSI-82/17) Avail: NTIS HC A07/MF A01 CSCL 01C

This report covers the results of a two part research effort on the Ball-Bartoe Jetwing propulsive lift concept. This effort was conducted by the University of Tennessee Space Institute, Tullahoma, Tennessee for the Advanced Aircraft Development and Systems Objectives Office (AIR-03PA) of Naval Air Systems Command under contract Number N00019-81-C-0506. The first part of the effort, which is covered in part 1 of this report, was a follow on to a previous effort conducted under Naval Air Systems Command Contract Number N00019-80-C-1026 and reported in UTSI Report 81-1(1). The effort reported herein consisted of a performance flight test with the upper wing (ejector wing) removed, and flyover noise measurements with and without the upper wing. Performance, Stability and Control flight test with the upper wing installed were a part of the previous effort. The second part of the effort consisted of an analytical study to develop a method, or methods, to predict the aerodynamic coefficients of a Jetwing configured aircraft. These coefficients would be of sufficient accuracy for use in preliminary design studies, The results of this analytical effort are reported in part 2 of this report. Results of both the flight test and analytical effort are compared to full scale test results of the research aircraft in the NASA Ames Research Center 40' x 80' wind tunnel with the aim of evaluating the Jetwing concept for applications to future flight vehicles. GRA

N83-20939# Army Aviation Engineering Flight Activity, Edwards AFB, Calif.

AH-1 AIR GROUND ENGAGEMENT SIMULATION/AIR DEFENSE (AGES/ADES) POD JETTISON EVALUATION Final Report, 31 Aug. - 2 Sep. 1982

R. T. SAVAGE and R. A. WILLIAMS Sep. 1982 29 p

(Contract DA PROJ. N61-62209-AH-76)

(AD-A122623; USAAEFA-82-06) Avail: NTIS HC A03/MF A01 CSCL 01C

The AH-1 Air Ground Engagement Simulation/Air Defense (AGES/ADES) Pod Jettison Evaluation was conducted at Edwards Air Force Base, California (elevation 2302 feet). Six flights totaling 2.4 hours were flown from 31 August to 2 September 1982. Satisfactory jettison envelopes for the AGES/ADES pod were defined at a hover, in coordinated level flight to 130 KCAS, and in coordinated autorotation to 85 KCAS. One Equipment Performance Report was submitted pertaining to the difficulty of attaching the AGES/ADES pod to the aircraft. Author (GRA)

N83-20940# Sandia Labs., Albuquerque, N. Mex.

INVESTIGATION OF THE FEASIBILITY OF A HELICOPTER-LAUNCHED CRUISE MISSILE SYSTEM

C. W. MOSES Jan. 1982 13 p refs

(Contract DE-AC04-76DP-00789)

(DE82-008623; SAND-81-2415) Avail: NTIS HC A02/MF A01

In addition to determining the feasibility of a helicopter-launched cruise missile, a configuration and a concept of operations were developed that consists of a flight of three CH-53E helicopters. Two of these helicopters carry eight cruise missiles each; the third carries a security force. This flight could be dispersed to the field and maintained in the field by use of the security force helicopter and alternate load-carrying helicopters required under present regulations governing movement of nuclear weapons. Operational constraints of security and weather were investigated, and the cost of acquiring and maintaining a helicopter-launched cruise missile force was estimated. DOE

N83-22102# Smiths Industries Ltd., Bishops Cleeve (England). Aerospace and Defence Systems Div.

THE USE OF MULTIPLEX DATA BUSES IN A HIGH INTEGRITY SYSTEM

P. CROUCH and A. G. SEABRIDGE (British Aerospace Aircraft Group) *In* AGARD Advan. in Guidance and Control Systems 11 p Jan. 1983 refs

Avail: NTIS HC A11/MF A01

The utility systems of an aircraft were analyzed and shown to benefit considerably from integration into a connected system with shared processing resources. The MIL-STD-15538 data bus was selected as the most cost effective tool for integration, but raises problems connected with ensuring the safety of the aircraft. Careful design of the data bus components and controllers with particular attention being paid to built-in-test techniques and in the functional segregation of the interfaces, subsystems and computing facilities has allowed a sufficiently reliable system to be designed and this is now entering full scale development. R.J.F.

N83-22188*# Boeing Vertol Co., Philadelphia, Pa.

LARGE ROTORCRAFT TRANSMISSION TECHNOLOGY DEVELOPMENT PROGRAM Final Test Report

J. C. MACK Mar. 1983 106 p

(Contract NAS3-22143)

(NASA-CR-168120; NAS 1.26:168120; D210-11944-1) Avail: NTIS HC A06/MF A01 CSCL 01C

Testing of a U.S. Army XCH-62 HLH aft rotor transmission under NASA Contract NAS 3-22143 was successfully completed. This test establishes the feasibility of large, high power rotorcraft transmissions as well as demonstrating the resolution of deficiencies identified during the HLH advanced technology programs and reported by USAAMRDLTR-77-38. Over 100 hours of testing was conducted. At the 100% design power rating of 10,620 horsepower, the power transferred through a single spiral bevel gear mesh is more than twice that of current helicopter bevel gearing. In the original design of these gears, industry-wide

design methods were employed and failures were experienced which identified problem areas unique to gear size. To remedy this technology shortfall, a program was developed to predict gear stresses using finite element analysis for complete and accurate representation of the gear tooth and supporting structure. To validate the finite element methodology gear strain data from the existing U.S. Army HLH aft transmission was acquired, and existing data from smaller gears were made available. Author

N83-22189# Systems Technology, Inc., Hawthorne, Calif.
FLYING QUALITIES OF RELAXED STATIC STABILITY AIRCRAFT, VOLUME 1 Final Report, Aug. 1981 - Oct. 1982
R. H. HOH, D. G. MITCHELL, D. MCRUER, and T. T. MYERS Sep. 1982 96 p refs
(Contract DTFA-03081-C-00069)
(FAA-CT-82-130-1; TR-1178-1-1) Avail: NTIS HC A05/MF A01

Airworthiness assessment and flying qualities evaluation of highly augmented aircraft covered by Parts 23 and 25 of the Federal Aviation Regulations are addressed. Particular emphasis was placed on aircraft with relaxed static stability and on the use of active augmentation systems to achieve the minimum requirement for a level of safety in such aircraft. Significant modifications and expansion to the FAA Engineering Flight Test Guides are detailed. Author

N83-22190# Systems Technology, Inc., Hawthorne, Calif.
FLYING QUALITIES OF RELAXED STATIC STABILITY AIRCRAFT, VOLUME 2 Final Report, Aug. 1981 - Oct. 1982
R. H. HOH, D. G. MITCHELL, D. MCRUER, and T. T. MYERS Sep. 1982 118 p refs
(Contract DTFA-03081-C-00069)
(FAA-CT-82-130-2; TR-1178-1-1) Avail: NTIS HC A06/MF A01

The relative similarities and differences between heavily augmented and conventional aircraft are determined. A number of important generic distinctions were found and are described and explained. Author

N83-22191*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
EVALUATION OF G SEAT AUGMENTATION OF FIXED-BASE/MOVING BASE SIMULATION FOR TRANSPORT LANDINGS UNDER TWO VISUALLY IMPOSED RUNWAY WIDTH CONDITIONS
R. V. PARRISH and G. G. STEINMETZ Apr. 1983 25 p refs
(NASA-TP-2135; L-15540; NAS 1.60:2135) Avail: NTIS HC A02/MF A01 CSCL 01C

Vertical-motion cues supplied by a g-seat to augment platform motion cues in the other five degrees of freedom were evaluated in terms of their effect on objective performance measures obtained during simulated transport landings under visual conditions. In addition to evaluating the effects of the vertical cueing, runway width and magnification effects were investigated. The g-seat was evaluated during fixed base and moving-base operations. Although performance with the g-seat only improved slightly over that with fixed-base operation, combined g-seat platform operation showed no improvement over improvement over platform-only operation. When one runway width at one magnification factor was compared with another width at a different factor, the visual results indicated that the runway width probably had no effect on pilot-vehicle performance. The new performance differences that were detected may be more readily attributed to the extant (existing throughout) increase in vertical velocity induced by the magnification factor used to change the runway width, rather than to the width itself. Author

N83-22192*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
MOTION/VISUAL CUEING REQUIREMENTS FOR VORTEX ENCOUNTERS DURING SIMULATED TRANSPORT VISUAL APPROACH AND LANDING
R. V. PARRISH and R. L. BOWLES Apr. 1983 23 p refs
(NASA-TP-2136; L-15544; NAS 1.60:2136) Avail: NTIS HC A02/MF A01 CSCL 17G

This paper addresses the issues of motion/visual cueing fidelity requirements for vortex encounters during simulated transport visual approaches and landings. Four simulator configurations were utilized to provide objective performance measures during simulated vortex penetrations, and subjective comments from pilots were collected. The configurations used were as follows: fixed base with visual degradation (delay), fixed base with no visual degradation, moving base with visual degradation (delay), and moving base with no visual degradation. The statistical comparisons of the objective measures and the subjective pilot opinions indicated that although both minimum visual delay and motion cueing are recommended for the vortex penetration task, the visual-scene delay characteristics were not as significant a fidelity factor as was the presence of motion cues. However, this indication was applicable to a restricted task, and to transport aircraft. Although they were statistically significant, the effects of visual delay and motion cueing on the touchdown-related measures were considered to be of no practical consequence. Author

N83-22193*# McDonnell Aircraft Co., St. Louis, Mo.
THE YAV-8B SIMULATION AND MODELING. VOLUME 1: AIRCRAFT DESCRIPTION AND PROGRAM SUMMARY Final Report
1983 205 p refs
(Contract NAS4-2839)
(NASA-CR-170397; NAS 1.26:170397; MDC-A7910) Avail: NTIS HC A10/MF A01 CSCL 01C

A FORTRAN batch simulation of the YAV-8B aircraft and supporting documentation are presented. The aircraft is described. Simulation outputs are compared with flight test data. S.L.

N83-22194*# McDonnell Aircraft Co., St. Louis, Mo.
THE YAV-8B SIMULATION AND MODELING. VOLUME 2: PROGRAM LISTING Final Report
Mar. 1983 668 p refs
(Contract NAS4-2839)
(NASA-CR-170397; NAS 1.26:170397; MDC-A7910) Avail: NTIS HC A99/MF A01 CSCL 01C

Detailed mathematical models of varying complexity representative of the YAV-8B aircraft are defined and documented. These models are used in parameter estimation and in linear analysis computer programs while investigating YAV-8B aircraft handling qualities. Both a six degree of freedom nonlinear model and a linearized three degree of freedom longitudinal and lateral directional model were developed. The nonlinear model is based on the mathematical model used on the MCAIR YAV-8B manned flight simulator. This simulator model has undergone periodic updating based on the results of approximately 360 YAV-8B flights and 8000 hours of wind tunnel testing. Qualified YAV-8B flight test pilots have commented that the handling qualities characteristics of the simulator are quite representative of the real aircraft. These comments are validated herein by comparing data from both static and dynamic flight test maneuvers to the same obtained using the nonlinear program. S.L.

N83-22195# Naval Postgraduate School, Monterey, Calif.
US NAVY HELICOPTERS IN COMBAT SEARCH AND RESCUE M.S. Thesis
D. J. ROWLEY Jun. 1982 42 p refs
(AD-A122451) Avail: NTIS HC A03/MF A01 CSCL 01C

Research was conducted to examine the validity of the employment of U. S. Navy helicopters for the combat search and rescue (CSAR) mission. It is proposed that the Navy does not currently have the capability to conduct CSAR operations in an opposed environment with an acceptable loss rate. A mission

description is offered including mission essentials, phases and profile. Current Battle Group helicopter assets are presented. Training and equipment shortfalls are noted. A discussion of resource management includes dollar, political and psychological costs. A proposal is offered to initiate a viable CSAR capability that recognizes the need for CSAR and makes its tactical development a matter of CNO policy, develops an appreciation for the fact that this is a TACAIR problem, and suggests a measured approach to solving the problem. Finally, a decision matrix is presented to assist the Battle Group Commander in the employment of his helicopter assets in the pursuit of a CSAR mission. GRA

N83-22477# City Univ., London (England). Dept. of Mechanical Engineering.
FURTHER ADVANCES IN HELICOPTER VIBRATION CONTROL
G. T. S. DONE *In* Shock and Vibration Center The Shock and Vibration Digest, Vol. 15, No. 2 p 17-22 Feb. 1983 refs
Avail: SVIC, Code 5804, Naval Research Lab., Washington, D.C. 20375 CSCL 01C

Advances that were made since 1979 in the control of helicopter vibration and the associated literature were reviewed. Vibration isolation, absorbers, direct rotor control, structural design and modification, and vibration studies are considered. Author

06

AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

A83-27123
FLIGHT DECK DISPLAY
T. E. FORD Aircraft Engineering, vol. 55, Mar. 1983, p. 2-5.

The use of advanced digital technology in avionics systems is discussed, focusing on the use of this technology for the flight deck displays of both civil and military aircraft. Cathode ray tube (CRT) and other displays in civil aircraft are employed to provide improvements in flight safety and airline operations. The designs of the flight deck displays for several recent civil transport aircraft are examined. For military aircraft, improvements in flight deck technology have included the introduction of the Head Up Display, which enhances the operational flexibility of the aircraft. Possible future developments in flight deck display technology for both civil and military aircraft are also discussed. N.B.

A83-29807#
IMPROVED FATIGUE LIFE TRACKING PROCEDURES FOR NAVY AIRCRAFT STRUCTURES
R. E. PINCKERT (McDonnell Aircraft Co., St. Louis, MO) and P. A. KOZEL (U.S. Navy, Naval Air Development Center, Warminster, PA) IN: Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 2 . New York, American Institute of Aeronautics and Astronautics, 1983, p. 1-14. Navy-supported research. refs
(AIAA 83-0805)

An investigation is performed to establish and optimize three types of potential fatigue life tracking systems. The first is a multichannel system comprising 12 to 14 data recording channels, the second is a limited channel system consisting of 4 to 7 data channels, and the third is a combined system which multichannel recorders are used on 20 percent of the fleet and limited channel recorders are used on 80 percent of the fleet. Analytical techniques are established to determine the damage indices for both crack initiation and crack growth to be used for fleet management and individual aircraft safety. Load truncation criteria are developed on the basis of element tests and analysis. On-board instrumentation and ground based support equipment are conceptually designed for fleet damage tracking. The various candidate systems are evaluated with respect to accuracy and cost, and an optimum multi-channel system, limited channel system, and combined system are selected. Regression equations are developed to convert F/A-18 flight parameters to loads and strains for the inner wing, horizontal tail, and forward fuselage. C.R.

N83-20941*# *Honeywell, Inc., Minneapolis, Minn. Avionics Div.*
DEMONSTRATION ADVANCED AVIONICS SYSTEM (DAAS) Final Report
Jan. 1982 161 p refs
(Contract NAS2-10021)
(NASA-CR-166281; NAS 1.26:166281) Avail: NTIS HC A08/MF A01 CSCL 01D

The feasibility of developing an integrated avionics system suitable for general aviation was determined. A design of reliable integrated avionics which provides expanded functional capability that significantly enhances the utility and safety of general aviation at a cost commensurate with the general aviation market was developed. The use of a data bus, microprocessors, electronic displays and data entry devices, and improved function capabilities were emphasized. An avionics system capable of evaluating the most critical and promising elements of an integrated system was designed, built and flight tested in a twin engine general aviation aircraft. S.L.

N83-22113# General Dynamics Corp., Fort Worth, Tex.
AVIONIC SOFTWARE DESIGN
D. E. SUNDSTROM *In* AGARD Software for Avionics 8 p Jan. 1983 refs
Avail: NTIS HC A19/MF A01

Time, theory, and applications experience have lead us to an understanding of a very specific software product, the avionics operational flight program. The knowledge we now have permits us to identify a common software structure and design methodology. The structure reflects the characteristics of the avionics environment, and is applicable to mission processors, stores management processors, integrated cockpit control processors, and possibly others. We identified a number of characteristics of the avionics environment and related these characteristics to design requirements for a common software operating structure. The adoption of this structure supports a design methodology which has many desirble features, beginning with common naming conventions, an emphasis on data flow specification, and clearly identified design responsibilities. A discussion of the structure and the design methodology are provided. This structure and methodology was demonstrated in production of F-16 airplanes and is currently the development basis for multiple software programs in advanced F-16 versions. It represents a mature and transferable technology. Author

N83-22116# Electronique Serge Dassault, St. Cloud (France).
TOWARDS A VERITABLE SUPERVISOR PROGRAM FOR AVIONICS SOFTWARE [VERS UN VERITABLE ATELIER DE LOGICIEL AVIONIQUE]
G. BRACON *In* AGARD Software for Avionics 14 p Jan. 1983 refs In FRENCH
Avail: NTIS HC A19/MF A01

Experience acquired in the development of equipment and avionics software for the Mirage FI and the Mirage 2000, led to the definition of a software overseer. The AIGLE supervisor program is oriented toward considering methodologies and assists in developing, maintaining, and following the project. It involves a group of complementary operational tools which use a central data base and can then divide the information. The integration of official service and the comfort of man machine dialog permits improved productivity. The essential characteristics of AIGLE is the automatic knowledge of quality control information and of project management. This permits validation of production processes, an indispensable element in software certification.
Transl. by A.R.H.

N83-22119# Electronique Serge Dassault, St. Cloud (France).
D.L.A.O.: A SUPPORT SYSTEM FOR DEFINING AVIONICS SOFTWARE [D.L.A.O.: UN SYSTEME D'AIDE]
S. CHENUT-MARTIN and F. DOLADILLE *In* AGARD Software for Avionics 11 p Jan. 1983 refs In FRENCH
Avail: NTIS HC A19/MF A01

Major principles are described for a system for the computer aided design of software. This support system helps elaborate the specifications of real time software, particularly avionics programs. The steps followed in analyzing definition processes applied for onboard computers, as well as in analyzing user needs and existing systems are considered. The discreet solutions obtained are then developed with particular stress on simplicity of use and ease in constructing documents. The system should be integrated in a coherent ensemble of tools covering the different stages of the life cycle of the software. The problems posed by integration with a system for computer aided design are raised. Transl. by A.R.H.

N83-22142# Institut de Genie Logiciel, Paris (France).
THE QUALITY OF AVIONICS SOFTWARE: SPECIFICATION AND EVALUATION [LA QUALITE DES LOCICIELS AVIONIQUES: SPECIFICATION ET EVALUATION]
G. GERMAIN, M. GALINIER, and M. DELACROIS *In* AGARD Software for Avionics 15 p Jan. 1983 refs In FRENCH
Avail: NTIS HC A19/MF A01

While the IEEE glossary defines software quality as the ensemble of characteristics of a software product relative to its ability to satisfy given needs (such as those established in written specifications), the characteristics of quality which can be modelled and measured are not specified. A total approach to quality is described including the levels of decomposition of parameters. The identification and evaluation of internal and external parameters of avionics software are discussed. Transl. by A.R.H.

N83-22144# Marconi Avionics Ltd., Rochester (England).
THE MANAGEMENT OF A LARGE REAL-TIME MILITARY AVIONICS PROJECT
P. J. CARRINGTON, R. M. GISBEY, and K. P. J. MANNING *In* AGARD Software for Avionics 8 p Jan. 1983
Avail: NTIS HC A19/MF A01

The AQS 901, an airborne submarine detection system installed in the Royal Australian Air Force Orion and the RAF Nimrod Long-Range Maritime Patrol Aircraft, is described. to counter the modern submarine threat, the development of sensor and processing systems to detect and locate the enemy submarine has a high priority. Expendable, sensitive underwater listening devices, called sonobuoys, pick up the faint but characteristics submarine sounds. These sonobuoy signals are transmitted on an radio frequency link to the aircraft where real-time analysis is performed by the AQS 901 Sonics Processor to extract the wanted signal from the noise, to present the data to the operator in the most easily assimilated form, and to provide a wide range of user options for display manipulation and data combination. The AQS 901 system consists of 22 units of special-purpose hardware and 150 K of CORAL software. The project started in 1973, the first flight trials took place in 1977, and the system went into service in 1980. The software is now in maintenance. R.J.F.

N83-22146# Bundesakademie fuer Wehrverwaltung und Wehrtechnik, Mannheim (West Germany).
A LIFE CYCLE MODEL FOR AVIONIC SYSTEMS
H. SCHAAFF *In* AGARD Software for Avionics 7 p Jan. 1983 refs
Avail: NTIS HC A19/MF A01

A life cycle model that puts emphasis on design activities of avionics system is given. The objective of the project management of an avionic system must be to bring forth the user requirements as completely, as correctly and as early as possible because this saves money and time. The life cycle model presented helps to achieve this especially by the introduction of the formal activity functional design and its distinct separation from the technical design. The presented model is valid for avionic systems, but not only for these. It is valid for military embedded computer systems in general. R.J.F.

N83-22147# Air Force Avionics Lab., Wright-Patterson AFB, Ohio.
AVIONICS SOFTWARE SUPPORT COST MODEL
D. V. FERENS *In* AGARD Software for Avionics 8 p Jan. 1983 refs
Avail: NTIS HC A19/MF A01

The development of the Avionics Software Support Cost Model (ASSCM) is discussed. ASSCM promises to represent a significant milestone in the area of software life cycle cost analysis. The use of historical data insures that ASSCM reflects actual costs of software support, as well as the policies and procedures used by USAF Air Logistics Centers to support software. The use of the Delphi survey results enables ASSCM to be useful for a wide variety of avionic software programs. The model was designed to be easy to use, especially during the conceptual or early design phase of a software program. Minimal input data is required. The model was developed in a modular format so that the model would be relatively easy to modify as new data becomes available or new application types are added. ASSCM can be useful to some degree for many U.S. and NATO software programs, especially on military avionics projects. The model may need some degree of modification for applications significantly different from those for which ASSCM was developed. R.J.F.

N83-22149# Ministry of Defence, London (England).
THE MILITARY USER VIEW OF SOFTWARE SUPPORT THROUGHOUT THE IN-SERVICE LIFE OF AVIONIC SYSTEMS
S. J. BARKER and B. HAMBLING *In* AGARD Software for Avionics 5 p Jan. 1983
Avail: NTIS HC A19/MF A01

It is argued that software-based military avionic systems should be considered as vehicles requiring continuous software development throughout their operating life. The reasons for software change are discussed and emphasis is given to an increasing need to adapt avionic systems to match a changing hostile environment with both speed and safety. More thought should be given to basic system design to facilitate both hardware and software replacement by greater modularity and reduced hardware/software dependence. Some examples of current system inadequacies are given. The need to reduce the cost of software development is emphasized and the type of software support environment as envisaged in the current ADA/APSE development is seen as a significant step towards this end. R.J.F.

N83-22196*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
TIME-BASED SELF-SPACING TECHNIQUES USING COCKPIT DISPLAY OF TRAFFIC INFORMATION DURING APPROACH TO LANDING IN A TERMINAL AREA VECTORING ENVIRONMENT
D. H. WILLIAMS Apr. 1983 43 p refs
(NASA-TM-84601; L-15520; NAS 1.15:84601) Avail: NTIS HC A03/MF A01 CSCL 01D

A simulation study was undertaken to evaluate two time-based self-spacing techniques for in-trail following during terminal area approach. An electronic traffic display was provided in the weather radarscope location. The displayed self-spacing cues allowed the simulated aircraft to follow and to maintain spacing on another aircraft which was being vectored by air traffic control (ATC) for landing in a high-density terminal area. Separation performance data indicate the information provided on the traffic display was adequate for the test subjects to accurately follow the approach path of another aircraft without the assistance of ATC. The time-based technique with a constant-delay spacing criterion produced the most satisfactory spacing performance. Pilot comments indicate the workload associated with the self-separation task was very high and that additional spacing command information and/or aircraft autopilot functions would be desirable for operational implementational of the self-spacing task. Author

N83-22197*# University of Southern Colorado, Pueblo. School of Applied Science and Engineering Technology.
TECHNOLOGY RESEARCH FOR DIGITAL FLIGHT CONTROL Status Report, 1 Oct. 1982 - 31 Mar. 1983
R. A. CARESTIA 1983 12 p refs
(Contract NCC2-041)
(NASA-CR-170194; NAS 1.26:170194) Avail: NTIS HC A02/MF A01 CSCL 01D

The use of advanced digital systems for flight control and guidance for a specific mission is investigated. The research areas include advanced electronic system architectures, tests with the global positioning system (GPS) in a helicopter, and advanced integrated systems concept for rotorcraft. Emphasis is on a search and rescue mission, differential global positioning systems to provide a data base of performance information for navigation, and a study to determine the present usage and trends of microcomputers and microcomputer components in the avionics industries. S.L.

A83-27190
DISCHARGE RATE CAPABILITY OF NICKEL-CADMIUM AIRCRAFT BATTERIES
S. HERZLICH, T. KOPICKI, and T. STONEHAM (Marathon Battery Co., Waco, TX) In: IECEC '82; Proceedings of the Seventeenth Intersociety Energy Conversion Engineering Conference, Los Angeles, CA, August 8-12, 1982. Volume 2. New York, Institute of Electrical and Electronics Engineers, 1982, p. 691-694. refs

Conventional E-I load curves offer a format for characterizing nickel-cadmium aircraft battery performance. A wide range of discharge rates and temperature conditions can be represented with a few straight lines, provided adjustments toward conservative estimates are made. Ratings for maximum power, battery resistance and power density can be computed from these curves and a derating factor for partially charged batteries can be indicated on the graph. Test methods for generation of load curves are described and application of the data to the problem of aircraft engine starting is discussed. (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.

A83-27163
A STEADY STATE PERFORMANCE MODEL FOR GENERAL AVIATION SPARK-IGNITION PISTON ENGINES
R. C. H. PARKINSON (Office of Technology Assessment, Washington, DC) In: IECEC '82; Proceedings of the Seventeenth Intersociety Energy Conversion Engineering Conference, Los Angeles, CA, August 8-12, 1982. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, p. 473-478. refs

It is pointed out that the range of piston engine aircraft is determined by a number of factors related to airframe, propeller, engine, and the atmosphere in which the aircraft flies. The engine's contribution to range is the Brake Specific Fuel Consumption (BSFC). In order to maximize the range in any flight condition, the BSFC must be minimized. The BSFC is a function of engine design and of engine operation. The present investigation is concerned with an engine performance model which can be used as a guide to determine operating practices and control laws which minimize BSFC in the steady state operation of general aviation piston engines of fixed design. The model computes the steady-state cruise performance of naturally aspirated, spark-ignition, inlet port fuel injection, four-stroke piston aero engines. G.R.

A83-27187
A SAMARIUM COBALT MOTOR-CONTROLLER FOR MINI-RPV PROPULSION
P. CURRAN and D. FAULKNER (Sundstrand Corp., Rockford, IL) In: IECEC '82; Proceedings of the Seventeenth Intersociety Energy Conversion Engineering Conference, Los Angeles, CA, August 8-12, 1982. Volume 2. New York, Institute of Electrical and Electronics Engineers, 1982, p. 672-677.

This paper presents a brief summary of a program that was undertaken to develop a rare earth permanent magnet motor and controller to serve as the propulsion system for the first flight of an electrically powered Air Force XBQM-106 remotely piloted vehicle (RPV). The paper discusses the aspects of the propulsion system, and presents the salient design features of the motor and controller. The performance data that was obtained from the development tests is presented, as is the data that was gained from the flight tests during the demonstration phase of the program. In summarizing the results of the demonstration flight tests, several of the vehicle performance aspects unique to electrical propulsion systems are also discussed. (Author)

A83-27324
LOW POWER, AIR-COOLED DC-LINK AIRCRAFT GENERATION SYSTEMS
J. F. VONDEREMBSE and R. J. NISONGER (Westinghouse Electric Corp., Electrical Systems Div., Lima, OH) In: IECEC '82; Proceedings of the Seventeenth Intersociety Energy Conversion Engineering Conference, Los Angeles, CA, August 8-12, 1982. Volume 5. New York, Institute of Electrical and Electronics Engineers, 1982, p. 2114-2119.

A 10 kVa air-cooled DC-Link VSCF system with individually packaged components is described. The generator, power converter, and generator control unit (GCU) are discussed. The power converter components and functions include a rectifier bridge/DC-Link filter, three-phase inverter, inverter waveform and output filter, neutral forming transformer, power stage sensing, and converter cooling. The GCU modules and functions include an inverter drive logic module, a voltage regulator module, protection module, built-in test/failure monitoring/annunciation, and cooling. The system can be readily uprated to a 20 dVA rating by an increase in generator capacity. The air-cooled configuration and lower rating permit the system to be implemented for an emergency power system at competitive cost and weight. C.D.

A83-27479#
SEPARATION CHARACTERISTICS OF THE T700 ENGINE INLET PARTICLE SEPARATOR
F. A. LASTRINA (General Electric Co., Aircraft Engine Business Group, Lynn, MA) In: Particulate laden flows in turbomachinery; Proceedings of the Joint Fluids, Plasma, Thermophysics and Heat Transfer Conference, St. Louis, MO, June 7-11, 1982. New York, American Society of Mechanical Engineers, 1982, p. 59-62.

