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Aeronautical Engineering
A Continuing Bibliography with Indexes

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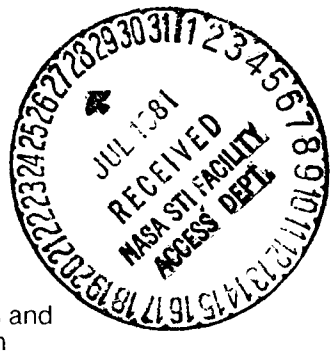
May 1981



National Aeronautics and Space Administration

Aeronautical Engineering

ACCESSION NUMBER RANGES

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

STAR (N-10000 Series)	N81-15968 – N81-17980
IAA (A-10000 Series)	A81-19673 – A81-23368

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NASA SP–7037(135)

AERONAUTICAL ENGINEERING

A Continuing Bibliography

Supplement 135

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 April 1981 in

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

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INTRODUCTION

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

This supplement to *Aeronautical Engineering -- A Continuing Bibliography* (NASA SP-7037) lists 536 reports, journal articles, and other documents originally announced in April 1981 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 in two major sections, *IAA Entries* and *STAR Entries*, in that order. 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. This procedure, which saves time and money, accounts for the slight variation in citation appearances.

Three indexes -- subject, personal author, and contract number -- are included.

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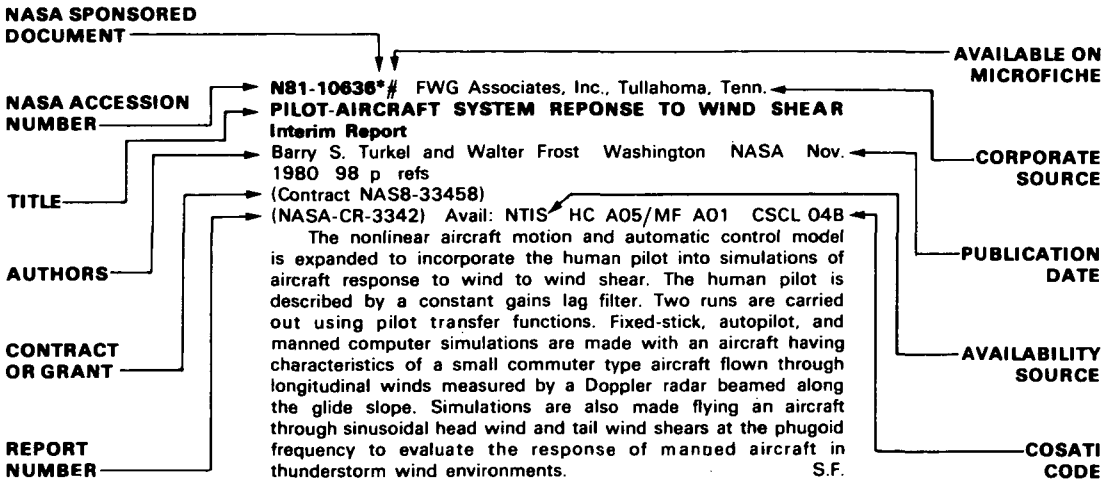

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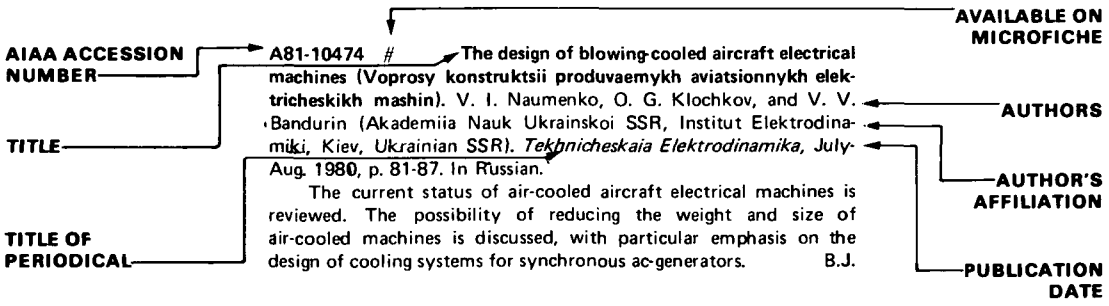

AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 135)

IAA ENTRIES

A81-19799 # **Angle of attack - Its measurement and usage. I (Kat natarcia - Jego pomiar i wykorzystanie. I).** J. Dabrowska (Instytut Lotnictwa, Warsaw, Poland). *Techika Lotnicza i Astronautyczna,* vol. 35, Dec. 1980, p. 9, 10. In Polish.

The dependences of aerodynamic lift and drag coefficients on the angle of attack are explained and used to demonstrate the importance of the angle of attack as a flight control parameter. Landing approach maneuvers, flight times, and maximum range are shown to be affected by proper control of the angle of attack. Methods of measuring this variable are described. T.M.

A81-19800 # **Runway surface loading during aircraft landings (Obciazenie nawierzchni drogi startowej w czasie iadowania samolotu).** J. Rakowski. *Technika Lotnicza i Astronautyczna,* vol. 35, Dec. 1980, p. 22-24. In Polish.

Forces acting on an aircraft during landing are related to the forces exerted on the runway surface. Instrumentation used to measure runway loading patterns is explained, and an equivalent model is described for the surface loading caused by a landing aircraft. T.M.

A81-19836 **Computer-aided process planning system for aircraft engine rotating parts.** V. A. Tipnis, S. A. Vogel, and C. E. Lamb. In: Advanced manufacturing technology: Programming research and operations logistics; Proceedings of the Fourth International Conference, Ann Arbor, Mich., May 21-23, 1979. Amsterdam, North-Holland Publishing Co., 1980, p. 151-169. 6 refs.

A computer-aided process planning system for aircraft engine rotating parts (RPO) was developed to aid the planner with an up-to-date machining technology data base, computer graphics analysis, retrieval capacity, and new technology. This system was compared with the 'varient' process which is unsuitable due to lack of machining and manufacturing requirements for rotating parts, and with the 'generative' approach which requires four man-months to prepare a decision model. The RPO system comprises several software modules for process planning, quality control, and machine tool diagnostics; the software module creates cost estimates, process plans, monitors planning, and communicates with the work center. The feeds, speeds, and tool changes are accomplished by economic analyses which consider metal removal, setup, and cutting tool costs. A.T.

A81-19845 **New developments of data processing in computer-controlled manufacturing systems /DNC, FMS/.** M. Weck, K. Zenner, and Y. Tuchelmann. In: Advanced manufacturing technology: Programming research and operations logistics; Proceedings of the Fourth International Conference, Ann Arbor, Mich., May 21-23, 1979. Amsterdam, North-Holland Publishing Co., 1980, p. 349-368.

A computer-controlled manufacturing system DNC was constructed by using standardized process peripherals (CAMAC) and modular process control software written in a Process-FORTRAN language. The systems concept allows easy integration of supplemental functions such as acquisition of operating data and material-flow control. The DNC-system is being equipped with additional functions for handling and process monitoring for profile milling of aircraft components and rotational parts. A.T.

A81-19872 # **On a linear theory of a supersonic flow past a delta wing with subsonic leading edges.** S. Kubo (Kyoto University, Kyoto, Japan). *Japan Society for Aeronautical and Space Sciences, Transactions,* vol. 23, Nov. 1980, p. 127-138. 21 refs.

The wing form is obtained theoretically in a supersonic flow past a delta wing with a thin but finite thickness at an angle of attack when the leading edges are subsonic for a given velocity potential, which is a known solution of a linearized equation with a simplified boundary condition. The boundary condition is set exactly in order to study the detailed behaviours of the flow around the leading edge. The results support the linearization of the equation qualitatively, when there is no crossflow shock. The wing form is a little modified in the neighbourhood of the leading edge. The limit, beyond which the crossflow can be supersonic, of the angle of attack is found vs. the Mach number of the uniform flow. (Author)

A81-19873 # **Lifting-line theory of oblique wings - Application of the Galerkin method to the lifting-line equation.** T. Kida (Osaka Prefecture, University, Sakai, Japan). *Japan Society for Aeronautical and Space Sciences, Transactions,* vol. 23, Nov. 1980, p. 139-154. 21 refs.

This paper is concerned with the lifting-line approximation for a steady oblique wing with a high aspect ratio in an incompressible fluid flow. The lifting-line theory is constructed more systematically by using an asymptotic method than by using Prandtl's lifting-line theory, and a singular linear integro-differential equation is derived. The method of Galerkin for obtaining approximate solutions is applied to this equation, and the chordwise and spanwise distributions, which were originally introduced by Watkin et al., are used as approximation functions. This approximate method is first applied to a flat-plate elliptic wing without yawing in order to examine the availability of this method, so that it is found that an asymptotic expansion of the lift-slope obtained by the second order chordwise and spanwise approximations is the same as in Van Dyke's lifting-line theory. Therefore, the second-order chordwise and spanwise approximation are secondly applied to the basic integral equation of the oblique wing and the numerical results are compared with earlier theories. (Author)

A81-19940 **Improving surface current injection techniques via one- and two-dimensional models.** J. W. Williams, L. T. Simpson

(Mission Research Corp., Albuquerque, N. Mex.), and K. S. Kunz (LuTech, Inc., Albuquerque, N. Mex.). *(IEEE, U.S. Defense Nuclear Agency, Jet Propulsion Laboratory, and DOE, Annual Conference on Nuclear and Space Radiation Effects, 17th, Ithaca, N.Y., July 15-18, 1980.) IEEE Transactions on Nuclear Science,* vol. NS-27, Dec. 1980, p. 1845-1850. Research supported by the U.S. Defense Nuclear Agency; Contract No. N60921-77-C-0117.

A basic objective in the development of a surface current injection technique (SCIT) is to provide an inexpensive, transportable simulator which will allow electromagnetic pulse (EMP) hardness checks of aircraft in the field. The development effort has been conducted as a combined theoretical and experimental study. Detailed solutions for free field scattering problems are obtained from computer models such as the THREDE finite difference code. It has been found that simplified one- and two-dimensional models can be used to provide insight and understanding less easily obtained from more detailed numerical models. These models appear to be especially useful in the study of basic symmetry and polarity requirements which are likely to be employed in any direct injection scheme. Electrical and mechanical analogs are developed and applied to EMP simulation by direct injection. Predictions of the simplified models are compared to results obtained with the THREDE finite difference code. (Author)

A81-20023 # **Considerations of the use of vitiated preheat.** J. Odgers and D. Kretschmer (Université Laval, Quebec, Canada). *Journal of Engery,* vol. 4, Nov.-Dec. 1980, p. 260-265. 12 refs. Research supported by the National Research Council of Canada.

It is widely held in industry that the use of vitiated heaters is to be avoided in combustion tests. The present paper reviews the situation and gives results which suggest the magnitude of the problem with respect to the various combustion test measurements. Vitiation temperatures up to 800 K are considered, and the effects are assessed against: (1) gas temperatures within the combustor, (2) combustor wall temperatures, (3) flame radiation, (4) air/fuel distribution within primary zone, and (5) pollutant formation. It is demonstrated that some of these effects may be minimized by using oxygen replenishment. The paper concludes that in no circumstances should vitiated preheating be used. Oxygen replenishment, while largely overcoming these deleterious effects, is not sufficient to overcome the effects upon the formation of pollutants, particularly oxides of nitrogen. (Author)

A81-20051 Symposium on Internal Noise in Helicopters, University of Southampton, Southampton, England, July 17-20, 1979, Proceedings. Southampton, England, University of Southampton, 1980. 337 p.

Helicopter internal noise is discussed with regard to the acoustic environment, noise sources, vibration transmissibility, structures and acoustic radiation, and noise control. Particular papers are presented on such topics as speech communication considerations for helicopter interiors, gear unit noise and transmission errors, impact excited mobility measurements in the audio frequency range, acoustic radiation from uniform and honeycomb sandwich plates, and helicopter rotor system isolation. B.J.

A81-20053 # **US Army working group on aircraft noise.** S. Moreland (U.S. Army, Directorate for Development and Qualification, St. Louis, Mo.). In: Symposium on Internal Noise in Helicopters, Southampton, England, July 17-20, 1979, Proceedings. Southampton, England, University of Southampton, 1980, p. A2 1-A2 30. 15 refs.

The research carried out by a U.S. Army working group on the internal noise of helicopters is discussed. A new noise standard is felt to be needed because the standard used to date has never been considered adequate for helicopters and because of the Surgeon General's hearing conservation program. Attention is given to the preliminary considerations of the working group, and data on current noise levels and on aircrew exposure to noise are presented. The two noise limit curves (for helicopters weighing less than/more than 20,000 lbs) proposed by the working group for the design of helicopters are discussed. It is concluded that while current technology is able to bring noise levels in helicopters having a gross weight of less than 20,000 lbs within acceptable limits, reduction of internal noise in helicopters weighing more than 20,000 lbs poses a major problem. C.R.

A81-20054 # **An overview of the research conducted in Aerospatiale on internal noise.** F. N. d'Ambra and H. J. Marze (Société Nationale Industrielle Aérospatiale, Marignane, Bouches-du-Rhône, France). In: Symposium on Internal Noise in Helicopters, Southampton, England, July 17-20, 1979, Proceedings. Southampton, England, University of Southampton, 1980, p. A3 1-A3 32.

A research program conducted with the objective of helicopter cabin noise reduction is reviewed with reference to qualification and identification of annoyance, meshing noise reduction in the main gear box, and improvement of the internal noise levels by optimizing the cabin acoustic treatment. The combined application of treatments at the source, transfer of vibratory energy level, and optimization of soundproofing have made it possible to achieve a pure tone (1850 Hz) reduction of about 53 dB. The overall noise level expressed in dB SIL and dBA has been improved by 30 dB. V.L.