Test results are presented which characterize the performance of the integral inlet particle separator for the T700 turboshaft engine, an advanced design, high performance powerplant currently in production for the US Army Blackhawk helicopter. The integral inlet particle separator offers significant advances in engine performance, reliability and durability when the engine is exposed to a 'dirt' laden air environment, which can include sand/dirt particulates, stones, and other items causing long term or rapid engine performance deterioration. Among the tests results reported are the separator pressure loss and the separation efficiency characteristics with various discrete sand particle sizes including 1/4 inch diameter stones. N.B.

A83-28006*# General Electric Co., Cincinnati, Ohio.
THE INFLUENCE OF INLET DESIGN ON THE AEROACOUSTIC PERFORMANCE OF A JT15D TURBOFAN ENGINE AS MEASURED IN THE NASA-AMES 40 X 80 FOOT WIND TUNNEL
R. G. HOLM (General Electric Co., Aircraft Engine Group, Cincinnati, OH), A. KARCHMER (NASA, Lewis Research Center, Cleveland, OH), C. HORNE, and A. ATENCIO (NASA, Ames Research Center, Moffett Field, CA) American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 8th, Atlanta, GA, Apr. 11-13, 1983, 58 p. refs
(Contract NAS2-8675)
(AIAA PAPER 83-0681)

The influence of inlet design on the aeroacoustic performance of a JT15D turbofan engine was investigated in the NASA-Ames 40 x 80 ft wind tunnel. Four inlet designs representative of those found in commercial service were evaluated at a forward velocity of 80 kn. The inlet designs considered were selected to evaluate the importance of circumferential static pressure distortion (SPD) for a diffusing sound suppressing inlet and throat Mach number (Mth) for a hardwall inlet on the acoustic characteristics of the JT15D engine. Several speed points were studied simulating the operating conditions spanning approach to take-off. Results demonstrated that the dependency of the forward radiated noise on inlet aerodynamic design parameters was significant (about 5 dB) for the range of SPD (0.1-3.0%) and Mth (0.3-0.6) tested. The performance of the bulk absorber acoustic treatment used in the diffusing sound suppressing inlet is also discussed. (Author)

A83-28019#
MODEL AND FULL-SCALE STUDIES OF THE EXHAUST NOISE FROM A BYPASS ENGINE IN FLIGHT
R. C. K. STEVENS, W. D. BRYCE (National Gas Turbine Establishment, Farnborough, Hants., England), and V. M. SZEWCZYK (Rolls-Royce Ltd., Derby, England) American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 8th, Atlanta, GA, Apr. 11-13, 1983, 10 p. refs
(AIAA PAPER 83-0751)

Noise levels from under-wing RB211 engines in flight have been obtained from measurements of the flyover noise of a Lockheed Tristar aircraft. The spectra at one engine power and two aircraft speeds have been found to agree well with absolute levels predicted from complementary ground-based tests. These comprised model-scale simulation tests to define the jet noise and installation effects, and source location tests on a static engine to define the engine core noise. Although the high-frequency levels in the rear arc are not predicted accurately, the results are consistent with the engine exhaust noise being represented by the sum of the installed jet noise and the installed core noise. (Author)

A83-28510
THE INTERACTION BETWEEN A SEPARATED BLADE AND THE ARMOR RING [O VZAIMODEISTVII OTORVAVSHEISIA LOPATKI I BRONEVOGO KOL'TSA]
N. S. KONDRASHOV Problemy Prochnosti, Mar. 1983, p. 53-57. In Russian.

A closed system of equations is obtained which describes the deformations of a separated blade and of the armor ring of a gas-turbine engine during their interaction, as well as the motion of the blade as a solid. A method is proposed for reducing this system of equations to conventional equations in canonical form, and the initial conditions are formulated. For a particular case, the blade motion parameters and the contact interaction force are determined as a function of time. V.L.

A83-28667#
RESEARCH ON THE THERMOMECHANICAL STRESS IN TURBINE DISKS UNDER THERMAL MANIPULATIONS [BEITRAG ZUR UNTERSUCHUNG DER THERMISCH-MECHANISCHEN SPANNUNGSBEEINFLUSSUNG IN TURBINENSCHEIBEN MITTELS TEMPERATURFELDMANIPULATION]
W. ERHARD Muenchen, Technische Universitaet, Fakultaet fuer Maschinenwesen, Dr.-Ing. Dissertation, 1982. 135 p. In German. refs

The main structural stresses arising in turbine rotors during operation at high inlet temperatures and pressures, blade tension at the outer edge, eigencentrifugal force, and differential thermal tension, are analytically examined using a simple model of a disk of constant thickness. The heat balance at the disk and the strength of the disk are numerically evaluated using a computer program and finite element analysis. The effect of various cooling parameters on the stationary temperature and stress distributions is discussed, and calculation examples for nonstationary states are considered. The test technology is described, including the mechanical test structure and the technique of measurement. The results of cooling and heating tests are presented, and the determination of the local heat transfer coefficient is shown. C.D.

A83-29011#
ANALYSIS OF ENGINE USAGE DATA FOR TACTICAL SYSTEMS
R. J. MAY, JR., D. R. CHAFFEE, P. B. STUMBO, and M. D. REITZ (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) Journal of Aircraft (ISSN 0021-8669), vol. 20, May 1983, p. 390-396. refs
(AIAA PAPER 81-1370)

It is noted that turbine engine field experience has demonstrated a need to consider realistic engine usage profiles and duty cycles in the preliminary design phase of development. This increased emphasis on understanding usage results from hardware failures in today's engines brought on by aircraft/engine usage that is considerably different from design. Data are analyzed to identify *driving parameters on engine usage. The results of data analysis* from continuously recorded engine/aircraft parameters on F-15, F-5E, and A-10 aircraft are presented. The aircraft were flown in combat training exercises, normal training exercises, normal training, and check flight sorties. It is found that all three systems have usage that includes a large number of small amplitude throttle cycles. The F-15 and F-5E usage is found to be very similar for combat air patrol missions in terms of flight profile, number of major cycles, and time at maximum temperature conditions. C.R.

A83-29014#
PROPULSION SYSTEM INSTALLATION DESIGN FOR HIGH-SPEED PROP-FANS
B. H. LITTLE, JR. (Lockheed-Georgia Co., Propulsion and Acoustics Dept., Marietta, GA) Journal of Aircraft (ISSN 0021-8669), vol. 20, May 1983, p. 411-417. refs

Previously cited in issue 20, p. 3469, Accession no. A81-43144

A83-29024*# General Electric Co., Cincinnati, Ohio.
TURBINE BLADE NONLINEAR STRUCTURAL AND LIFE ANALYSIS
R. L. MCKNIGHT, J. H. LAFLEN (General Electric Co., Aircraft Engine Business Group, Cincinnati, OH), G. R. HALFORD, and A. KAUFMAN (NASA, Lewis Research Center, Structures and Mechanical Technologies Div., Cleveland, OH) Journal of Aircraft (ISSN 0021-8669), vol. 20, May 1983, p. 475-480. refs

Previously cited in issue 17, p. 2687, Accession no. A82-34981

A83-29277
EVALUATION OF THE PRODUCTIVITY OF AN AUTOMATED SYSTEM FOR THE TESTING OF AIRCRAFT ENGINES [OTSENKA PROIZVODITEL'NOSTI AVTOMATIZIROVANNOGO TEKHNOLOGICHESKOGO KOMPLEKSA ISPYTANII AVIATSIONNYKH DVIGATELEI]
M. M. BERKHEEV Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 4, 1982, p. 20-24. In Russian.

The paper proposes a method for calculating the productivity of an automated system for the testing of aircraft engines based on the use of closed stochastic queueing networks. An algorithm and program were developed for calculating the efficiency of automatic testing systems of various structures. Particular attention is given to a two-level system that uses one minicomputer and two combined minicomputers on the first level and one minicomputer on the second level. B.J.

A83-29294
ON THE DETERMINATION OF THE LOAD-CARRYING CAPACITY OF THE GLASS-PLASTIC PROPELLER BLADE OF AN AIRCRAFT [K VOPROSU OB OPREDELENII NESUSHCHEI SPOSOBNOSTI STEKLOPLASTIKOVOI LOPASTI VINTA SAMOLETA]
G. P. ZAITSEV and S. A. SILANTEV Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 4, 1982, p. 95-99. In Russian. refs

A theoretical analysis is presented of the load-carrying capacity of a glass-fiber-reinforced propeller blade under short-term and cyclic loads. Attention is also given to the problem of determining a reinforcement angle that is optimal with respect to safety factor. It is shown that a reinforcement angle of + or - 37 deg is optimal for static loads while an angle of + or - 5 deg is optimal for cyclic loads. B.J.

A83-29737*# Pratt and Whitney Aircraft Group, East Hartford, Conn.
STRUCTURAL TAILORING OF ENGINE BLADES (STAEBL)
K. W. BROWN, T. K. PRATT (United Technologies Corp., Pratt and Whitney Aircraft Group, East Hartford, CT), and C. C. CHAMIS (NASA Lewis Research Center, Cleveland, OH) IN: Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 1 . New York, American Institute of Aeronautics and Astronautics, 1983, p. 79-88. refs
(Contract NAS3-22525)
(AIAA 83-0828)

Mathematical optimization is applied to the design of gas turbine fan blades. The automated procedure replaces the current manual process which requires experience and intuition on the part of the designer to achieve successful blade designs. The optimization procedure that is developed utilizes the COPES/CONMIN optimization code. Approximate vibration and stress analyses are used for the optimization process. Analysis recalibrations are achieved through the application of more detailed, refined analysis. Optimizations of a hollow titanium fan blade with composite inlays and of a superhybrid composite blade are demonstrated. Author

A83-29777#
AN OVERVIEW OF TURBINE ENGINE STRUCTURAL DESIGN - DEVELOPMENT TRENDS IN THE AIR FORCE
W. D. COWIE (USAF, Aeronautical Systems Div., Wright-Patterson AFB, OH) IN: Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 1 . New York, American Institute of Aeronautics and Astronautics, 1983, p. 493-498.
(AIAA 83-0952)

Problems related to the structural durability of aircraft turbine engines are reviewed in a historical perspective, with emphasis on lessons learned from past engine development programs. The structural failure modes typical of turbine engines are then discussed. Particular attention is given to those design variables and failure modes that have had the greatest effect on operational readiness and cost of ownership. The current trends in durability testing on full-scale engines are examined. Finally, the current status of the Air Force Engine Structural Integrity Program is discussed. V.L.

A83-29856#
ANALYTICAL AND EXPERIMENTAL INVESTIGATION OF BIRD IMPACT ON FAN AND COMPRESSOR BLADING
A. F. STORACE, R. P. NIMMER, and R. RAVENHALL (General Electric Co., Cincinnati, OH) IN: Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 2 . New York, American Institute of Aeronautics and Astronautics, 1983, p. 457-465. refs
(Contract F33615-77-C-5221)
(AIAA 83-0954)

An analytical design tool and structural design criteria have been developed to assess and improve the foreign object damage (FOD) tolerance of turbine engine fan and compressor blading. The analytical method is based on a three-dimensional finite element computer code that incorporates an interactive bird loading model. The computer code and design criteria provide a systematic transient-structural analysis approach that will aid in the design of structurally efficient - impact damage resistant blading. Author

N83-20945*# Notre Dame Univ., Ind. Dept. of Electrical Engineering.
ALTERNATIVES FOR JET ENGINE CONTROL Annual Technical Progress Report, 1 Oct. 1981 - 30 Sep. 1982
M. K. SAIN, S. YURKOVICH, J. P. HILL, and T. A. KINGLER 23 Mar. 1983 197 p refs
(Contract NSG-3048)
(NASA-CR-170100; NAS 1.26:170100) Avail: NTIS HC A09/MF A01 CSCL 21E

The development of models of tensor type for a digital simulation of the quiet, clean safe engine (QCSE) gas turbine engine; the extension, to nonlinear multivariate control system design, of the concepts of total synthesis which trace their roots back to certain early investigations under this grant; the role of series descriptions as they relate to questions of scheduling in the control of gas turbine engines; the development of computer-aided design software for tensor modeling calculations; further enhancement of the softwares for linear total synthesis, mentioned above; and calculation of the first known examples using tensors for nonlinear feedback control are discussed. Author

N83-20946*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Business Group.
THE RENE 150 DIRECTIONALLY SOLIDIFIED SUPERALLOY TURBINE BLADES, VOLUME 1 Final Report
G. J. DEBOER Dec. 1981 116 p refs
(Contract NAS3-20074)
(NASA-CR-167992; NAS 1.26:167992; R82AEB540-VOL-1)
Avail: NTIS HC A06/MF A01 CSCL 21E

Turbine blade design and analysis, preliminary Rene 150 system refinement, coating adaptation and evaluation, final Rene 150 system refinement, component-test blade production and evaluation, engine-test blade production, and engine test are discussed. N.W.

N83-20947*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NEW TRENDS IN COMBUSTION RESEARCH FOR GAS TURBINE ENGINES
E. J. MULARZ 1983 13 p refs Proposed for presentation at 6th Intern. Symp. on Air Breathing Engines, Paris, 6-11 Jun. 1983; sponsored by the International Society on Air Breathing Engines and the Association Aeronautique et Astronautique de France
(NASA-TM-83338; E-1590; NAS 1.15:83338; AVRADCOM-TR-83-C-1) Avail: NTIS HC A02/MF A01 CSCL 21E

Research on combustion is being conducted to provide improved analytical models of the complex flow and chemical reaction processes which occur in the combustor of gas turbine engines, in order to enable engine manufacturers to reduce the development time of these concepts. The elements of the

combustion fundamentals program is briefly discussed with examples of research projects described more fully. Combustion research will continue to emphasize the development of analytical models and the support of these models with fundamental flow experiments to assess the models accuracy and shortcomings.
S.L.

N83-20950# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics.
A SYSTEM DYNAMICS POLICY ANALYSIS MODEL OF THE AIR FORCE ENGINE MANAGEMENT SYSTEM M.S. Thesis
G. K. LEMAIRE Sep. 1982 224 p refs
(AD-A122829; AFIT-LSSR-92-82) Avail: NTIS HC A10/MF A01 CSCL 15E

The Air Force contains several complex management systems. These systems are, for the most part, examples of goal-oriented, feedback control systems. They often display counter-intuitive behavior in their operations. One of the best ways to study these systems is by using computer simulation techniques. Forrester has developed a system dynamics simulation technology, DYNAMO, which can be used to study such complex systems. The Air Force engine management system is one of these systems. Additionally, it is an example of a multi-item, multiechelon production and inventory system. Forrester's work with these systems indicated that they are unstable and this instability is due to the structure of the system. This thesis modified an existing DYNAMO simulation model to study the operation of the engine management system. Personal experience, interviews with system managers, and a literature review indicated that this was an acceptable choice. The results of the model's operation were reported. The model is a reasonable approximation of the engine management system. Recommendations for model expansion and improvement are presented. GRA

N83-22198*# Westinghouse Research and Development Center, Pittsburgh, Pa.
LABYRINTH SEAL FORCES ON A WHIRLING ROTOR Final Report
D. V. WRIGHT Jan. 1983 111 p refs
(Contract NAS3-10825; DA PROJ. 1L1-62209-AH-76)
(NASA-CR-168016; NAS 1.26:168016) Avail: NTIS HC A06/MF A01 CSCL 21E

An experimental investigation of air labyrinth seal forces on a subsynchronously whirling model rotor is described and test results are given for diverging, converging, and straight two-strip seals. The effects of pressure drop, provide basic experimental data needed in the development of design methods for predicting and preventing self-excited whirl of turbine rotors and other machines having labyrinth seals. The total dynamic seal forces on the whirling model rotor are measured accurately by means of an active damping and stiffness system that is adjusted to obtain neutral whirl stability of the model rotor system. In addition, the whirling pressure pattern in the seal annulus is measured for a few test conditions and the corresponding pressure forces on the rotor are compared with the total measured forces. This comparison shows that either radial and axial pressure gradients in the seal annulus or drag forces on the rotor are significant. Comparisons made between the measured seal forces and theoretical results show that present theory is inadequate. M.G.

N83-22200*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL INVESTIGATION OF A TWO-DIMENSIONAL SHOCK-TURBULENT BOUNDARY LAYER INTERACTION WITH BLEED
W. R. HINST and F. T. TANJI 1983 19 p refs Presented at the 21st Aerospace Sci. Conf., Reno, Nev., 10-13 Jan. 1983; sponsored by AIAA Announced in AIAA as A83-19581
(NASA-TM-83057; E-1522; NAS 1.15:83057; AIAA-83-0135)
Avail: NTIS HC A02/MF A01 CSCL 21E

The two-dimensional interaction of an oblique shock wave with a turbulent boundary layer that included the effect of bleed was examined experimentally using a shock generator mounted across a supersonic wind tunnel The studies were performed at Mach numbers 2.5 and 2.0 and unit Reynolds number of approximately 2.0 x 10 to the 7th/meter. The study includes surface oil flow visualization, wall static pressure distributions and boundary layer pitot pressure profiles. In addition, the variation of the local bleed rates were measured. The results show the effect of the bleed on the boundary layer as well as the effect of the flow conditions on the local bleed rate. Author (IAA)

N83-22201*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.
FLIGHT EVALUATION OF MODIFICATIONS TO A DIGITAL ELECTRONIC ENGINE CONTROL SYSTEM IN AN F-15 AIRPLANE
F. W. BURCHAM, JR., L. P. MYERS, and J. R. ZELLER 1983 12 p refs Presented at the 21st Aerospace Sci. Conf., Reno, Nev., 10-13 Jan. 1983; sponsored by AIAA Original document was announced as A83-19593
(NASA-TM-83088; E-1515; NAS 1.15:83088; AIAA-83-0537)
Avail: NTIS HC A02/MF A01 CSCL 21E

The third phase of a flight evaluation of a digital electronic engine control system in an F-15 has recently been completed. It was found that digital electronic engine control software logic changes and augmentor hardware improvements resulted in significant improvements in engine operation. For intermediate to maximum power throttle transients, an increase in altitude capability of up to 8000 ft was found, and for idle to maximum transients, an increase of up to 4000 ft was found. A nozzle instability noted in earlier flight testing was investigated on a test engine at NASA Lewis Research Center, a digital electronic engine control software logic change was developed and evaluated, and no instability occurred in the Phase 3 flight evaluation. The backup control airstart modification was evaluated, and gave an improvement of airstart capability by reducing the minimum airspeed for successful airstarts by 50 to 75 knots. Author

N83-22203*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.
AIRSTART PERFORMANCE OF A DIGITAL ELECTRONIC ENGINE CONTROL SYSTEM IN AN F-15 AIRPLANE
S. J. LICATA and F. W. BURCHAM, JR. Apr. 1983 31 p refs
(NASA-TM-84908; NAS 1.15:84908) Avail: NTIS HC A03/MF A01 CSCL 21E

The airstart performance of the F100 engine equipped with a digital electronic engine control (DEEC) system was evaluated in an F-15 airplane. The DEEC system incorporates closed-loop airstart logic for improved capability. Spooldown and jet fuel starter-assisted airstarts were made over a range of airspeeds and altitudes. All jet fuel starter-assisted airstarts were successful, with airstart time varying from 35 to 60 sec. All spooldown airstarts at airspeeds of 200 knots and higher were successful; airstart times ranged from 45 sec at 250 knots to 135 sec at 200 knots. The effects of altitude on airstart success and time were small. The flight results agreed closely with previous altitude facility test results. The DEEC system provided successful airstarts at airspeeds at least 50 knots lower than the standard F100 engine control system. Author

N83-22204*# General Electric Co., Cincinnati, Ohio. Advanced Engineering and Technology Programs Dept.
ENERGY EFFICIENT ENGINE COMPONENT DEVELOPMENT AND INTEGRATION PROGRAM Semiannual Report, 1 Oct. 1980-31 Mar. 1981
30 Jan. 1981 412 p
(Contract NAS3-20643)
(NASA-CR-170089; NAS 1.26:170089; R81AEG316; SAR-6)
Avail: NTIS HC A18/MF A01 CSCL 21E

The technology that will improve the energy efficiency of propulsion systems for subsonic commercial aircraft is investigated. A reduction of 14.4% in cruise installed sfc (0.572 versus 0.668 for the CF6-50C) and a direct operation cost reduction in excess of the 5% goal is projected. Noise and emissions projections are consistent with the established goals. S.L.

N83-22454*# Curtiss-Wright Corp., Wood-Ridge, N.J.
ADVANCED ROTARY ENGINES
C. JONES *In* NASA. Lewis Research Center Aviation Gasolines and Future Alternatives p 123-137 May 1983 Original document was announced as A80-38982
Avail: NTIS HC A08/MF A01 CSCL 21E

The broad objectives of this paper are the following: (1) to summarize the Curtiss-Wright design, development and field testing background in the area of rotary aircraft engines; (2) to briefly summarize past activity and update development work in the area of stratified charge rotary combustion engines; and (3) to discuss the development of a high-performance direct injected unthrottled stratified charge rotary combustion aircraft engine. Efficiency improvements through turbocharging are also discussed. Author

N83-22455*# Teledyne Continental Motors, Mobile, Ala. General Products Div.
LIGHTWEIGHT DIESEL AIRCRAFT ENGINES FOR GENERAL AVIATION
S. G. BERENYI *In* NASA. Lewis Research Center Aviation Gasolines and Future Alternatives p 136-147 May 1983
Avail: NTIS HC A08/MF A01 CSCL 21E

Two different engines were studied. The advantages of a diesel to general aviation were reduced to fuel consumption, reduced operating costs, and reduced fire and explosion hazard. There were no ignition mixture control or inlet icing problems. There are fewer controls and no electrical interference problems. Author

N83-22456*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AN OVERVIEW OF GENERAL AVIATION PROPULSION RESEARCH PROGRAMS AT NASA LEWIS RESEARCH CENTER
E. A. WILLIS *In its* Aviation Gasolines and Future Alternatives p 149-160 May 1983 Original document was announced as N81-16052
Avail: NTIS HC A08/MF A01 CSCL 21E

The review covers near-term improvements for current-type piston engines, as well as studies and limited corroborative research on several advanced g/a engine concepts, including diesels, small turboprops and both piston and rotary stratified-charge engines. Also described is basic combustion research, cycle modeling and diagnostic instrumentation work that is required to make new engines a reality. T.M.

N83-22457*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
GENERAL AVIATION TURBINE ENGINE (GATE) OVERVIEW
W. C. STRACK *In its* Aviation Gasolines and Future Alternatives p 161-166 May 1983 refs
Avail: NTIS HC A08/MF A01 CSCL 21E

When all the technology studies were done and the accompanying market analyses were complete, the conclusion was that it is indeed possible to reduce the cost of turbine engines by a factor of 3 using low-cost manufacturing techniques and increased production rates. In the interest of reducing engine cost, some performance was sacrificed. Yet we ended up with about a 20 percent predicted improvement in SFC over current technology turboprops. However, even this level of improvement does not match the low SFC of reciprocating powerplants--particularly those advanced concepts described earlier. The 20 percent better SFC and much lower weight of a turboprop does mean that if such a powerplant were installed in a resized small airplane, one could save between 10 and 30 percent fuel relative to existing recip engines, depending on different mission and airplane combinations. The price of the aircraft would go down about 15 percent in the case of a high powered single, or 25 percent in the case of a normal size twin. The operating costs would decrease about 10 percent in the case of the single, and as much as 35 percent in the case of the twin. Author

08

AIRCRAFT STABILITY AND CONTROL

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

A83-28183
THE EXTENDED KALMAN FILTER AND ITS USE IN ESTIMATING AERODYNAMIC DERIVATIVES
A. J. ROBINS (British Aerospace, Bristol, England) Aerospace Dynamics, Sept. 1982, p. 16-24.

A Kalman filter has been designed which is able to estimate the five yaw derivatives from flight test data, as has been verified through the use of computer simulations of the aerodynamics treated by the filter under realistic system and measurement noise conditions. Although the present study is restricted to the yaw plane, more complex filters can be designed along the same lines, incorporating the full nonlinear dynamics of the airframe in question, including its cross-coupling terms. Given appropriate measurements, such a filter is able to estimate all the aerodynamic derivatives described and allows a full mathematical model of aircraft aerodynamic behavior to be derived O.C.

A83-29016*# Systems Technology, Inc., Hawthorne, Calif.
HEAVY-LIFT AIRSHIP DYNAMICS
M. B. TISCHLER, R. F. RINGLAND, and H. R. JEX (Systems Technology, Inc., Hawthorne, CA) Journal of Aircraft (ISSN 0021-8669), vol. 20, May 1983, p. 425-433. refs
(Contract NAS2-10330)

The basic aerodynamic and dynamic properties of an example heavy-lift airship (HLA) configuration are analyzed using a nonlinear, multibody, 6-degrees-of-freedom digital simulation. The slung-payload model is described, and a preliminary analysis of the coupled vehicle-payload dynamics is presented. Trim calculations show the importance of control mixing selection and suggest performance deficiencies in crosswind stationkeeping for the unloaded example HLA. Numerically linearized dynamics of the unloaded vehicle exhibit a divergent yaw mode and an oscillatory pitch mode whose stability characteristic is sensitive to flight speed. An analysis of the vehicle-payload dynamics shows significant coupling of the payload dynamics with those of the basic HLA. It is shown that significant improvement in the vehicle's dynamic behavior can be achieved with the incorporation of a simple flight controller having proportional, rate, and integral-error feedbacks. V.L.

A83-29023*# Joint Inst. for Advancement of Flight Sciences, Hampton, Va.
AIRPLANE MODEL STRUCTURE DETERMINATION FROM FLIGHT DATA
V. KLEIN (Joint Institute for Advancement of Flight Sciences, Hampton, VA), J. G. BATTERSON, and P. C. MURPHY (NASA, Langley Research Center, Hampton, VA) Journal of Aircraft (ISSN 0021-8669), vol. 20, May 1983, p. 469-474. refs

Previously cited in issue 21, p. 3626, Accession no. A81-44562

A83-29286
ON THE CRITICAL SPEED OF EMPENNAGE FLUTTER WITH ALLOWANCE FOR THE RUDDER [O KRITICHESKOI SKOROSTI FLATTERA OPERENIIA S RULEM]
V. A. PAVLOV and S. K. CHERNIKOV Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 4, 1982, p. 61-64. In Russian.

A method is developed for determining critical flutter speed with allowance for rudder bending energy in the frontal plane. The dependence of critical flutter speed on the frontal rigidity of the rudder is shown. It is noted that a neglect of the frontal rigidity will lead to quantitative and qualitative error, since flutter does not arise at all at large values of frontal rigidity. B.J.

A83-29291
SOLUTION OF THE FUNDAMENTAL CONTROL PROBLEM /FCP/ [K RESHENIIU OSNOVNOI ZADACHI UPRAVLENIIA /OZU/]
R. T. SIRAZETDINOV Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 4, 1982, p. 85-89. In Russian.

The present study involves the determination of a certain subset of solutions of the fundamental control problem for objects described by differential and integrodifferential equations. An expression is obtained defining the domain in the vicinity of the base point in control space in which all the requirements imposed on the performance criterion are satisfied for flight vehicles described by a system of ordinary differential equations. B.J.

A83-29869#
ACTIVE SUPPRESSION OF AEROELASTIC INSTABILITIES ON A FORWARD SWEPT WING
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: Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 2 . New York, American Institute of Aeronautics and Astronautics, 1983, p. 577-588. refs
(AIAA 83-0991)

Analytical studies were conducted to investigate the potential of applying active feedback principles for controlling aeroelastic instabilities on a forward swept wing. Using doublet-lattice unsteady aerodynamics approximated by Pade polynomials and applied in root locus procedures, control laws were developed for a cantilever flexible wing and for the wing/fuselage model free in pitch. Design philosophy consisted of using a leading edge surface with displacement feedback to prevent the lower frequency instability of the wing (divergence or short period/bending flutter), and using a trailing edge surface commanded by angular acceleration feedback to increase the flutter speed of a higher frequency mode involving coupling of 2nd bending and torsion. The blended system successfully controlled the instabilities of both wind configurations up to a significantly higher airspeed. Besides large speed improvements, the design provided respectable gain margins. However, phase margins were low and would require tradeoffs with airspeed improvement to obtain more desirable values.
Author

A83-29870#
ANTI-FLUTTER CONTROL CONCEPT USING A REDUCED NON-LINEAR DYNAMIC MODEL OF ELASTIC STRUCTURE AIRCRAFT
J. JANKOVIC (Beograd, Univerzitet, Belgrade, Yugoslavia) IN: Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers, Part 2 . New York, American Institute of Aeronautics and Astronautics , 1983, p. 589-596. refs
(AIAA 83-0993)

The present investigation has the objective to develop a spatial procedure for Antiflutter control. The antiflutter control is carried out by changing the configuration of the aerodynamic load. The modification of the aerodynamic parmeters of the system makes it possible to control any instabilities which could lead to the flutter phenomenon. In this investigation, the antiflutter control is implemented for a reduced dynamic model of an elastic structure aircraft. Attention is given to the basic equations, the determination of the control surface angle, and the conditions for the application of the considered method. G.R.