A81-20055 # **Helicopter internal noise - An overview.** J. W. Leverton and J. S. Pollard (Westland Helicopters, Ltd., Yeovil, Somerset, England). In: Symposium on Internal Noise in Helicopters, Southampton, England, July 17-20, 1979, Proceedings. Southampton, England, University of Southampton, 1980, p. A4 1-A4 22. 16 refs.

The basic mechanisms involved in the generation of helicopter cabin noise are discussed together with the engineering constraints and other issues relevant to the noise reduction task. Consideration is given to gearbox isolation, damping, soundproofing, inner cabin concept, and the low frequency problem. V.L.

A81-20060 # **Gear unit noise and transmission errors.** B. A. Shotter and C. Barker (Westland Helicopters, Ltd., Yeovil, Somerset, England). In: Symposium on Internal Noise in Helicopters, Southampton, England, July 17-20, 1979, Proceedings. Southampton, England, University of Southampton, 1980, p. C1 1-C1 11.

Helicopter cabin noise is ordinarily traced to transmission units. With output shaft speed for main rotor drives usually between 200 and 500 rpm, and with gear tooth numbers usually associated with output stage gearing, low-frequency noise is almost unavoidable. Although cabin levels may be reduced with the installation of acoustic materials, these materials add weight and take up space. The paper investigates the nature of gear-tooth motion errors and their contribution to the noise emanating from the Lynx helicopter output stage gears. Theodolites were used for quasi-static observations of the three main driveshafts over 13 as well as 2-3 tooth-mesh cycles, after which full-speed loaded tests were run. Although major errors in tooth geometry were corrected, the motion error curve changed little. It is suspected that the final stage gear noise is linked with gear-tooth stiffness variations and their interaction with the position of actual contact between the gear teeth. R.S.

A81-20061 * # **Gear meshing action as a source of vibratory excitation.** W. D. Mark and R. W. Fischer (Bolt Beranek and Newman, Inc., Cambridge, Mass.). In: Symposium on Internal Noise in Helicopters, Southampton, England, July 17-20, 1979, Proceedings. Southampton, England, University of Southampton, 1980, p. C2 1-C2 13. 8 refs. NASA-supported research.

A81-20062 # **Development and application of an analytical method for predicting helicopter transmission noise.** M. A. Bowes (Kaman Aerospace Corp., Bloomfield, Conn.). In: Symposium on Internal Noise in Helicopters, Southampton, England, July 17-20,

1979, Proceedings. Southampton, England, University of Southampton, 1980, p. C3 1 - C3 17. 10 refs.

A method is presented for predicting the noise generation and radiation properties of a helicopter transmission which can model it as a fully coupled dynamic system consisting of rotating gearshafts, the shaft support bearings, and the housing. The modeling method can be applied during preliminary design to make rough estimates of the transmission, and in detail design by using finite element techniques; finally, during hardware development, improved elemental models can be constructed by using mobility test data. A.T.

A81-20063 # **Modelling techniques for the reduction of noise and vibration in gearboxes.** D. G. Astridge and M. L. W. Salzer (Westland Helicopters, Ltd., Mechanical Research Dept., Yeovil, Somerset, England). In: Symposium on Internal Noise in Helicopters, Southampton, England, July 17-20, 1979, Proceedings. Southampton, England, University of Southampton, 1980, p. C4 1-C4 14. 14 refs.

Helicopter noise and vibration may be eliminated with modification of the dynamic response of the gearbox. The paper presents an analytical model which determines the overall system dynamic matrix from geometric data for shafts and certain casing components and from directly input local stiffness matrices for bearings. Natural frequencies and mode shapes are evaluated, and forced response to any given mesh excitation is determined via summation of normal mode responses. Torsion-only natural frequencies are compared with combined torsion-lateral frequencies for five modes. The overall system technique has been applied to a single mesh spiral level gearbox. R.S.

A81-20064 # **Measurements of structural mobility on helicopter structures.** D. J. Ewins and J. M. M. Silva (Imperial College of Science and Technology, London, England). In: Symposium on Internal Noise in Helicopters, Southampton, England, July 17-20, 1979, Proceedings. Southampton, England, University of Southampton, 1980, p. D1 1-D1 19. 6 refs. Research supported by the Westland Helicopters, Ltd. and Ministry of Defence (Procurement Executive).

The complexity of helicopter structures requires mathematical models using measurements on a scale model or the actual component in addition to modelling by purely theoretical methods. The acquisition of suitable experimental data is discussed along with the analysis stages following measurement which are necessary for modelling the helicopter structures. All the data is collected for use with the impedance coupling method. Mobility measurements relating to the complete airframe, the external platform structure, and the tailcone are investigated. Measurements of translation and rotation motion encompassing a frequency range of 3 to 500 Hz are examined. R.C.

A81-20069 # **Sandwich structures with high transmission loss.** D. J. Mead (Southampton, University, Southampton, England). In: Symposium on Internal Noise in Helicopters, Southampton, England, July 17-20, 1979, Proceedings. Southampton, England, University of Southampton, 1980, p. E2 1, E2 2.

A81-20070 # **Acoustic radiation from honeycomb sandwich plates.** K. H. Heron (Royal Aircraft Establishment, Aerodynamics Dept., Farnborough, Hants., England). In: Symposium on Internal Noise in Helicopters, Southampton, England, July 17-20, 1979, Proceedings. Southampton, England, University of Southampton, 1980, p. E3 1-E3 14. 8 refs.

The growing use of honeycomb sandwich panels in helicopter cabins requires an improved design that lowers core-shear stiffness without reducing static bending stiffness. Using the Kurtze and Watters (1959) concept, the paper outlines the basic theory associated with the modern panels and predicts their acoustic properties. Five sandwich plates constructed from resin-impregnated paper honeycomb cores with aluminum skins are then subjected to mechanical excitation tests in a reverberant room of 64 cubic meters. Held in a 70-kg frame inset in antivibration mounts attached to a wall, the plates, 1.4 m x 0.9 m, were hard-bolted to the frame every 8 cm. Nine 0.5-g accelerometers were then attached at various points on each plate, with five microphones positioned randomly about the room. Results show good agreement with the theory in terms of radiation ratio, power ratio, and transmission loss, when the plate damping value is 1%. R.S.

A81-20073 # **Gearbox isolation for reducing gear tooth noise in single rotor helicopter.** J. I. Smullin (Cambridge Collaborative, Inc., Cambridge, Mass.). In: Symposium on Internal Noise in Helicopters, Southampton, England, July 17-20, 1979, Proceedings. Southampton, England, University of Southampton, 1980, p. F3 1 -F3 12.

Results of a program for developing in-cabin noise-reduction treatments for a single-rotor helicopter are reviewed with emphasis on methods for isolating the main transmission gear tooth frequency vibration from the main airframe structure. It is shown that, as a minimum design goal, it is necessary to consider the tuning of the gear mounting system, whether rigid or elastic, in order to avoid resonant amplification of gear tones. A higher design goal is to generate peak isolation at the gear tone frequencies. V.L.

A81-20074 Problems of voice communication in helicopters. F. B. Johnson (Royal Signals and Radar Establishment, Malvern, Worcs., England). In: Symposium on Internal Noise in Helicopters, Southampton, England, July 17-20, 1979, Proceedings. Southampton, England, University of Southampton, 1980, p. F4 1-F4 9. 5 refs.

A81-20079 Measurement of radar in radio service aircraft (Radarvermessung im Radarführungsdienst Luftwaffe). Mr. Manz (Luftwaffe, Luftwaffenführungsdienstkommando, Cologne, West Germany). In: Symposium on Radar Technology, 4th, Werthhoven, West Germany, November 6-8, 1979, Reports. Düsseldorf, Deutsche Gesellschaft für Ortung und Navigation, 1980. 29 p. In German.

This paper discusses the evaluation of radar equipment from the radio service aircraft. A circular search radar with a range of 450 km and distortion suppression capabilities is investigated along with an altitude measuring radar with a range of 360 km. A reflection measuring device for video and high frequency circuits is used for the evaluation along with free flying and fastened radio sondes. Antenna tilt, the antenna reflected ray, and position accuracy are measured in the evaluation. R.C.

A81-20083 Improved secondary radar angennas for flight safety installations (Verbesserte Sekundärradarantennen für Flugsicherungsanlagen). D. Siebert (Bundesanstalt für Flugsicherung, Frankfurt am Main, West Germany). In: Symposium on Radar Technology, 4th, Werthhoven, West Germany, November 6-8, 1979, Reports. Düsseldorf, Deutsche Gesellschaft für Ortung und Navigation, 1980. 27 p. In German.

Characteristics of secondary surveillance radar antennas are examined in relation to the development of open array antennas and integrated primary radar/secondary surveillance antennas. Emphasis is placed on improved vertical focussing. Results with an integrated primary radar/secondary radar antenna are examined. A procedure for diminishing the influence of the primary radar diagram is discussed, and improved suppression of false targets is observed. R.C.

A81-20084 New ways in antenna technology for optimal adjustment of the background clutter (Neue Wege der Antennentechnik zur optimalen Anpassung an die Clutterumgebung). A. Rupp (Telefunken AG, Ulm, West Germany). In: Symposium on Radar Technology, 4th, Werthhoven, West Germany, November 6-8, 1979, Reports. Düsseldorf, Deutsche Gesellschaft für Ortung und Navigation, 1980. 29 p. In German.

This paper examines the problem of radar clutter with emphasis on residual clutter that is independent of geographical location. The origins of residual clutter in the scanning effect and instability in the radar sender are examined. Methods for reducing clutter by using

frequency diversity, coherent senders, and sensitivity time control are discussed. The SRE-M5 antenna operating in the L-band is investigated in relation to reduced clutter. R.C.

A81-20089 The state of development and design of target data processing of the ELRA system (Stand der Arbeiten und Struktur der Zieldatenverarbeitung des ELRA-Systems). G. van Keuk (Gesellschaft zur Förderung der astrophysikalischen Forschung, Forschungsinstitut für Funk und Mathematik, Werthhoven, West Germany). In: Symposium on Radar Technology, 4th, Werthhoven, West Germany, November 6-8, 1979, Reports.
Düsseldorf, Deutsche Gesellschaft für Ortung und Navigation, 1980. 12 p. 12 refs. In German.

Characteristic features and early results from the ELRA system are investigated. Multiple tracking is considered with emphasis on the degree of freedom of multifunction systems. The clear display of real targets is examined in relation to the tracking logic and sensor control. Minimal interference with the operation of the computer and the use of higher program languages are discussed for the design of software. Experimental results of a test flight with an army commando helicopter are also examined. R.C.

A81-20090 Increased target resolution and minor lobe reduction with active group antennas (Erhöhte Zielauflösung und bereichsweise Nebenzipfelabsenkung bei aktiven Gruppenantennen). U. Nickel and I. Gröger (Gesellschaft zur Förderung der astrophysikalischen Forschung, Forschungsinstitut für Funk und Mathematik, Werthhoven, West Germany). In: Symposium on Radar Technology, 4th, Werthhoven, West Germany, November 6-8, 1979, Reports. Düsseldorf, Deutsche Gesellschaft für Ortung und Navigation, 1980. 17 p. 7 refs. In German.

The falsification of radar bearings at low elevations due to ground reflection is discussed. A procedure for the suppression of multipath errors which permits angle resolution of direct and reflected paths is examined. A sequential evaluation method is derived from the Maximum-Likelihood estimation for the calculation of two point targets. Diagram formation is discussed in relation to evaluation of individual antennas in the group. Minor lobe reduction is examined along with the maximization of a weighted antenna gain. R.C.

A81-20091 Improvement of effective minor lobe behavior of radar antennas through signal processing (Zur Verbesserung des effektiven Nebenzipfelverhaltens von Radarantennen durch Signalverarbeitung). H.-W. Bock and K. Krücker (Forschungsgesellschaft für angewandte Naturwissenschaften, Forschungsinstitut für Hochfrequenzphysik, Werthhoven, West Germany). In: Symposium on Radar Technology, 4th, Werthhoven, West Germany, November 6-8, 1979, Reports. Düsseldorf, Deutsche Gesellschaft für Ortung und Navigation, 1980. 18 p. 21 refs. In German.

The method of spatial filtering for processing the element signal of a group antenna is examined. Applications and limits to adaptive spatial filtering are investigated. Results with an analog and digital operating spatial filter experimental system integrated in a short range radar are discussed. Improvement of radar antenna minor lobe damping with small aperture measurements is observed. R.C.

A81-20092 Side lobe suppression with digital signal processing (Nebenzipfelunterdrückung mit digitaler Signalverarbeitung). Mr. Hauptmann. In: Symposium on Radar Technology, 4th, Werthhoven, West Germany, November 6-8, 1979, Reports. Düsseldorf, Deutsche Gesellschaft für Ortung und Navigation, 1980. 15 p. 5 refs. In German.

The size of surveillance antennas for locating low flying aircraft is minimized for mobility and to decrease the likelihood of discovery. Specifications for a small antenna and a high gain result in a trade-off in side lobe damping. Side lobe suppression methods are examined to dampen noise without influencing the radar signal. Emphasis is placed on digital methods and the influence of the noise environment radar sensor on side lobe supression. Side lobe blanking and side lobe cancelling procedures are investigated. R.C.

A81-20094 Target detection and parameter estimation in surveillance radars using MTI-FFT processing (Zielentdeckung und Parameterschätzung in Rundsuchradars mit MTI-FFT-Verabeitung). A. Ludloff, M. Minker, and N. Füchter (Telefunken AG, Ulm, West Germany). In: Symposium on Radar Technology, 4th, Werthhoven, West Germany, November 6-8, 1979, Reports.
Düsseldorf, Deutsche Gesellschaft für Ortung und Navigation, 1980. 30 p. 9 refs. In German.

A surveillance radar system with 10 to 20 hits per scan using an MTI-FFT filter bank processor is examined. The system design is investigated along with criteria for selection of the transmitter signal. Comparisons are made for several Doppler filters and MTI moving window processing. A 20 dB improvement in ground clutter is observed with a 30 dB improvement in rain clutter, and a reduction in the number of false alarms. R.C.

A81-20097 Coherent signal processing in frequency agile pulse radar units (Zur kohärenten Signalverarbeitung in frequenzagilen Puls-Radargeräten). W. Bühring (Gesellschaft zur Förderung der astrophysikalischen Forschung, Forschungsinstitut für Funk und Mathematik, Werthhoven, West Germany). In: Symposium on Radar Technology, 4th, Werthhoven, West Germany, November 6-8, 1979, Reports. Düsseldorf, Deutsche Gesellschaft für Ortung und Navigation, 1980. 18 p. 11 refs. In German.

Signals from a radar unit can be received by a discriminator and evaluated for electronic interference and a weapon attack on the radar. A radar signal form with a frequency change between impulses and unequal impulse distances complicates the evaluation of signals from individual radar units. The signal form and signal processing is examined for a radar unit with electronically controlled group antennas. A processing method for the coherent staggered echo series is derived for the suppression of ground and weather interference. R.C.

A81-20098 A mobile computer-aided detection and tracking system for low-flying attack aircraft (Ein mobiles rechnergestütztes System zur Tieffliegererfassung und -leitung). W. Schwarz (Siemens AG, Munich, West Germany). In: Symposium on Radar Technology, 4th, Werthhoven, West Germany, November 6-8, 1979, Reports. Düsseldorf, Deutsche Gesellschaft für Ortung und Navigation, 1980. 22 p. In German.

Advances in weaponry and aircraft systems, such as the terrain-following radar, have provided for flying attack capability at speeds up to Mach = 1. The present paper deals with a sophisticated system devised for detecting low-flying attack aircraft which, at the same time, uses a digital computer to provide tracking data to the intercepter aircraft. V.P.

A81-20099 Detection of direction changes of flying targets from position coordinates of the radar data (Entdeckung von Richtungsänderungen bei Flugzielen aus den Positionskoordinaten der Radarinformation). R. Ehrmanntraut (EUROCONTROL, Beek, Netherlands). In: Symposium on Radar Technology, 4th, Werthhoven, West Germany, November 6-8, 1979, Reports. Düsseldorf, Deutsche Gesellschaft für Ortung und Navigation, 1980. 21 p. In German.

A81-20100 Evaluation of false alarm information with the ELRA (Auswertung der Falschmeldeinformation bei ELRA). W. Fleskes (Gesellschaft zur Förderung der Astrophysikalischen Forschung, Forschungsinstitut für Funk und Mathematik, Werthhoven, West Germany). In: Symposium on Radar Technology, 4th, Werthhoven, West Germany, November 6-8, 1979, Reports. Düsseldorf, Deutsche Gesellschaft für Ortung und Navigation, 1980. 8 p. 6 refs. In German.

The information from false alarms is reintegrated into the ELRA system. The modules of the central computer software are examined for the construction of a clutter map. Variations in the computer load are investigated using a search mode along the horizon and a recovery procedure for the information in the clutter map. R.C.

A81-20101 **Application of Doppler information to automatic target tracking (Zur Verwendung von Doppler-Information bei der automatischen Zielverfolgung).** J. Bümmerstede (Gesellschaft zur Förderung der astrophysikalischen Forschung, Forschungsinstitut für Funk und Mathematik, Werthhoven, West Germany). In: Symposium on Radar Technology, 4th, Werthhoven, West Germany, November 6-8, 1979, *Reports.* Düsseldorf, Deutsche Gesellschaft für Ortung und Navigation, 1980. 16 p. 5 refs. In German.

A81-20102 **New techniques for the monopulse-radar tracking of high-maneuverability aircraft (Neue Verfahrenswege bei der Monoradarzielverfolgung von Flugzeugen mit hoher Manövrierfähigkeit).** H. Völker (Telefunken AG, Ulm, West Germany). In: Symposium on Radar Technology, 4th, Werthhoven, West Germany, November 6-8, 1979, Reports. Düsseldorf, Deutsche Gesellschaft für Ortung und Navigation, 1980. 21 p. 6 refs. In German.

A81-20103 **New techniques and development trends in the system architecture of EDP systems for radar data processing and airspace control (Neue Wege und Entwicklungstrends der Systemarchitektur von EDV Systemen zur Radardatenverarbeitung, Luftraumkontrolle).** H. Ebert (Telefunken AG, Ulm, West Germany). In: Symposium on Radar Technology, 4th, Werthhoven, West Germany, November 6-8, 1979, Reports. Düsseldorf, Deutsche Gesellschaft für Ortung und Navigation, 1980. 39 p. 9 refs. In German.

A81-20110 # **Application of low frequency eddy-current for inspection of civil aircraft.** G. Nagel and F. Schur (Deutsche Lufthansa AG, Hamburg, West Germany). In: World Conference on Non-destructive Testing, 9th, Melbourne, Australia, November 19-23, 1979, Sessions 2A(1-8), 2B, and 4B. Parkville, Victoria, Australia, Australian Institute for Nondestructive Testing, 1980. (2A-2). 10 p.

The development of low frequency eddy-current inspection is demonstrated with examples of various applications. The applications discussed include corrosion inspection, wing-splice inspection, and lap-joint inspection. Future developments in equipment performance, signal processing, and probe layout are also discussed. B.J.

A81-20135 # **Evaluation and comparison of nondestructive service inspection methods.** E. A. B. De Graaf and P. De Rijk (Nationaal Lucht- en Ruimtevaartlaboratorium, Emmeloord, Netherlands). In: World Conference on Non-destructive Testing, 9th, Melbourne, Australia, November 19-23, 1979, Sessions 1C(1-6), 3B(1-6), and 4A(1-7). Parkville, Victoria, Australia, Australian Institute for Nondestructive Testing, 1980. (4A-1). 8 p. Research supported by the Royal Netherlands Air Force.

Fatigue cracks in 102 specimens were inspected with eddy currents, ultrasonics, X-rays and penetrants. The specimens were then corroded and the inspections repeated. Inspection results were verified by fractographic examination of the opened up fatigue cracks. (Author)

A81-20162 # **Non-destructive testing of adhesive-bonded joints.** E. A. Lloyd, D. S. Wadhwani, and A. F. Brown (City University, London, England). In: *World Conference on Non-destructive Testing*, 9th, Melbourne, Australia, November 19-23, 1979, Sessions 6, 7(1&2), 5A/5B, and 4H(1-6). Parkville, Victoria, Australia, Australian Institute for Nondestructive Testing, 1980. (5B-1). 8 p.

Ultrasonic spectroscopy has been used to monitor the early stages of hydrothermal degradation of adhesive-bonded joints of the type used in aircraft. In this paper, attention is given to the experimental setup, the ultrasonic technique, the interpretation of the spectra, and the detection of hydrothermal degradation. B.J.

A81-20168 # **New NDT techniques used for aircraft maintenance.** R. Macleod (Quantas Airways, Ltd., Sydney, Australia). In: World Conference on Non-destructive Testing, 9th, Melbourne, Australia, November 19-23, 1979, Sessions 2A, 4H, and 7. Parkville, Victoria, Australia, Australian Institute for Nondestructive Testing, 1980. (2ADD-2). 10 p.

Description of various NDT techniques used to ensure reliable and efficient maintenance and operation of the Quantas fleet of transport aircraft. Isotope inspection and eddy current inspection methods used to monitor engine condition are discussed along with airframe fatigue measurements, fuselage sampling inspections, wheel hub inspections, and assurance of correct post-overhaul component assembly. T.M.

A81-20211 # **Acoustic emission and corrosion.** I. G. Scott (Department of Defence, Aeronautical Research Laboratories, Melbourne, Australia). In: *World Conference on Non-destructive Testing*, 9th, Melbourne, Australia, November 19-23, 1979, Sessions 4D, 4G, and 4J. Parkville, Victoria, Australia, Australian Institute for Nondestructive Testing, 1980. (4J-5). 8 p. 8 refs.

The use of acoustic emission (AE) for the practical detection and characterization of corrosion is examined from an experimental viewpoint. An attempt is made to characterize AE signals in terms of spectral content, signal amplitude distribution, etc. The role of bubbles in AE is discussed and some NDI applications of AE are described. (Author)

A81-20214 # **The use of acoustic emission for detecting and evaluating of fatigue cracks severity during static and cyclic loading of structure elements.** A. F. Selikhov, Iu. P. Borodin, I. V. Gulevskii (Tsentral'nyi Aerogidrodinamicheskii Institut, Moscow, USSR), V. I. Ivanov, V. N. Kuranov, and A. N. Riabov (Tsentral'nyi Nauchno-Issledovatel'skii Institut Tekhnologii i Mashinostroeniia, Moscow, USSR). In: World Conference on Non-destructive Testing, 9th, Melbourne, Australia, November 19-23, 1979, Sessions 4D, 4G, and 4J. Parkville, Victoria, Australia, Australian Institute for Nondestructive Testing, 1980. (4J-8). 8 p.

A81-20223 * **Radiation boundary conditions for wave-like equations.** A. Bayliss (Institute for Computer Applications in Science and Engineering, Hampton, Va.; New York University, New York, N.Y.) and E. Turkel (New York University, New York, N.Y.; Tel Aviv University, Tel Aviv, Israel). *Communications on Pure and Applied Mathematics*, vol. 33, Nov. 1980, p. 707-725. 21 refs. Contract No. NAS1-14101; Grant No. AF-AFOSR-76-2881.

In the numerical computation of hyperbolic equations it is not practical to use infinite domains; instead, the domain is truncated with an artificial boundary. In the present study, a sequence of radiating boundary conditions is constructed for wave-like equations. It is proved that as the artificial boundary is moved to infinity the solution approaches the solution of the infinite domain as O(r exp -m-1/2) for the m-th boundary condition. Numerical experiments with problems in jet acoustics verify the practical nature of the boundary conditions. B.J.

A81-20297 **Thermal considerations in the patching of metal sheets with composite overlays.** R. Jones and J. Callinan (Department of Defence, Aeronautical Research Laboratories, Melbourne, Australia). *Journal of Structural Mechanics*, vol. 8, no. 2, 1980, p. 143-149. 8 refs.

In the reinforcing of structures or the patching of cracks with a bonded overlay of high strength composite material, the thermal mismatch between the composite patch and the underlying material is often thought to be a major problem. This paper shows that the temperature fields used in the repair process together with the support conditions cause a significant lowering of the effective coefficient of expansion in the structure which is being repaired, which in turn results in low values for the residual thermal stresses. (Author)

A81-20349 # **Adaptive airfoils and wings for efficient transonic flight.** H. Sobieczky (Deutsche Forschungs- und Versuchs-

anstalt für Luft- und Raumfahrt, Göttingen, West Germany) and A. R. Seebass (Arizona, University, Tucson, Ariz.). *International Council of the Aeronautical Sciences, Congress, 12th, Munich, West Germany, Oct. 12-17, 1980, Paper.* 25 p. 18 refs.

The elliptic continuation shock-free flow design method was applied to test examples to provide a theoretical basis for the design of adaptive wing geometry at variable operating conditions. A system is proposed for automatic shape variations of wings based on experience with systematic computational design. The special designs and the adaptive shape control system must be tested experimentally, possibly in combination with the new aerodynamic concepts for higher efficiency of transonic aircraft like variable geometry and boundary layer control investigations. A.T.

A81-20350 # **Fuel consumption aspects of some noise abatement procedures.** N. M. Standen and S. E. Rosborough (Transport Canaca, Ottawa, Canada). *International Council of the Aeronautical Sciences, Congress, 12th, Munich, West Germany, Oct. 12-17, 1980, Paper.* 15 p. 11 refs.

A computer program has been developed to assess the fuel consumption of jet transport aircraft in terminal area operations. Performance characteristics of the Boeing 737 type aircraft have been used to determine the fuel consumed and the noise levels produced under several departure profiles normally considered as noise abatement procedures. An index is suggested which is intended to provide a measure of the relative effects of fuel consumed and noise level experienced by groundbased observers. (Author)

A81-20351 # **Delta canard configuration at high angle of attack.** W. Kraus (Messerschmitt-Bölkow-Blohm GmbH, Ottobrunn, West Germany). *International Council of the Aeronautical Sciences, Congress, 12th, Munich, West Germany, Oct. 12-17, 1980, Paper.* 34 p.

The usefulness of a high angle of attack regime in a dogfight is discussed, together with the role of a delta canard configuration to control instability in transonic and supersonic flight. The area of poststall utilization is indicated, noting that good angles of attack are between 25 and 90 degrees for Mach numbers between 0.3 and 1 depending on altitude. It is shown that there are no problems for the configuration at high angles of attack regarding longitudinal characteristics, neither for trimming nor control. Spin susceptibility can be avoided at stall conditions by inproving yaw control and finally, lateral stability can be improved by a special trim schedule. N.D.

A81-20352 # **Influence of jet location on the efficiency of spanwise blowing.** W. Staudacher (Messerschmitt-Bölkow-Blohm GmbH, Ottobrunn, West Germany). *International Council of the Acronautical Sciences, Congress, 12th, Munich, West Germany, Oct. 12-17, 1980, Paper.* 29 p. 28 refs. Research sponsored by the Bundesministerium der Verteidigung.