A83-29888#
AFTI/F-16 AEROSERVOELASTIC ANALYSES AND GROUND TEST WITH A DIGITAL FLIGHT CONTROL SYSTEM
M. G. ALLEN (General Dynamics Corp., Fort Worth, TX) and S. J. POLLOCK (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) IN: Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 2 . New York, American Institute of Aeronautics and Astronautics, 1983, p. 767-774.
(AIAA 83-0994)

The AFTI/F-16 airplane utilizes a triplex, digital flight control system (FCS). The FCS finite sample rate for the analog/digital conversion modifies the system from continuous to discontinuous and invalidates the conventional approach to aeroservoelastic analysis, which is predicated on using analog or continuous signals. Therefore, the conventional approach has been modified to account for the digital effects by including the use of Z transforms. The new approach has been used to perform aeroservoelastic analysis for AFTI/F-16. Author

N83-20897# Royal Aircraft Establishment, Farnborough (England).
DYNAMIC RESPONSE OF AIRCRAFT WITH FLUCTUATING FLOW FIELDS
J. G. JONES *In* Von Karman Inst. for Fluid Dynamics Unsteady Airloads and Aeroelastic Probl. in Separated and Transonic Flow 24 p 1981 refs
Avail: NTIS HC A15/MF A01

The mathematical models of motions in terms of the coupled system involving the aerodynamic flow field and the aircraft dynamic response to aerodynamic forces are outlined. The systems have two types of behavior which are determined by the magnitude of a controlling parameter which influences stability. For a finite range or parameter values the system is stable and its structure is described by a deterministic set of differential equations. At the critical value of the parameter, however, the system becomes unstable and beyond this boundary no longer achieves a state of equilibrium but may exist in a state typified by continuous fluctuations. This state may be either a regular limit cycle type of oscillation or may be random in nature. E.A.K.

N83-20898# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany).
AEROELASTIC BUFFETING PREDICTION TECHNIQUE. A GENERAL REVIEW
H. FOERSCHING *In* Von Karman Inst. for Fluid Dynamics Unsteady Airloads and Aeroelastic Probl. in Separated and Transonic Flow 49 p 1981 refs
Avail: NTIS HC A15/MF A01

Analytical techniques for the prediction of the aeroelastic buffeting behavior of flexible aircraft are described. The basic characteristics of separated flow unsteady airloads as they relate to the aeroelastic buffet problem are outlined. The problem of formulating appropriately the various types of regular or irregular buffeting oscillations is treated, and the corresponding mathematical/physical models are reviewed. The problem of acquisition and conversion of wind tunnel model data to form full scale generalized aerodynamic buffet forcing functions and motion induced airload terms is discussed. E.A.K.

N83-20899# Royal Aircraft Establishment, Bedford (England).
SOME REMARKS ON BUFFETING
D. G. MABEY *In* Von Karman Inst. for Fluid Dynamics Unsteady Airloads and Aeroelastic Probl. in Separated and Transonic Flow 15 p 1981 refs
Avail: NTIS HC A15/MF A01

Buffeting which is the structural response to the aerodynamic excitation produced by separated flow is discussed. Buffet onset is often defined as the first appearance of a significant area of separated flow. The term buffeting was first introduced when a structural failure occurred to the tail of a Junkers monoplane in 1930. This failure was attributed to buffeting of the tailplane excited by flow separations on the wing. The flow separations on the

wing were caused by an encounter with a severe gust which was attributed to the structural failure of the wing caused by the gust. It is emphasized that buffeting often occurs in critical flight situations, when limit loads are approached or when the aircraft is approaching lateral or longitudinal stability boundaries. E.A.K.

N83-20951*# Purdue Univ., Lafayette, Ind. School of Aeronautics and Astronautics.
THE INTEGRATED MANUAL AND AUTOMATIC CONTROL OF COMPLEX FLIGHT SYSTEMS Semiannual Status Report, 1 Jul. - 31 Dec. 1982
D. K. SCHMIDT 3 Mar. 1983 42 p refs
(Contract NAG4-1)
(NASA-CR-170099; NAS 1.26:170099) Avail: NTIS HC A03/MF A01 CSCL 01C

Development of a unified control synthesis methodology for complex and/or non-conventional flight vehicles, and prediction techniques for the handling characteristics of such vehicles are reported. Identification of pilot dynamics and objectives, using time domain and frequency domain methods is proposed. N.W.

N83-20952*# Purdue Univ., Lafayette, Ind. School of Aeronautics and Astronautics.
ENHANCED MANUAL CONTROLLABILITY VIA ACTIVE CONTROL OF AEROELASTIC VEHICLES Semiannual Status Report, 1 Aug. 1982 - 31 Jan. 1983
D. K. SCHMIDT 1983 58 p refs
(Contract NAG1-254)
(NASA-CR-170118; NAS 1.26:170118) Avail: NTIS HC A04/MF A01 CSCL 01C

A modal analysis technique was developed for evaluating the effects of elastic modes on aircraft dynamic response, and the handling qualities implication of these effects. Author

N83-22094# Systems Technology, Inc., Hawthorne, Calif.
PROGRESS AND PITFALLS IN ADVANCED FLIGHT CONTROL SYSTEMS
D. MCRUER *In* AGARD Advan. in Guidance and Control Systems 17 p Jan. 1983 refs
Avail: NTIS HC A11/MF A01

Unfavorable side effects of the conjunction of multiple-fail-operational fly-by-wire flight control and high-performance new aircraft technology are discussed. Greater flight control system (FCS) complexity and cost are obvious disadvantages but other unfavorable effects are more subtle. The first is associated with the flight control and flying qualities of unstable relaxed static stability aircraft. In solving the control problem an equivalent vehicle is created in which the key dynamic properties comprise a mix of FCS and airframe parameters. Unfortunately, the equivalent vehicle dynamics may no longer correspond to those of conventional aircraft. Instead, they are different in kind as well as degree. There are very few flying quality data that are appropriate for such systems and, not surprisingly, existing criteria are difficult or impossible to apply directly. Such data as do exist are summarized and implications for possible criteria developed. The second issue is the accumulation of lags and delays resulting when stick and flexible mode suppression filters, high-frequency actuation dynamics, and computational delays, are combined. These give rise to a net effective time lag or delay in the vehicle dynamics as seen by the pilot which, if excessive, can cause serious piloting problems. The third example focuses on some of the peculiarities associated with sampled, as contrasted with continuous, control. R.J.F.

N83-22095# Office National d'Etudes et de Recherches Aeronautiques, Paris (France).
DESIGNING IMPROVED TRACKING REGULATORS FOR PILOTING HIGHLY MANEUVERABLE AIRCRAFT [REALISATION DE REGULATEURS DE POURSOUTE AMELIORES POUR LE PILOTAGE DES AVIONS A GRANDE MASOEUVRABILITE]
O. L. MERCIER *In* AGARD Advan. in Guidance and Control Systems 13 p Jan. 1983 refs
Avail: NTIS HC A11/MF A01

The multivariable control of an highly maneuvering aircraft in an extended flight envelope is receiving a growing attention in recent years. From the control designer point of view, it bears close relationship to the servomechanism problem in the sense that a vector of output variables is regulated to track continuously set command variables. This tracking problem is further complicated by the fact that, in the range of considered maneuvers, the dynamic model is highly nonlinear, variable about the flight domain, and prone to severe modeling errors and variations. Yet, piloting objectives must be met while satisfying handling qualities specifications. In addition, tracking must be maintained under continuously acting external disturbances and low-frequency turbulence must be rejected. Important defects of classical methods are shown and an improved theory is presented and applied to the fighter control problem. Tolerance of model mismatch and nonlinearities is especially demonstrated in numerical simulations. Author

N83-22096# Salford Univ. (England). Dept. of Aeronautical and Mechanical Engineering.
MICROPROCESSOR IMPLEMENTATION OF FAST-SAMPLING DIRECT DIGITAL FLIGHT-MODE CONTROLLERS
B. PORTER, A. BRADSHAW, A. GARIS, and M. A. WOODHEAD *In* AGARD Advan. in Guidance and Control Systems 8 p Jan. 1983 refs
Avail: NTIS HC A11/MF A01

Some general results are extended to allow for a computational time-delay of up to one sampling period by a simple modification of the control algorithms. The resulting control algorithms are simple to implement and provide tight non-interacting control. Their efficiency and effectiveness are demonstrated by the presentation of the results of a laboratory microprocessor implementation in which the controllers are required to effect fuselage pitch pointing and vertical translation maneuvers in the case of an analogue computer representation of the YF-16 aircraft. R.J.F.

N83-22097# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. fuer Dynamik der Flugsysteme.
SYSTEMATIC COMPUTER AIDED CONTROL DESIGN
G. GRUEBEL and G. KREISSELMEIER *In* AGARD Advan. in Guidance and Control Systems 7 p Jan. 1983 refs
Avail: NTIS HC A11/MF A01

Computerized synthesis techniques of modern control theory are in widespread use, but a number of fundamental design problems still remain. They are the design specfications problem, the free design parameter problem, the plant complexity versus controller simplicity problem, and the dirty design environment problem. A design procedure which comes close to solving these design problems is recommended: it is an iterative design technique using a performance index vector which provides a systematic guidance for the designer to take care of multiple design objectives simultaneously and individually. As a design tool unconstrained parameter optimization is used. A practical application is briefly reported: The design of a robust control loop for a fighter aircraft where 42 performance criteria of 9 different sorts have been considered simultaneously. R.J.F.

N83-22101# Crouzet Aerospace and Systems, Valence (France).
ANEMOBAROMETRIC SYSTEMS FOR NEXT GENERATION AIRCRAFT [SYSTEMES ANEMOBAROMETRIQUES POUR AVIONS DE LA PROCHAINE GENERATION]
J. MANDLE *In* AGARD Advan. in Guidance and Control Systems 9 p Jan. 1983 refs In FRENCH
Avail: NTIS HC A11/MF A01

Major principles and significant results are presented for a general study of the vehicles for anemometry and barometry of the next generation aircraft. The evolution of equipment in the past is reviewed and recent trends are presented which represent two different concepts - integrated systems and specific systems. A survey conducted in 1980 among numerous organizations in France as well as in the United States shows that the second solution has more supporters. Transl. by A.R.H.

N83-22105# Calspan Advanced Technology Center, Buffalo, N.Y.
FLIGHT CONTROL SYSTEM DESIGN USING ROBUST OUTPUT OBSERVERS
E. G. RYNASKI *In* AGARD Advan. in Guidance and Control Systems 8 p Jan. 1983 refs
Avail: NTIS HC A11/MF A01

An investigation was made of the application of robust output observer theory to the design of flight control systems for advanced aircraft configurations. Observer theory constitutes a natural design tool because the resulting observers are in themselves unobservable and do not increase the order of the closed-loop response, thereby more closely satisfying flying qualities requirements. Examples are presented to show that the observer configuration is not unique in either the observer poles or the output sensors, and many different control system configurations using a variety of sensors can be designed to yield identical closed-loop dynamic behavior. In this way, considerable analytic and physical redundancy can be incorporated into nearly any flight control system. Author

N83-22108# Northrop Corp., Hawthorne, Calif. Flight Control Research Dept.
DEVELOPMENT AND APPLICATION OF DIGITAL CONTROL FOR TACTICAL AIRCRAFT FLUTTER SUPPRESSION
D. S. JOSHI, D. F. KESLER, and E. H. JOHNSON *In* AGARD Advan. in Guidance and Control Systems 14 p Jan. 1983 refs
(Contract F33615-80-C-3217)
Avail: NTIS HC A11/MF A01

Active control methods have been applied to synthesize and mechanize digital control laws for tactical aircraft futter suppression. Several methods to digitize analog control laws have been compared. The State Space Method with Jordan Canonical Transformation offers a systematic and efficient digital flutter control design for multivariable systems. A transonic wind tunnel test conducted under a U.S. Air Force contract conclusively demonstrated the feasibility of digital implementation. Author

N83-22110# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany). Aircraft Div.
FLIGHT TEST EXPERIENCE WITH A DIGITAL INTEGRATED GUIDANCE AND CONTROL SYSTEM IN A CCV FIGHTER AIRCRAFT
U. KORTE *In* AGARD Advan. in Guidance and Control Systems 11 p Jan. 1983 refs
Avail: NTIS HC A11/MF A01

A quad redundant digital FBW Control System for a highly unstable fighter aircraft has been developed and flight tested by MBB in a single seater F-104 G which had been modified as a CCV demonstrator. The CCV program was funded by the German MOD. From Dec. 1977 to Nov. 1981 a total of 118 flights has been conducted. During these flights the quadruplex system was successfully tested for five different configurations starting with the highly stable basic aircraft and ending up with the highly unstable canard configuration with a static instability up to 22% mean aerodynamic chord (MAC). Some of the results obtained regarding control system design, handling evaluation and redundancy management with the digital system will be presented. Author

N83-22111# Marconi Avionics Ltd., Rochester (England). Combat Aircraft Controls Div.
GROUND AND FLIGHT TESTING ON THE FLY-BY-WIRE JAGUAR EQUIPPED WITH A FULL TIME QUADRUPLEX DIGITAL INTEGRATED FLIGHT CONTROL SYSTEM
T. D. SMITH, C. J. YEO, and R. E. W. MARSHALL *In* AGARD Advan. in Guidance and Control Systems 20 p Jan. 1983 refs
Avail: NTIS HC A11/MF A01

A national (U.K.) research programme has been undertaken with the aim of the design, development and demonstration of a safe, practical full time fly-by-wire flight control system for a combat aircraft. Throughout the program, the flight control system was to be treated in all airworthiness aspects as though it were intended for production. The flight trials were to include flight assessment of an integral spin prevention system and aircraft configurations which are unstable in pitch. The first major objective of the program has been achieved, namely the generation of confidence in the airworthiness of such a system, by the successful completion of the design, development, ground testing and initial flight test assessment of a fully representative system. Author

N83-22143# Marconi Avionics Ltd., Rochester (England). Flight Controls Div.
DISSIMILAR SOFTWARE IN HIGH INTEGRITY APPLICATIONS IN FLIGHT CONTROLS
D. J. MARTIN *In* AGARD Software for Avionics 13 p Jan. 1983 refs
Avail: NTIS HC A19/MF A01

The requirements of high integrity systems are defined and examples of failure surviving systems given. Having discussed the impact of digital processors on system design, various solutions are reviewed. Multiplex similar redundant systems are used widely in flight controls and some of their strengths and weaknesses are detailed. Software techniques applied to similar redundant systems are then briefly described. A dissimilar redundant solution, using two different microprocessors, is discussed and the impact of this architecture on software procedures is reported. Finally, a review of the strengths and weaknesses of the dissimilar architecture approach is given. M.G.

N83-22205*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EFFICIENT ALGORITHMS FOR COMPUTING TRIM AND SMALL-DISTURBANCE EQUATIONS OF MOTION OF AIRCRAFT COORDINATED AND UNCOORDINATED, STEADY, STEEP TURNS
R. T. N. CHEN Feb. 1983 41 p refs
(NASA-TM-84324; A-9220; NAS 1.15:84324) Avail: NTIS HC A03/MF A01 CSCL 01C

The development of computational algorithms that permit efficient calculation of aircraft trim states and of the associated small disturbance equations of motion for a systematic investigation of the statics and dynamics of aircraft in coordinated and uncoordinated, steady, steep turning flight is reported. The efficiency in the trim computation is realized by decoupling the governing equations. The small disturbance equations of motion, which are given in a general body axis system, include aerodynamic acceleration derivatives; they are cast in a familiar first order, vector matrix format of modern system theory. These algorithms were applied to a variety of rotorcraft simulation models. Results pertaining to a simulated hingeless rotor helicopter are also presented S.L.

N83-22206*# Old Dominion Univ., Norfolk, Va. Dept. of Mechanical Engineering and Mechanics.
INHERENT SPIRAL STABILITY IN A FIXED WING AIRCRAFT BY MEANS OF A SIMPLIFIED PNEUMATIC WING TIP CONTROL SYSTEM Progress Report, period ending 31 Dec. 1982
G. L. GOGLIA and B. K. ARUNKUMAR Apr. 1983 27 p refs
(Contract NSG-1177)
(NASA-CR-170207; NAS 1.26:170207) Avail: NTIS HC A03/MF A01 CSCL 01C

The concept of the lateralizer device is to sense the difference in wing tip static pressures (differential pressures being created by wing tip venturis) produced when any deviation from straight to level flight occurs. In a steady state turn the low slow wing tip experiences less venturi suction than the high fast wing tip. This signal activates the appropriate servos connected to the ailerons to produce a wing leveling restoring moment. If the wing is subjected to rolling velocities due to changes of the local angle of attack at the tip, the downgoing wing tip operates at a higher angle than the upgoing one. If with an increase in the angle of attack the signal is such that it increases the venturi pressure, then the servos are activated to produce the most negative signal to an upgoing aileron which results in a wing leveling restoring moment. In other words, any deviation from straight and level flight in either roll or yaw is exploited and the difference signal from the differential pressures activates the servo to effect or produce the necessary corrective action to null the signal.
Author

N83-22207*# Systems Technology, Inc., Hawthorne, Calif.
FLIGHT DYNAMICS ANALYSIS AND SIMULATION OF HEAVY LIFT AIRSHIPS. VOLUME 1: EXECUTIVE SUMMARY Final Report, Sep. 1979 - Dec. 1982
R. F. RINGLAND, M. B. TISCHLER, H. R. JEX, R. D. EMMEN, and I. L. ASHKENAS Dec. 1982 40 p refs 5 Vol.
(Contract NAS2-10330)
(NASA-CR-166471-VOL-1; NAS 1.26:166471-VOL-1; TR-1151-2-VOL-1) Avail: NTIS HC A03/MF A01 CSCL 01C

A generic, yet comprehensive mathematical model and computer simulation of the HLA flight dynamics over its entire flight envelope was developed. Implicit in this simulation development are the data reviews and analyses which support the equations of motion and the calculation of forces and moments acting on the vehicle. The simulation, HYBRDS, is addressed to the broad requirements and is intended for use as a synthesis and analysis tool for the evaluation of competing HLA design concepts. S.L.

N83-22208*# Systems Technology, Inc., Hawthorne, Calif.
FLIGHT DYNAMICS ANALYSIS AND SIMULATION OF HEAVY LIFT AIRSHIPS. VOLUME 2: TECHNICAL MANUAL Final Report, Sep. 1979 - Dec. 1982
R. F. RINGLAND, M. B. TISCHLER, H. R. JEX, R. D. EMMEN, and I. L. ASHKENAS Dec. 1982 314 p refs 5 Vol.
(Contract NAS2-10330)
(NASA-CR-166471-VOL-2; NAS 1.26:166471-VOL-2; TR-1151-2-VOL-2) Avail: NTIS HC A14/MF A01 CSCL 01C

The mathematical models embodied in the simulation are described in considerable detail and with supporting evidence for the model forms chosen. In addition the trimming and linearization algorithms used in the simulation are described. Appendices to the manual identify reference material for estimating the needed coefficients for the input data and provide example simulation results. S.L.

N83-22210*# Systems Technology, Inc., Hawthorne, Calif.
FLIGHT DYNAMICS ANALYSIS AND SIMULATION OF HEAVY LIFT AIRSHIPS, VOLUME 4. USER'S GUIDE: APPENDICES Final Report, Sep. 1979 - Dec. 1982
R. D. EMMEN and M. B. TISCHLER Dec. 1982 234 p refs 5 Vol.
(Contract NAS2-10330)
(NASA-CR-166471-VOL-4; NAS 1.26:166471-VOL-4; TR-1151-2-VOL-4) Avail: NTIS HC A11/MF A01 CSCL 01C

This table contains all of the input variables to the three programs. The variables are arranged according to the name list groups in which they appear in the data files. The program name, subroutine name, definition and, where appropriate, a default input value and any restrictions are listed with each variable. The default input values are user supplied, not generated by the computer. These values remove a specific effect from the calculations, as explained in the table. The phrase 'not used' indicates that a variable is not used in the calculations and are for identification purposes only. The engineering symbol, where it exists, is listed to assist the user in correlating these inputs with the discussion in the Technical Manual. S.L.

N83-22211*# Systems Technology, Inc., Hawthorne, Calif.
FLIGHT DYNAMICS ANALYSIS AND SIMULATION OF HEAVY LIFT AIRSHIPS. VOLUME 5: PROGRAMMER'S MANUAL Final Report, Sep. 1979 - Dec. 1982
R. F. RINGLAND, M. B. TISCHLER, H. R. JEX, R. D. EMMEN, and I. L. ASHKENAS Dec. 1982 152 p refs 5 Vol.
(Contract NAS2-10330)
(NASA-CR-166471-VOL-5; NAS 1.26:166471-VOL-5; TR-1151-2-VOL-5) Avail: NTIS HC A08/MF A01 CSCL 01C

The Programmer's Manual contains explanations of the logic embodied in the various program modules, a dictionary of program variables, a subroutine listing, subroutine/common block/cross reference listing, and a calling/called subroutine cross reference listing. S.L.

N83-22212*# Systems Technology, Inc., Mountain View, Calif.
ANALYSIS OF PILOT CONTROL STRATEGY Final Contractor Report, Feb. - Sep. 1982
R. K. HEFFLEY, G. D. HANSON, W. F. JEWELL, and W. F. CLEMENT Apr. 1983 136 p refs
(Contract NAS4-2941)
(NASA-CR-170399; NAS 1.26:170399; TR-1188-2) Avail: NTIS HC A07/MF A01 CSCL 01C

Methods for nonintrusive identification of pilot control strategy and task execution dynamics are presented along with examples based on flight data. The specific analysis technique is Nonintrusive Parameter Identification Procedure (NIPIP), which is described in a companion user's guide (NASA CR-170398). Quantification of pilot control strategy and task execution dynamics is discussed in general terms followed by a more detailed description of how NIPIP can be applied. The examples are based on flight data obtained from the NASA F-8 digital fly by wire airplane. These examples involve various piloting tasks and control axes as well as a demonstration of how the dynamics of the aircraft itself are identified using NIPIP. Application of NIPIP to the AFTI/F-16 flight test program is discussed. Recommendations are made for flight test applications in general and refinement of NIPIP to include interactive computer graphics. Author

N83-22213*# Analytical Mechanics Associates, Inc., Hampton, Va.

TERMINAL AREA AUTOMATIC NAVIGATION, GUIDANCE AND CONTROL RESEARCH USING THE MICROWAVE LANDING SYSTEM (MLS). PART 5: DESIGN AND DEVELOPMENT OF A DIGITAL INTEGRATED AUTOMATIC LANDING SYSTEM (DIALS) FOR STEEP FINAL APPROACH USING MODERN CONTROL TECHNIQUES Final Report

N. HALYO Washington Apr. 1983 81 p refs

(Contract NAS1-15116)

(NASA-CR-3681; NAS 1.26:3681; REPT-8242-PT-5) Avail: NTIS HC A05/MF A01 CSCL 01C

The design and development of a 3-D Digital Integrated Automatic Landing System (DIALS) for the Terminal Configured Vehicle (TCV) Research Aircraft, a B-737-100 is described. The system was designed using sampled data Linear Quadratic Gaussian (LOG) methods, resulting in a direct digital design with a modern control structure which consists of a Kalman filter followed by a control gain matrix, all operating at 10 Hz. DIALS uses Microwave Landing System (MLS) position, body-mounted accelerometers, as well as on-board sensors usually available on commercial aircraft, but does not use inertial platforms. The phases of the final approach considered are the localizer and glideslope capture which may be performed simultaneously, localizer and steep glideslope track or hold, crab/decrab and flare to touchdown. DIALS captures, tracks and flares from steep glideslopes ranging from 2.5 deg to 5.5 deg, selected prior to glideslope capture. Digital Integrated Automatic Landing System is the first modern control design automatic landing system successfully flight tested. The results of an initial nonlinear simulation are presented here. Author

N83-22214*# Lockheed-Georgia Co., Marietta.

SIMULATOR INVESTIGATION PLAN FOR DIGITAL FLIGHT CONTROLS VALIDATION TECHNOLOGY

D. B. MULCARE, W. G. NESS, and J. E. MCCORD Jul. 1982 187 p refs

(Contract NAS2-10270)

(NASA-CR-166427; NAS 1.26:166427; FAA-CT-21-161) Avail: NTIS HC A09/MF A01 CSCL 01C

Recommendations for real time simulation based research investigations designed to study validation methods for digital flight control systems (DFCS) are presented. These recommendations focus on utilization of the DFCS test bed established as a validation test facility. Twelve areas of investigation are broadly defined with the following six being specifically presented: (1) cross channel synchronization; (2) sensor comparator dependability; (3) mode fault logic path determination; (4) multiple fault insertions; (5) revalidation of stability augmentation modifications; and (6) fault survivability of stability augmentation. S.L.

N83-22215# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).

RECENT TRANSONIC FLUTTER INVESTIGATION FOR WINGS AND EXTERNAL STORES

Jan. 1983 66 p refs Meeting held in Toronto, Sep. 1982

(AGARD-R-703; ISBN-92-835-1443-2) Avail: NTIS HC A04/MF A01

Recent activities in the areas of aeroelasticity, subsonic flutter and transonic flutter are described. Results achieved in developing an adaptive flutter-suppression are described. Wind tunnel test results on aeroelastic wing models with external stores are discussed.

N83-22216# National Aeronautical Establishment, Ottawa (Ontario). High Speed Aerodynamics Lab.

A CANADIAN APPROACH TO FLUTTER CLEARANCE FOR EXTERNAL STORES

B. H. K. LEE and J. H. GOODEY (Canadair Limited) *In* AGARD Recent Transonic Flutter Invest. for Wings and External Stores 20 p Jan. 1983 refs

Avail: NTIS HC A04/MF A01

The Canadian capability in flutter clearance of military aircraft carrying underwing stores is reviewed. The flight test facilities and procedures, on-line analogue and post-flight digital data analysis, and analytical flutter model are described. Some results for the LAU-5003/A rocket launchers carrying C14 rockets armed with Mk I warheads are presented. Frequencies and damping values obtained from strip derivatives and doublet lattice aerodynamics methods used in the flutter computational code are discussed. Experimental results from on-line and post-flight analyses are compared for one aircraft/store configuration. Author

N83-22217# Messerschmidt-Boelkow G.m.b.H., Munich (West Germany). Unternehemensbereich Flugzeuge.

FLUTTER INVESTIGATIONS IN THE TRANSONIC FLOW REGIME FOR A FIGHTER TYPE AIRCRAFT

W. LUBER and H. SCHMID *In* AGARD Recent Transonic Flutter Invest. for Wings and External Stores 14 p Jan. 1983 refs

Avail: NTIS HC A04/MF A01

A correction method for subsonic potential airforces especially for the transonic flow regime is proposed. The airforces are corrected by modifying the theoretical pressure coefficients locally with measured static pressure slopes. Trends of transonic airloads and moments with reduced frequency, Mach number and mean static incidence are given. The application of corrected airforces in flutter calculations is described, and its effect on flutter behavior is analyzed. It could be confirmed by analysis that the aerodynamic damping of the most important low-frequency vibration modes is reduced by aerodynamic transonic effects, which was indicated by flight flutter test results. Author

N83-22218*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

FLUTTER AND STEADY/UNSTEADY AERODYNAMIC CHARACTERISTICS OF SUPERCRITICAL AND CONVENTIONAL TRANSPORT WINGS

W. F. GROSSER (Lockheed-Georgia Co.), R. T. BRITT (Lockheed-Georgia Co.), C. B. CHILDS (Lockheed-Georgia Co.), O. J. CROOKS (Lockheed-Georgia Co.), and F. W. CAZIER, JR. *In* AGARD Recent Transonic Flutter Invest. for Wings and External Stores 14 p Jan. 1983 refs

Avail: NTIS HC A04/MF A01 CSCL 01C

This paper presents the technical details and results of a high-speed wind-tunnel test program of an aeroelastic cantilevered transport type wing with two pylon-mounted engines. The tests were conducted in the NASA-Langley 16-foot Transonic Dynamic tunnel (TDT) during December 1981. Flutter of identical planforms, mass properties, and stiffness. The test parameters included different values of model stiffness and wing loading at various angles of attack. The models were instrumented at span-wise wing stations to determine bending and torsion deflections and vertical accelerations. At two model wing stations, pressure transducers were distributed along the chord to record static and unsteady oscillatory pressures during the approach to and onset of flutter. This paper presents the test program with results of the flutter characteristics and selected steady and unsteady aerodynamic data for both airfoils at different angles of attack for various Mach numbers and dynamic pressures. Author

N83-22219*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ADAPTIVE FLUTTER SUPPRESSION, ANALYSIS AND TEST
E. H. JOHNSON (Northrop Corp.), C. HWANG (Northrop Corp.), D. S. JOSHI (Northrop Corp.), C. A. HARVEY (Honeywell, Inc.), L. T. HUTTSELL (AFWAL), and M. G. FARMER *In* AGARD Recent Transonic Flutter Invest. for Wings and External Stores 12 p Jan. 1983 refs
Avail: NTIS HC A04/MF A01 CSCL 01C

Methods of adaptive control have been applied to suppress a potentially violent flutter condition of a half-span model of a lightweight figher aircraft. This marked the confluence of several technologies with active flutter suppression, digital control and adaptive control theory the primary contributors. The control algorithm was required to adapt both to slowly varying changes, corresponding to changes in the flight condition or fuel loading and to rapid changes, corresponding to a store release or the transition from a stable to an unstable flight condition. The development of the adaptive control methods was followed by a simulation and checkout of the complete system and a wind tunnel demonstration. As part of the test, a store was released from the model wing tip, transforming the model abruptly from a stable configuration to a violent flutter condition. The adaptive algorithm recognized the unstable nature of the resulting configuration and implemented a stabilizing control law in a fraction of a second. The algorithm was also shown to provide system stability over a range of wind tunnel Mach numbers and dynamic pressures.
Author

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RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tube facilities; and engine test blocks.

A83-28832*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SOME SOLUTIONS TO THE PROBLEMS AND PITFALLS OF LASER VELOCIMETRY IN A LARGE TRANSONIC WIND TUNNEL
D. E. REUBUSH and J. M. FRANKE (NASA, Langley Research Center, Hampton, VA) IN: Engineering applications of laser velocimetry; Proceedings of the Symposium, Phoenix, AZ, November 14-19, 1982 . New York, American Society of Mechanical Engineers, 1982, p. 7-12. refs

Attention is given to engineering design and development features of a two-component, coaxial backscatter laser velocimetry system which attempts to realize the long-recognized desirability of this technique's use for nonintrusive flow measurement. The design of the optics for the present 16-foot transonic wind tunnel device, and problems associated with the installation of the system in the hostile, test section plenum chamber environment are discussed. O.C.

A83-28952*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
WIND TUNNEL NOISE REDUCTION AT MACH 5 WITH A ROD-WALL SOUND SHIELD
T. R. CREEL and I. E. BECKWITH (NASA, Langley Research Center, High-Speed Aerodynamics Div., Hampton, VA) AIAA Journal (ISSN 0001-1452), vol. 21, May 1983, p. 643, 644; Abridged. refs
(AIAA PAPER 82-0570)

A method of shielding a wind-tunnel model from noise radiated by the tunnel-wall boundary layer has been developed and tested at the Langley Research Center. The shield consists of a rectangular array of longitudinal rods with boundary-layer suction through gaps between the rods. Tests were conducted at Mach 5 over a unit Reynolds number range of 1.0-3.5 x 10 to the 7th/m. Hot-wire measurements indicated the freestream noise, expressed in terms of the rms pressure fluctuations normalized by the mean pressure, was reduced from about 1.4 percent just upstream of the shielded region of a minimum level of about 0.4 percent in the forward portion of the shielded flow. Author

A83-29846*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
DYNAMIC CHARACTERISTICS OF THE 40- BY 80-/80- BY 120-FOOT WIND TUNNEL DRIVE FAN BLADES
W. WARMBRODT (NASA, Ames Research Center, Moffett Field, CA) IN: Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 2 . New York, American Institute of Aeronautics and Astronautics, 1983, p. 368-379. refs
(AIAA 83-0918)

The existing 40- by 80-Foot Wind Tunnel at Ames Research Center is being modified to upgrade and expand the research capabilty of the facility. The modification project includes an enhancement of the wind-tunnel drive power capability by installing large capacity electric motors and new drive fans to attain higher airspeeds in the existing 40- by 80-ft test section. It also involves the constructin of a new tunnel leg which includes a larger 80--by 120-ft test section. The 40-by 80-ft test section will have a maximum airspeed approaching 300 knots. It was previously limited to about 200 knots. The maximum airspeed of the 80- by 120-ft test section will be about 100 knots. Becaue of the critical nature of the drive fans in the operation of the facility, an extensive effort was undertaken to verify, for each blade-retention system, its structural integrity and its dynamic characteristics. G.R.

N83-20905# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
WIND TUNNEL WALL INTERFERENCE IN UNSTEADY TRANSONIC TESTING
N. C. LAMBOURNE *In its* Unsteady Airloads and Aeroelastic Probl. in Separated and Transonic Flow 17 p 1981 refs
Avail: NTIS HC A15/MF A01

The sources of wind tunnel interference are identified and particular attention being given to those affecting unsteady transonic measurements. The results of comparative measurements in different transonic tunnels are described and their implications regarding the avoidance of large interference effects are discussed. E.A.K.

N83-20953# Committee on Science and Technology (U. S. House).
FAA NATIONAL AIRSPACE SYSTEM PLAN
Washington GPO 1982 221 p Hearings before the Subcomm. on Transportation, Aviation and Mater. of the Comm. on Sci. and Technol., 97th Congr., 2d Sess., no. 86, 28-29 Apr. 1982
(GPO-94-438) Avail: Subcommittee on Transportation, Aviation and Materials

The following items of concern were discussed: data links, remote maintenance monitoring, consolidation of air route traffic control centers, new DOT/FAA communications network, development of long range radar, flight service station modernization, sector suites, traffic alert and collision avoidance systems (TCAS), microwave landing system, and national airspace review (NAR). B.G.

N83-20955# RAND Corp., Santa Monica, Calif.
THE TAXIWAY REPAIR SCHEDULE PROBLEM: A HEURISTIC RULE AND A BRANCH-AND-BOUND SOLUTION Interim Report
L. H. WEGNER Oct. 1982 39 p refs
(Contract F49620-82-C-0018)
(AD-A122497; RAND/N-1883-AF) Avail: NTIS HC A03/MF A01 CSCL 12A

After an attack on an airbase, the system of taxiways that connect aircraft shelters or parking areas to the airbase runway may be so damaged that some of the aircraft are not able to

reach the runway. In this Note, the Taxiway Repair Schedule Problem is defined to be the problem of finding the optimal sequence for repairing the damaged taxiway sections, assuming that each section has a known repair time and that the sections are repaired one at a time. An optimal taxiway repair sequence minimizes the average time that aircraft have been denied access to the runway. Two procedures are presented for selecting repair schedules: one, a branch-and-bound algorithm, actually determines an optimal schedule, but at a high computational cost (which becomes infeasibly high for large number of damaged taxiway sections); the second, a heuristic rule, is computationally simple but does not select optimal schedules for all problems. The two procedures are compared for 100 example problems. GRA

N83-20957# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
WALL INTERFERENCE IN WIND TUNNELS
London Sep. 1982 222 p refs Conf. held in London, 19-20 May 1982
(AGARD-CP-335; ISBN-92-835-0321-X) Avail: NTIS HC A10/MF A01

Current usage and basic developments for wind tunnel wall corrections are addressed including Reynold's number corrections, wall and support interference, flow quality and aeroelasticity. Solid wall, ventilated wall, and adaptive wall wind tunnels are among the topics discussed. Progress in the area of wind tunnel correction is evident with adaptive walls to reduce or eliminate wall interference.

N83-20958# Royal Aircraft Establishment, Bedford (England). Aerodynamics Dept.
A METHOD FOR DETERMINING WALL-INTERFERENCE CORRECTIONS IN SOLID-WALL TUNNELS FROM MEASUREMENTS OF STATIC PRESSURE AT THE WALLS
P. R. ASHILL and D. J. WEEKS *In* AGARD Wall Interference in Wind Tunnels 12 p Sep. 1982 refs
Avail: NTIS HC A10/MF A01

A method is described for calculating wall interference in solid wall tunnels from measurements of pressures at the walls. The method has the advantage over similar techniques of not requiring a description of the flow in the region of the model. Calculations of wall interference for aerofoil tests at high subsonic speeds are presented, and the wall corrections obtained are compared with results from other methods. Generally good agreement is obtained. A theoretical evaluation of the method suggests that it is suitable for calculating wall corrections for three dimensional configurations that are not amendable to correction by classical methods.
Author

N83-20959# British Aerospace Aircraft Group, Brough (England).
THE USE OF PANEL METHODS FOR THE EVALUATION OF SUBSONIC WALL INTERFERENCE
D. R. HOLT and B. HUNT *In* AGARD Wall Interference in Wind Tunnels 16 p Sep. 1982 refs
Avail: NTIS HC A10/MF A01

The use of panel methods is discussed for the evaluation of subsonic wall interference effects in both two and three dimensions. The techniques that the experimenter must adopt in order to use the methods efficiently and accurately were evaluated rather than on once and for all corrections. Particular examples are given to illustrate the general approach together with further uses of panel methods in the general field of support interference. Author

N83-20960*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SIMILARITY RULES FOR EFFECTS OF SIDEWALL BOUNDARY LAYER IN TWO-DIMENSIONAL WIND TUNNELS
R. W. BARNWELL and W. G. SEWALL *In* AGARD Wall Interference in Wind Tunnels 10 p Sep. 1982 refs
Avail: NTIS HC A10/MF A01 CSCL 14B

A simple analysis of the interaction of the model pressure field with the boundary layer on an unventilated wind tunnel wall is presented. It is shown that the effects of this interaction are similar to compressibility effects for sidewall boundary layers in two dimensional wind tunnels. This similarity is used to derive modified forms of the Prandtl Glauert rule for subsonic flow and the von Karman rule for transonic flow which are validated by comparison with experimental data. The three dimensional interaction problem is discussed, and it is shown that model pressure field/wall boundary layer interaction effects are not similar to compressibility effects in three dimensional wind tunnels.
Author

N83-20961# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany). Unternehmensbereich Flugzeuge.
REYNOLDS NUMBER EFFECTS ON TRANSONIC SHOCK LOCATION
F. AULEHLA and A. EBERLE *In* AGARD Wall Interference in Wind Tunnels 12 p Sep. 1982 refs
Avail: NTIS HC A10/MF A01

The example of a variable density transonic wind tunnel shows that the boundary layer displacement at the test section wall is about hundred times bigger than the corresponding effects at the model. Computations using variable boundary conditions at the test section wall show that the shock location on an axisymmetric body is noticeably altered. These computed shifts in shock location agree very well with those measured in the wind tunnel leaving little room for true Reynolds number effects on the model itself. Lastly, an opposite and purely theoretical approach is presented, in which the shock location on a Korn profile was computed for the free flight case and for a model boundary layer assumed to be fully turbulent. The results show that for this particular example with fixed transition there is only a negligible change in shock location when Reynolds number is raised from 4 million to 20,000 million. The conclusion drawn from these three different examples is that the true Reynolds number effects on transonic shock location appear to be by orders of magnitudes smaller than generally quoted from variable density wind tunnel measurements. B.G.

N83-20962# Group for Aeronautical Research and Technology in Europe, Amsterdam (Netherlands).
TWO-DIMENSIONAL TRANSONIC TESTING METHOD
A. ELSENAAR and E. STANEWSKY *In* AGARD Wall Interference in Wind Tunnels 16 p Sep. 1982 refs
Avail: NTIS HC A10/MF A01

Measurements were made of the CAST-7/DOA1 airfoil in 7 European facilities, involving perforated, slotted and flexible wall wind tunnels. A comparison was made of the 'best data available' for each tunnel, using various wall interference correction methods. Also, a limited comparison of some of the correction methods themselves was carried out. A large variation in experimental results was found for the uncorrected data. However, different types of correction methods reduce this scatter considerably. From this comparison it can be concluded that measured boundary condition methods and the flexible wall concept appear to be very promising. It is expected that a further analysis of these preliminary results might reduce the experimental uncertainty even more, so establishing a well defined data base for viscous transonic flow computational methods. Author

N83-20963# Royal Inst. of Tech., Stockholm (Sweden).
FLOW PROPERTIES OF SLOTTED-WALL TEST SECTIONS
S. B. BERNDT *In* AGARD Wall Interference in Wind Tunnels 7 p Sep. 1982 refs
Avail: NTIS HC A10/MF A01

A brief survey of results and problems relevant to the objective of eliminating wall interference in three-dimensional transonic tests by proper shaping of the slots was evaluated. The principal features of the flow in a slotted test section are described and then illustrated by experimental results from two FFA wind tunnels. The importance of maintaining free stream velocity to the full depth of the slots is stressed; the viscous effects evident in the experiments are viewed against this need. The classical inviscid flow model of two dimensional slotted wall flow is compared with experiments and shown to give fair agreement in its range of validity. A fully three

dimensional and general inviscid flow model is described briefly and interference free slot shapes for axisymmetric flows computed with this flow model are reviewed. Finally, problems of correcting the theoretical results for viscous effects are touched upon.
Author

N83-20964# National Aeronautical Establishment, Ottawa (Ontario). High Speed Aerodynamics Lab.
WALL BOUNDARY-LAYER EFFECTS IN TRANSONIC WIND TUNNELS
Y. Y. CHAN *In* AGARD Wall Interference in Wind Tunnels 15 p Sep. 1982 refs
Avail: NTIS HC A10/MF A01

Boundary layer developments on the perforated walls and the sidewalls of a transonic two dimensional wind tunnel have been studied experimentally and computationally. For the upper and lower walls, the wall characteristics are strongly modulated by the boundary layer and a correlation depending explicitly on the displacement thickness is obtained. A method of calculating the boundary-layer displacement effect is derived, providing the boundary condition for the interference flow in the tunnel. For the sidewalls, the three dimensional boundary layer developments at the vicinity of the model mount has been calculated and its displacement effect analyzed. The effectiveness of controlling the adverse effects by moderate surface suction is demonstrated.
Author

N83-20965# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Aerodynamische Versuchsanstalt.
THREE-DIMENSIONAL WALL CORRECTIONS FOR VENTILATED WIND TUNNELS
H. HOLST *In* AGARD Wall Interference in Wind Tunnels 11 p Sep. 1982 refs
Avail: NTIS HC A10/MF A01

Correction factors (angle of incidence and flow curvature) have been calculated or ventilated wind tunnels by the vortex lattice method. For the cases of open and closed test sections these results agree very good with those calculated using the image technique. For ventilated walls (slotted and/or perforated) results are presented. The vortex lattice method is then used to calculate wall pressures in closed and ventilated test sections. Measurements in a 1.3m closed square test section were made using circular discs for blockage and a rectangular wing as a lift generator. The results (wall pressure distributions and force coefficients) are presented and will be a basis of comparison for wall pressures in a slotted wall test section.
Author

N83-20966# National Aerospace Lab., Amsterdam (Netherlands).
MEASURED BOUNDARY CONDITIONS METHODS FOR 2D FLOW
J. SMITH *In* AGARD Wall Interference in Wind Tunnels 15 p Sep. 1982 refs
Avail: NTIS HC A10/MF A01

Modern developments in wind tunnel wall correction methods are for a major part directed towards the use of in situ measured boundary conditions in order to eliminate the need to describe the complicated aerodynamic characteristics of test section walls. This paper presents a short general review of the principles of such methods for two dimensional flow. The major practical problems associated with the application of the methods are discussed and some typical results are shown.
Author

N83-20967# National Aeronautical Establishment, Ottawa (Ontario). High Speed Aerodynamics Lab.
SUBSONIC WALL INTERFERENCE CORRECTIONS FOR FINITE-LENGTH TEST SECTIONS USING BOUNDARY PRESSURE MEASUREMENTS
M. MOKRY *In* AGARD Wall Interference in Wind Tunnels 15 p Sep. 1982 refs
Avail: NTIS HC A10/MF A01

Subsonic wall interference corrections by using the Fourier solution for the Dirichlet problem in a circular cylinder, interior to the three dimensional test section were evaluated. The required boundary values of the streamwise component of wall interference velocity are obtained from pressure measurements by a few static pressure tubes located on the cylinder surface. The coefficients of the resultant Fourier-Bessel series are obtained in closed form and the coefficients of the Fourier sine series are calculated by the fast Fourier transform, so that the method is very efficient and suitable for routine tunnel testing.
E.A.K.

N83-20968# Office National d'Etudes et de Recherches Aeronautiques, Paris (France).
IMPROVING CALCULATIONS OF WALL EFFECTS IN INDUSTRIAL WIND TUNNELS AT ONERA [AMELIORATIONS DES CALCULS DES EFFETS DE PAROIS DANS LES SOUFFLERIES INDUSTRIELLS DE L'ONERA]
X. VAUCHERET *In* AGARD Wall Interference in Wind Tunnels 12 p Sep. 1982 refs *In* FRENCH; ENGLISH summary
Avail: NTIS HC A10/MF A01

Methods used to compute wall interference corrections for the ONERA large wind tunnels were improved over the years. The mathematical description of the model and its sting support is more and more sophisticated; an increasing number of singularities is used until an agreement between theoretical and experimental signatures of the model and sting on the walls of the closed test section is obtained. The effect of the singularity displacement from the central position is calculated when the model reaches large angles of attack. The porosity factor cargography on the perforated walls deduced from the measured signatures avoids to carry out reference tests in large tunnel as previously. The porosity factors obtained from the blockage terms (signatures at zero lift) and from the lift terms are in good agreement. In each case (model + sting + test section) wall corrections are now determined, before the tests, as a function of the fundamental parameters M, CD, Cl. During the wind tunnel tests, the corrections are quickly computed from these functions.
Author

N83-20969# Technische Univ., Berlin (West Germany). Inst. fuer Luft-und Raumfahrt.
ON THE USE OF ADAPTIVE WALLS FOR TRANSONIC WIND TUNNEL TESTING
U. GANZER *In* AGARD Wall Interference in Wind Tunnels 8 p Sep. 1982 refs
Avail: NTIS HC A10/MF A01

A wind tunnel test section with two adaptive walls for aerofoil testing and another one with eight flexible walls for 3-D model tests was developed. The constructional features, the calculation procedure for determining the adapted wall configuration and the computer based automatic control system are described. Test results obtained for the supercritical aerofoil CAST 7 are presented to demonstrate the potentiality of the adaptive wall concept in 2-D model tests. First test result with the 3-D test section using an ONERA C 5 body of revolution verify the feasibility of the adaptive wall technique for three dimensional model tests. An alternative 3-D test section design is discussed.
E.A.K.

N83-20970# Office National d'Etudes et de Recherches Aeronautiques, Paris (France). Div. Aerodynamique Experimentale.
USE OF ADAPTIVE WALLS IN 2D TESTS [UTILISATION DE PAROIS ADAPTABLES POUR LES ESSAIS EN COURANT PLAN]
J. P. ARCHAMBAUD and J. P. CHEVALLIER *In* AGARD Wall Interference in Wind Tunnels 14 p Sep. 1982 refs *In* FRENCH; ENGLISH summary
Avail: NTIS HC A10/MF A01

A new method for computing wall effects which answers questions arising from wall concept applications is outlined. The method computes: length of adapted regions, fairings with up and downstream regions, residual misadjustments effects, and reference conditions. The acceleration of the iterative process convergence and the development of an efficient technology used in CERT T2 wind tunnel gives the required test conditions in a single run. The efficiency of the whole process to obtain significant results with consideration of 3D case extension is demonstrated. E.A.K.

N83-20971*# Southampton Univ. (England). Dept. of Aeronautics and Astronautics.
THE STATUS OF TWO- AND THREE-DIMENSIONAL TESTING IN THE UNIVERSITY OF SOUTHAMPTON TRANSONIC SELF-STREAMLINING WIND TUNNEL
S. W. D. WOLF, I. D. COOK, and M. J. GOODYER *In* AGARD Wall Interference in Wind Tunnels 14 p Sep. 1982 refs (Contract NSG-7172)
Avail: NTIS HC A10/MF A01

An automated test section was used to develop a flexible walled testing technique which eliminates some sources of uncertainty in boundary interference effects which exist in conventional transonic test sections. The flexible floor and ceiling of the test section were adjusted to contours which produce a constant Mach number distribution along each wall with no model present. These aerodynamically straight contours form the basis for all streamlining. The wall data are to contain information on the models performance and on lift. Two dimensional validation testing has continued with a cambered NPL 9510 section. Lift data up to Mach 0.87 are compared with reference data. Drag information on a NACA 0012-64 section is presented to indicate the powerful effects of streamlining. Preliminary three dimensional testing in the two dimensional test section has demonstrated that model and support blockage can be relieved by wall contouring. E.A.K.

N83-20972*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ADAPTIVE-WALL WIND-TUNNEL RESEARCH AT AMES RESEARCH CENTER
E. T. SCHAIRER and J. P. MENDOZA *In* AGARD Wall Interference in Wind Tunnels 13 p Sep. 1982 refs
Avail: NTIS HC A10/MF A01

Adaptive-wall wind-tunnel research is summarized. This research includes small-scale two- and three-dimensional wind-tunnel experiments and numerical experiments with a three-dimensional adaptive-wall simulator. Airflow through the test-section walls is controlled by adjusting the pressures in segmented plenums. Interference free conditions are successfully attained in subsonic and transonic flows. An adaptive wall test section is constructed for the transonic wind tunnel. Wall interference was reduced in the three dimensional experiment at several angles of attack at Mach 0.60. A wing on wall configuration was modeled in the numerical experiments. These flow simulations showed that free air conditions can be approximated by adjusting boundary conditions at only the floor and ceiling of the test section. No sidewall control was necessary. E.A.K.

N83-20973# ARO, Inc., Arnold Air Force Station, Tenn.
DEVELOPMENT OF A THREE-DIMENSIONAL ADAPTIVE WALL TEST SECTION WITH PERFORATED WALLS
R. L. PARKER, JR. and J. C. ERICKSON, JR. *In* AGARD Wall Interference in Wind Tunnels 14 p Sep. 1982 refs
Avail: NTIS HC A10/MF A01

The two dimensional, porous adaptive wall development is described. Three dimensional experiments employing adaptive techniques to adjust variable porosity walls individually to minimize the interference on a generalized transonic model are summarized. The embodiment of the adaptive wall concept for three dimensional applications was investigated. A fully automated, computer controlled, closed loop three dimensional adaptive wall system was designed. Development of the subsystems includes the interface measurement instrumentation, the exterior-flow computation method, the actively controllable wall configuration, microprocessor-controlled hardware for the walls and instrumentation and the overall minicomputer based adaptive wall control algorithm. A two velocity component static pipe system is selected for the interface measurement system. Transonic small disturbance theory is used to compute the exterior flow region and a segmented, variable porosity configuration is selected for the test section walls. E.A.K.

N83-22972# Joint Publications Research Service, Arlington, Va.
USE OF GEOCHEMICAL INVESTIGATIVE METHODS FOR PRELIMINARY HYGIENIC ASSESSMENT OF EFFECT OF AIRPORTS ON ENVIRONMENT
V. M. KOTLYAR, L. N. PAVLOVA, and R. S. SMIRNOVA *In its* USSR Rept.: Life Sci. Biomed. and Behavioral Sci., No. 28 (JPRS-82696) p 13-16 21 Jan. 1983 Transl. into ENGLISH from Gig. Sanit. (Moscow), no. 7, Jul. 1982 p 63-65
Avail: NTIS HC A06/MF A01

Geochemical methods were used to identify chemical pollutants specific to airports and to measure the range of influence of airports as a source of pollution. High concentrations of 19 pollutants were found in soil and the localization of the zones of most intensive pollution was found to be related to the sites of prolonged or forced operation of aircraft engines. Atmospheric and hydrologic routes of pollution transport also correlated with soil concentration results. Pollution absorption by plants is also addressed. 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.

A83-27215
IS LH2 THE HIGH COST OPTION FOR AIRCRAFT FUEL
G. D. BREWER (Lockheed-California Co., Burbank, CA) In: IECEC '82; Proceedings of the Seventeenth Intersociety Energy Conversion Engineering Conference, Los Angeles, CA, August 8-12, 1982. Volume 3. New York, Institute of Electrical and Electronics Engineers, 1982, p. 1191-1196. refs

Applications, costs, and various concepts for production of LH2 are outlined. NASA studies have shown that if LH2 is used as aviation fuel the higher cost, as compared to CH4 or synjet, will be offset by lowered operational costs because of lighter weight and higher heat of combustion. A continuous steam-iron process for converting coal and water to H2 for aircraft fuels is projected to have a delivered cost of $8/MBtu, if the plant also generates electricity for sale to the grid. Untapped geothermal and hydroelectric resources are cited as favorable locations to set up electrolysis plants, thus assuring that future fuel cost increases will not affect the plant operating costs. Magnetic refrigeration, i.e., the magnetocaloric effect could yield a 25-40% reduction in the cost of liquefaction. A suggestion is presented to use LH2 in

aircraft to cool an intermediate gas, e.g., N2, which can be piped through tubes in the surface of the aircraft in cruise conditions to create laminar flow. Charging airline passengers 4 mills/mile travelled would be sufficient to equip all major U.S. airports to handle LH2 in 5 yr. M.S.K.

A83-28478
THE EFFECT OF ANISOTROPY, THICKNESS, AND OPERATING TIME ON THE CRACK GROWTH IN PRESSED AND ROLLED PRODUCTS OF D16CHT AND V95PCHT1 ALLOYS [VLIIANIE ANIZOTROPII, TOLSHCHINY I NARABOTKI NA ROST TRESHCHIN V PRESSOVANNYKH I KATANYKH POLUFABRIKATAKH IZ SPLAVOV D16CHT I V95PCHT1]
S. IA. IAREMA, O. P. OSTASH, A. G. VOVNIANKO, G. S. MARGOLIN, and G. IU. BENGUS (Akademiia Nauk Ukrainskoi SSR, Fiziko-Mekhanicheskii Institut, Lvov, Ukrainian SSR) Fiziko-Khimicheskaia Mekhanika Materialov, vol. 19, Jan.-Feb. 1983, p. 20-24. In Russian.

The durability of aircraft structures is determined to a large extent by the growth of small initial crack-like defects originating during metallurgical processes or machining operations. For parts and structures which cannot be readily inspected during the service of aircraft, it is essential that the crack growth time from the initial defect to failure exceed the service life of the aircraft. Here, the growth of through cracks in pressed and rolled sheets and panels of D16chT and V95pchT1 alloys is analyzed for the maximum stress intensity factor ranging from 5 to 40 MPa times square root of m. It is shown that the crack growth rate depends only to a slight extent on the operating time. V.L.

A83-28775
THE REMOVAL OF METALS FROM A JET FUEL USING A MANGANESE CATALYST [K VOPROSU DEMETALLIZATSII REAKTIVNOGO TOPLIVA NA MARGANTSEVOM KATALIZATORE]
A. SH. KANDELAKI (Kutaisskii Politekhnicheskii Institut, Kutaisi, Georgian SSR) Akademiia Nauk Gruzinskoi SSR, Soobshcheniia, vol. 108, Nov. 1982, p. 357-360. In Russian. refs

Experiments were carried out on a jet fuel distilled from a mixture of oils to investigate the effectiveness of using a manganese-base catalyst for the removal of metal impurities. It is shown that under optimum conditions, the degree of metal removal reaches 95-97%, the average yield of the fuel product being 94%. The catalyst remains sufficiently active during three months; after six months of use, the activity of the catalyst decreases by 20-25%. V.L.

A83-29282
CALCULATION OF THE DEPTH AND HARDNESS OF THE CARBURIZATION LAYER OF CYLINDRICAL PARTS [RASCHET GLUBINY I TVERDOSTI TSEMENTATSIONNOGO SLOIA TSILINDRICHESKIKH DETALEI]
F. I. DEMIN Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 4, 1982, p. 43-48. In Russian.

A method is proposed for the calculation of the depth and hardness of the carburization layer of cylindrical aircraft-engine parts. An analysis is presented of the probability of obtaining prescribed values of the depth and hardness of the carburization layer. B.J.

A83-29392#
SOME FUEL EFFECTS ON CARBON FORMATION IN GAS TURBINE COMBUSTORS
J. ODGERS and D. KRETSCHMER (UniversiteLaval, Quebec, Canada) Canadian Aeronautics and Space Journal (ISSN 0008-2821), vol. 28, Dec. 1982, p. 327-338. refs

With the introduction of gas turbine engine fuels from such new sources as oil shales, heavy oils, tar sands, etc., an increase in fuel aromatic content may be expected which could have a significant impact on carbon formation within gas turbine engine combustors. Two correlations are suggested which will assess the effects of alternative fuels on the formation of carbon in combustors. While neither of these correlations yields high accuracy, one is found to furnish an estimate of carbon for a wide range of equipment conditions within a factor of about five. O.C.

A83-29715
REPRODUCIBLE PROCESSING AND RELIABLE REPEATABILITY IN CARBON FIBRE COMPOSITES
T. SHARPLES (British Aerospace, Aircraft Group, Preston, Lancs., England) Composites (ISSN 0010-4361), vol. 14, April 1983, p. 101-106.

The processes employed in the manufacture of carbon fiber composite structural components for aircraft are described. An indication of the repeatability of these processes is given in terms of the mechanical properties and geometric shapes. The factors that contribute to variability are listed. These include manufacture of the fiber, manufacture of the resin, lay-up of the prepreg, cutting to shape, forming onto the tool, and the post-cure work. The ways that the quality of the raw materials and manufacturing processes can be controlled are surveyed. C.R.

A83-29718
COMPOSITES IN THE CONSTRUCTION OF THE LEAR FAN 2100 AIRCRAFT
J. V. NOYES (Lear Fan, Ltd., Newtownabbey, Northern Ireland) Composites (ISSN 0010-4361), vol. 14, April 1983, p. 129-139.