An experimental study of the optimization of the jet location for concentrated spanwise blowing over the upper surface of the wing was made. Variations of 45 nozzle positions were performed including jet locations in the body, over flaps and controls and over the basic wing. Optimum jet positions were determined as functions of improvements in performance, stability and control. A correlation of the effects of spanwise blowing with lift-drag development was attempted through the use of the Polhamus leading edge suction analogy. N.D.

A81-20353 # **Some aspects of advanced flight management systems and their application to modern transport aircraft.** H. Griem (Vereinigte Flugtechnische Werke GmbH, Bremen, West Germany). *International Council of the Aeronautical Sciences, Congress, 12th, Munich, West Germany, Oct. 12-17, 1980, Paper.* 34 p. Research supported by the Bundesministerium für Forschung und Technologie.

Various aspects of takeoff, landing approach, and landing are discussed in relation to the maximum stress exerted on the cockpit crew and ATC personnel and maximum accident frequency during these phases. The separation of flight paths used for automatic control is defined, and elements of the flight test system (HFB S 1) used in the studies are described, namely the sensor system, control system, mode concept and control system, displays and operation, set-value computation, and flight control computer. The most important results from eight test flights involving approaches to the Braunschweig terminal in West Germany are presented. C.R.

A81-20418 # **High-level languages in affordable aircraft simulators.** P. H. Ackermans (CAE Electronics, Ltd., St. Laurent, Quebec, Canada). *Astronautics and Aeronautics,* vol. 19, Jan. 1981, p. 53-55.

Extended versions of the minicomputer, so-called 'superminicomputers', have been designed for use with high-level languages in aircraft simulators. The languages, including FORTRAN, COBOL and BASIC, yield program statements that are very near English. As an example, the VAX-11/780 model has a physical memory capacity of 8 megabytes and can store and execute complex programs. The demand for memory is minimized by using a FORTRAN IV-plus compiler which translates the programs into an efficient, machine-usable code. The high-level languages have been shown to significantly increase simulation detail. Special subroutines, called 'handlers', may be integrated so that the system recognizes and works with interfaces to input and control simulator elements. Simulators are designed for the particular features of a specific aircraft, and can be updated to reflect later changes made to the aircraft. S.C.S.

A81-20419 # **Laser measurement of angle of attack on wind-tunnel models.** C. R. Pond and E. G. Hill (Boeing Commercial Airplane Co., Renton, Wash.). *Astronautics and Aeronautics,* vol. 19, Jan. 1981, p. 56, 57, 79.

A Laser Angle Meter (LAM), that yields angle-of-attack measurements for wind-tunnel models with a precision of 0.005 deg has been developed. The LAM measures model pitch altitude at working distances of 4-5 miles and is free from temperature and model vibration effects. The high-response level of the LAM permits essentially real-time measurements and rapid data acquisition. The system determines angle of attack by detecting the phase-shift of fringes produced when a collimated light beam rebounds off a reflector attached to the body spar. The angle of attack is given by the periodic variation in fringe amplitude. The collimated light beam passes through a code disk and the reflected signal is amplitude-modulated at 21.6 kHz, where the model attitude determines the phase of the AM signal. A shearing interferometer is used as the reflector assembly. The change in signal phase relative to the reference phase is displayed on an electronic processor. As the model is tracked, a reference reflector compensates for the angular change of the optical unit. LAM accuracy is particularly applicable to sting-mounted models. S.C.S.

A81-20448 **A correlated random numbers generator and its use to estimate false alarm rates of airplane sensor failure detection algorithms.** Y. K. Chan and R. W. Edsinger (Boeing Computer Services, Inc., Tukwila, Wash.). In: Conference on Decision and Control, and Symposium on Adaptive Processes, 18th, Fort Lauderdale, Fla., December 12-14, 1979, Proceedings. Volume 1. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 242-246. 8 refs. Research supported by the Boeing Commercial Airplane Co.

A routine procedure is presented to generate random number series with specified power spectral density and composite Gaussian probability distribution functions. This can be used to simulate airplane sensor outputs in the synthesis and evaluation of failure detection schemes for redundant sensor sets. An example is given comparing some statistics of simulated sensor outputs to their observed counterparts. (Author)

A81-20450 **Precision correlation tracking via optimal weighting functions.** J. M. Fitts (Hughes Aircraft Co., Culver City, Calif.). In: Conference on Decision and Control, and Symposium on Adaptive Processes, 18th, Fort Lauderdale, Fla., December 12-14,

1979, Proceedings. Volume 1. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 280-283.

A brief description of correlation tracker techniques is given, with particular attention paid to the mathematical background. It is noted that one distinguishing feature of the correlation tracker developed by the Hughes Aircraft Company (Time Optimal, Target Adaptive Correlation, Digital Tracker) is that the optimal weighting function is the negative derivative of the signal. The weighting function is effectively matched to the signal. It is pointed out that the centroid and edge trackers are special cases of this correlation tracker. Because of these optimal or matched weighting functions, a gate is not needed to reduce noise as is required for the centroid tracker. It is shown through computer simulations that the correlation tracker is far superior to the centroid tracker and in fact provides better tracking if the tracking gage encompasses the full image. C.R.

A81-20454 Design of disturbance-rejection controllers for linear multivariable discrete-time systems using entire eigenstructure assignment. J. J. D'Azzo (USAF, Institute of Technology, Wright-Patterson AFB, Ohio). In: Conference on Decision and Control, and Symposium on Adaptive Processes, 18th, Fort Lauderdale, Fla., December 12-14, 1979, Proceedings. Volume 1.
Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 315-321. 23 refs.

The method of entire eigenstructure assignment constitutes a powerful new method for the design of on-board digital flight controllers. This fact is demonstrated by the presentation of a technique for the design of finite settling time disturbance-rejection controllers for linear multivariable discrete-time systems incorporating digital integrators. The computational attractiveness of the method of entire eigenstructure assignment is illustrated by designing a time-optimal disturbance-rejection controller for the lateral dynamics of the F-4 aircraft. The transient-response characteristics of the controlled aircraft are illustrated by the presentation of the results of simulation studies for a number of sampling periods when the aircraft is subjected to a very severe yaw-torque disturbance. (Author)

A81-20465 Operational energy conservation strategies in commercial aviation. R. R. Covey, G. J. Mascetti, W. U. Roessler (Aerospace Corp., El Segundo, Calif.), and R. L. Bowles (U.S. Department of Energy, Washington, D.C.). In: Conference on Decision and Control, and Symposium on Adaptive Processes, 18th, Fort Lauderdale, Fla., December 12-14, 1979, Proceedings. Volume 1. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 408-414. 12 refs.

Various fuel conservation strategies that are applicable to commercial aviation and that lend themselves to real-time decision and control techniques are discussed. It is noted that these 12 strategies could potentially save 12 percent of current fuel usage. The strategies are as follows: optimized takeoff procedures, optimized cruise Mach number selection, optimized altitude selection, optimized descent procedures, reduced/delayed flap approaches, flow control, linear holding, gate holding, profile descent, reduced final approach spacing, area navigation/direct routing, and airborne performance computer systems. It is concluded that since the costs incurred and benefits derived in implementing these techniques and strategies are intimately related to fuel prices, comprehensive parametric analyses are needed to clearly identify those strategies for which automatic decision and control can provide the highest energy conservation returns on investment. C.R.

A81-20466 * Application of trajectory optimization principles to minimize aircraft operating costs. J. A. Sorensen (Analytical Mechanics Associates, Inc., Mountain View, Calif.), S. A. Morello (NASA, Langley Research Center, Hampton, Va.), and H. Erzberger (NASA, Ames Research Center, Moffett Field, Calif.). In: Conference on Decision and Control, and Symposium on Adaptive Processes, 18th, Fort Lauderdale, Fla., December 12-14, 1979, Proceedings. Volume 1. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 415-421. 31 refs.

This paper summarizes various applications of trajectory optimization principles that have been or are being devised by both government and industrial researchers to minimize aircraft direct operating costs (DOC). These costs (time and fuel) are computed for aircraft constrained to fly over a fixed range. Optimization theory is briefly outlined, and specific algorithms which have resulted from application of this theory are described. Typical results which demonstrate use of these algorithms and the potential savings which they can produce are given. Finally, need for further trajectory optimization research is presented. (Author)

A81-20468 Integration of fuel conservative procedures in the high density terminal area. R. G. Dear (California State University, Fullerton, Calif.). In: Conference on Decision and Control, and Symposium on Adaptive Processes, 18th, Fort Lauderdale, Fla., December 12-14, 1979, Proceedings. Volume 1.
Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 427-431. 8 refs.

Fuel conservative procedures reduce fuel consumption in high density thermal areas if properly planned, but their effectiveness is affected by air traffic controls. Real-time pilot-and-control-in-the-loop simulations showed that fuel savings can be made under moderately heavy traffic conditions; in heavy traffic, high controller workload and lower fuel savings indicate that time-controlled aircraft guidance and computer scheduling may be required to realize the possibilities of fuel conservative procedures. A.T.

A81-20470 Adaptive control for electronic countermeasures. B. Friedlander and A. J. Rockmore (Systems Control, Inc., Palo Alto, Calif.). In: Conference on Decision and Control, and Symposium on Adaptive Processes, 18th, Fort Lauderdale, Fla., December 12-14, 1979, Proceedings. Volume 2.
Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 621-623. 10 refs. Contract No. N00039-79-C-0124.

The deception of a tracking radar by electronic countermeasures is formulated as the problem of controlling a dynamic system with unknown parameters. Adaptive controllers are derived for destabilizing the radar and for inducing fixed tracking errors. The structure of the controllers is that of a self-tuning regulator, with some special features arising from the requirements of this application. (Author)

A81-20471 * VTOL control for shipboard landing in high sea states. C. G. McMuldroch, G. Stein, and M. Athans (MIT, Cambridge, Mass.). In: Conference on Decision and Control, and Symposium on Adaptive Processes, 18th, Fort Lauderdale, Fla., December 12-14, 1979, Proceedings. Volume 2.
Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 626-629. Grant No. NGL-22-009-124.

A control algorithm is developed for a VTOL type aircraft landing on a small ship in rough seas. The work covers modelling the dynamics of the two vehicles, the design of an aircraft-tracking-ship-motion controller, and the specification of an actual landing control algorithm. The landing controller design is more practical and found to perform better than the hover controller. In addition to outlining a design technique, the results provide design guidelines and performance bounds for practical landing control systems. (Author)

A81-20473 Robust autoregressive models for predicting aircraft motion from noisy data. S. F. Huling, M. Mintz (Pennsylvania, University, Philadelphia, Pa.), S. A. Goodman, and W. Dziwak (U.S. Army, Armament Research and Development Command, Dover, N.J.). In: Conference on Decision and Control, and Symposium on Adaptive Processes, 18th, Fort Lauderdale, Fla., December 12-14, 1979, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 638-643. 6 refs.

It was found previously (Huling, et al., 1971) that in a noiseless environment higher order autoregressive models provided robust predictors which could significantly improve the capabilities of an antiaircraft artillery weapon system against a large class of aircraft

maneuvers at extended times of flight. This study examines the case where the observations made by the weapon system are corrupted by noise. The achieved results show that robust higher order autoregressive models still yield considerable improvement, especially in the filtering of the sensor signals. (Author)

A81-20474 Parameter identification and discriminant analysis for jet engine mechanical state diagnosis. C. Baskiotis, J. Raymond, and A. Rault (ADERSA/GERBIOS, Palaiseau, Essonne, France). In: Conference on Decision and Control, and Symposium on Adaptive Processes, 18th, Fort Lauderdale, Fla., December 12-14, 1979, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 648-650. 5 refs. Research supported by the Institut de Recherches d'Informatique et d'Automatique; Ministère de la Défense Contract No. 77,93304,00.

A general methodology has been developed for diagnosing systems whose internal wear has an effect on their dynamic performance. The methodology involves (1) measurement of performance; (2) determination and measurement of the mechanical state on a test population; (3) establishment of relationships between the performance and the mechanical state; and (4) diagnosis of the mechanical state directly from performance measurement. Results of the methodology application to jet engines are presented. V.L.

A81-20475 A frequency-domain technique for aeroelastic mode estimation. A. Cumani and R. Del Bello (Istituto Elettrotecnico Nazionale, Turin, Italy). In: Conference on Decision and Control, and Symposium on Adaptive Processes, 18th, Fort Lauderdale, Fla., December 12-14, 1979, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 651, 652. 5 refs. Research supported by Aeritalia S.p.A.

A frequency-domain identification technique has been developed for flutter analysis which can resolve coupled modes even with substantial noise in the input-output data. The proposed method has been implemented in a software package which is the central part of an interactive minicomputer-based flutter analysis system. The identification procedure is illustrated by a simulated example. V.L.

A81-20476 Development and demonstration of an automatic control and recovery system for remotely piloted vehicles. B. Hardy (U.S. Naval Weapons Center, China Lake, Calif.) and W. R. Sturgeon (Systems Analysis and Control, Ridgecrest, Calif.). In: Conference on Decision and Control, and Symposium on Adaptive Processes, 18th, Fort Lauderdale, Fla., December 12-14, 1979, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 653, 654.

The need for an automatic system for the rapid, safe recovery of remotely piloted vehicles (RPVs) is stressed. A new recovery system developed under the Hybrid Terminal Assist Landing (HYTAL) program is discussed, with the system's conceptual layout presented schematically. Factors considered in the design of the system are given, for example, the steady-state position error arising from a constant wind and the undesirably large attitudes and velocities resulting from large changes in the commanded position. Flight tests are described wherein each axis of control (pitch, roll, and vertical) was separately tested, the axes not under test remaining under the control of the operator. It is noted that automatically controlled takeoff, hover, translation, and landing were demonstrated. C.R.