The level of application of composites in the construction of the Lear Fan 2100 aircraft is reviewed. Specific structural applications of carbon and Kevlar fibre-based composites in the airframe are described, together with the associated design criteria, material properties and environmental considerations. The paper discusses the manufacturing processes and structural assembly steps, and the scope and depth of material and structural testing associated with developing and certifying the airframe design. The basic inspection techniques used to monitor quality, and the pay-offs in terms of reduced fuel consumption and increased speed/altitude performance are outlined. Author

A83-29736*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
FRACTURE BEHAVIOR OF HYBRID COMPOSITE LAMINATES
J. M. KENNEDY (NASA, Langley Research Center, Hampton, VA) IN: Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 1 . New York, American Institute of Aeronautics and Astronautics, 1983, p. 68-78. refs
(AIAA 83-0804)

The tensile fracture behavior of 15 center-notched hybrid laminates was studied. Three basic laminate groups were tested: (1) a baseline group with graphite/epoxy plies, (2) a group with the same stacking sequence but where the zero-deg plies were one or two plies of S-glass or Kevlar, and (3) a group with graphite plies but where the zero-deg plies were sandwiched between layers of perforated Mylar. Specimens were loaded linearly with time; load, far field strain, and crack opening displacement (COD) were monitored. The loading was stopped periodically and the notched region was radiographed to reveal the extent and type of damage (failure progression). Results of the tests showed that the hybrid laminates had higher fracture toughnesses than comparable all-graphite laminates. The higher fracture toughness was due primarily to the larger damage region at the ends of the slit; delamination and splitting lowered the stress concentration in the primary load-carrying plies. A linear elastic fracture analysis, which ignored delamination and splitting, underestimated the fracture toughness. For almost all of the laminates, the tests showed that the fracture toughness increased with crack length. The size of the damage region at the ends of the slit and COD measurements also increased with crack length. Author

A83-29789#
TITANIUM POWDER METALLURGY COMPONENTS FOR ADVANCED AEROSPACE APPLICATIONS
D. EYLON (Metcut-Materials Research Group, Wright-Patterson AFB, OH), F. H. FROES, and L. D. PARSON (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) IN: Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 1 . New York, American Institute of Aeronautics and Astronautics, 1983, p. 586-593. refs
(AIAA 83-0982)

The three major steps of titanium powder metallurgy, i.e., powder production, shape-making, and consolidation, are reviewed. It is noted that careful selection of the powder production method and consolidation parameters results in a microstructure exhibiting tensile, fracture toughness, and fatigue properties that are at least equivalent to those of wrought alloy products. Contaminant-free powder is identified as the key factor in maintaining high fatigue strength, which is critical for many aerospace components. Complex shaped Ti-6Al-4V airframe and gas turbine engine components as large as 40 x 48 in. have already been produced by the ceramic mold method from prealloyed spherical rotating electrode powder. These components have demonstrated potential cost savings from 20 to 50 percent, compared with cast and wrought parts. V.L.

A83-29790#
STATISTICAL MODELING OF BALLISTIC DAMAGE AND RESIDUAL STRENGTH IN COMPOSITE STRUCTURES
H. P. KAN and M. M. RATWANI (Northrop Corp., Aircraft Div., Hawthorne, CA) IN: Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 1 . New York, American Institute of Aeronautics and Astronautics, 1983, p. 594-599. refs
(AIAA 83-1002)

Experimental data on ballistic damage size of composites is analyzed statistically to determine the data scatter and to establish higher levels of confidence in damage size predictions. Probability-based models for damage size and residual strength are developed. These models take into consideration the statistical variation in the test data of damage size and residual strength. The models are based on Weibull distribution of damage size. Analysis indicates that the model can be used to describe the damage size and residual strength distribution. Author

N83-21062# University of Southern California, Los Angeles. Dept. of Mechanical Engineering.
ABSTRACTS: 1982 AFOSR CONTRACTORS MEETING ON AIR BREATHING COMBUSTION DYNAMICS RESEARCH Interim Report
M. GERSTEIN and R. CHOUDHURY Nov. 1982 101 p refs Meeting held in Clearwater Beach, Fla., 1-4 Nov. 1982
(Contract AF-AFOSR-0222-82; AF PROJ. 2308)
(AD-A121647; AFOSR-82-0841TR) Avail: NTIS HC A06/MF A01 CSCL 21A

This report consists of a collection of expanded abstracts of the numerous research progress reports given by AFOSR supported contractors on the Air Force basic research program on Energy Conversion Related to Air-Breathing Propulsion and Explosions and of invited papers from other governmental agencies and contractors. These papers presented over a four-day period composed the 1982 contractors meeting on Air-Breathing Combustion Dynamics Research. The principal investigators and their organizational association are also identified. GRA

N83-21102 British Library Lending Div., Boston Spa (England).
PROTECTIVE COATINGS AGAINST FRETTING IN AIRCRAFT ENGINE CONSTRUCTION
R. SCHARWAECHTER and A. SICKINGER 6 Jan. 1983 14 p refs Transl. into ENGLISH from Tech. Zentral. Prakt. Metall. (USSR), v. 72, no. 8, 197 p 45-48
(BLL-CE-TRANS-7736-(9022.09)) Avail: British Library Lending Div., Boston Spa, England

The large number of positive and friction drives in aircraft engines encourages the occurrence of fretting. The wear process involved and those components most affected by wear are considered. Protective coatings are described which are suitable as preventive protection against fretting, as well as for repairing components already worn by fretting. A description is also given of various methods by which these coatings are applied. S.L.

N83-21168# California Univ., Irvine. Lab. for Sanitary Engineering and Environmental Health.
ENVIRONMENTAL QUALITY RESEARCH: FATE OF TOXIC JET FUEL COMPONENTS IN AQUATIC SYSTEMS Annual Report, 1 Jun. 1981 - 31 Aug. 1982
R. C. COOPER, L. HUNTER, P. C. ULRICHS, and R. DANIELSON Wright-Patterson AFB, Ohio AFAMRL Oct. 1982 101 p refs
(Contract F33615-80-C-0512; AF PROJ. 6302)
(AD-A122548; AFAMRL-TR-82-64) Avail: NTIS HC A06/MF A01 CSCL 06T

This report describes an investigation into the nature of the toxic components in the jet fuel JP-4. Toxicity evaluation was based on the inhibitory effect of the fuel water soluble extract (WSF) on the hatchability of Artemia salina eggs. JP-4 samples from different sources were shown to differ substantially both in hydrocarbon composition and toxicity. Toxicity tests with individual model hydrocarbons and mixtures indicated that: (1) contrary to widely held views, alkane hydrocarbons were substantially (20-50 times) more toxic than aromatics; (2) the major WSF components benzene, toluene, and xylenes (70-90% of total) accounted for less than 30% of WSF toxicity; and (3) the estimated toxicity of the remaining WSF hydrocarbons was high enough (approximately 2 ppm) to account for the rest of the WSF toxicity. It was concluded that all the JP-4 hydrocarbons were toxic, their contribution being dependent on the proportion present in the water soluble fraction, and that JP-4 toxicity was the sum of the toxicities of its component hydrocarbons. Least squares plots have been developed that allow prediction of maximum JP-4 WSF toxicities from: (1) benzene/toluene levels in the neat fuel and; (2) total hydrocarbon levels in the WSF. Author (GRA)

N83-21169# Boeing Military Airplane Development, Seattle, Wash. Operational Analysis Group.
FUEL/ENGINE/AIRFRAME TRADE-OFF STUDY: OPERATIONAL EFFECTS OF INCREASED FREEZE POINT FUELS Final Report, 2 Mar. 1981 - 30 Apr. 1982
P. M. MCCONNELL, L. A. MASSMANN, G. N. PETERSON, and F. P. TOLLE Wright-Patterson AFB, Ohio AFWAL Aug. 1982 180 p refs
(Contract F33615-78-C-2001; AF PROJ. 3048)
(AD-A121688; AFWAL-TR-82-2067) Avail: NTIS HC A09/MF A01 CSCL 21D

This study of extreme low temperature C-141, KC-135, and B-52 operational missions indicates that the -58 C freeze point specification for JP-4 fuel is ultra conservative. The study suggests that the freeze point could be increased by at least 12 C with no effect on in-flight performance and that there is a good possibility that commercial, Jet A fuel (-40 C freeze point) would be acceptable for these aircraft. A method of identifying realistic extreme low temperature, in-flight exposure and airplane fuel system response was developed. The ground environmental extremes were not studied and could impact the conclusions. GRA

N83-22320*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
FIRE RESISTANT FILMS FOR AIRCRAFT APPLICATIONS
D. A. KOURTIDES Mar. 1983 36 p refs Presented at the 8th Intern. Conf. on Fire Safety, Millbrae, Calif., 17-21 Jan. 1983
(NASA-TM-84337; A-9218; NAS 1.15:84337) Avail: NTIS HC A03/MF A01 CSCL 01C

Alternative sandwich panel decorative films were investigated as replacements for the polyvinyl fluoride currently used in aircraft interiors. Candidate films were studied for flammability, smoke emission, toxic gas emission, flame spread, and suitability as a printing surface for the decorative acrylic ink system. Several of the candidate films tested were flame modified polyvinyl fluoride, polyvinylidene fluoride, polyimide, polyamide, polysulfone, polyphenylsulfone, polyethersulfone, polybenzimidazole, polycarbonate, polyparabanic acid, polyphosphazene, polyetheretherketon, and polyester. The films were evaluated as pure films only, films silk-screened with an acrylic ink, and films adhered to a phenolic fiberglass substrate. Films which exhibited the highest fire resistant properties included PEEK polyetheretherketon, Aramid polyamide, and ISO-BPE polyester.
Author

N83-22441# Falcon Research and Development Co., Englewood, Colo.
CORRELATION OF FLAMMABILITY TEST DATA OF ANTIMISTING FUELS Final Report, Aug. 1980 - Aug. 1981
L. MAHOOD and R. L. TALLEY Dec. 1982 47 p refs
(Contract DTFA03-80-C-00061)
(FAA-CT-82-29; FALCON-TR-364010) Avail: NTIS HC A03/MF A01

As a part of a comprehensive program to minimize post-crash fire hazards of jet transport aircraft, a correlation study was conducted on flammability test data of neat Jet A fuel, and the same fuel with various antimisting additives. The data were from full scale aircraft crash tests, large scale fuel spillage/ignition tests, and several small scale flammability tests. Various rheometric tests were also considered. The ability of certain antimisting fuels to eliminate large fireballs during occupant survivable aircraft crashes was amply supported. Large scale crash simulations were found to be highly developed, and provide essential credibility on a given antimisting fuel near the end of its development. Small scale flammability test rigs used for screening antimisting fuels were found generally effective, but with some conflicting data between rigs, and with some derivations from large scale results. Methods were defined which can provide higher confidence and resolution for selected test rigs.
S.L.

N83-22442*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AVIATION GASOLINES AND FUTURE ALTERNATIVES
D. J. PATTERSON, ed. Washington May 1983 164 p refs Workshop held in Cleveland, Ohio, 3-5 Feb. 1981
(NASA-CR-2267; E-1260; NAS 1.55:2267) Avail: NTIS HC A08/MF A01 CSCL 21D

General aviation industry needs and directions, fuel supply/demand issues, and general aviation technology prospects are discussed.

N83-22443*# Federal Aviation Administration, Washington, D.C. Aircraft Engineering Div.
FAA CERTIFICATION REQUIREMENTS FOR FUTURE FUELS, FUEL SYSTEMS AND POWERPLANTS
T. C. HOREFF *In* NASA. Lewis Research Center Aviation Gasolines and Future Alternatives p 7-9 May 1983
Avail: NTIS HC A08/MF A01 CSCL 21D

The current FAA procedures for approving fuels, along with a comment or two as to what might be done relative to assuring the safety of using these alternative fuels, whatever they may be are addressed.
Author

N83-22444*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AVIATION ENERGY AND THE FUTURE OF THE RECREATIONAL USE OF SPORT AND GENERAL AVIATION AIRCRAFT
P. POBEREZNY (Experimental Aircraft Association) and H. ZEISLOFT (Experimental Aircraft Association) *In its* Aviation Gasolines and Future Alternatives p 9-14 May 1983
Avail: NTIS HC A08/MF A01 CSCL 21D

The activities of the Experimental Aviation Association (EAA) are summarized.
N.W.

N83-22445*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INDUSTRY'S ASSESSMENT OF THE NUMBER OF AIRPLANES IN THE GENERAL AVIATION FLEET ALONG WITH THEIR HOURS FLOWN AND FUEL CONSUMPTION DATA POWERED BY WHAT TYPE OF ENGINES, WHEN AND FOR WHAT REASONS, THROUGH THE YEAR 2000
T. J. SMITH (Mooney Aircraft) *In its* Aviation Gasolines and Future Alternatives p 15-32 May 1983
Avail: NTIS HC A08/MF A01 CSCL 21D

The future of general aviation, its fuels, and the piston powered fleet of aircraft up to the year 2000, and beyond are considered.
Author

N83-22446*# Michigan Univ., Ann Arbor.
LIGHTWEIGHT AIRCRAFT ENGINES, THE POTENTIAL AND PROBLEMS FOR USE OF AUTOMOTIVE FUELS
D. J. PATTERSON *In* NASA. Lewis Research Center Aviation Gasolines and Future Alternatives p 39-44 May 1983 Original document was announced as N81-18057
Avail: NTIS HC A08/MF A01 CSCL 21D

A comprehensive data research and analysis for evaluating the use of automotive fuels as a substitute for aviation grade fuel by piston-type general aviation aircraft engines is presented. Historically known problems and potential problems with fuels were reviewed for possible impact relative to application to an aircraft operational environment. This report reviews areas such as: fuel specification requirements, combustion knock, preignition, vapor lock, spark plug fouling, additives for fuel and oil, and storage stability.
Author (GRA)

N83-22447*# Shell Oil Co., Houston, Tex.
GENERAL AVIATION FUEL QUALITY CONTROL
H. POITZ *In* NASA. Lewis Research Center Aviation Gasolines and Future Alternatives p 45-50 May 1983
Avail: NTIS HC A08/MF A01 CSCL 21D

Quality control measures for aviation gasoline, and some of the differences between quality control on avgas and mogas are discussed. One thing to keep in mind is that with motor gasoline you can always pull off to the side of the road. It's not so easy to do in an airplane. Consequently, there are reasons for having the tight specifications and the tight quality control measures on avgas as compared to motor gasoline.
Author

N83-22448*# Phillips Petroleum Co., Bartlesville, Okla.
MANUFACTURING COMPARISONS OF AVIATION AND MOTOR GASOLINES
L. O. MEYER *In* NASA. Lewis Research Center Aviation Gasolines and Future Alternatives p 51-59 May 1983
Avail: NTIS HC A08/MF A01 CSCL 21D

The manufacturing of avgas is compared with that of autogas.
Author

N83-22449*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FUEL SUPPLY AND DISTRIBUTION. FIXED BASE OPERATION
L. C. BURIAN (National Air Transportation Association) *In its* Aviation Gasolines and Future Alternatives p 63-67 May 1983
Avail: NTIS HC A08/MF A01 CSCL 21D

Aviation gasoline versus other products, a changing marketplace, the Airline Deregulation Act of 1978, aviation fuel credit card purchases, strategic locations, storage, co-mingling of fuel, and transportation to/from central storage are discussed.
Author

N83-22450*# Teledyne Continental Motors, Mobile, Ala. Aircraft Products Div.
THE SPARK-IGNITION AIRCRAFT PISTON ENGINE OF THE FUTURE
K. J. STUCKAS *In* NASA. Lewis Research Center Aviation Gasolines and Future Alternatives p 75-87 May 1983
Avail: NTIS HC A08/MF A01

The advanced technology, spark ignition, aircraft piston engine design study was conducted to determine the improvements that could be made by taking advantage of technology that could reasonably be expected to be made available for an engine intended for production by January 1, 1990. Two engines were proposed to account for levels of technology considered to be moderate risk and high risk. The moderate risk technology engine is a homogeneous charge engine operating on avgas and offers a 40% improvement in transportation efficiency over present designs. The high risk technology engine, with a stratified charge combustion system using kerosene-based jet fuel, projects a 65% improvement in transportation efficiency. Technology enablement program plans are proposed herein to set a timetable for the successful integration of each time of required advanced technology into the engine design. Author

N83-22451*# Cessna Aircraft Co., Wichita, Kans.
AIRFRAME AND ENGINE INTEGRATION AND POTENTIAL IMPROVEMENTS
D. R. ELLIS *In* NASA. Lewis Research Center Aviation Gasolines and Future Alternatives p 89-97 May 1983
Avail: NTIS HC A08/MF A01 CSCL 21D

Airframe design alternative to cope with degraded engine performance, such as lower power or increased fuel consumption resulting from changes in fuels, are addressed. Author

N83-22452*# Avco Lycoming Div., Williamsport, Pa.
CURRENT DESIGNS, FUTURE POSSIBILITIES AND PROGRAMMATIC SUGGESTIONS
L. C. DUKE *In* NASA. Lewis Research Center Aviation Gasolines and Future Alternatives p 99-105 May 1983
Avail: NTIS HC A08/MF A01 CSCL 21D

Current piston engines, future engines, and the approach to develop them are addressed. Technology requirements are mentioned. Author

N83-22453*# Garrett Turbine Engine Co., Phoenix, Ariz.
FUTURE OF ALTERNATE FUELS FOR TURBINE ENGINES
H. SCHELP *In* NASA. Lewis Research Center Aviation Gasolines and Future Alternatives p 107-121 May 1983
Avail: NTIS HC A08/MF A01 CSCL 21D

The fuel property variations that were identified to be of concern with the utilization of alternate fuels for aircraft turbine engines are related to the potential problem areas. Author

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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.

A83-27189
TRANSIENT PERFORMANCE OF PERMANENT MAGNET SYNCHRONOUS MOTORS
W. U. BORGER (USAF, Aero Propulsion Laboratory, Wright-Patterson AFB, OH) In: IECEC '82; Proceedings of the Seventeenth Intersociety Energy Conversion Engineering Conference, Los Angeles, CA, August 8-12, 1982. Volume 2. New York, Institute of Electrical and Electronics Engineers, 1982, p. 684-690.

The performance of a permanent magnet synchronous machine is presented for transient conditions including: starting, load application and load removal. The machine studied possesses asynchronous torque for starting as well as synchronous torque for high efficiency and high power factor during normal operation. The transient performance of the synchronous machine is compared with a high efficiency induction machine of the same rating. The comparison presented is strictly analytical and is approached by developing the required equations for the idealized synchronous and induction machines. Solutions for the equations are approximated on the digital computer. Although the study is not universal in scope, it shows that the permanent magnet synchronous motor rivals the induction machine in weight and in transient performance while at the same time besting the induction machine from an efficiency and power factor standpoint.
(Author)

A83-27265
WHENCE STIRLING ENGINES
W. R. MARTINI (Martini Engineering, Richland, WA) In: IECEC '82; Proceedings of the Seventeenth Intersociety Energy Conversion Engineering Conference, Los Angeles, CA, August 8-12, 1982. Volume 4. New York, Institute of Electrical and Electronics Engineers, 1982, p. 1669-1674. refs

The Stirling engine, invented in 1816, was used from about 1860-WW I for machinery and households requiring a few kilowatts of power. The gasoline engine provided better efficiency and the electric motors to which they could be coupled were as silent as a Stirling engine. Development was revived in Holland in the 1930s to power radio transmitters silently, and the technology was carried over into compressors for producing liquified air. Engines from 0.25-30 hp were produced in the 1940s, with efficiencies as high as in gasoline engines as well as compactness and silent operation. The invention of the rhombic drive permitted a perfectly balanced one-cylinder operation. Work has proceeded on Stirling engines for solar space power, train and submarine propulsion, and for military ground power units. A DOE program has led to an engine that can increase land vehicle propulsion efficiency by over 30%, but with a nearly doubling of the engine costs. Further work is recommended for producing Stirling cogeneration and biomass-burning engines. M.S.K.

A83-28477
AN ANALYSIS OF THE DURABILITY CHARACTERISTICS OF AIRCRAFT STRUCTURES ON THE BASIS OF FRACTURE MECHANICS [RASCHET KHARAKTERISTIK EKSPLUATATSIONNOI ZHIVUCHESTI SAMOLETNYKH KONSTRUKTSII NA OSNOVE MEKHANIKI RAZRUSHENIIA]
G. I. NESTERENKO (Seminar po Fiziko-Khimicheskoi Mekhanike Khrupkogo Razrusheniia Konstruktsionnykh Materialov, June 23-25, 1982, Slavskoe, Ukrainian SSR). Fiziko-Khimicheskaia Mekhanika Materialov, vol. 19, Jan.-Feb. 1983, p. 12-20. In Russian. refs

The durability of aircraft structures is largely determined by the residual strength and the fatigue crack growth time. Here, fracture mechanics methods are presented for calculating the two principal durability characteristics for several typical cases of structural damage occurring during the operation of aircraft. The calculated results are compared against test data for full-scale structures. V.L.

A83-28507
A SOFTWARE PACKAGE FOR COMPUTING THE THREE-DIMENSIONAL STRESSED STATE OF THE BLADES OF GAS-TURBINE ENGINES [PROGRAMMNYI KOMPLEKS DLIA RASCHETA OB'EMNOGO TERMONAPRIAZHENNOGO SOSTOIANIA LOPATOK GTD]
L. A. ZASLOTSKAIA and S. E. UMANSKII (Akademiia Nauk Ukrainskoi SSR, Institut Problem Prochnosti, Kiev, Ukrainian SSR) Problemy Prochnosti, Mar. 1983, p. 34-39. In Russian. refs

A software package has been developed for computing the three-dimensional stressed state of the blades of gas-turbine engines by using the method of finite elements. The program performs automatic division of a given region into elements and solves the nonstationary heat conduction problem and the quasi-three-dimensional thermoelasticity problem. A computation example is presented. V.L.

A83-28634#
STUDY OF A HYPERTROCHOIDAL COMPRESSOR WITH PADDLES [ETUDE D'UN COMPRESSEUR HYPERTROCHOIDAL A PALETTES]
B. LEMOINE Lille I, Universite, Docteur-Ingenieur Thesis, 1982. 179 p. In French. refs

The design of hypertrochoidal compressors with paddles was examined. A hypertrochoidal compressor consists of a finite number of groups of dual circular wheels on which radial paddles are mounted. Each wheel has a different radius. The first member of each group has a fixed base, while the second member has a base fixed to the circumference of the first member, but none display any absolute motion around the center of the primary group. The centers of the rolling circumference of the second group members are fixed mechanically to the centers of a preceding group of two in the multiple group form of the hypertrochoidal compressor. An method of optimized choice of the form of the configuration of the hypertrochoidal configuration is defined, based on minimization of the stresses on the paddles within the wheels and controlling their parasitic motions. Numerical and experimental results are presented from determination of the most influential dynamic stress factors for the paddles. The hypertrochoidal compressor offers the possibility of operation without lubricants. M.S.K.

A83-28782#
CONEX GYROSCOPE
P. L. PREVITE, R. F. CIMERA, and T. MCDONOUGH (Singer Co., Kearfott Div., Wayne, NJ) In: National Aerospace Meeting, Moffett Field, CA, March 24, 25, 1982, Proceedings. Washington, DC, Institute of Navigation, 1982, p. 41-46.

The CONEX control and stabilization gyroflex gyro is an inertial instrument whose design is predicted on a building block concept and whose baseline is configured for the lowest production cost. Design features include a modular construction principle to which minor modifications may be made in order to enhance instrument performance for specific applications. Attention is presently given to CONEX gyro electrical and mechanical characteristics, test results, and performance in various gimballed and strapdown systems. Future developments of this technology are suggested which involve the use of molded plastic technology and of robotic assembly manufacturing methods. O.C.

A83-28966#
AN ALTERNATING METHOD FOR ANALYSIS OF SURFACE-FLAWED AIRCRAFT STRUCTURAL COMPONENTS
S. N. ATLURI (Georgia Institute of Technology, Atlanta, GA) and T. NISHIOKA (Structures, Structural Dynamics and Materials Conference, 23rd, New Orleans, LA, May 10-12, 1982, Collection of Technical Papers. Part 1, p. 287-300.) AIAA Journal (ISSN 0001-1452), vol. 21, May 1983, p. 749-757. refs
(Contract AF-AFOSR-81-0057)

Previously cited in issue 13, p. 2107, Accession no. A82-30107

A83-29215
MACROENCAPSULATION OF ELECTRONIC CIRCUITS
J. F. WAGNER (USAF, PRAM Program Office, Wright-Patterson AFB, OH) Journal of Environmental Sciences (ISSN 0022-0906), vol. 26, Mar.-Apr. 1983, p. 23-25. refs

Macroencapsulation of airborne electronic circuits has been developed to prevent moisture and contamination damage. Aircraft corrosion damage to circuitry causes $8 billion in losses in the U.S. each year. Particle impact noise detection testing is used to screen out new defective parts before installation. Coating materials presently used are normally application-specific. An all-purpose conformal coating was needed that was low cost, pinhole free, fast-drying, easily applied, moisture-proof, strong, and could be removed with common solvents. An organic polymer was evaluated for encapsulation of circuits for military use and tested for tensile strength, outgassing, thermal properties, resistance, dielectric breakdown, humidity, sealing, and bond strength in thermal cycling. The existing encapsulent, Parylene, was found to be superior or equivalent overall, but not in the areas of repairability and cost. The macroencapsulation did perform to military specifications. M.S.K.

A83-29278
ON AN ALGORITHM FOR SOLVING THE INCOMPLETE EIGENVALUE PROBLEM IN THE VIBRATION ANALYSIS OF COMPLEX STRUCTURES OF FUSELAGE TYPE [OB ODNOM ALGORITME RESHENIIA NEPOLNOI SOBSTVENNOI PROBLEMY PRI RASCHETE NA KOLEBANIIA SLOZHNYKH KONSTRUKTSII TIPA FIUZELIAZH]
V. P. BORISOV and P. A. SHAKIRZIANOV Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 4, 1982, p. 24-28. In Russian. refs

The Rayleigh-Ritz method is used to reduce the dimensionality of the problem of determining the lower frequencies and modes of vibration of structures in the form of the method of forces using discrete models. For free structures, an equation for natural vibrations of reduced dimensionality is obtained, and an algorithm for forming the matrix of initial basis forms is proposed. The efficiency of the method is illustrated by the analysis of five plane free frames of the same type with 12, 18, 48, 66, and 96 degrees of freedom on the basis of the Jacobi algorithm. B.J.

A83-29283
THE USE OF MULTIPLE COORDINATE SYSTEMS TO FORM STIFFNESS MATRICES OF THIN-WALLED STRUCTURES ON THE BASIS OF HYBRID COMPUTATIONAL SCHEMES [PRIMENENIE MNOZHESTVENNYKH KOORDINATNYHKH SISTEM DLIA POSTROENIIA MATRITS ZHESTKOSTI TONKOSTENNYKH KONSTRUKTSII NA OSNOVE GIBRIDNYKH RASCHETNYKH SKHEM]
P. D. LEVASHOV Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 4, 1982, p. 48-53. In Russian.

The paper examines a method for forming the stiffness matrices and load vectors for thin-walled structures which are analyzed on the basis of hybrid computational schemes with the introduction of several coordinate systems, common for nodal points of transition sections from one part of the structure to another. An

algorithm implementing this method is presented, and the stress analysis of a thin-walled conical wing of variable sweep is considered as an example. B.J.

A83-29696
JANUS - AN AIRCRAFT PROTOTYPE OF A LOW EARTH ORBIT SPLIT BEAM STEREOSCOPIC OBSERVING SYSTEM
A. BERROIR, P. DE FELICE, L. PONTIER, and P. SITBON (CNRS, Laboratoire de Meteorologie Dynamique, Palaiseau, Essonne, France) (COSPAR, Topical Meeting on Weather Satellites: Stereoscopy and Sounding, Ottawa, Canada, May 16-June 2, 1982) Advances in Space Research (ISSN 0273-1177), vol. 2, no. 6, 1982, p. 125-131. refs

The principle of determination of wind fields by a tomographic method is described. The airborne stereoscopic radometer JANUS has been built to assess the feasibility of such measurements. Results of preliminary flights over isolated cumulus compare favorably with direct measurements. New flights with improved auxiliary parameter determinations are ongoing. Author

A83-29741*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
STRUCTURAL OPTIMIZATION BY MULTILEVEL DECOMPOSITION
J. SOBIESZCZANSKI-SOBIESKI (NASA, Langley Research Center, Hampton, VA), B. JAMES, and A. DOVI (Kentron Technical Center, Hampton, VA) IN: Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers, Part 1 . New York, American Institute of Aeronautics and Astronautics, 124-143, 1983. refs
(AIAA 83-0832)

The application of formal optimization techniques to the design of large engineering structures such as aircraft is presently hindered in connection with the large number of design variables involved. According to an approach which attempts to overcome the difficulties, the problem is broken up into several smaller subproblems. This approach has, however, weaknesses which may prevent a determination of the minimum structural weight. Schmit and Ramanathan (1973) have developed a method, which is designed to incorporate control of the material distribution among the finite elements of an assembled structure for a two-level optimization. However, the optimization schemes considered would not be suitable to optimization schemes considered would not be suitable to multidisciplinary optimization of large engineering systems. Sobieszczanski-Sobieski (1982) proposed a method for decomposing a large multidisciplinary optimization problem into a number of small subproblems. The present investigation is concerned with the implementation of this method. G.R.

A83-29747#
ON THE EFFECT OF RESIDUAL STRESSES ON CRACK GROWTH FROM A HOLE
A. F. LIU (Northrop Corp., Aircraft Div., Hawthorne, CA) IN: Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 1 . New York, American Institute of Aeronautics and Astronautics, 1983, p. 191-195. Research supported by the Northrop Independent Research and Development Program.
(AIAA 83-0840)

A series of cyclic crack growth tests has been carried out on center-cracked specimens and specimens containing a yielded hole to investigate the effect of residual stresses on constant amplitude fatigue crack growth rates. The mechanics of a crack growing through a superimposed stress field (i.e., combining the residual stresses around the hole and the subsequently applied cyclic stresses) is elucidated by the 'Variable Stress Intensity Ratio' concept. Good correlations between theory and experiments have been obtained. Author

A83-29751#
IMPROVED DAMAGE-TOLERANCE ANALYSIS METHODOLOGY
J. B. CHANG (Rockwell International Corp., Los Angeles, CA) and R. M. ENGLE (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, OH) IN: Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 1 . New York, American Institute of Aeronautics and Astronautics, 1983, p. 224-236. refs
(Contract F33615-77-C-3121)
(AIAA 83-0863)

An improved damage-tolerance analysis methodology has been developed for predicting the fatigue crack growth behavior and the lives of various types of cracks and crack-like flaws in metallic airframe structures subjected to random spectrum loadings. The new methodology has been incorporated into a computer program, and a series of crack growth data correlation studies have been conducted. The improved damage-tolerance analysis methodology has been demonstrated to provide accurate predictions of fatigue crack growth lives for various classes of aircraft and various types of metallic materials. V.L.