A81-20485 Some implementation considerations for numerically stable flight filters. S. M. Strickland (Boeing Co., Seattle, Wash.) and J. Vagners (Washington, University, Seattle, Wash.). In: Conference on Decision and Control, and Symposium on Adaptive Processes, 18th, Fort Lauderdale, Fla., December 12-14, 1979, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 828, 829. 9 refs.

An efficient error covariance reset scheme is presented for upper-unitary triangular-diagonal (U-D) factored multimode filter applications. The numerical sensitivity of the U-D measurement update algorithm to state vector ordering is analyzed, and the algorithm is shown to be sensitive to ordering of the measurement matrix with respect to zero and non-zero elements. An ordering scheme that takes advantage of this sensitivity is suggested by the results. It is demonstrated that position states should be last in the state vector for maximum accuracy benefits from position fix updates, for example. This ordering is compatible with that necessary for the simplified error state reset. C.R.

A81-20508 A new technique for tracking sequences of digitized images. M. Llewellyn and S. Dougherty (USAF, Avionics and Armament Development Div., Wright-Patterson AFB, Ohio). In: Conference on Decision and Control, and Symposium on Adaptive Processes, 18th, Fort Lauderdale, Fla., December 12-14, 1979, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 1028-1031.

The middle ground between point trackers and correlation trackers is discussed, and it is noted that feature extraction techniques can be employed to reduce the computation normally associated with correlation tracking while preserving high accuracy. It is found that ways exist to reduce the number of pixels in the reference set and at the same time increase the effective tracking signal-to-noise ratio for a correlation tracker. The success of this approach to reducing the required computation rate depends on the application of high speed feature extraction techniques (here, gradient magnitude estimation) and an adaptive Kalman filter. C.R.

A81-20526 # Particle dynamics of inlet flow fields with swirling vanes. A. Hamed (Cincinnati, University, Cincinnati, Ohio). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0001.* 15 p. 12 refs. Contract No. N00014-78-C-0590.

The particle trajectories are investigated in an inlet flow field, of a helicopter engine with swirling vanes and particle separator. The flow field resulting from the swirling vanes is first computed on a hub-shroud mid-channel stream surface. The trajectories of the solid particles are then determined in this flow field, including particle impacts with the hub, tip, and vane surfaces. The particle rebounding velocity and direction after each impact is determined using empirical correlations derived from experiments conducted in a special tunnel. Different particle sizes, are considered, and the resulting trajectories and separator effectiveness are presented. (Author)

A81-20527 # Body-fitted 3-D full-potential flow analysis of complex ducts and inlets. C. K. Forester (Boeing Military Airplane Co., Seattle, Wash.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0002.* 27 p. 34 refs.

A full-potential three-dimensional flow analysis is developed using a nonorthogonal constructed-coordinate system, finite-difference techniques, and coupled multiple-mapping methods. The flow field is divided into subdomains coupled at suitable interfaces; simple grid generators using parametric and elliptic equations are cost effective. Results of the three-dimensional analysis are presented for a rectangular-to-round diffuser, jet engine noise suppressor lobe mixer passageways and mixing chamber, and a jet engine thrust reverser duct. A.T.

A81-20531 # Experimental study of the influence of supports on the aerodynamic loads on an ogive cylinder at high angles of attack. T. N. Canning and J. N. Nielsen (Nielsen Engineering and Research, Inc., Mountain View, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0007.* 8 p. 5 refs. Contract No. F08635-79-C-0119.

The influence of the model support system on an ogive cylinder at high angles of attack has been determined in subsonic and transonic tests. Stings of varying diameter and struts in various orientations were studied. The stings did not alter the development of large side loads resulting from asymmetric vortex separation and had only moderate progressive effects on in-plane forces and moments. Struts supporting the model through its leeward meridian seriously altered normal and side forces and sharply reduced base drag at several combinations of Mach number and angle of attack. A strut supporting the model at its windward meridian (near the base) yielded results like those for the stings. (Author)

A81-20532 * # **Wing-alone aerodynamic characteristics at high angles of attack.** R. L. Stallings, Jr. and M. Lamb (NASA, Langley Research Center, High-Speed Aerodynamics Div., Hampton, Va.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0008.* 8 p. 6 refs.

An experimental investigation has been conducted to determine wing-alone supersonic aerodynamic characteristics at high angles of attack. The family of wings tested varied in aspect ratio from 0.5 to 4.0 and taper ratio from 0.0 to 1.0. The wings were tested at angles of attack ranging from 0 to 60 deg and Mach numbers from 1.6 to 4.6. The aerodynamic characteristics were obtained by integrating local pressures measured over the wing surface. Comparison of these data with the limited available data from the literature indicate the present data are free of sting interference effects through the test range of angle of attack. Presented and discussed are results showing the effects of model geometry, Mach number and angle of attack on aerodynamic characteristics consisting of normal force, pitching moment, bending moment, longitudinal center-of-pressure locations, and lateral center-of-pressure locations. (Author)

A81-20535 # **An analytical solution of lift loss for a round planform with a central lifting jet.** K. T. Yen (U.S. Naval Material Command, Naval Air Development Center, Warminster, Pa.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0011.* 9 p. 11 refs. Navy-sponsored research.

An analysis of the lift loss for a round planform fitted with a centrally-located round jet is presented. The pressure distribution over the lower surface of the planform is solved analytically by matching an inner viscous solution with an outer potential solution. By comparing the calculated pressure distributions with NACA experimental data, satisfactory agreement has been obtained, although the planforms are not exactly the same. In addition, Wyatt's formula for the lift loss is found to be essentially valid, but only under limited conditions, and an improved formula is suggested. Additional works, both experimental and theoretical, needed to solve the lift loss problem are discussed with recommendations. (Author)

A81-20537 # **Prediction of tilt rotor outwash.** R. K. Wernicke (Bell Helicopter Textron, Fort Worth, Tex.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0013.* 12 p. 6 refs.

Increased disc loadings (the ratio of gross weight to rotor area) have made working beneath a hovering aircraft difficult. A review of downwash/outwash data for various rotor craft with disc loadings of 4-40 psf indicates that the flow field in the area under the craft at 1.2-1.6 rotor radii from the center of the rotor produces the highest overturning moments. If it is unsteady, however, the downwash may become upsetting at a relatively low velocity, suggesting that parameters other than disc loading also effect downwash pressure and, consequently, overturning moments. Although the flow fields beneath the rotors of tilt rotor aircraft like the XV-15 are essentially identical to those of a single-rotor craft, they create an additional outwash from the vehicle's nose and tail. This outwash is problematic though at disc loadings greater than 25 psf. R.S.

A81-20538 * # **Scale effects on turbulent boundary layer development and flow separation around V/STOL inlets at high incidence.** D. C. Chou, J. H. Baek (New Mexico, University, Albuquerque, N. Mex.), R. W. Luiden, and N. O. Stockman (NASA, Lewis Research Center, Wind Tunnel and Flight Div., Cleveland, Ohio). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0014.* 8 p. 18 refs.

Numerical methods for calculating laminar and turbulent boundary layers development around V/STOL engine inlets at high incidence angles, along with the procedures for predicting flow separation, are presented. Results of scale-effects, which are obtained by a numerical scaling procedure on the boundary layer characteristics and incidence angles at onset of separation are discussed. The interesting 'cross-over' phenomena, where the full-scale models actually exhibit earlier separation than the scaled-models, is illustrated for a typical V/STOL inlet at a certain operating condition. Some of the numerical results are compared with the existing wind-tunnel test data for a 1/6 scale inlet model to demonstrate the validity of the numerical approach. (Author)

A81-20539 # **Numerical calculation of jet-induced ground effect in VTOL.** J. C. Hwang and F. K. Tsou (Drexel University, Philadelphia, Pa.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0015.* 9 p. 9 refs. Contract No. N68335-79-C-2055.

Numerical schemes based on Navier-Stokes equations and a k-turbulence kinetic energy-turbulence dissipation energy model of turbulence have been utilized to obtain solutions for an undeveloped two-dimensional jet impinging on a ground plane. In order to save time of computation, a 17 x 24 nonuniform grid system has been used. The results including flow velocities, fluid entrainment, turbulence energy and dissipation, and pressures are presented. Comparison of the present results with available data indicates that the application of the present model is satisfactory. (Author)

A81-20540 * # **Numerical optimization of circulation control airfoils.** T. C. Tai (U.S. Naval Material Command, David W. Taylor Naval Ship Research and Development Center, Bethesda, Md.), G. H. Kidwell, Jr. (NASA, Ames Research Center, Helicopter and Powered Lift System Div., Moffett Field, Calif.), and G. N. Vanderplaats (U.S. Naval Postgraduate School, Monterey, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0016.* 8 p. 17 refs. Navy-supported research.

A numerical procedure for optimizing circulation control airfoils, which consists of the coupling of an optimization scheme with a viscous potential flow analysis for blowing jet, is presented. The desired airfoil is defined by a combination of three baseline shapes (cambered ellipse, and cambered ellipse with drooped and spiralled trailing edges). The coefficients of these shapes are used as design variables in the optimization process. Under the constraints of lift augmentation and lift-to-drag ratios, the optimal airfoils are found to lie between those of cambered ellipse and the drooped trailing edge, towards the latter as the angle of attack increases. Results agree qualitatively with available experimental data. (Author)

A81-20541 * # **Classical and modern control design of a speed-hold system for a STOL airplane.** J. D. Blight and D. Gangsaas (Boeing Commercial Airplane Co., Seattle, Wash.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0017.* 9 p. Contract No. NAS2-9081.

A speed-hold system for an experimental short takeoff and landing jet airplane has been designed using both classical root-locus and modern optimal control synthesis techniques. The purpose of the speed-hold system is to maintain airspeed during final approach in the presence of wind shears, gusts, engine failures, and pilot control inputs. Designs were based on using airspeed as a single measurement and two symmetrically deployed upper surface blown

flaps as a single control. An optimal control law feeding back all the states and the integral of airspeed through constant gains provided superior performance in terms of speed tracking and control surface activity. However, when a constant-gain Kalman filter was inserted to estimate the states using only the measurement of airspeed, the performance of the optimal control law was reduced to the same as that of a much simpler classical proportional-path plus integral-path control law. To improve the performance of the optimal control law, additional measurements would be required. (Author)

A81-20542 * # **Disturbance estimation for a STOL transport during landing.** J. A. Bossi (Washington, University, Seattle, Wash.) and A. E. Bryson, Jr. (Stanford University, Stanford, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0018.* 10 p. 19 refs. Grant No. NGR-05-020-019.

Transport aircraft can experience dangerously high sink rates if wind shear or thrust loss are encountered during landing approach. This is of special concern for STOL aircraft that use engine thrust for lift augmentation. Such conditions must be detected quickly and available power increased promptly to avoid serious flight path deviations. This study demonstrates the feasibility of designing constant-gain estimators, which use on-board instrumentation, to detect such conditions with sufficient speed and accuracy to provide adequate warning. Estimator design techniques are discussed and simulation results presented. (Author)

A81-20543 # **Application of singular perturbation theory to onboard aircraft trajectory optimization.** A. J. M. Chakravarty and J. Vagners (Washington, University, Seattle, Wash.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0019.* 9 p. 13 refs. Research supported by the Boeing Co.

This paper formulates the problem of minimizing direct operating cost in dollars (combined cost per hour and cost of fuel per hour) for a typical commercial jet transport model. Singular perturbation theory is applied to reduce the computational burden of solving the resulting optimal control problem. The work of previous investigators is extended to include the aircraft weight variation in the state equations and the resulting seven-state model is analyzed for time scale separation. It is shown that a realistic time scale separation involves only two scales. The resulting model is then used to develop the inner and outer solutions as dictated by singular perturbation theory. A comprehensive model for the aerodynamic and fuel flow terms appearing in the equations is developed for use in optimal trajectory computation. Numerical results are presented that illustrate the nature of the optimal trajectory and the control variables. (Author)

A81-20544 * # **Practical gust load alleviation and flutter suppression control laws based on a LQG methodology.** D. Gangsaas, U. Ly, and D. C. Norman (Boeing Commercial Airplane Co., Seattle, Wash.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0021.* 11 p. 5 refs. Contract No. NAS1-15325.

A modified linear quadratic Gaussian (LQG) synthesis procedure has been used to design low-order robust multiloop controllers for a flexible airplane. The introduction of properly constructed fictitious Gauss-Markov processes in the control loops allowed meeting classical frequency-domain stability criteria using the direct synthesis procedures of modern time-domain control theory. Model reduction was used to simplify the control laws to the point where they could be easily implemented on onboard flight computers. These control laws provided excellent gust load and flutter mode control with good stability margins and compared very favorably to other control laws synthesized by the classical root-locus technique. (Author)

A81-20545 # **Robustness properties of a new multirate digital control system.** D. P. Glasson (Analytic Sciences Corp., Reading, Mass.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0022.* 7 p. 6 refs.

A new approach for designing multirate digital flight control systems based on optimal control theory is described. The robustness properties of control systems designed by the new technique are investigated through a case study. The example considered is the F-14 aircraft controlled by a multirate proportional-plus-integral (PI) controller. The aircraft/controller system is 'flown' through a turbulent atmosphere; a covariance analysis of state variable errors determines the ability of the controller to reject turbulence-induced errors. The controller sample rate and control sequence are varied to determine their influence on the disturbance rejection properties of the controller. Finally, a sample rate optimization scheme based on a robustness/computation tradeoff is presented. (Author)

A81-20559 # **Numerical investigation of a model of turbulent combustion of hydrocarbons.** R. Borghi and E. Pourbaix (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0039.* 11 p. 23 refs.