A83-29763#
DESIGN, FABRICATION AND TEST OF GRAPHITE/POLYIMIDE COMPOSITE JOINTS AND ATTACHMENTS
J. B. CUSHMAN and D. E. SKOUMAL (Boeing Aerospace Co., Seattle, WA) IN: Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 1 . New York, American Institute of Aeronautics and Astronautics, 1983, p. 337-347. refs
(AIAA 83-0907)

The results of a program design to extend the current epoxy matrix composite technology in joint and attachment design to include the high-temperature polyimide matrix composites and adhesives are presented. In particular, the design, development, and evaluation of graphite/polyimide attachments that may be used for high-speed aircraft and space transportation systems operating in the 116-589 K temperature range are discussed. It is shown that the fabrication of graphite/polyimide attachment joints that will sustain the load levels specified for control surfaces of advanced aerospace vehicles and space transportation systems is possible with currently available materials. V.L.

A83-29766*# California Univ., Los Angeles.
STRUCTURAL OPTIMIZATION WITH DYNAMIC BEHAVIOR CONSTRAINTS
W. C. MILLS-CURRAN and L. A. SCHMIT (California, University, Los Angeles, CA) IN: Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 1 . New York, American Institute of Aeronautics and Astronautics, 1983, p. 369-382. refs
(Contract NSG-1490)
(AIAA 83-0936)

The minimum weight optimum design of damped linearly elastic structural systems subjected to periodic loading with behavior constraints on maximum deflections and side constraints on design variables is addressed. Attention is focused on the two major impediments to an optimal solution: (1) the time parametric nature of the behavior constraints; and (2) the severe nonconvexity of the design space. A solution method based on upper bound approximations for the behavior constraints and an innovative mathematical programming scheme for seeking the optimal frequency subspace is set forth. Numerical results for several test problems illustrate the effectiveness of the method reported. Author

A83-29769#
AN OPTIMALITY CRITERION METHOD FOR STRUCTURES WITH STRESS, DISPLACEMENT AND FREQUENCY CONSTRAINTS
A. ZACHAROPOULOS, K. D. WILLMERT (Clarkson College of Technology, Potsdam, NY), and M. R. KHAN (Bechtel Corp., Power Div., San Francisco, CA) IN: Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 1 . New York, American Institute of Aeronautics and Astronautics, 1983, p. 400-407. refs
(AIAA 83-0939)

Presented in this paper is a procedure, based on optimality criterion methods, for the minimum weight design of structures subjected to stress, displacement and natural frequency constraints. The technique presented is a combination of a previously developed method for stress and displacement constraints alone and one for frequency limited structures. The method is applied to a delta-wing example, and the optimal designs obtained are compared to previously published results. The new method is capable of obtaining the optimal design in a small number of iterations, without significant calculations beyond a standard analysis. No approximate analyses or determination of large numbers of Lagrange multiplies are involved. Author

A83-29775#
A BUILDING BLOCK APPROACH TO DESIGN VERIFICATION TESTING OF PRIMARY COMPOSITE STRUCTURE
R. S. WHITEHEAD and R. B. DEO (Northrop Corp., Aircraft Div., Hawthorne, CA) IN: Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 1 . New York, American Institute of Aeronautics and Astronautics, 1983, p. 473-477.
(AIAA 83-0947)

A building block approach to the certification of primary composite structure is presented. Static design development test data from an advanced fighter aircraft wing are used to illustrate the building block concept. Specimens ranging in complexity from coupons to subcomponents were tested under two conditions: room temperature ambient and 250 F/Wet. The test data showed that static strength reduction at 250 F/Wet conditions was a function of specimen failure mode, moisture content and specimen complexity. The influence of specimen complexity on failure mode demonstrated the necessity for the building block approach in the certification of composite structures. Specimen failure mode was also shown to be the dominant influence on the variability in tatic strength data. The test data were used to make recommendations for certification procedures for primary composite structures.
Author

A83-29796#
APPLICATION OF MULTIPLE OBJECTIVE OPTIMIZATION TECHNIQUES TO FINITE ELEMENT MODEL TUNING
H. C. BRIGGS, A. R. DEWISPELARE (USAF, Institute of Technology, Wright-Patterson AFB, OH), and C. R. DEVORE IN: Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 1 . New York, American Institute of Aeronautics and Astronautics, 1983, p. 649-656. refs
(AIAA 83-1010)

A procedure for tuning finite element models to reproduce selected experimental data is presented which incorporates multiple objective optimization theory and a weighted performance ranking system. First, the performance indices are extremized using multiple objective optimization theory, producing a set of possible solutions. Then, the solutions are rank ordered according to a decision maker's preferences to select the best answer. The tuning procedure is demonstrated by applying it to a T-38 horizontal stabilizer. The procedure performs smoothly, although much time and effort has to be expended to construct the data tables. The method can be easily adapted to various types of model tuning or optimization problems. V.L.

A83-29805*# United Technologies Corp., Stratford, Conn.
DESIGN, ANALYSIS AND TEST OF COMPOSITE CURVED FRAMES FOR HELICOPTER FUSELAGE STRUCTURE
M. J. RICH and D. W. LOWRY (United Technologies Corp., Sikorsky Aircraft Div., Stratford, CT) IN: Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 1 . New York, American Institute of Aeronautics and Astronautics, 1983, p. 730-737. Army-supported research. refs
(Contract NAS1-16826)
(AIAA 83-1005)

Curved beam effects in composite frame structures representative of a light helicopter airframe are examined, and currently available analytical methods for studying these effects are briefly reviewed. A finite element study of curved composite frames is then reported, and it is shown that the curved frame effects must be accurately accounted for to avoid premature fracture. The finite element method is shown to be accurate to within 10 percent in accounting for the curved beam effects in composite structures. V.L.

A83-29808#
STATISTICAL CRACK PROPAGATION IN FASTENER HOLES UNDER SPECTRUM LOADING
J. N. YANG (George Washington University, Washington, DC) and R. C. DONATH (USAF, Materials Laborfatory, Wright-Patterson AFB, OH) IN: Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 2 . New York, American Institute of Aeronautics and Astronautics, 1983, p. 15-21. refs
(Contract F33615-81-C-5015)
(AIAA 83-0808)

A simple fracture mechanics-based statistical model for fatigue crack propagation in fastener holes under spectrum loadings is proposed and investigated. A method is presented for analyzing the crack growth rate data to calibrate the model parameters. Emphasis is placed upon crack propagation in the small crack size region where the statistical dispersion is very significant. The statistical distributions of both the crack size at any service time instant and the crack propagation life to reach any specific crack size are derived analytically. Available fractographic data for 7475-T7351 aluminum fastener hole specimens under a B-1 bomber spectrum have been analyzed statistically. It is demonstrated that the correlation between the statistical model and the fractographic results is very reasonable. Author

A83-29814#
NEAR-REAL-TIME FLUTTER BOUNDARY PREDICTION FROM TURBULENCE EXCITED RESPONSE
B. H. WENDLER (Lockheed-California Co., Burbank, CA) IN: Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 2 . New York, American Institute of Aeronautics and Astronautics, 1983, p. 58-67. refs
(AIAA 83-0814)

This paper describes a computational method to predict instability boundaries during flight flutter tests or wind tunnel flutter model tests in a near-real-time fashion. The technique does not require prior knowledge of the flutter mechanism or measurement of the input force exciting the system if turbulence is exciting the structure. An adaptive filter model of the aircraft is formed from the aircraft response and then the stability coefficients of the filter are solved using the Levinson algorithm in a recursive procedure. Results from an application on a wind tunnel flutter model show that projected boundaries compare very accurately with actual flutter boundaries encountered during the test. Author

A83-29822*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THE COUPLED AEROELASTIC RESPONSE OF TURBOMACHINERY BLADING TO AERODYNAMIC EXCITATIONS
D. HOYNIAK (NASA, Lewis Research Center, Cleveland, OH; Purdue University, West Lafayette, IN) and S. FLEETER (Purdue University, West Lafayette, IN) IN: Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 2 . New York, American Institute of Aeronautics and Astronautics, 1983, p. 137-148. refs
(AIAA 83-0844)

An energy balance technique is developed to predict the coupled bending-torsion mode aerodynamically forced response of an airfoil. In this technique, the energy input to the airfoil system per cycle of oscillation is generated by gust forces and moments and, under certain conditions, the self-induced aerodynamic forces and moments. The energy dissipation per cycle is associated with the structural damping, the static moment term for coupled motions, and under certain conditions, the self-induced aerodynamic forces and moments. The effects of the various aerodynamic parameters on the coupled forced response are then considered.In particular, the effects of the inlet Mach number, the interblade phase angle, the level of structural damping, and the cascade geometry on the coupled bending-torsion aerodynamically forced response of a flat plate airfoil cascade are demonstrated. Author

A83-29823*# Massachusetts Inst. of Tech., Cambridge.
FLUTTER AND FORCED RESPONSE OF MISTUNED ROTORS USING STANDING WAVE ANALYSIS
J. DUGUNDJI and D. J. BUNDAS (MIT, Cambridge, MA) IN: Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 2 . New York, American Institute of Aeronautics and Astronautics, 1983, p. 149-159. refs
(Contract NAG3-214)
(AIAA 83-0845)

A standing wave approach is applied to the analysis of the flutter and forced response of tuned and mistuned rotors. The traditional traveling wave cascade airforces are recast into standing wave arbitrary motion form using Pade approximants, and the resulting equations of motion are written in the matrix form. Applications for vibration modes, flutter, and forced response are discussed. It is noted that the standing wave methods may prove to be more versatile for dealing with certain applications, such as coupling flutter with forced response and dynamic shaft problems, transient impulses on the rotor, low-order engine excitation, bearing motions, and mistuning effects in rotors. V.L.

A83-29824*# Textron Bell Aerospace Co., Buffalo, N. Y.
FLUTTER ANALYSIS OF ADVANCED TURBOPROPELLERS
V. ELCHURI and G. C. C. SMITH (Bell Aerospace Textron, Buffalo, NY) IN: Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 2 . New York, American Institute of Aeronautics and Astronautics, 1983, p. 160-165. refs
(Contract NAS3-22533)
(AIAA 83-0846)

The two-dimensional subsonic cascade unsteady aerodynamic theory of Jones and Rao (1975) has been modified to account for the variable sweep angles of the blades of advanced turbopropellers. The aerodynamics and the structural modal properties have been formally integrated to determine the generalized aerodynamic coefficients matrix for the blade modes. Modal flutter analysis has been conducted for two SR-5 five- and ten-blade propellers, and analytical results have been found to be in very good agreement with wind tunnel test data. V.L.

A83-29847#
GENERAL EQUATIONS OF MOTION FOR AN ELASTIC WING AND METHOD OF SOLUTION
V. J. E. STARK (Saab-Scania AB, Linkoping, Sweden) IN: Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 2 . New York, American Institute of Aeronautics and Astronautics, 1983, p. 380-388. Research supported by the Forsvaret Materielverk. refs
(AIAA 83-0921)

General equations of motion for a finite elastic wing are derived by first defining appropriate indicial aerodynamic coefficients. Calculation of these for a rectangular wing in incompressible flow by a vortex method, subtraction of steady state values, and normalization yield results very close to a single function for all modes. Solving the equations by Laplace transformation, the simple function transforms into an analytic function by means of which the inverse transform integral is simplified. As the system matrix determinant becomes analytic in the whole plane, the zeros of this determinant, which determine part of the solution, can be found by Newton's method. Author

A83-29848*# Lockheed-Georgia Co., Marietta.
FLUTTER ANALYSIS OF A TRANSPORT WING USING XTRAN3S
M. R. MYERS (Lockheed-Georgia Co., Marietta, GA), P. GURUSWAMY (Informatics General Corp., Palo Alto, CA), and P. M. GOORJIAN (NASA, Ames Research Center, Moffett Field, CA) IN: Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 2 . New York, American Institute of Aeronautics and Astronautics, 1983, p. 389-398. Research sponsored by the Lockheed-Georgia Co. and NASA. refs
(AIAA 83-0922)

As part of the continuing process of evaluating and validating the XTRAN3S unsteady transonic aerodynamic computer program, the code has been applied to the flutter analysis of a transport type wing. The configuration analyzed was an aspect ratio 8 wing with a taper ratio of 0.4, a quarter chord sweep of 20 degrees and a NACA 65A-012 airfoil section. The analytical results compare well with the experimental flutter boundary and exhibit the classical 'transonic dip'. A literature search of available transport wing transonic flutter data is included. Author

A83-29857#
THE EFFECT OF ACOUSTIC-THERMAL ENVIRONMENTS ON ADVANCED COMPOSITE FUSELAGE PANELS
J. SOOVERE (Lockheed-California Co., Burbank, CA) IN: Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 2 . New York, American Institute of Aeronautics and Astronautics, 1983, p. 466-472. refs
(Contract N62269-80-C-0239)
(AIAA 83-0955)

The sonic fatigue program, to determine the effect of elevated temperature on flat integrally-stiffened graphite/epoxy panels, is described. The program involved comparative sonic fatigue testing of two J-stiffened monolithic and two blade-stiffened orthogrid panels, with one panel of each design tested at ambient temperature and the other at a temperature of 254 Fahrenheit. The program also involved evaluation of existing analysis methods. Elevated temperature could affect the sonic fatigue life of composite panels. The higher damping in one of the panel designs is attributed to acoustic radiation. Sonic fatigue analysis methods for multimodal nonlinear panel response need to be developed. Author

A83-29874#
ACOUSTIC FATIGUE TEST EVALUATION OF ADHESIVELY BONDED ALUMINUM FUSELAGE PANELS USING FM 73/BR 127 ADHESIVE/PRIMER SYSTEM
H. F. WOLFE and K. R. WENTZ (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, OH) IN: Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 2 . New York, American Institute of Aeronautics and Astronautics, 1983, p. 626-631.
(AIAA 83-0999)

Adhesively bonded fuselage panels were tested in a plane progressive wave duct to determine their acoustic fatigue service lifetimes. The fatigue tests were conducted at sound pressures higher than the service conditions. The instrumentation consisted of strain and sound pressure measurements. The panels were visually inspected and ultrasonically inspected for cracks or bond failure at regular intervals. A wide variety of structural fatigue failures were obtained from the tests including adhesive disbonds, skin cracking and frame, clip angle and longeron cracking. The substructure frames, clips and longerons failed prior to the disbonds. The bonds and substructure did not survive one service lifetime. A smaller bay size design did survive the service lifetime. Author

A83-29879#
LARGE-AMPLITUDE MULTIMODE RESPONSE OF CLAMPED RECTANGULAR PANELS TO ACOUSTIC EXCITATION
C. MEI (Old Dominion University Norfolk, VA), H. F. WOLFE, D. B. PAUL (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, OH), and M. H. SHEN — IN: Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 2 . New York, American Institute of Aeronautics and Astronautics, 1983, p. 676-684. refs
(Contract AF-AFOSR-80-0107)
(AIAA 83-1033)

Large-deflection and multiple modes are included in the analysis to improve the prediction of random response of clamped rectangular panels subjected to broadband acoustic excitation. The von Karman large-deflection plate equations, Gelerkin's method, and equivalent linearization technique are employed. Mean-square deflections, mean-square stains, and equivalent linear frequencies are obtained for rectangular panels at various acoustic loadings. Author

A83-29885#
COMPARISON OF FREQUENCY DETERMINATION TECHNIQUES FOR CANTILEVERED PLATES WITH BENDING-TORSION COUPLING
D. W. JENSEN and E. F. CRAWLEY (MIT, Cambridge, MA) IN: Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 2 . New York, American Institute of Aeronautics and Astronautics, 1983, p. 737-743. refs
(Contract F33615-77-C-5155)
(AIAA 83-0953)

Various techniques for solution of the variational statement governing vibration of cantilevered composite plates are compared. The partial Ritz method assumes mode shapes only in the chordwise direction and reduces the problem to a set of ordinary differential equations. The important nondimensional parameters for cantilevered plates with bending-torsion coupling are then easily identified, including two which expressed the relative contribution of the warping stiffness to torsional vibration (beta-66) and chordise vibration (beta-22). The Rayleigh-Ritz solution, requiring assumed mode shapes in both directions, reveals the fundamental coupling mechanisms affecting the natural mode shapes and frequencies. The finite element method yields direct accurate results, yet masks the fundamental behavior. Experiments were performed to provide data for correlation with the analyses. Author

A83-29887#
BENDING EFFECTS ON STRUCTURAL DYNAMIC INSTABILITIES OF TRANSONIC WINGS
N. D. MALMUTH, S. R. CHAKRAVARTHY (Rockwell International Science Center, Thousand Oaks, CA), J. D. COLE (Rensselaer Polytechnic Institute, Troy, NY), and T. P. GOEBEL (Rockwell International Corp., El Segundo, CA) IN: Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 2 . New York, American Institute of Aeronautics and Astronautics, 1983, p. 753-766. refs
(Contract F33615-80-C-3208)
(AIAA 83-0920)

An approach referred to as the nonlinear coupled model is used to predict the destabilizing effects of sweepback. The model is based on strip theory with a revised version of LTRAN2 (a time integration procedure) and an idealization of the wing as a cantilever beam. The nonlinear coupled model is shown to provide accurate predictions of transonic flutter frequencies associated with two out of three nonclassical instability points for the B-1 and HiMAT observed experimentally. The model also correctly predicts the divergence features of the wing displacement on a qualitative basis. For the third point, where damped rather than experimentally observed amplified oscillations are predicted, one source of discrepancy is that the model assumes a temporal modulation of the free fundamental spatial mode, whereas the observed modulation was on the second mode. V.L.

A83-29970
THE STIFFNESS OF TRANSPORT WINGS FOR MINIMUM WEIGHT
H. HITCH (British Aerospace Public, Ltd., Co., Bristol, England) Aeronautical Journal (ISSN 0001-9240), vol. 87, March 1983, p. 104.

It is noted that, for a simple cantilever, thin walled tortion tube of area A(y), where y is the spanwise coordinate, the torsional deflection Phi at the tip, when subjected to a torque T(y), is a minimum for constant tube weight if the skin thickness t(y) is proportional to the square root of T/A. A parallel to these relationships is pointed out in the fact that the bending angle at the tip of a cantilever beam, whose section can be represented by two spar caps of equal area S(y) at a distance d(y) apart, when subjected to a bending moment M(y), is a minimum for constant spar cap weight when S(y) is proportional to the square root of M/d. O.C.

N83-21209*# Tufts Univ., Medford, Mass. Dept. of Engineering Design.
SIMULATION FIDELITY AND NUMEROSITY EFFECTS IN CDTI EXPERIMENTATION Final Report
J. G. KREIFELDT Jan. 1983 10 p refs
(Contract NCC2-93)
(NASA-CR-166459; NAS 1.26:166459) Avail: NTIS HC A02/MF A01 CSCL 17B

Twenty pilot workload assessment techniques were compared using a simulated flying task in which three levels of psychomotor workload were imposed. The experiment was conducted in a three degree of freedom motion base simulator. Opinion measures, spare mental capacity measures, physiological measures, eye movement behavior and primary task performance measures were evaluated. The primary task was an instrument landing system (ILS) approach and landing. All measures were recorded between the outer and middle markers on the approach. Three levels of psychomotor load were obtained by the combined manipulation of wind gust disturbance level and simulated aircraft pitch stability. Six instrument rated general aviation pilots participated in the experiment. Cooper-Harper ratings, WCI/TE ratings, time estimation standard deviation, pulse rate mean, and control movements per unit time demonstrated sensitivity to psychomotor load. No intrusion into primary task performance was found that the sensitivities of workload estimation techniques vary widely, and that only a few techniques appear to be sensitive to psychomotor load. A.R.H.

N83-21210*# Tufts Univ., Medford, Mass. Dept. of Engineering Design.
MULTI-MAN FLIGHT SIMULATOR *Progress Report, Oct. 1979-Sep. 1980*
G. MACDONALD Feb. 1983 44 p refs
(Contract NSG-2156)
(NASA-CR-166449; NAS 1.26:166449) Avail: NTIS HC A03/MF A01 CSCL 17B

A prototype Air Traffic Control facility and multiman flight simulator facility was designed and one of the component simulators fabricated as a proof of concept. The facility was designed to provide a number of independent simple simulator cabs that would have the capability of some local, stand alone processing that would in turn interface with a larger host computer. The system can accommodate up to eight flight simulators (commercially available instrument trainers) which could be operated stand alone if no graphics were required or could operate in a common simulated airspace if connected to the host computer. A proposed addition to the original design is the capability of inputing pilot inputs and quantities displayed on the flight and navigation instruments to the microcomputer when the simulator operates in the stand alone mode to allow independent use of these commercially available instrument trainers for research. The conceptual design of the system and progress made to date on its implementation are described. Author

N83-21212# Federal Aviation Administration, Atlantic City, N.J. Technical Center.
EN ROUTE MOVING TARGET DETECTOR (MTD) 2: TEST AND EVALUATION Final Report, Nov. 1979 - Sep. 1981
H. R. KLEUSKENS, E. W. HESS, and M. S. HULSE Washington Nov. 1982 40 p refs
(Contract FAA PROJ. 022-243-810)
(FAA-RD-82-34; FAA-CT-82-4) Avail: NTIS HC A03/MF A01

The moving target detector (MTD) 2 is a sophisticated signal processor designed to provide improved radar detection of aircraft in the air traffic control environment, particularly in areas of heavy radar clutter. The MTD 2 was installed on one channel of the FPS-67B en route surveillance radar. The operational performance of the MTD 2 was compared with that of the common digitizer (CD) operating with the other radar channel. Performance relative to percentage of target detection, false alarm rate, interference reduction, processor improvement factor, subclutter visibility, system dynamic range, velocity response, and flight testing of the MTD 2A and CD equipped radar channels are covered. The results of the test show that the MTD 2 provides performance superior to that of the CD. S.L.

N83-21314*# General Electric Co., Wilmington, Mass. Aircraft Instruments Dept.
HIGH ACCURACY FUEL FLOWMETER, PHASE 1 Final Report
C. MAYER, L. ROSE, A. CHAN, B. CHIN, and W. GREGORY Mar. 1983 156 p refs
(Contract NAS3-22139)
(NASA-CR-167893; NAS 1.26:167893) Avail: NTIS HC A08/MF A01 CSCL 14B

Technology related to aircraft fuel mass - flowmeters was reviewed to determine what flowmeter types could provide 0.25%-of-point accuracy over a 50 to one range in flowrates. Three types were selected and were further analyzed to determine what problem areas prevented them from meeting the high accuracy requirement, and what the further development needs were for each. A dual-turbine volumetric flowmeter with densi-viscometer and microprocessor compensation was selected for its relative simplicity and fast response time. An angular momentum type with a motor-driven, spring-restrained turbine and viscosity shroud was selected for its direct mass-flow output. This concept also employed a turbine for fast response and a microcomputer for accurate viscosity compensation. The third concept employed a vortex precession volumetric flowmeter and was selected for its unobtrusive design. Like the turbine flowmeter, it uses a densi-viscometer and microprocessor for density correction and accurate viscosity compensation. Author

N83-21357# Detroit Diesel Allison, Indianapolis, Ind.
FULL-AUTHORITY FAULT-TOLERANT ELECTRONIC ENGINE CONTROL SYSTEM FOR VARIABLE CYCLE ENGINES Final Report, 1 Sep. 1979 - 30 Apr. 1982
L. BAKER, W. E. BRAINARD, C. E. CURRY, C. P. DISPARTE, L. J. DOLNY, R. E. FLEMING, and D. E. WARNER Wright-Patterson AFB, Ohio AFWAL Apr. 1982 161 p refs
(Contract F33615-79-C-2002; AF PROJ. 3066)
(AD-A121746; DDA-EDR-10895; AFWAL-TR-82-2037) Avail: NTIS HC A08/MF A01 CSCL 21E

The objective of this program was to develop a design approach for full-authority digital electronic control systems with reliability the primary consideration factor. The approach used in attacking this objective was to identify a baseline full-authority digital electronic control system for and advanced fighter aircraft and then improve on this baseline control with respect to specific goals using redundancy, recovery strategies, and maintenance philosophies. Ambitious goals were established for controls-related mission reliability (2.5 mission aborts per million operating hours), mean time between control removals (1800 hours), and fail operational capability. Candidate control designs were evaluated with respect to cost and weight in addition to their ability to satisfy the design goals. The baseline control system was modularized to yield identifiable components (pumps, thermocouples, actuators, etc.). For these components, reliability and cost information was accumulated. Many of these configurations were screened with a Markov-based constant failure rate analysis simulation called the Generalized Reliability and Maintainability Program (GRAMP). A Generalized Reliability and Maintainability Simulator (GRAMS) tested promising configurations from GRAMP, using a time-varying analysis approach based on Monte Carlo techniques. The results of the GRAMP and GRAMS analysis showed necessary cost and weight increases associated with achieving an order of magnitude improvement in mission reliability by using a fault-tolerant structure as opposed to the baseline system. GRA

N83-21391*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
TIRE MODELING
J. A. TANNER, comp. Washington Mar. 1983 245 p refs Workshop held in Hampton, Va., 7-9 Sep. 1982
(NASA-CP-2264; L-15578; NAS 1.55:2264) Avail: NTIS HC A11/MF A01 CSCL 20K

The workshop was organized into six sessions dealing with finite element developments, applications to tire dynamic problems, solution techniques for tire contact problems, experimental data, tire thermal studies, and current design practices.

N83-21394*# Bendix Corp., South Bend, Ind. Brake and Strut Div.
APPLICATION OF TIRE DYNAMICS TO AIRCRAFT LANDING GEAR DESIGN ANALYSIS
R. J. BLACK *In* NASA. Langley Research Center Tire Modeling p 71-94 Mar. 1983 refs
Avail: NTIS HC A11/MF A01 CSCL 20K

The tire plays a key part in many analyses used for design of aircraft landing gear. Examples include structural design of wheels, landing gear shimmy, brake whirl, chatter and squeal, complex combination of chatter and shimmy on main landing gear (MLG) systems, anti-skid performance, gear walk, and rough terrain loads and performance. Tire parameters needed in the various analyses are discussed. Two tire models are discussed for shimmy analysis, the modified Moreland approach and the von Schlippe-Dietrich approach. It is shown that the Moreland model can be derived from the Von Schlippe-Dietrich model by certain approximations. The remaining analysis areas are discussed in general terms and the tire parameters needed for each are identified. Accurate tire data allows more accurate design analysis and the correct prediction of dynamic performance of aircraft landing gear. Author

N83-21401*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
RESULTS FROM RECENT NASA TIRE THERMAL STUDIES
J. L. MCCARTY *In its* Tire Modeling p 211-222 Mar. 1983 refs
Avail: NTIS HC A11/MF A01 CSCL 20K

The testing technique and some results from an experimental study to determine tire temperature profiles to aid in defining the strength and fatigue limitations of the tire carcass structure are described. This effort is part of a program to explore analytically and through experiment the temperature distribution in an aircraft tire during free roll and braked and yawed rolling conditions. Author

N83-22498# California Univ., Livermore. Lawrence Livermore Lab.
ELECTROMAGNETIC TEST-FACILITY CHARACTERIZATION: AN IDENTIFICATION APPROACH
J. E. ZICKER and J. V. CANDY Dec. 1982 92 p refs
(Contract W-7405-ENG-48)
(DE83-004274; UCID-19620) Avail: NTIS HC A05/MF A01

The response of an object subjected to high energy, transient electromagnetic (EM) fields sometimes called electromagnetic pulses (EMP), is an important issue in the survivability of electronic systems (e.g., aircraft), especially when the field is generated by a high altitude nuclear burst. The characterization of transient response information is a matter of national concern. Techniques to: (1) improve signal processing at a test facility; and (2) parameterize a particular object response are discussed. The application of identification based signal processing techniques to improve signal levels is considered. Models of test equipment are identified and used to deconvolve the input/output sequences for the object under test. A parametric model of the object is identified from this data. The model can be used to extrapolate the response to these threat level EMP. Also discussed is the development of a facility simulator (EMSIM) useful for experimental design and calibration and a deconvolution algorithm (DECONV) useful for removing probe effects from the measured data. DOE

N83-22517# Boeing Aerospace Co., Seattle, Wash.
HIGH VOLTAGE TESTING. VOLUME 2: SPECIFICATIONS AND PROCEDURES Final Report, 29 Sep. 1979 - 1 Jul. 1982
W. G. DUNBAR Wright-Patterson AFB, Ohio AFWAL Aug. 1982 463 p
(Contract F33615-79-C-2067; AF PROJ. 3145)
(AD-A122355; AFWAL-TR-82-2057-VOL-2) Avail: NTIS HC A20/MF A01 CSCL 10B

The High Voltage Design Guide and High Voltage Specifications and Tests Documents referred to in this report pertain to high voltage/high power airborne equipment. A test plan was designed to evaluate and verify test parameters specified in these documents. This was done by writing detailed test procedures obtaining representative test samples, and testing the specified parameters. This report is a revision of the High Voltage Specifications and Tests Document (AFAPL-TR-79-2024) which reflects the findings of the High Voltage Testing portion of the program. GRA

N83-22593# Federal Aviation Administration, Atlantic City, N.J. Technical Center
BRAKING OF AN AIRCRAFT TIRE ON GROOVED AND POROUS ASPHALTIC CONCRETE Final Report
S. K. AGRAWAL Jan. 1983 37 p refs
(Contract FAA PROJ. 082-531-500)
(FAA-CT-82-147; FAA-RD-82-77) Avail: NTIS HC A03/MF A01

An experimental program that investigated the braking and hydroplaning performance of an aircraft tire on asphaltic concrete surfaces having various treatments is described. The tests were conducted on a dynamic track in the speed range of 70 to 150 knots, and under other operating conditions whose magnitudes represented values widely used by airlines or aircraft. The results show that the type of surface treatment has a significant influence on the braking performance of an aircraft tire on 'puddled' runways, grooves at closure spacings provide higher friction levels. When the runways are 'wet' or 'flooded' the braking capability on all surfaces is either very high or very low, respectively. The braking performance on the reflex percussive grooves, the porous friction overlay, and the saw cut grooves spaced at 3 inches is comparable. S.L.