The probability density function (PDF) method can take into account the coupling of turbulent combustion with complicated flow fields and various types of flow flames in predicting combustion in turbomachines. It is shown that a type of skeleton of PDF can be determined in a multidimensional space even with complicated chemistry; the case of hydrocarbon combustion in a premixed turbulent flame stabilized by a pilot jet in a constant area duct is used as an example. A.T.

A81-20563 # **The numerical solution of incompressible turbulent flow over airfoils.** H. A. Hegna (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, Ohio). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0047.* 12 p. 50 refs.

Numerical solutions are obtained for two-dimensional incompressible turbulent viscous flow over airfoils of arbitrary geometry. A body-fitted coordinate system is numerically transformed to a rectangular grid in the computational plane. The time dependent Reynolds averaged Navier-Stokes equations in the primitive variables of velocity and pressure are used. Turbulence is modelled with an algebraic eddy viscosity technique modified for separated adverse pressure gradient flows. The set of transformed partial differential equations is solved with an implicit finite difference method. Numerical solutions for a NACA 0012 airfoil near stall at a chord Reynolds number of 170,000 are favorably compared with surface pressure and velocity field measurements. A small laminar separation bubble near the suction pressure peak is observed. Computed lift and drag coefficients agree well with experimental values. (Author)

A81-20564 # **Numerical simulation of wing-fuselage interference.** J. S. Shang (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0048.* 9 p. 19 refs.

Numerical solutions of the mass-averaged Navier-Stokes equations were accomplished for a nominal Mach number of six and Reynolds number of fifteen million. The wing-fuselage configuration consists of a tangent-ogive forebody and a highly swept wedge delta wing. The numerical results were verified by comparing with experimental measurements and solutions of Euler equations under identical free stream conditions. The flow field structure is delineated by identifying the shock wave and the cross flow velocity field. The computations were performed on the CRAY 1 computer using a vectorized version of the Navier-Stokes code. (Author)

A81-20566 * # **A numerical simulation of hypersonic viscous flow over arbitrary geometries at angle of attack.** D. S. Chaussee, P. Kutler, T. H. Pulliam (NASA, Ames Research Center, Moffett Field,

Calif.), J. L. Patterson (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, Ohio), and J. L. Steger (Stanford University, Stanford, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0050.* 15 p. 25 refs. Contract No. F33615-79-C-3001.

An implicit conservative, noniterative, finite-difference algorithm that predicts the supersonic, laminar or turbulent viscous flow about arbitrary geometries at large angles of attack is presented. The three-dimensional parabolized form of the thin-layer Navier-Stokes equations are written in generalized coordinates. These equations are solved using the delta form of the Beam-Warming implicit algorithm. Flow field simulations have been obtained for a blunt biconic with windward and leeward cuts and an X-24C lifting body for both laminar and turbulent flow at various Mach numbers and angles of attack. When compared with experiment or with previous theories, these computational predictions show good agreement. (Author)

A81-20567 # **Viscous-inviscid interaction on oscillating airfoils in subsonic flow.** W. J. McCroskey and S. L. Pucci (U.S. Army, Aeromechanics Laboratory, Moffett Field, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0051.* 17 p. 11 refs.

Selected results from an extensive oscillating-airfoil experiment are analyzed and reviewed. Four distinct regimes of viscous-inviscid interaction are identified, corresponding to varying degrees of unsteady flow separation. The dominant fluid dynamic phenomena are described for each regime. Ten specific test cases, including the appropriate flow conditions and experimental results, are proposed for evaluating unsteady viscous theories and computational methods. (Author)

A81-20568 * # **Prediction and experimental verification of transient airfoil motion in a small wind tunnel.** S. M. Rock (Systems Control, Inc., System Identification and Control Div., Palo Alto, Calif.) and D. B. DeBra (Stanford University, Stanford, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0052.* 12 p. 28 refs. Grant No. NsG-4002.

The theory for aerodynamic loading associated with transient motion of an airfoil in a wind tunnel has been extended and verified experimentally. A generalized Theodorsen Function which includes wall effects is described, and finite-state approximations are developed for large wing-semichord to wall-spacing ratios. Finally, experimental results are presented which verify the theoretical predictions for transient airfoil motions. These results were obtained using a small, low-subsonic wind tunnel with a unique airfoil suspension design that provides uncoupled sensing and actuation for two degrees of freedom. (Author)

A81-20570 # **Sound sources in aerodynamics - Fact and fiction.** J. E. Ffowcs Williams (Cambridge University, Cambridge, England). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0056.* 12 p. 15 refs.

Sound and sound sources are defined as non-overlapping in space, and surface sources are incorporated within this definition by a formal mathematical step. Linear noise sources, the sound of compact sources, non-compact sources, acoustic coincidence, and nonlinear sources are examined. An analysis in which aerodynamic source terms appear as linear is used to illustrate the importance of vorticity in the aerodynamic generation of sound. Viscous sources of sound are considered, and it is pointed out that such sources cannot be neglected near the sharp edge of aerofoils. V.L.

A81-20578 # **Dynamic pressure response with stall on axial flow compressor rotor blades.** W. T. Cousins, W. F. O'Brien, Jr. (Virginia Polytechnic Institute and State University, Blacksburg, Va.), and M. R. Sexton (Virginia, University, Charlottesville, Va.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0069.* 7 p. 9 refs. Navy-supported research.

Measurements and related analyses are presented for dynamic pressure variations observed in a single-stage compressor which was instrumented with high-response, on-rotor pressure transducers. A circumferential flow distortion was imposed at the inlet of the compressor by means of wire screens. Rotor inlet conditions were measured, and the resulting dynamic pressure response was recorded at several chordwise locations on the suction and pressure sides of a rotor blade passage. Fourier analysis techniques provided insight into the dynamic behavior of the pressures at each location. The results can be useful in compressor models where dynamic behavior is important. (Author)

A81-20579 # **Turbo-compressors surge and surge control.** A. Mobarak, M. Elaraby, and Y. Shash (Cairo University, Cairo, Egypt). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0070.* 10 p. 13 refs.

The paper presents a theoretical study of the surge phenomena in turbocompressors. A linear model is developed to predict the dynamic behavior of a compression system subjected to a perturbation from steady operating conditions. The effect of system parameters on the flow stability is studied, showing under what conditions compressors will surge. An available experimental set of characteristics is used to get the surge line, which defines the maximum limit of operating points. In turbocompressors surging can be controlled by shifting the operating point toward a higher mass flow to the right from the surge limit line. One method of doing this is to open a bypass valve to recycle part of the gas from the discharge piping to the suction piping. Based on the surge line, a control equation is derived to be a basis for the control system design. The control system will operate a recirculation valve if the operating point approaches the critical region, in order to increase the flow rate at the suction of the compressor. (Author)

A81-20581 # **Effects of design variables on spoiler control effectiveness, hinge moments, and wake turbulence.** W. H. Wentz, Jr., C. Ostowari (Wichita State University, Wichita, Kan.), and H. C. Seetharam (Boeing Commercial Airplane Co., Seattle, Wash.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0072.* 9 p. 6 refs.

Wind tunnel tests have been conducted to determine effects of certain design variables on spoiler performance and spoiler flow field characteristics. Measurements include forces and surface pressures, oil flow surveys on a vertical splitter plate, wake pressures, and wake velocity and turbulence measurements using a dual split-film anemometer system. Results include the effects of spoiler design variables, such as: spoiler slope for constant projection height, hingeline gap, lower surface venting and deflector, spoiler trailing edge notching and spoiler porosity. Hingeline gap, porosity, lower surface venting and lower surface deflector can be designed to reduce control dead-band tendency. Wake turbulence studies show that certain modifications can be utilized to diminish peak frequencies in the wake. (Author)

A81-20582 * # **Application of a tip-fin controller to the Shuttle Orbiter for improved yaw control.** R. W. Powell and D. C. Freeman, Jr. (NASA, Langley Research Center, Space Systems Div., Hampton, Va.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0074.* 8 p.

Aerodynamic and flight control analyses have shown that the application of the tip-fin controller and removal of the centerline vertical tail does not produce improved flyability of the Shuttle Orbiter in the supersonic speed regime. Preliminary design studies show that removal of the centerline vertical tail and the installation of tip-fin controllers could result in savings up to 900 kg. It is also shown that the reaction control system could be deactivated much sooner than it is possible with the present nominal orbiter configuration. A.T.

A81-20588 * # **Electromagnetic measurement of lightning strikes to aircraft.** F. L. Pitts (NASA, Langley Research Center, Hampton, Va.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0083.* 8 p. 7 refs.

Recent in-flight direct-strike lightning research, using an NASA F-1068 aircraft, is reviewed. The instrumentation system which records the rates of change of electric and magnetic flow density at several locations on the aircraft and rate of change of strike current to the boom is described. The measurement parameters are: rate of change of electric flux density over a range of 50 amperes per square meter, rate of change of magnetic flux density over a range of 20,000 tesla per second, and rate of change of strike current over a range of 100 kilo-amperes per microsecond. The isolated and shielded instrumentation system employs high-sample-rate digital transient recorders with augmented memory capacity and a wideband analog recorder for data acquisition and recording. The data obtained during the 1980 flight test program are presented and the data significance is discussed. (Author)

A81-20589 # **Aircraft and environmental factors influencing lightning strike.** P. B. Corn (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0084.* 6 p. 18 refs.

The hypothesis of lightning triggering by aircraft in a high static electric field region in or near an active thunderstorm area is supported by known information. The aircraft factors affecting lightning trigger and statistical probability of an encounter are predicted by the Pierce-Nanevicz criterion, field measurements, and incomplete incident records to be the aircraft flight profile and aircraft size. Lightning transient detection and display systems have aided the avoidance of active lightning regions and storm-assisted turbulence. A.T.

A81-20591 # **The Global Positioning System versus gravity disturbance modeling in an inertial navigation system.** J. Hopkins (U.S. Defense Mapping Agency, Aerospace Center, St. Louis Air Force Station, Mo.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0087.* 12 p. 11 refs.

The Global Positioning System provides a real-time means of updating an aircraft inertial navigation system to reduce position and velocity errors due, in part, to an inexact knowledge of the gravity field in which the aircraft is flying. Gravity disturbance modeling via such techniques as point mass or finite element modeling provides a real-time means of reducing this gravity field error. This paper demonstrates that should the navigator be denied the GPS signal, the modeling of gravity disturbances can adequately minimize the navigation error. In the presence of the GPS signal, the gravity disturbance component information, combined with GPS data via Kalman filtering, constitutes a further refinement in the system. (Author)

A81-20593 # **Control strategy for tracking a maneuverable model.** M. N. Wagdi (Riyadh, University, Riyadh, Saudi Arabia). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0089.* 7 p. 8 refs.

A method is presented for synthesizing a control strategy that causes the outputs of a given system to track those of a maneuverable model. Stochastic plant and model conditions are considered. The present problem is cast into an (LQG) format with a nonhomogeneous differential constraint. The resulting control strategy is composed of a feed forward of the model measurement vector, the estimate of the model nonobservable subvector of state and the model control vector and a feed back of the plant measurement vector and the estimate of the plant nonobservable subvector of state. The present control logic does not require the construction of a filter (observer) since reduced order observers for the nonobservable subvectors of state for both plant and model are already imbedded in the algorithm. The computational time and the storage capacity required for the present control strategy are thus greatly reduced. (Author)

A81-20594 # **Noise generation mechanism of low pressure propeller fans.** H. Fijita (Hitachi, Ltd., Mechanical Engineering Research Laboratory, Tsuchiura, Ibaraki, Japan). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0090.* 7 p. 10 refs.

Blade passing noise of a low pressure propeller fan is separated from broad band noise by means of periodic sampling and averaging technique, and the characteristics of the noise in relation to the fan efficiency is studied experimentally together with the usual narrow band spectral measurements. Blade passing noise is found to be dominant in high efficiency operating region while broad band noise dominates in low efficiency range. Comparison of the experimental results with existing aerodynamic noise theories indicates that blade passing noise is mainly produced by a few per cent of thrust fluctuation of the blade, which is supposed to be caused by inlet flow distortion. Blades seem to be sensitive to the inlet flow fluctuation and produce high rate of thrust fluctuation in high efficiency range. When flow separation occurs over the blade, wide wake results in higher drag force or lower efficiency and lower thrust fluctuation but higher broad band noise is produced due to random vortex shedding in the wake. Validity of unsteady Kutta condition at the blade trailing edge in relation to the blade passing noise is also discussed. (Author)

A81-20595 # **A lifting surface theory for the sound generated by the interaction of velocity disturbances with a leaned vane stator.** J. B. H. M. Schulten (Nationaal Lucht- en Ruimtevaart-laboratorium, Amsterdam, Netherlands). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0091.* 15 p. 15 refs. Research sponsored by the Nederlands Instituut voor Vliegtuigontwikkeling en Ruimtevaart.

An unsteady 3-D lifting surface theory to predict the sound field of a stator with leaned, i.e., nonradial, vanes in an annular duct is presented. The duct carries a uniform subsonic main flow and is assumed to be anechoic. The sound is generated by the interaction of velocity disturbances with the stator vanes. The problem is formulated as an integral equation for the pressure jump across the vanes. This equation is solved by a Fourier series expansion, followed by a collocation procedure. The effect of vane lean on the sound field of a typical stator exposed to the viscous wake system of a rotor is studied. The modal distribution proves to be very sensitive to lean variation. Unless the rotor speed is very low (1 mode cut-on), no reduction of acoustic power at the blade passing frequency is found for any lean angle. On the contrary, even a moderate amount of lean raises the power significantly. (Author)

A81-20596 * # **Acoustics of rotors utilizing circulation control.** M. Mosher (NASA, Ames Research Center, Moffett Field, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0092.* 13 p. 7 refs.

The acoustic characteristics of circulation-controlled rotors are examined by comparing data from three full-scale rotors: a conventional rotor, the X-Wing rotor, and the Circulations Control Rotor. Both the X-Wing rotor and Circulation Control Rotor had higher sound levels than the conventional rotor at identical advancing-tip Mach numbers. There is excess noise due to the compressor on the X-Wing rotor and excess broadband noise on the Circulation Control Rotor. The X-Wing rotor had lower sound levels than the conventional rotor at identical forward speeds because of the lower tip speed feasible with the use of circulation control. (Author)

A81-20597 * # **A general mapping procedure for variable area duct acoustics.** J. W. White (Tennessee, University, Knoxville, Tenn.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0094.* 8 p. 34 refs. Contract No. NAG3-18.

A general mapping procedure is described and applied to the study of noise propagation in variable area ducts. The mapping provides a boundary fitted co-ordinate system which is ideal for the finite difference solution of acoustic fields with irregular boundaries, without the burden of large matrices required by finite element methods. The procedure is first described in general and then applied to a particular two-dimensional geometry under current experimental investigation. This method should be ideally suited to the study of high frequency noise propagation in variable area ducts and in cases where the far field is included in the calculation procedure. Moreover, the current approach can be directly extended to three-dimensions, resulting in numerical calculation over a rectangular parallelepiped in the transformed plane. (Author)

A81-20598 * # **Unsteady fan blade pressure and acoustic radiation from a JT15D-1 turbofan engine at simulated forward speed.** J. S. Preisser, J. A. Schoenster, R. A. Golub (NASA, Langley Research Center, Hampton, Va.), and C. Horne (NASA, Ames Research Center, Moffett Field, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0096.* 13 p. 12 refs.

Tests have been conducted on a JT15D-1 turbofan engine both statically and at simulated forward speed in the Ames 12 x 24 Meter Wind Tunnel. Both far-field acoustic data and unsteady pressure data from transducers mounted on the fan blades were acquired. Results showed a sound power reduction of about 10 dB in the far-field acoustic levels with simulated forward speed over those measured without forward speed. Blade mounted transducer results showed rotor-turbulence interaction dominated the noise field at very low speeds while an interaction between the rotor and internal struts dominated at higher speeds. Results are presented to show the effects of varying engine rpm, changing the angle-of-attack of the engine inlet to tunnel flow and mounting an aircraft wing to simulate an installation condition on an actual aircraft. (Author)

A81-20623 * # **A head-up display for low-visibility approach and landing.** R. S. Bray (NASA, Ames Research Center, Moffett Field, Calif.) and B. C. Scott (FAA, Moffett Field, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0130.* 13 p.

An electronic flight-guidance display format was designed for use in evaluations of the collimated head-up display concept in low-visibility landings of transport aircraft. In the design process of iterative evaluation and modification, some general principles, or guidelines, applicable to such flight displays were suggested. The usefulness of an indication of instantaneous inertial flightpath was clearly demonstrated, particularly in low-altitude transition to visual references. Evaluator pilot acceptance of the unfamiliar display concepts was very positive when careful attention was given to indoctrination and training. (Author)

A81-20632 # **Experimental development of an advanced circulation control wing system for Navy STOL aircraft.** J. H. Nichols, Jr., R. J. Englar, M. J. Harris, and G. G. Huson (U.S. Naval Material Command, David W. Taylor Naval Ship Research and Development Center, Bethesda, Md.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0151.* 11 p. 14 refs.

An advanced high lift system is being developed which combines a Circulation Control Wing (CCW) with Upper Surface Blowing (USB) to produce significant lift for STOL operations by Navy aircraft. The concept uses circulation control to pneumatically deflect USB engine thrust and thus augment aerodynamic wing lift produced by the outboard CCW. Two series of wind tunnel investigations have confirmed significant thrust turning to angles near 160 deg, suggesting the possibility for a simple, highly effective STOL and thrust reverser system. Two-dimensional investigations of reduced diameter CCW trailing edges suggest their application as a no-moving-parts high lift system with minimal cruise penalty. The paper presents these experimental results and summarizes the technology development progressing towards an advanced STOL aircraft. (Author)

A81-20633 * # **QSRA Joint Navy/NASA sea trials.** S. Queen (U.S. Naval Air Test Center, Patuxent River, Md.) and J. Cochrane (NASA, Ames Research Center, Quiet Short-Haul Aircraft Office, Moffett Field, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0152.* 10 p.

The Quiet Short-Haul Research Aircraft (QSRA), used to conduct a broad program of terminal area and low speed propulsive-lift flight research, is discussed. Flight performance of the QSRA is presented together with the results of the joint Navy/NASA flight program. It is found that both free-deck takeoffs and unarrested landings can be conducted with winds across the deck of zero to 35 knots on an aircraft carrier the size of the USS Kitty Hawk with all engines operating. QSRA characteristics and aerodynamic data are included. C.R.

A81-20635 # **The XV-15 - An initial Navy look.** W. S. Lawrence and D. A. DuFresne (U.S. Naval Air Test Center, Patuxent River, Md.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0155.* 11 p. 6 refs.

Navy flight test measurements with the XV-15 tilt rotor are investigated. Pilot qualitative flying data are presented and evaluated with the Cooper-Harper rating scale. Tests using a Developmental Stability and Control Augmentation System (SCAS) and a Force Feel System (FFS) are also discussed. Observations on gust response are reported along with airspeed control and retention, cockpit field-of-view, and pilot workload. An airspeed indicator designed with sensitivity in low and high speed flight is examined. R.C.

A81-20636 * # **Measurements of flow quality in the Ames 2 x 2ft transonic wind tunnel.** F. K. Owen (Complere, Inc., Palo Alto, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0156.* 7 p. USAF-supported research; Contract No. NAS2-10352.

For decades, wind tunnel testing has been conducted in test section environments which have not been adequately documented. However, with the advent of the energy shortage, the need for improved fuel-efficient transports employing supercritical or LFC airfoils has increased the awareness of the possible influence of freestream turbulence on advanced experimental testing. This has already lead to detailed flow quality measurements in NASA transonic wind tunnels. The purpose of this paper is to present results of a study in the Ames 2 x 2 ft transonic wind tunnel. (Author)

A81-20638 # **A new concept for dynamic stability testing.** M. E. Beyers (South African Council for Scientific and Industrial Research, Pretoria, Republic of South Africa). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0158.* 13 p. 9 refs.

A new approach to dynamic stability testing is introduced, based on the concept of orbital fixed-plane motion. An apparatus is conceived with which an aircraft model is forced in an orbital path while constrained to the fixed-plane reference system. An exposition of the concept is given and the potential advantages in captive model testing and applications in flight mechanics are indicated. Using a single apparatus, it is possible to (1) determine all of the first-order, dynamic stability derivatives, (2) vary the relationships between the pertinent motion parameters, and (3) simulate representative motions of the aircraft under consideration. An aerodynamic-data/mathematical model validation scheme is presented to show how the considerable flexibility of this captive testing method and the 2-degree-of-freedom nature of the dynamic derivative data may be exploited. (Author)

A81-20639 # **Computational design of large-scale blast simulators.** A. Mark (U.S. Army, Ballistics Research Laboratory, Aberdeen Proving Ground, Md.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0159.* 11 p. 9 refs.

The quasi one-dimensional Euler equations are applied to a geometrically complicated shock tube and integrated by an implicit numerical technique. The driver section consists of many contractions so that rarefaction waves generated there catch up to the main shock and mitigate it progressively to the point where it has the appearance of an exponentially decaying wave of the type generated by a free air blast. The computational capability is tested to an extreme because of the severe area contractions and high initial diaphragm pressures. The shock capturing numerical technique used for these cases employ coordinate stretching and clustering for sharp shock definition. Operation of a rarefaction wave eliminator is computationally exercised and is shown to well define a blast-type waveform if its closure rate is selected judiciously. (Author)

A81-20640 # **Numerical simulations of a segmented-plenum, perforated, adaptive-wall wind tunnel.** J. C. Erickson, Jr. and G. F. Homicz (Calspan Advanced Technology Center, Buffalo, N.Y.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0160.* 15 p. 39 refs. Navy-USAF-sponsored research.

Flow within a tunnel is simulated by modeling incompressible interaction of the transpired turbulent boundary layers on the walls with flow over the airfoil. Unconfined flow about the airfoil with a finite number of plenum chambers is investigated. Velocity differences produced at control surfaces outside the boundary layers by changing the pressure in the plenum chambers are examined. Influence functions away from the immediate vicinity of a plenum appear to depend only on the integrated normal velocity. Implications for tunnel design and automation are also discussed. R.C.

A81-20659 * # **Numerical study of a scramjet engine flow field.** J. P. Drummond and E. H. Weidner (NASA, Langley Research Center, High-Speed Aerodynamics Div., Hampton, Va.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0186.* 14 p. 15 refs.

A computer program has been developed to analyze the turbulent reacting flow field in a two-dimensional scramjet engine configuration. The program numerically solves the full two-dimensional Navier-Stokes and species equations in the engine inlet and combustor, allowing consideration of flow separation and possible inlet-combustor interactions. The current work represents an intermediate step towards development of a three-dimensional program to analyze actual scramjet engine flow fields. Results from the current program are presented that predict the flow field for two inlet-combustor configurations, and comparisons of the program with experiment are given to allow assessment of the modeling that is employed. (Author)

A81-20661 # **Calculation of viscous, sonic flow over hemisphere-cylinder at 19 deg incidence - The capturing of nose vortices.** T. Hsieh (U.S. Navy, Naval Surface Weapons Center, Silver Spring, Md.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0189.* 9 p. 15 refs. Navy-supported research.

Numerical simulation of viscous, sonic flow over a hemisphere-cylinder at 19 deg incidence using the computer code of Pulliam and Steger, who solve the three dimensional unsteady Navier-Stokes equations with 'thin-layer' approximation, and comparison with experimental data have been carried out. Most features of three dimensional separation, particularly the physical reasoning about the formation of nose vortex made previously by Hsieh and Wang are confirmed by the numerical results. The limitation of the numerical simulation of such a complicated three dimensional separated flowfield and the discrepancy between the numerical results and measured data are discussed. (Author)

A81-20684 # **Aircraft lateral parameter estimation from flight data with unsteady aerodynamic modelling.** W. R. Wells (Wright State University, Dayton, Ohio), S. S. Banda, and D. L. Quam (Dayton, University, Dayton, Ohio). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0221.* 9 p. 7 refs.

An unsteady aerodynamic model for the aircraft lateral motion was considered in the development of a parameter extraction algorithm in the frequency domain. This algorithm was applied to flight test data. The data were transformed into the frequency domain by the use of FFT algorithms. The results indicate that modelling of unsteady aerodynamics results in significant differences in the parameters in various flights. The sensitivity of the extracted parameters to the control input with the inclusion of unsteady aerodynamic modelling was also investigated. (Author)

A81-20685 # **Application of aerodynamic jump prediction theory to supersonic, high fineness ratio, cruciform finned bodies.** L. E. Lijewski (USAF, Armament Laboratory, Eglin AFB, Fla.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0222.* 12 p. 21 refs.

A jump angle prediction theory for supersonic free flight missiles used six-degree-of-freedom calculations to determine that it accurately predicts the jump angle of finned bodies for a wide range of conditions. The data are fitted to a 4th order polynomial and an epicyclic motion using initial conditions and jump angles of actual missiles established by test firings of flechettes. Analysis of firing data shows that the initial conditions result from an impulse imparted to the flechette through sabot separation and asymmetrical muzzle blast. The maximum yaw location places the initial conditions of free flight; the initial momentum balance is the reason for the dispersion of flechettes. A.T.

A81-20688 # **Designing the Hornet for improved R and M.** R. D. Dighton (McDonnell Aircraft Co., St. Louis, Mo.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0230.* 10 p.

Major emphasis has been placed on designing superior reliability (R) and maintainability (M) characteristics into the F/A-18. Principal reliability features include avionics equipment derating, better avionics cooling, and fewer parts in the major subsystems such as radar, engine and crew station. The Hornet's F404 engine is also about four times more reliable than the J79. Maintainability features of the F/A-18 design include better equipment access, extensive Built-In-Test (BIT) and fault isolation, an APU for ground maintenance, and corrosion resistant materials. The Hornet flight test program is demonstrating that the challenging R and M requirements are being met and often exceeded. (Author)

A81-20690 # **AV-8B composite fuselage design.** J. C. Watson (McDonnell Aircraft Co., St. Louis, Mo.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0232.* 7 p.

The AV-8B composite forward fuselage development structure was designed as a flight vehicle. Thus, the design incorporates provisions for all functional systems as they relate to the structure. The final design required efforts in structure layout, functional systems integration, trade studies, materials characterization, process development, and configuration iteration. Primary considerations were low cost and light weight. The approach was to design with as few parts and fasteners as possible. This was accomplished by cocuring large graphite/epoxy structural components which required no secondary bonding operations. Component sizes were based on practical geometric shapes, complex tooling limitations, inspection accessibility, and manufacturing assembly sequences. (Author)

A81-20691 # **Pulsed Doppler radar detects weather hazards to aviation.** D. S. Zrnic' and J. T. Lee (NOAA, National Severe Storms Laboratory, Norman, Okla.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0235.* 12 p. 21 refs. U.S. Department of Transportation Contract No. FA77WAI-808; Contract No. AT(49-25)-1004.