N83-22625# Aeronautical Research Labs., Melbourne (Australia). Dept. of Defence Support.
SPECIAL FINITE ELEMENTS FOR SHEETS WITH LOADED CIRCULAR HOLES
K. C. WATTERS Jun. 1982 34 p refs
(ARL-STRUC-REPT-392; AR-002-895) Avail: NTIS HC A03/MF A01

A special hybrid finite element to represent a loaded hole in a sheet is described. The shape functions of the element satisfy stress equilibrium and strain compatibility throughout the element, and the applied loading boundary conditions. The applied loading is represented by a finite Fourier series, and the coefficients of the element shape functions are matched with the Fourier coefficients. A computer program was written to generate the element stiffness and stress recovery matrices. The program also produces equivalent nodal forces and initial stresses related to the applied loading. Accurate results are obtained from several example analyses. S.L.

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GEOSCIENCES

Includes geosciences (general); earth resources; energy production and conversion; environment pollution; geophysics; meteorology and climatology; and oceanography.

A83-27040
WIND SHEAR DETECTION WITH A MODIFIED AIRPORT SURVEILLANCE RADAR
D. L. OFFI and W. LEWIS (FAA, Technical Center, Atlantic City, NJ) In: Conference on Radar Meteorology, 20th, Boston, MA, November 30-December 3, 1981, Preprints. Boston, MA, American Meteorological Society, 1981, p. 424-429.

Recent studies that defined the nature and extent of certain performance characteristics applicable to the Federal Aviation Administration Technical Center (Atlantic City Airport, NJ) are discussed. Dangerous winds associated with thunderstorms were detected and measured, and a glide-slope-scanning technique and a simplified velocity-azimuth-display (VAD) were developed and tested. A table setting forth the system parameters for glide-slope-scan is included, as is a graph showing the contours of constant radial velocity for a typical glide-slope-scan. C.R.

A83-27043
DOPPLER RADAR AND AIRCRAFT MEASUREMENTS OF THUNDERSTORM TURBULENCE
W. LEWIS (FAA, Technical Center, Atlantic City, NJ) In: Conference on Radar Meteorology, 20th, Boston, MA, November 30-December 3, 1981, Preprints. Boston, MA, American Meteorological Society, 1981, p. 440-445. refs

A83-27044
ESTIMATION OF TURBULENCE SEVERITY IN PRECIPITATION ENVIRONMENTS BY RADAR
A. R. BOHNE (USAF, Geophysics Laboratory, Bedford, MA) In: Conference on Radar Meteorology, 20th, Boston, MA, November 30-December 3, 1981, Preprints. Boston, MA, American Meteorological Society, 1981, p. 446-453. refs

A method is demonstrated for estimating turbulence severity in precipitation environments by use of Doppler spectrum variance alone. Radar relations are examined in some detail and observations - taken simultaneously from an Air Force F104 aircraft penetrating a thunderstorm and by the National Severe Storms

Laboratory Normal Doppler radar - are described. Only a reasonable guess of the turbulence outer scale is necessary if the need is only to classify turbulence severity D.H.

A83-27203
ENGINEERING PROPERTIES OF HUGHES/AIR FORCE NICKEL-HYDROGEN CELLS
H. H. ROGERS, S. J. STADNICK, and D. W. WONG (Hughes Aircraft Co., Space and Communications Group, El Segundo, CA) In: IECEC '82; Proceedings of the Seventeenth Intersociety Energy Conversion Engineering Conference, Los Angeles, CA, August 8-12, 1982. Volume 2. New York, Institute of Electrical and Electronics Engineers, 1982, p. 769-773.

In connection with the present investigation, various experiments with flight type nickel-hydrogen cells were carried out. The tests had the objective to obtain information regarding the characteristics of the nickel-hydrogen cell under normal conditions as well as under conditions produced by unusual environmental factors. Attention is given to the shorting test of a fully charged cell, the temperature-induced failure of a fully charged cell, the temperature-induced failure of a fully charged cell during high-rate overcharge, the temperature coefficient of charge voltage, the steady-state charge voltage, low temperature oxygen recombination, the tolerance of a nickel-hydrogen cell to inert gas, and cell reversal under negative limited conditions. G.R.

A83-28647#
THE DESIGN AND CONSTRUCTION OF A LOW POWER GAS TURBINE FOR SOLAR ENERGY CONVERSION - AN ANALYTICAL MODEL OF OPERATION OF THE INSTALLATION IN A VARIABLE MODE [CONCEPTION ET REALISATION D'UNE TURBINE A GAZ DE FAIBLE PUISSANCE DESTINEE A LA CONVERSION DE L'ENERGIE SOLAIRE - MODELISATION DU FONCTIONNEMENT DE L'INSTALLATION EN REGIME VARIABLE]
J. F. LEONE Lyon, Institut National des Sciences Appliquees, Docteur-Ingenieur Thesis, 1982. 183 p. In French. refs

A thermodynamic analysis of a Brayton cycle engine used for the conversion of solar thermal energy to electricity is presented and compared with experimental results. The power configuration is a parabolic concentrator with the engine placed at the focus. Its benefits are a minimal visual impact, modular construction, rapid start-up, simple site planning, and flexibility as to end use. Consideration is given to a generator powered by hot air and mounted in series with other modules, and to heating elements mounted in parallel. A numerical model accounts for system losses, and application is demonstrated with a system producing 2.5 kWe at 800 C, i.e., a 45 kWt output. A second model is devised to describe the isentropic efficiencies which can be expected during variable speed operations. Finally costs of the power plant are compared with costs of conventionally fueled facilities. M.S.K.

N83-21495# Sandia Labs., Albuquerque, N. Mex.
MODULAR AIRBORNE REMOTE SAMPLING AND SENSING SYSTEM (MARSSS)
R. O. WOODS Apr. 1982 20 p Presented at the APCA Specialty Conf., San Diego, Calif., 18-21 Jan. 1982
(Contract DE-AC04-76DP-00789)
(DE82-014657; SAND-81-1522) Avail: NTIS HC A02/MF A01

Sandia is developing a modular airborne instrumentation system for the Environmental Protection Agency. This system will allow flexibility in the choice of instruments by standardizing mountings, power supplies and sampling modes. The objective is to make it possible to perform aerial surveys from chartered aircraft that have not been adapted in a more than superficial manner. It will also allow the experimenter to tailor his choice of instruments to the specific problem. Since the equipment will have a stand alone capability, it can be applied to other problems such as long term unattended use at remote locations or in toxic or otherwise hazardous environments. DOE

N83-21503* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AEROELASTIC INSTABILITY STOPPERS FOR WIND TUNNEL MODELS Patent
R. V. DOGGETT, JR. and R. H. RICKETTS, inventors (to NASA) 17 Jun. 1981 4 p Filed 17 Jun 1981 Supersedes N81-31230 (19 - 22, p 3020)
(NASA-CASE-LAR-12458-1; US-PATENT-4,372,158; US-PATENT-APPL-SN-274705; US-PATENT-CLASS-73-147)
Avail: US Patent and Trademark Office CSCL 10A

A mechanism for constraining models or sections thereof, was wind tunnel tested, deployed at the onset of aeroelastic instability, to forestall destructive vibrations in the model is described. The mechanism includes a pair of arms pivoted to the tunnel wall and straddling the model. Rollers on the ends of the arms contact the model, and are pulled together against the model by a spring stretched between the arms. An actuator mechanism swings the arms into place and back as desired.
Official Gazette of the U.S. Patent and Trademark Office

N83-21504* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AEROELASTIC INSTABILITY STOPPERS FOR WIND TUNNEL MODELS Patent
R. V. DOGGETT, JR. and R. H. RICKETTS, inventors (to NASA) 17 Jun. 1981 6 p Filed 17 Jun 1981 Supersedes N81-31229 (19 - 22, p 3020)
(NASA-CASE-LAR-12720-1; US-PATENT-4,372,159; US-PATENT-APPL-SN-274706; US-PATENT-CLASS-73-147)
Avail: US Patent and Trademark Office CSCL 10A

A mechanism for diverting the flow in a wind tunnel from the wing of a tested model is described. The wing is mounted on the wall of a tunnel. A diverter plate is pivotally mounted on the tunnel wall ahead of the model. An actuator fixed to the tunnel is pivotably connected to the diverter plate, by plunger. When the model is about to become unstable during the test the actuator moves the diverter plate from the tunnel wall to divert maintaining stable model conditions. The diverter plate is then retracted to enable normal flow.
Official Gazette of the U.S. Patent and Trademark Office

N83-21509*# Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.
SIMPLIFIED AEROELASTIC MODELING OF HORIZONTAL AXIS WIND TURBINES Final Report
J. H. WENDELL Sep. 1982 231 p refs
(Contract NSG-3303; DE-AI01-76ET-20320)
(NASA-CR-168109; DOE/NASA/3303-3; NAS 1.26:168109; MIT-ASRL-TR-197-4) Avail: NTIS HC A11/MF A01 CSCL 10A

Certain aspects of the aeroelastic modeling and behavior of the horizontal axis wind turbine (HAWT) are examined. Two simple three degree of freedom models are described in this report, and tools are developed which allow other simple models to be derived. The first simple model developed is an equivalent hinge model to study the flap-lag-torsion aeroelastic stability of an isolated rotor blade. The model includes nonlinear effects, preconing, and noncoincident elastic axis, center of gravity, and aerodynamic center. A stability study is presented which examines the influence of key parameters on aeroelastic stability. Next, two general tools are developed to study the aeroelastic stability and response of a teetering rotor coupled to a flexible tower. The first of these tools is an aeroelastic model of a two-bladed rotor on a general flexible support. The second general tool is a harmonic balance solution method for the resulting second order system with periodic coefficients. The second simple model developed is a rotor-tower model which serves to demonstrate the general tools. This model includes nacelle yawing, nacelle pitching, and rotor teetering. Transient response time histories are calculated and compared to a similar model in the literature. Agreement between the two is very good, especially considering how few harmonics are used. Finally, a stability study is presented which examines the effects of support stiffness and damping, inflow angle, and preconing.
Author

N83-21711*# FWG Associates, Inc., Tullahoma, Tenn.
FLIGHT IN LOW-LEVEL WIND SHEAR Final Report, 22 Jun. 1981 - 22 Aug. 1982
W. FROST Washington NASA Mar. 1983 120 p refs
(Contract NAS8-33458)
(NASA-CR-3678; NAS 1.26:3678) Avail: NTIS HC A06/MF A01 CSCL 04B

Results of studies of wind shear hazard to aircraft operation are summarized. Existing wind shear profiles currently used in computer and flight simulator studies are reviewed. The governing equations of motion for an aircraft are derived incorporating the variable wind effects. Quantitative discussions of the effects of wind shear on aircraft performance are presented. These are followed by a review of mathematical solutions to both the linear and nonlinear forms of the governing equations. Solutions with and without control laws are presented. The application of detailed analysis to develop warning and detection systems based on Doppler radar measuring wind speed along the flight path is given. A number of flight path deterioration parameters are defined and evaluated. Comparison of computer-predicted flight paths with those measured in a manned flight simulator is made. Some proposed airborne and ground-based wind shear hazard warning and detection systems are reviewed. The advantages and disadvantages of both types of systems are discussed. N.W.

N83-21730*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
GREENLAND 1979 MICROWAVE REMOTE SENSING DATA CATALOG REPORT, 14-15 OCTOBER 1979
H. F. HENNIGAR (Deepsea Ventures, Inc., Gloucester Point, Va.), W. S. HIRSTEIN (Bionetics Corp., Hampton, Va.), S. K. SCHAFFNER (OAO Corp., Hampton, Va.), V. E. DELNORE (Kentron International, Inc., Hampton, Va.), and W. L. GRANTHAM Mar. 1983 64 p refs
(NASA-TM-84571; L-15529; NAS 1.15:84571) Avail: NTIS HC A04/MF A01 CSCL 08C

Microwave remote sensing measurements were cataloged for active and passive instruments in support of the 1979 Greenland Remote Sensing Experiment. Instruments used in this field experiment include the stepped frequency microwave radiometer (4 to 8 GHz) and the airborne microwave scatterometer (14.6 GHz). The microwave signature data are inventoried and cataloged in a user friendly format and are available on 9 track computer compatible tapes upon request. Author

N83-22179# Civil Aviation Authority, London (England).
FUEL CONSERVATION AND ECONOMY CONSTRAINTS
D. BARBER and J. C. MORRALL *In* AGARD Air Traffic Control in Face of Users' Demand and Econ. Constraints 8 p Feb. 1983
Avail: NTIS HC A06/MF A01

Fuel conservation in civil aviation may be achieved by increasing the efficiency of the aircraft themselves, by operating the aircraft more efficiently, and by providing them with a more efficient air traffic environment. Three aspects are discussed briefly, and possible improvements in the air traffic management environment are examined in more detail. Finally, attention is drawn to the Research and Development program needed to achieve fuel conservation by improved air traffic management. Author

N83-22689*# GeoScience Research Corp., Salisbury, Md.
ICE SHEET SURFACE FEATURES IN SOUTHWESTERN GREENLAND FROM SATELLITE RADIO ALTIMETRY
R. L. BROOKS and G. A. NORCROSS May 1982 27 p refs
(Contract NAS6-3232)
(NASA-CR-156887; NAS 1.26:156887) Avail: NTIS HC A03/MF A01 CSCL 08L

Fourteen SEASAT and ten GEOS-3 satellite radar altimeter groundtracks across a 1 deg x 2.5 deg study area in southwestern Greenland have yielded 3,328 ice sheet surface elevations. The surface elevations derived from SEASAT were recalculated based on a waveform retracking algorithm. The elevations have been utilized to develop a surface profile, a three dimensional surface representation, and surface contours. Analysis of the elevations reveals the presence of surface terraces, some greater than 100 km in length; each terrace is at a discrete elevation. Renormalized SEASAT AGC values are shown to be correlated with the surface slope. The ice surface undulations caused frequent altimeter losses-of-lock. Future satellite radar altimeters could significantly contribute to ice sheet mapping in the next decade, particularly if they incorporate tracking systems with more frequent updates.
Author

N83-22740*# Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.
SOME EXPERIMENTS ON YAW STABILITY OF WIND TURBINES WITH VARIOUS CONING ANGLES Final Report
D. BUNDAS and J. DUGUNDJI Jul. 1981 31 p refs
(Contract NSG-3303; DE-AI01-76ET-20320)
(NASA-CR-168108; DOE/NASA/3303-1; NAS 1.26:168108; MIT-ASRL-TR-197-2) Avail: NTIS HC A03/MF A01 CSCL 10B

A horizontal axis wind turbine was constructed to study the effect of coning angle on the yawing moments produced. Coning angles of 0 deg, +10 deg and -10 deg were studied in the upwind and downwind cases. Moment and rotational frequency of the blades at each yaw angle setting were taken. It was found that as the coning angle increased from -10 deg to +10 deg in either the upwind or downwind case the stability decreased. The downwind case was slightly more stable for all coning angles than was the upwind case. It is found that all the previous cases were stable for high rotation speeds, but at lower rotation speeds, they were all unstable and could not self start unless held in the wind. E.A.K.

N83-22747*# Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.
DEVELOPMENT OF METHODOLOGY FOR HORIZONTAL AXIS WIND TURBINE DYNAMIC ANALYSIS Final Summary Report
J. DUGUNDJI Sep. 1982 11 p refs
(Contract NSG-3303; DE-AI01-76ET-20320)
(NASA-CR-168110; DOE/NASA/3303-4; NAS 1.26:168110; MIT-ASRL-TR-197-5) Avail: NTIS HC A02/MF A01 CSCL 10B

Horizontal axis wind turbine dynamics were studied. The following findings are summarized: (1) review of the MOSTAS computer programs for dynamic analysis of horizontal axis wind turbines; (2) review of various analysis methods for rotating systems with periodic coefficients; (3) review of structural dynamics analysis tools for large wind turbine; (4) experiments for yaw characteristics of a rotating rotor; (5) development of a finite element model for rotors; (6) development of simple models for aeroelastics; and (7) development of simple models for stability and response of wind turbines on flexible towers. E.A.K.

N83-22759# Westinghouse Electric Corp., Concordville, Pa. Combustion Turbine Systems Div.
COMPRESSED-AIR ENERGY STORAGE PRELIMINARY DESIGN AND SITE DEVELOPMENT PROGRAM IN AN AQUIFER. VOLUME 5, PART 1: TURBOMACHINERY DESIGN Final Report
P. A. BERMAN, J. S. BONK, W. F. KOBETT, N. S. KOSANOVICH, L. J. LONG, and D. J. MARINACCI Nov. 1982 564 p
(Contract DE-AC02-78ET-29232; EPRI PROJ. 1081-3)
(DE83-004005; EPRI-EM-2351-VOL-5-PT-1) Avail: NTIS HC A24/MF A01

The development of the design approach for a combustion turbine heat cycle and the major mechanical equipment for use by an electric utility at a selected aquifer air storage site is documented. A compressed air energy storage (CAES) system utilizes off peak electric power, available from base load power plants, to store compressed air underground in an aquifer. During subsequent periods, the stored air is extracted from the aquifer and used as an air supply for a generating combustion turbine expander. The aquifer has an initial discovery pressure of 840 psia. An initial air injection temperature of 1500 F was selected. The major mechanical equipment considered includes: the turbine motor/generator compressor train, intercooler and aftercooler

system, and the exhaust gas regenerator. The cycle and machinery configuration and the specific mechanical equipment were selected for their Media site characteristics. These characteristics and the effect of component interdependency are considered when a conservative component design approach is established which satisfies the Media site CAES system requirements. DOE

N83-22769# Pacific Gas and Electric Co., San Francisco, Calif.
DEVELOPMENT OF THE UTILIZATION OF COMBUSTIBLE GAS PRODUCED IN EXISTING SANITARY LANDFILLS: EFFECTS OF CORROSION AT THE MOUNTAIN VIEW, CALIFORNIA LANDFILL GAS-RECOVERY PLANT
Oct. 1982 64 p refs
(Contract DE-FG01-79CS-20291)
(DE83-001576; DOE/CS-20291/3) Avail: NTIS HC A04/MF A01

Corrosion of equipment has occurred at the Mountain View, California Landfill Gas Recovery Plant. Corrosion is most severe on compressor valve seats and cages, tubes in the first and second stages of the interstage gas cooler, and first and second stage piping and liquid separators. Corrosion occurs because the raw landfill gas contains water, carbon dioxide, and oxygen. Some corrosion may also result from trace concentrations of organic acids present in the landfill gas. Corrosion of the third stage compressor, cooler, and piping does not occur because the gas is dehydrated immediately prior to the third stage. Controlling corrosion is necessary to maintain the mechanical integrity of the plant and to keep the cost of the gas competitive with natural gas. Attempts to reduce corrosion rates by injecting a chemical inhibitor have proved only partially successful. Recommendations for dealing with corrosion include earlier dehydration of the gas, selection of special alloys in critical locations, chemical inhibition, and regular plant inspections. DOE

N83-22817# Oak Ridge National Lab., Tenn. Energy Div.
HEAT-ACTIVATED HEAT-PUMP DEVELOPMENT AND POTENTIAL APPLICATION OF STIRLING-ENGINE TECHNOLOGY
P. D. FAIRCHILD and C. D. WEST 1982 43 p refs Presented at the 20th Automotive Technol. Develop. Contractor Coordination Meeting, Dearborn, Mich., 25-28 Oct. 1982
(Contract W-7405-ENG-26)
(DE83-002134; CONF-821055-1) Avail: NTIS HC A03/MF A01

Presented is a brief overview of the heat-activated heat pump technology development program being carried out with emphasis on the Stirling engine technology projects. The major projects are reviewed as they were formulated and carried out under the previous product development guidelines. The revised technology development focus and current status of those major hardware projects are discussed. The key issues involved in applying Stirling engine technology to heat pump equipment are assessed. The approach and planned future activities to address those issues are described. Also included are brief descriptions of two projects in this area supported by the Gas Research Institute. DOE

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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.

A83-29285
ON THE SYNTHESIS OF THE OPTIMAL CONTROL OF A CERTAIN HYDROMAGNETIC PROCESS [K ZADACHE SINTEZA OPTIMAL'NOGO UPRAVLENIIA NEKOTORYM GIDROMAGNITNYM PROTSESSOM]
E. G. PAVLOV Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 4, 1982, p. 58-61. In Russian.

In order to obtain optimal control for flight vehicles and for vehicles with partially-fluid-filled shells, for the temperature distribution of a body, and for MHD processes it is necessary to determine the appropriate weighting coefficients. This paper proposes a procedure for solving this problem and illustrates it by the example of the optimal control of an ideal conducting fluid filament. B.J.

N83-22104# Royal Aircraft Establishment, Farnborough (England). Flight Systems Dept.
A MODULAR APPROACH TO HIGH RELIABILITY SOFTWARE GENERATION WITH APPLICATION TO NONLINEAR CONTROL
S. M. WRIGHT and J. S. WINTER *In* AGARD Advan. in Guidance and Control Systems 11 p Jan. 1983 refs
Avail: NTIS HC A11/MF A01

This paper describes an interlocking set of techniques covering control law and control system architecture design, documentation and validation. These address the problems experienced by the airframe manufacturer in proving the integrity of a digital control system (hardware and software) in such a way that the undoubted power and flexibility of digital techniques can be fully exploited. An idealized processor architecture and instruction set is presented and its application illustrated by reference to a set of nonlinear control laws. This shows how the control law coding and verification can be eliminated as a separate step in the design process. Finally the beneficial effect of the control law structure on the process of failure identification and subsequent failure management is described. Author

N83-22114# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany). Unternehmnsbereich.
SOFTWARE DEVELOPMENT: DESIGN AND REALITY
H. VONGROOTE and F. SCHWEGLER *In* AGARD Software for Avionics 10 p Jan. 1983 refs
Avail: NTIS HC A19/MF A01

Experiences gained during the development of the Operational Flight Program of the MRCA Tornado were described. A short outline of the organisational structure and of the Avionic System is given, followed by the description of the different design and test stages. Then some general reasons are presented which caused major changes to the software specifications and which are believed to be true for any development of a new avionic system. A description of the purging process of the assembler program was discussed. Author

N83-22125# Naval Weapons Center, China Lake, Calif.
OPERATIONAL FLIGHT PROGRAM DEVELOPMENT WITH A HIGHER ORDER LANGUAGE
R. E. WESTBROOK and L. L. CREWS *In* AGARD Software for Avionics 4 p Jan. 1983
Avail: NTIS HC A19/MF A01

The problems and the future trends and solutions to many of the problems of developing Operational Flight Programs (OFP) for embedded computer systems are presented. Author

N83-22135# Aeritalia S.p.A., Caselle Torinese (Italy). Gruppo Sistemi Avionici ed Equipaggiamenti.
TORNADO FLIGHT CONTROL SOFTWARE VALIDATION: METHODOLOGY AND TOOLS
R. PELISSERO *In* AGARD Software for Avionics 13 p Jan. 1983
Avail: NTIS HC A19/MF A01

Methods and tools adopted in the Tornado project to perform software confidence testing; investigation of failure effect, performance prediction, and assessment and read across between simulated and in flight behavior are described. The real time facility in use is based on an integrated hardware/software system that was ad-hoc designed to allow closed loop testing of the Tornado TF/AFDS subsystem with particular emphasis given to autopilot. The real equipments of interest are installed on an avionic rig and the flight conditions are obtained via a data flow to/from an external computing facility which performs both the acquisition/stimulation functions and the various simulations (aircraft, engine, sensors, etc.). The validity of the results achieved by the facility is confirmed by repetition of maneuvers performed during previous flights. In addition, other possible applications of such a facility are summarized. M.G.

N83-22138# Litton Technische Werke, Freiburg (West Germany).
SOFTWARE VERIFICATION OF A CIVIL AVIONIC AHR SYSTEM
M. KLEINSCHMIDT and N. SANDNER *In* AGARD Software for Avionics 9 p Jan. 1983 refs
Avail: NTIS HC A19/MF A01

Requirements for software verification procedures to be used with highly integrated digital avionics software are defined. Verification tools are described along with their use in the testing of an attitude and heading reference system. M.G.

N83-22140# Naval Weapons Center, China Lake, Calif.
VALIDATION OF SOFTWARE FOR INTEGRATION OF MISSILES WITH AIRCRAFT SYSTEMS
J. R. MCMANIS *In* AGARD Software for Avionics 6 p Jan. 1983
Avail: NTIS HC A19/MF A01

Critical aspects involved in the validation of avionics software developed to integrate missiles with attack aircraft systems are addressed. The situation covered is where the missile and the aircraft both have embedded computer systems, and that they have evolved to their current state in separate and totally independent development efforts. M.G.

N83-22145# McDonnell Aircraft Co., St. Louis, Mo.
F/A-18 SOFTWARE DEVELOPMENT: A CASE STUDY
T. V. MCTIGUE *In* AGARD Software for Avionics 15 p Jan. 1983 refs
Avail: NTIS HC A01/MF A01

A description of the successful avionics software development for the U.S. Navy/McDonnell Douglas F/A-18 Hornet Fighter/Attack Weapon System is given. The avionics computer subsystem consists of two central mission computers and a number of distributed processors embedded in various sensor and display subsystems. This distributed processing system is interconnected by and communicates over a MIL STANDARD 1553A serial 1 MHz command/response multiplex network. The avionics software architecture is discussed and the rationale is presented for the partitioning of the software tasks between the central mission computers and the distributed processors are also discussed. Finally, the design of the operational flight program for the central mission computers is described, including a discussion of the development process and support facilities which were used for the software integration and validation. R.J.F.

N83-22150# British Aerospace Aircraft Group, Woodford (England).
DESIGN OF A SOFTWARE MAINTENANCE FACILITY FOR THE RAF
J. WHAILEY and T. H. SCOTT-WILSON *In* AGARD Software for Avionics 10 p Jan. 1983 refs
Avail: NTIS HC A19/MF A01

In order to establish the size of the software maintenance team required for the airborne computing system, it is necessary to have some measurement of software reliability and the number of system requirement changes likely to affect the software configuration. The data available to date is largely empirical and further research is required to establish acceptable techniques. Various options were discussed in order to satisfy the requirement for a software maintenance facility for the Central Navigation System of Nimrod AEW Mk 3, the configuration finally chosen for the software testing rig consisting of a mixture of aircraft hardware and computer based simulations of the system dynamics. The effort required in maintenance could be reduced in future by the adoption of better software design techniques, the adoption of computer based management packages and improved software testing tools. R.J.F.

N83-22152# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).
ON AIRCRAFT TEST SOFTWARE FOR FIRST LINE MAINTENANCE
H. KLENK *In* AGARD Software for Avionics 8 p Jan. 1983
Avail: NTIS HC A19/MF A01

A method is presented to provide suitable flexibility and easy maintenance for a test software package, even when written in a lower level language. The method essentially consists of a decisive separation of the test software package into an executive part and a descriptive part for the avionic hardware. Because the executive part is independent of the special avionic equipment, hardware modificatons result only in a change of the descriptive part of the software. These changes are easy to handle and suitable for future standardized methods using modern software development tools. The separation method was used to design and implement on-aircraft test software with good results. R.J.F.

N83-23048*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
USE OF INTERACTIVE GRAPHICS TO ANALYZE QUICK-GEOMETRY
J. C. TOWNSEND Dec. 1981 50 p refs
(NASA-TM-83234; NAS 1.15:83234) Avail: NTIS HC A03/MF A01 CSCL 09B

The QUICK InterActive Graphics Analysis (QUIAGA) program and its advantages for displaying aircraft QUICK-geometry to aid in detection and analysis of errors are described. The QUICK-geometry system generates a completely analytical aircraft geometry description for use by finite-difference flow codes. The QUIAGA program was developed to exercise the QUICK-geometry subroutines to examine the analytic definition of a configuration by plotting cross sections and body lines on a graphics terminal. A number of options are available, including multiple cross-section views, hidden-line removal, and display of control point locations. Use of these options for the detection and analysis of errors in the QUICK-geometry definition can be of great assistance in speedily arriving at a correct analytical geometry description for flow-field computation. The QUIAGA program has been used in developing a QUICK-geometry model of the NASA Space Shuttle Orbiter, and examples from this experience are given to show some of the program's features. Details of program usage and an example session are given in the appendixes. Author

N83-23049*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
USE OF INTERACTIVE GRAPHICS TO ANALYZE QUICK-GEOMETRY: SUPPLEMENT
J. C. TOWNSEND Jul. 1982 14 p
(NASA-TM-83234-SUPPL; L-15295; NAS 1.15:83234-SUPPL)
Avail: NTIS HC A02/MF A01 CSCL 09B

The advantages of using interactive computer graphics to display aircraft geometry to aid in detection and analysis of errors are described. The QUICK geometry system is reviewed and the Quick Interactive Graphics Analysis (QUIAGA) program is described. This QUIAGA program was developed to exercise the QUICK geometry subroutines to examine in several modes on a graphics terminal. Its use in the detection and analysis of errors in the QUICK geometry definition can be of great assistance in speedily arriving at a correct analytical geometry description for flow field computation. Experience with the program in developing a QUICK geometry model of the NASA Space Shuttle Orbiter is used to show some of its features. Appendixes giving details of program usage and an example session are included. 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.

A83-28002#
HELICOPTER FLIGHT NOISE TESTS ABOUT THE INFLUENCE OF ROTOR-ROTATIONAL AND FORWARD SPEED CHANGES ON THE CHARACTERISTICS OF THE IMMITTED SOUND
H. H. HELLER and W. SPLETTSTOESSER (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Institut fuer Entwurfs-Aerodynamik, Brunswick, West Germany) American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 8th, Atlanta, GA, Apr. 11-13, 1983, 11 p. refs
(AIAA PAPER 83-0672)

The noise characteristics of three modern medium-weight twin-turbo engine helicopters were determined using flight tests which collected straight-level overflight noise data. The data were analyzed spectrally and in terms of several commonly applied noise-metrics, such as the maximum. A-weighted Sound Pressure Level L sub A and the maximum Overall Sound Pressure Level OASPL. The results indicate the decisive effect of the advancing blade tip Mach-number on the emitted sound, which shows the growing influence of high-speed impulsive noise components on the noise signature at blade Mach-numbers beyond approximately 0.8. It is found that both the maximum tone-corrected and the Effective Perceived Noise Level observed on the ground for a helicopter in horizontal overflight depend strongly on the forward flight and the main rotor rotational speed. N.B.

A83-28004*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
MEASUREMENTS OF THE SCATTERING OF SOUND BY A LINE VORTEX
W. C. HORNE (NASA, Ames Research Center, Moffett Field, CA) American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 8th, Atlanta, GA, Apr. 11-13, 1983, 7 p.
(AIAA PAPER 83-0676)

This paper presents measurements of the phase and magnitude of the scattered field arising from the incidence of a monochromatic plane sound field as a steady vortex. The amplitude of the scattered field was found to vary linearly with the vortex strength, and with the incident wave amplitude and frequency as predicted by solutions based on the Born approximation. The scattered field was observed to be nonsingular in the incidence direction, and this was similar to predictions by the Parabolic Equation Method (PEM) rather than the Born approximation, which predicts singular behavior in the incidence direction. (Author)

A83-28005*#
A COMPACT INFLOW CONTROL DEVICE FOR SIMULATING FLIGHT FAN NOISE
L. HOMYAK, J. G. MCARDLE, and L. J. HEIDELBERG (NASA, Lewis Research Center, Cleveland, OH) American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 8th, Atlanta, GA, Apr. 11-13, 1983, 10 p. refs
(AIAA PAPER 83-0680)

Inflow control device (ICD's) of various shapes and sizes have been used to simulate inflight fan tone noise during ground static tests. A small, simple inexpensive ICD design was optimized from previous design and fabrication techniques. This compact two-fan-diameter ICD exhibits satisfactory acoustic performance characteristics without causing noise attenuation or redirection. In addition, it generates no important new noise sources. Design and construction details of the compact ICD are discussed and acoustic performance test results are presented. (Author)

A83-28007#
NEAR-FIELD FREQUENCY - DOMAIN THEORY FOR PROPELLER NOISE
D. B. HANSON (United Technologies Corp., Hamilton Standard Div., Windsor Locks, CT) American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 8th, Atlanta, GA, Apr. 11-13, 1983, 9 p. refs
(AIAA PAPER 83-0688)

Near-field noise equations are developed from the author's helicoidal surface theory for propeller aerodynamics and noise. Thickness, steady loading, and quadrupole sources are included. Apart from the thin blade approximation and neglect of radial source terms, the equations are exact. In a comparison with the previously published far-field theory, it is shown that several valuable features of the far-field equations are retained. In particular, blade sweep still appears explicitly as a phase lag effect. A brief correlation with test data is shown. (Author)

A83-28008*# United Technologies Corp., Windsor Locks, Conn.
MEASUREMENTS AND PREDICTIONS OF TURBOPROP NOISE AT HIGH CRUISE SPEED
F. B. METZGER (United Technologies Corp., Aircraft Systems Dept., Windsor Locks, CT) American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 8th, Atlanta, GA, Apr. 11-13, 1983, 8 p. NASA-supported research. refs
(AIAA PAPER 83-0689)

Acoustic tests of advanced turboprop (Prop-Fan) models have taken place in or on three facilities: an acoustic wind tunnel, an aerodynamic wind tunnel, and a flight vehicle. Comparisons of data from the three facilities are made for two model designs, the unswept SR-2 and the swept SR-3. The importance of noise propagation through the boundary layer to microphones mounted on the surface of a flight vehicle is discussed and limited comparisons between predictions and measurements are shown. It is concluded that existing methodology is adequate for predictions at high cruise Mach number and that further development is required to improve the methodology for predicting fuselage and wind tunnel boundary layer propagation effects. (Author)

A83-28009*# Cornell Univ., Ithaca, N. Y.
COMPARISON OF BROADBAND NOISE MECHANISMS, ANALYSES, AND EXPERIMENTS ON HELICOPTERS, PROPELLERS, AND WIND TURBINES
A. R. GEORGE and S.-T. CHOU (Cornell University, Ithaca, NY) American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 8th, Atlanta, GA, Apr. 11-13, 1983, 38 p. NASA-supported research. refs
(AIAA PAPER 83-0690)

Experimental data on broadband noise from airfoils are compared, together with analytical methods, in order to identify the mechanisms of noise emission. Rotor noise is categorized into discrete frequency, impulsive, and broadband components,

the last having a continuous spectrum originating from a random source. The results of computer simulations of different rotor blade types which produce broadband noise were compared with experimental data and among themselves in terms of predictions of the spectra obtained. Consideration was given to the overall sound pressure level, unsteady turbulence forces, rotational forces, inflow turbulence, self-generated turbulence, and turbulence in the flow. Data are presented for a helicopter rotor and light aircraft propeller. The most significant source was found to be inflow turbulence induced lift fluctuations in helicopter rotors and boundary layer trailing edge noise on large wind energy conversion systems M.S.K.

A83-28010*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THE ACOUSTIC RESPONSE OF A PROPELLER SUBJECTED TO GUSTS INCIDENT FROM VARIOUS INFLOW ANGLES
G. C. JONKOUSKI, W. C. HORNE, and P. T. SODERMAN (NASA, Ames Research Center, Moffett Field, CA) American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 8th, Atlanta, GA, Apr. 11-13, 1983, 11 p.
(AIAA PAPER 83-0692)

The acoustic effect of perturbing the inflow field of a propeller was studied. The perturbation was caused by a jet of air blowing into the propeller disc from various angles, creating spanwise and chordwise flow disturbances along the blades. The effects of the gust angle, speed and turbulence, and propeller rpm and thrust are shown with narrowband spectra and directivity plots of the acoustic field. A prediction method for the peaks of the harmonics of the blade passing frequency for various gust and propeller conditions is presented. (Author)

A83-28011*# Syracuse Univ., N. Y.
COAXIAL SUPERSONIC JET-FLOWS, SHOCK STRUCTURE AND RELATED PROBLEMS WITH NOISE-SUPPRESSION ASSESSMENT AND PREDICTION
D. S. DOSANJH (Syracuse University, Syracuse, NY) and R. S. MCAFEE, JR. American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 8th, Atlanta, GA, Apr. 11-13, 1983, 42 p. refs
(Contract NAG3-202)
(AIAA PAPER 83-0707)

It is now reasonably well established that the intense noise radiated by a single turbulent, heated, under or overexpanded round jet of high specific thrust can be significantly reduced if instead, 'equivalent' multinozzle coaxial supersonic jet flows of the same total thrust and mass flow rate were to be operated in the inverted pressure mode. A summary of some of the relevant observations on the coaxial supersonic jet flows and their shock structure is presented. Attention is given to the scope of the optical studies, the development of shock structure, the effects of exit stagger, coaxial supersonic jet flows with inner nozzle overexpanded, the role of the lip thickness, the role of the exit area ratios, cold/heated coaxial supersonic jet flows, acoustic observations, the conventional pressure mode of operation, comparative noise reduction assessment, and problems and prospects of noise prediction. G.R.

A83-28016*# Douglas Aircraft Co., Inc., Long Beach, Calif.
SOUND PROPAGATION IN SEGMENTED EXHAUST DUCTS - THEORETICAL PREDICTIONS AND COMPARISON WITH MEASUREMENTS
M. C. JOSHI, R. E. KRAFT (Douglas Aircraft Co., Long Beach, CA), G. H. FISKE (General Electric Co., Schenectady, NY), A. A. SYED, and R. E. MOTSINGER (General Electric Co., Evendale, OH) American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 8th, Atlanta, GA, Apr. 11-13, 1983, 12 p. refs
(Contract NAS3-22766)
(AIAA PAPER 83-0734)

Suppressions due to acoustic treatment in the annular exhaust duct of a model fan have been theoretically predicted and compared with measurements. The predictions are based on the modal analysis of sound propagation in a straight annular flow duct with segmented treatment. Measured values of the mode distribution of the fan noise source (fan-stator interaction source only) and the acoustic impedance of the treatment in the duct were used as input to the prediction program. The predicted suppressions (under the assumption of uniform flow in the duct) compared well with the measured in-duct suppression for all test conditions. The measurements were made in an anechoic chamber and the interaction modes generated in the fan spanned a cut-off ratio range from nearly one to seven. (Author)

A83-28021*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
APPLICATION OF 3-SIGNAL COHERENCE TO CORE NOISE TRANSMISSION
E. A. KREJSA (NASA, Lewis Research Center, Cleveland, OH) American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 8th, Atlanta, GA, Apr. 11-13, 1983, 16 p. refs
(AIAA PAPER 83-0759)

A method for determining transfer functions across turbofan engine components and from the engine to the far-field is developed. The method is based on the 3-signal coherence technique used previously to obtain far-field core noise levels. This method eliminates the bias error in transfer function measurements due to contamination of measured pressures by nonpropagating pressure fluctuations. Measured transfer functions from the engine to the far-field, across the tailpipe, and across the turbine are presented for three turbofan engines. (Author)

A83-28023*# Arizona Univ., Tucson.
NOISE GENERATION BY A FINITE SPAN SWEPT AIRFOIL
E. J. KERSCHEN and E. ENVIA (Arizona, University, Tucson, AZ) American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 8th, Atlanta, GA, Apr. 11-13, 1983, 9 p. refs
(Contract NAG3-357)
(AIAA PAPER 83-0768)

An analysis is developed for the noise generated by a convected gust interacting with a single swept airfoil. The airfoil spans a channel with infinite parallel walls which contains a uniform subsonic mean flow. High frequency gusts, for which the noise generation is concentrated at the airfoil leading edge, are considered. The solution utilizes the Wiener-Hopf technique applied to the equations in nonorthogonal coordinates. Closed form expressions for the farfield acoustic pressure are obtained. The convected gust is assumed to be a plane wave, i.e., the lowest order spanwise mode. Because of the swept leading edge, this convected gust generates acoustic modes of all orders. At high frequencies and low Mach numbers, moderate sweep angles produce substantial noise reductions. The residual acoustic energy is carried mainly by the higher modes. The airfoil sweep also modulates the basic high frequency farfield directivity, producing lobed patterns. The angular modulation of the directivity patterns is most pronounced for the lower order modes. (Author)

A83-28186* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A NEW MEASUREMENT METHOD FOR SEPARATING AIRBORNE AND STRUCTUREBORNE AIRCRAFT INTERIOR NOISE
M. C. MCGARY and W. H. MAYES (NASA, Langley Research Center, Noise Effects Branch, Hampton, VA) Noise Control Engineering Journal, vol. 20, Jan.-Feb. 1983, p. 21-30. refs

It is pointed out that interior noise levels of propeller driven aircraft are substantially higher than levels measured for other types of CTOL aircraft. Reduction of interior noise of such aircraft requires a knowledge of the relative importance of the acoustic and structural noise transmission paths. Noise entering the aircraft interior via an acoustic path is the noise radiated by an external noise source (propellers, exhaust noise), which propagates through the acoustic medium (air) and is then transmitted through the aircraft fuselage. This type of incoming noise is referred to as airborne noise. Noise entering the aircraft interior via a structural path is the noise which has its source in the vibrational energy

which has been transmitted through the structure from a remote vibrational energy source (engines, wind flutter). This type of incoming noise is referred to as structureborne noise. A new method for separating airborne and structureborne noise is presented. It is based on two-microphone cross spectral acoustic intensity measurements. G.R.

A83-28957*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SHOCK-ASSOCIATED NOISE IN SUPERSONIC JETS
S. P. PAO and J. M. SEINER (NASA, Langley Research Center, Aeroacoutics Branch, Hampton, VA) AIAA Journal (ISSN 0001-1452), vol. 21, May 1983, p. 687-693. refs
Previously cited in issue 24, p. 4250, Accession no. A81-49745

A83-29270
EFFECTIVE GENERALIZED CONDUCTIVITY OF THREE-PHASE CELLULAR SYSTEMS [OPREDELENIE KASATEL'NOGO NAPRIAZHENIIA NA STENKE PO IZMERENNOMU PROFILIU SKOROSTI V TURBULENTNOM IADRE V POLE MASSOVYKH SIL]
V. F. POTEMKIN Magnitnaia Gidrodinamika (ISSN 0025-0015), Jan.-Mar. 1983, p. 138-141. In Russian.
A method is proposed for determining the effective generalized electroconductivity of heterogeneous systems (e.g., three-phase emulsions and suspensions). It is shown that the relationship for determining this generalized conductivity is a cubic equation in the case of spherical particles of the same size but different in terms of conductivity and bulk concentration in a highly disperse three-phase system. B.J.

A83-29403
A STUDY OF HELICOPTER ROTOR NOISE, WITH SPECIAL REFERENCE TO TAIL ROTORS, USING AN ACOUSTIC WIND TUNNEL
H. TADGHIGHI and I. C. CHEESEMAN (Southampton, University, Southampton, England) Vertica (ISSN 0360-5450), vol. 7, no. 1, 1983, p. 9-32. refs
In connection with the undesirability of helicopter noise for a number of considerations, there is a need to control noise levels with a minimum of performance penalty. The present investigation is concerned with wind tunnel tests of a high tip speed helicopter in near ideal flow. Effects observed in connection with testing in another tunnel with different flow conditions are also considered. Various theoretical methods are examined in relation to the measured noise and aerodynamic performance of the rotor. A 1.35 m diameter helicopter rotor was designed to allow tests to be made at rotor speeds equal to those currently in full scale used. The aeroacoustic result from the model rotor are found to correspond to full scale results. The calculation of aerodynamic loads and rotational noise is found to provide an approach for predicting aerodynamic loads from noise experiments. It is shown that the 'thickness noise' values of the model rotor have no significant effects on the rotational noise results. G.R.

A83-29950*# United Technologies Research Center, East Hartford, Conn.
ROTOR-VORTEX INTERACTION NOISE
R. H. SCHLINKER and R. K. AMIET (United Technologies Research Center, East Hartford, CT) American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 8th Atlanta, GA, Apr. 11-13, 1983. 24 p. refs
(Contract NAS1-16392)
(AIAA PAPER 83-0720)
A theoretical and experimental study is carried out to develop a first-principles analysis for predicting noise generated by helicopter main-rotor shed vortices interacting with the tail rotor. The generalized prediction procedure calls for a knowledge of the incident vortex velocity field, the rotor geometry, and the rotor operating conditions. The analysis encompasses compressibility effects and chordwise and spanwise noncompactness and treats oblique intersections with the blade planform. In assessing the theory, a model rotor experiment which isolates the blade-vortex interaction noise from other rotor noise mechanisms is conducted. An isolated tip vortex, generated by an upstream semispan airfoil, is convected into the model rotor, and acoustic spectra, pressure signatures, and directivity are measured. Ingestion of the vortex by the rotor is experimentally observed to generate harmonic noise and impulsive waveforms. C.R.

N83-21895*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FARFIELD INFLIGHT MEASUREMENT OF HIGH-SPEED TURBOPROP NOISE
J. R. BALOMBIN and I. J. LOEFFLER 1982 19 p refs Presented at the AIAA 8th Aeroacoustics Conf., Atlanta, 11-13 Apr. 1983
(NASA-TM-83327; E-1574; NAS 1.15:83327; AIAA-83-9745)
Avail: NTIS HC A02/MF A01 CSCL 20A
A flight program was carried out to determine the variation of noise level with distance from a model high speed propeller. Noise measurements were obtained at different distances from a SR-3 propeller mounted on a JetStar aircraft, with the test instrumentation mounted on a Lear jet flown in formation. The propeller was operated at 0.8 flight Mach number, 1.12 helical tip Mach number and at 0.7 flight Mach number, 1.0 helical tip Mach number. The instantaneous pressure from individual blades was observed to rise faster at the 0.8 M flight speed, than at the 0.7 M flight speed. The measured levels appeared to decrease in good agreement with a 6 dB/doubling of distance decay, over the measurement range of approximately 16 m to 100 m distance. Further extrapolation, to the distances represented by a community, would suggest that the propagated levels during cruise would not cause a serious community annoyance. Author

N83-23112*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NOISE OF THE 10-BLADED 60 DEG SWEPT SR-5 PROPELLER IN A WIND TUNNEL
J. H. DITTMAR, G. L. STEFKO, and R. J. JERACKI Feb. 1983 12 p refs
(NASA-TM-83054; E-1508; NAS 1.15:83054) Avail: NTIS HC A02/MF A01 CSCL 20A
Noise generated by supersonic helical tip speed propellers is a possible cabin environment problem for future airplanes powered by these propellers. Noise characteristics of one of these propellers, designated SR-5, are presented. A matrix of tests was conducted to provide as much acoustic information as possible. During aerodynamic testing it was discovered that the propeller had an aeroelastic instability which prevented testing the propeller at its design advance ratio of 4.08 at axial Mach numbers over 0.7. Plots of the variation of the maximum blade passage tone with helical tip Mach number indicate that, at higher helical tip Mach numbers, the propeller operated on sharply increasing portion of the noise curve; therefore, extrapolations to the design condition would not be accurate. A possible extrapolation indicated that SR-5 at its design point should be quieter than SR-3 at its design point. Directivity plots at the higher helical tip Mach numbers indicate a lobed directivity pattern as was observed previously on the SR-3 propeller. M.G.

N83-23114*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
APPLICATION OF 3-SIGNAL COHERENCE TO CORE NOISE TRANSMISSION
E. A. KREJSA 1983 17 p refs Presented at the 8th Aeroacoustics Conf., Atlanta, 11-13 Apr. 1983; sponsored by AIAA
(NASA-TM-83333; E-1580; NAS 1.15:83333; AIAA-83-0759)
Avail: NTIS HC A02/MF A01 CSCL 20A
A method for determining transfer functions across turbofan engine components and from the engine to the far-field is developed. The method is based on the three-signal coherence technique used previously to obtain far-field core noise levels. This method eliminates the bias error in transfer function

measurements due to contamination of measured pressures by nonpropagating pressure fluctuations. Measured transfer functions from the engine to the far-field, across the tailpipe, and across the turbine are presented for three turbofan engines. M.G.

N83-23115*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPARISON OF MEASURED AND PREDICTED FLIGHT EFFECTS ON HIGH-BYPASS COAXIAL JET EXHAUST NOISE
J. R. STONE 1983 20 p refs Presented at the 8th Aeroacoustics Conf., Atlanta, 11-13 Apr. 1983; sponsored by AIAA
(NASA-TM-83347; E-1604; NAS 1.15:83347; AIAA-83-0749)
Avail: NTIS HC A02/MF A01 CSCL 20A

A semi-empirical model for predicting the noise generated by conventional-velocity profile coaxial jets is compared with full scale flight data and model scale simulated flight data for high bypass nozzles. The prediction model was shown to agree with small scale static data for primary jet velocities from 215 to 795 m/s for a wide range of area, temperature, and velocity ratios between streams. However, there were insufficient model nozzle, simulated flight data available at that time to permit validation of the flight effects prediction. The comparisons presented demonstrate that the prediction method is also valid in flight. M.G.

N83-23118# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio. Biodynamic Environment Branch.
USAF BIOENVIRONMENTAL NOISE DATA HANDBOOK. VOLUME 156. HH-1N IN-FLIGHT CREW NOISE
H. K. HILLE Nov. 1982 15 p refs
(Contract AF PROJ. 7231)
(AD-A122601; AMRL-TR-75-50-VOL-156) Avail: NTIS HC A02/MF A01 CSCL 01B

The HH-IN is a USAF multi-purpose utility helicopter providing support for various USAF missions. This report provides measured data defining the bioacoustic environments at flight crew locations inside this helicopter during normal flight operations. Data are reported for two locations in a wide variety of physical and psychoacoustic measures: overall and band sound pressure levels, C-weighted and A-weighted sound levels, preferred speech interference level, perceived noise level, and limiting times for total daily exposure of personnel with and without standard Air Force ear protectors. Refer to Volume 1 of this handbook, USAF Bioenvironmental Noise Data Handbook, Vol. 1: Organization, Content and Application, AMRL-TR-75-50(1) 1975, for discussion of the objective and design of the handbook, the types of data presented, measurement procedures, instrumentation, data processing, definitions of quantities, symbols, equations, applications, limitations, etc. Author (GRA)

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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.

A83-29730#
COST FACTORS AND APPROACH METHODOLOGY IN SELECTING STRUCTURAL MATERIALS AND MANUFACTURING TECHNOLOGIES
B. R. NOTON (Battelle Columbus Laboratories, Columbus, OH) IN: Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 1 New York, American Institute of Aeronautics and Astronautics, 1983, p. 1-18. refs
(AIAA 83-0791)

The need to arrest and reduce costs at all phases of the life cycle of aerospace systems is becoming increasingly important due to many external factors. Design features and manufacturing technology requirements of low-speed and high-speed aircraft are compared. Cost drivers are assessed according to their impact on the aircraft subsystems. It is found that projects which reduce material cost or increase material utilization (buy/fly ratio) and reduce energy requirements will provide cost savings not only to the aerospace industry but to industry in general. Airframe manufacture offers the best opportunity for manufacturing technology projects, with the possible exception of metal removal which has a greater effect on the other subsystems than on airframes. The Air Force 'Manufacturing Cost/Design Guide' (MC/DG) study is discussed, along with the principal steps in the development of the MC/DG. Attention is given to manufacturing cost drivers, a procedure to conduct tradeoffs utilizing MC/DG, and design guide computerization. G.R.

N83-22025*# Gellman Research Associates, Inc., Jenkintown, Pa.
ECONOMIC ANALYSIS OF AERONAUTICAL RESEARCH AND TECHNOLOGY Final Report
A. J. GELLMAN 30 Aug. 1982 147 p refs
(Contract NASW-3598)
(NASA-CR-170083; NAS 1.26:170083) Avail: NTIS HC A07/MF A01 CSCL 05C

The appropriateness of government intervention in the civilian market for aeronautics research and technology (R&T) is examined. The economic rationale for government intervention is examined. The conclusion is that the institutional role played by NASA in civilian aeronautics R&T markets is economically justified.
Author

N83-23240*# Systems Control, Inc., West Palm Beach, Fla.
HELICOPTER TECHNOLOGY BENEFITS AND NEEDS. VOLUME 1: SUMMARY
J. ZUK (National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.) and R. J. ADAMS Jul. 1980 34 p refs Presented at Public Service Helicopter Users' Workshop, Moffett Field, Calif., 14-16 Jul. 1980 2 Vol.
(Contract NAS2-10411)
(NASA-CR-166469-VOL-1; NAS 1.26:166469-VOL-1) Avail: NTIS HC A03/MF A01 CSCL 05A

Present public service helicopter benefits and the potential benefits of an advanced public service rotorcraft (200 knots to 300 knots) are summarized. Past and future public service growth is quantified and assessed and needs, problem areas, and desired vehicle characteristics are defined. Research and technology recommendations are formulated and the costs and benefits of research options are assessed. A.R.H.

N83-23241*# Systems Control, Inc., West Palm Beach, Fla.
HELICOPTER TECHNOLOGY BENEFITS AND NEEDS. VOLUME 2: APPENDICES
J. ZUK (National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.) and R. J. ADAMS Jul. 1980 53 p refs Presented at Public Service Helicopter Users' Workshop, Moffett Field, Calif., 14-16 Jul. 1980 2 Vol.
(Contract NAS2-10411)
(NASA-CR-166470-VOL-2; NAS 1.26:166470-VOL-2) Avail: NTIS HC A04/MF A01 CSCL 05A

Vehicle design, avionics and flight systems; safety and reliability; navigation, guidance and flight control; propulsion; auxiliary systems; human factors; and monitoring and diagnostic systems are the technology areas involved in solving operational and technical problems related to the use of helicopters. Tables show the problems encountered and the proposed research and technology for helicopter use for search and rescue; emergency medical services; law enforcement; environmental control; fire fighting; and resource management. A.R.H.

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SPACE SCIENCES

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

N83-22049# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Wesseling (West Germany). Space Research Group.
ASTROPLANE: A EUROPEAN RESEARCH AIRCRAFT FOR IR AND SUBMILLIMETRE ASTRONOMY (THE DFVLR PROPOSAL)
C. B. COSMOVICI, E. SCHMIDT, and U. STANGGASSINGER *In* ESA The Sci. Importance of Submillimetre Observations p 69-79 Aug. 1982 refs
Avail: NTIS HC A11/MF A01

A proposal for an European Aircraft carrying a competititve infrared submillimeter telescope on board is presented. The need for an Astroplane is pointed out. A Challenger 601 Aircraft as carrier for a 120 cm telescope is proposed. New concepts for a light weight updated airborne astrolaboratory are presented.
E.A.K.

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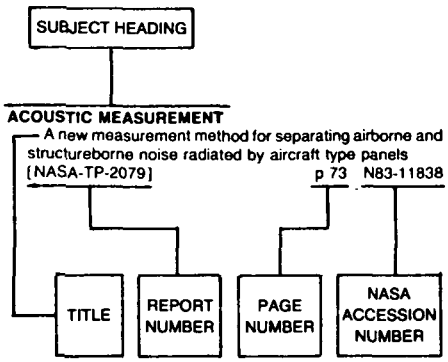

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The effect of acoustic-thermal environments on advanced composite fuselage panels
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Acoustic fatigue test evaluation of adhesively bonded aluminum fuselage panels using FM 73/BR 127 adhesive/primer system
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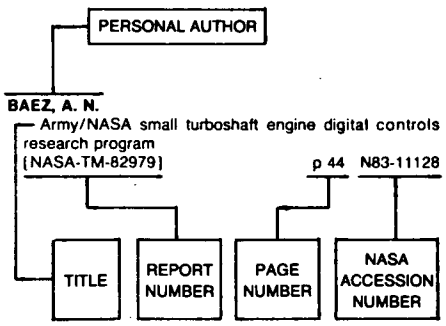

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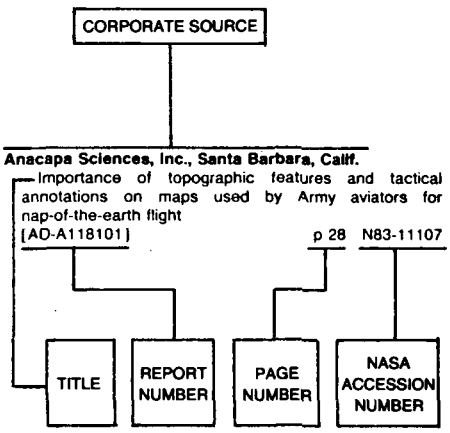

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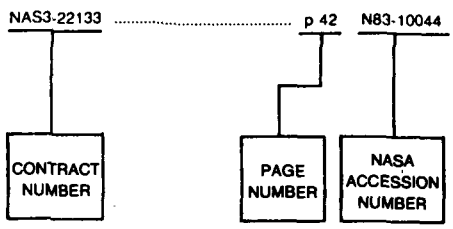

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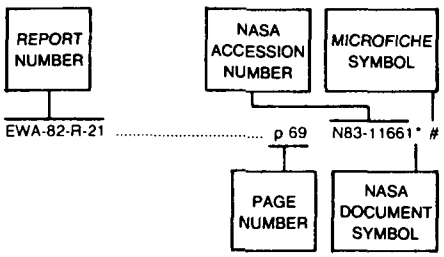

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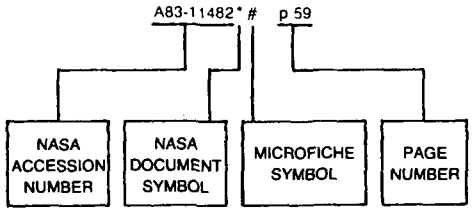

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