Over the last several years experiments were conducted with a pulsed Doppler radar that have significant consequences for hazard detection in the en route and terminal areas. Mesocyclones can be detected to over 250 km while tornadoes are seen to about 150 km. The radar can detect strong straight winds if they have a significant component along the beam. It is definitely demonstrated that aircraft measured turbulence correlates with the spread of the Doppler spectrum, but caution must be exercised in interpreting the Doppler spectrum width data because these are more prone to gross errors due to noise, antenna sidelobes, ground clutter, etc. Measurements of transient wind phenomena associated with thunderstorms near the airport require a suitably located radar, but it is not yet clear whether these can be always recognized. It appears that monitoring of winds along an aircraft glide path in clear air or otherwise is feasible. (Author)

A81-20692 # **New airborne weather radar systems.** G. A. Lucchi (RCA, Avionics Systems Div., Van Nuys, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0237.* 10 p.

The paper traces the evolution of airborne weather radar from the C-band system flown in 1955 to the solid-state coherent transmitter/receiver now in its final design stage. Although packages smaller than the 125-pound C-band were developed in the late 1950s and early 1960s, the airline industry requested transmitters of 65 KW or more, with pulse widths of up to 6 seconds and a range of 300 nautical miles. The digital radar evolution in the 1970s, introduced among other things post-detection correlation schemes which made adequate radar range achievable with lower-powered systems, led to the development of the solid-state converter and, eventually, the shadow-mask, 8-color CRT with 3-plane memory. The designers of solid-state radar have not only improved airborne weather-range detection as a whole, but have also developed state-of-the-art technology suitable for almost all powered aircraft. R.S.

A81-20694 * # **Design and preliminary tests of an IR-airborne LLWS remote sensing system.** F. Caracena (NOAA, Environmental Research Laboratories, Boulder, Colo.), P. M. Kuhn (Raven Systems and Research, Inc., Boulder, Colo.), and R. Kurkowski (NASA, Ames Research Center, Moffett Field, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0239.* 7 p. 8 refs.

Recent history underscores the need for in-cockpit alerts of LLWS for takeoffs and landings. The 13-15 micron portion of the CO2 molecular spectrum can be used to remote sense LLWS in and around thunderstorms. A radiometer with a designed look-distance of about 10 km remote senses an average air temperature along a forward, horizontal path. Wind shear alerts are based on the difference between this forward air temperature and the air temperature near the aircraft. Although spectral ranging, a major design improvement of an IR LLWS alert system, is not at present feasible with noncooled detectors, it is an important technique to keep in mind, given the rapid advance in IR technology. (Author)

A81-20702 # **A computational model for low speed flows past airfoils with spoilers.** N. J. Pfeiffer and G. W. Zumwalt (Wichita State University, Wichita, Kan.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0253.* 10 p. 23 refs.

A computer model has been developed to simulate low speed flow past an airfoil with a spoiler. An outer solution calculates the potential flow around an effective, closed-wake body. This body is formed by adding to the original airfoil and spoiler geometry: the boundary layer displacement thickness; a closed wake behind the spoiler; and a trapped vortex at the spoiler hinge. An inner flow solution uses a turbulent jet mixing analysis and conservation of mass and momentum to simulate the time average flow within the wake. The final solution is obtained by iterative matching outer and inner solutions. (Author)

A81-20703 * # **Three-dimensional turbulent boundary layer development and separation in V/STOL engine inlets at incidence with small-cross flow and curvature influences.** D. C. Chou, Z.-J. Yang (New Mexico, University, Albuquerque, N. Mex.), R. W. Luiden, and N. O. Stockman (NASA, Lewis Research Center, Wind Tunnel and Flight Div., Cleveland, Ohio). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0254.* 12 p. 33 refs.

The study concerns the influence of the three-dimensional cross flows on the compressible turbulent boundary layer development and flow separation prediction around V/STOL engine inlets at high incidence. The governing equations for the three-dimensional boundary layer flow with small-cross approximation are solved numerically on an intrinsic streamline coordinate system. Results are presented to illustrate the effects of small cross-flow, compressibility and streamline curvatures on the flow. Comparisons of the results with the wind tunnel data for scaled model and with data obtained from another existing compressible axisymmetric turbulent boundary layer scheme are included in the analysis. (Author)

A81-20704 # **Forced vortices near a wall.** H. Viets, M. Ball (Wright State University, Dayton, Ohio), and M. Piatt. *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0256.* 10 p. 17 refs. Grant No. AF-AFOSR-78-3525.

Transverse vortices are created near a flat wall by means of an active cam shaped rotor. The flowfield is examined with a hot wire anemometer operating in a conditioned sampling mode triggered by the vortex generator. The instantaneous flowfields are thereby determined and the vortices extracted from the data. The vortex trajectories are found and related to previous investigations of the rotor generator. (Author)

A81-20705 # **Solutions for slightly over- or under-expanded hot supersonic jets exhausting into cold subsonic mainstreams.** V. N. Vatsa, M. J. Werle, O. L. Anderson, and G. B. Hankins, Jr. (United Technologies Research Center, East Hartford, Conn.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0257.* 12 p. 15 refs. Research supported by the United Technologies Corp.; Contract No. F33615-76-C-2036.

An efficient method for solving the problem of a slightly under- or over-expanded supersonic jet exhausting into a subsonic coflowing stream is presented. This paper extends an earlier work on 2-D and axisymmetric flows to general 3-D flows with specific application to high aspect ratio slot-jet flows. The viscous problem is rendered parabolic through a unique use of an approximate inviscid flow intrinsic coordinate system to estimate only the streamline curvatures. This inviscid problem is formulated in terms of linearized perturbation potentials for ease of solution. The results of application of this approach to axisymmetric and high aspect ratio slot-jet flows will be presented. (Author)

A81-20720 # **3-D viscous analysis of ducts and flow splitters.** W. L. Blackmore and C. E. Thompson (AiResearch Manufacturing Company of Arizona, Phoenix, Ariz.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0277.* 7 p. 10 refs.

Until recently, viscous compressible flow solutions have not been sufficiently accurate for practical application to problems associated with internal, three-dimensional (3-D) duct flow. However, to analyze the effects and predict the losses due to secondary and corner flows in nonaxisymmetric ducts with flow splitters, a

fully viscous, 3-D compressible flow solution is required. This paper compares the results of the 3-D viscous analysis to those of conventional methods and scale model test data for several mixer-nozzle lobe designs. The comparison demonstrates that this 3-D viscous analysis accurately predicts velocity and static pressure distributions. The analysis also reliably predicts relative ranking with regard to losses. These capabilities enhance design optimization and can provide insight for test program development and reduce program test costs. (Author)

A81-20732 # **Extraction of wavedrag from airfoil wake measurements.** G. M. Elfstrom (National Research Council, Ottawa, Canada). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0291.* 8 p. 10 refs.

The possibility of determining airfoil wavedrag using routine wake drag measurements is examined. Two approaches are considered, one which utilizes the unsymmetrical nature of a wake profile when wavedrag is present, and another which reconstructs the deficit profile due to the wavedrag alone. The two methods are shown to agree reasonably well, but the latter one is preferred because it exhibits less data scatter. Checks on the reasonableness of the results are given, and several examples showing the utility of the method as a diagnostic tool are presented. (Author)

A81-20735 * # **An airborne sensor for the avoidance of clear air turbulence.** B. L. Gary (California Institute of Technology, Jet Propulsion Laboratory, Observational Systems Div., Pasadena, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0297.* 7 p. 7 refs.

This paper describes an airborne microwave radiometer that may be able to provide altitude guidance away from layers containing clear air turbulence, CAT. The sensor may also be able to predict upper limits for the severity of upcoming CAT. The 55 GHz radiometer is passive, not radar, and it measures the temperature of oxygen molecules in the viewing direction (averaged along a several-kilometer path). A small computer directs the viewing direction through elevation angle scans, and converts observed quantities to an 'altitude temperature profile'. The principle for CAT avoidance is that CAT is found statistically more often within inversion layers and at the tropopause, both of which are easily located from sensor-generated altitude temperature profiles. (Author)

A81-20736 # **A survey of recent atmospheric turbulence measurements from a subsonic aircraft.** L. J. Otten, A. L. Pavel, W. E. Finley (USAF, Weapons Laboratory, Kirtland AFB, N. Mex.), and W. C. Rose (USAF, Weapons Laboratory, Kirtland AFB, N. Mex.; Rose Engineering and Research, Inc., Incline Village, Nev.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0298.* 12 p. 8 refs.

The operation of constant temperature and constant current fine wire and thin film anemometers on an Air Force NC-135A aircraft is discussed. A review of the theory of anemometry measurements of atmospheric turbulence at high subsonic speeds is presented along with a discussion of the differences between thin film and fine wire sensors. Instrumentation has allowed data with a 10 kHz bandwidth to be gathered. Atmospheric turbulence data, including fluctuating velocity, temperature, and density, gathered at flight Mach numbers of 0.28 to 0.83 and operating altitudes of 3.6 km MSL to 12.5 km MSL, are presented. Samples of results from studies of orographic turbulence, stratospheric turbulence, the turbulence structure of the tropopause boundary, and turbulence influence on aircraft motion, are described. (Author)

A81-20739 # **Atmospheric disturbance models and requirements for the flying qualities Military Standard and Handbook.** R. K. Heffley, W. F. Jewell (Systems Technology, Inc., Mountain View, Calif.), R. H. Hoh (Systems Technology, Inc., Hawthorne, Calif.), and D. J. Moorhouse (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0302.* 12 p. 50 refs.

The new Military Standard for flying qualities involves the review, refinement, and possible revision of atmospheric disturbance models. The Standard is based on maintaining a simple modeling form and parameters with direct relationships to aircraft dynamics or flying qualities. The Standard will involve atmospheric disturbance models usually in the general Dryden form, and a deterministic model containing mean wind and wind shear effects. Special applications may require turbulence patchiness parameters, aircraft size effects, gust gradient and gust derivative effects, and synoptic meteorological phenomena such as generic frontal passage wind shear model. A.T.

A81-20740 * # **Ozone contamination in aircraft cabins - Results from GASP data and analyses.** J. D. Holdeman (NASA, Lewis Research Center, Combustion and Pollution Research Branch, Cleveland, Ohio) and G. D. Nastrom (Control Data Corp., Minneapolis, Minn.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0305.* 10 p. 21 refs. U.S. Department of Transportation Contract No. FA78WAI-893.

The paper reviews results from the NASA Global Atmospheric Sampling Program (GASP) pertaining to the problem of ozone contamination in commercial aircraft cabins. Specifically, analyses of GASP data have (1) confirmed the high ozone levels in aircraft cabins and documented the ratio of ozone inside and outside the cabins of two B747 airliners, including the effects of air conditioning modifications on that ratio; (2) defined ambient ozone climatology at commercial aircraft cruise altitudes, including tabulation of encounter frequency data; and (3) outlined procedures for estimating the frequency of flights encountering high cabin ozone levels using climatological ambient ozone data and verified these procedures against cabin measurements. (Author)

A81-20741 * # **Aircraft NO/x/ emissions and stratospheric ozone reductions - Another look.** R. P. Turco (R & D Associates, Marina del Rey, Calif.), R. C. Whitten, O. B. Toon, E. C. Y. Inn (NASA, Ames Research Center, Moffett Field, Calif.), and P. Hamill (Systems and Applied Sciences Corp., Hampton, Va.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0306.* 7 p. 33 refs. Contract No. NAS2-9881.

New estimates for stratospheric ozone perturbations attributable to supersonic transport (SST) emissions are presented. First, a review is given of recent data pointing to lower OH concentrations below 30 km, as compared to the values predicted by photochemical models. The evidence for lower OH comes from a wide range of laboratory and atmospheric studies. The sensitivity of theoretical estimates of ozone change to OH abundances, and the coupling mechanisms between the O(x)-NO(x)-HO(x)-Cl(x) families which are responsible for the sensitivity, are discussed. Updated calculations for SST-induced ozone alterations are compared with older predictions. For example, assuming continuous aircraft injection of NO2 at 20 km at a rate of 1 x 10 to the 9th kg per year (globally), a 4% ozone decrease, is now calculated where earlier a 3% ozone increase was found. This large variance from previous forecasts suggests that new assessments of certain other polluting agents, particularly nitrogen fertilizers, are needed. (Author)

A81-20743 # **Aircraft pollution in the vicinity of airports.** H. M. Segal (FAA, Office of Environment and Energy, Washington, D.C.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0309.* 9 p. 7 refs. USAF-supported research.

A study carried out by the FAA and the Environmental Protection Agency that reassessed the impact of aircraft emissions on air quality around airports is discussed. Improvements in measuring techniques, for example, the use of vertical towers at different elevations, made it possible to compare emissions with the National

Ambient Air Quality Standards (NAAQS). For CO, it was found that one-hour average concentrations never exceeded seven ppm, which is to be compared with the 35 ppm limiting level of the NAAQS. Emissions of NO2 were only 10% of the long-term NAAQS standard. With regard to the short-term standard, however, the measurements were inconclusive because it is not yet known how much of the NO emitted by the engine is converted into NO2 before reaching populated areas. C.R.

A81-20751 # Three-dimensional model of spray combustion in gas turbine combustors. F. Boysan, W. H. Ayers, J. Swithenbank, and Z. Pan (Sheffield, University, Sheffield, England). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0324.* 8 p. 26 refs. Grant No. AF-AFOSR-80-0174.

A mathematical model of the three-dimensional two-phase reacting flows in gas turbine combustors has been developed which takes into account the mass, momentum and energy coupling between the phases. The fundamental equations of motion of the droplets are solved numerically in a Lagrangian frame of reference using a finite difference solution of the governing equations of the gas. Well known relations are used to model the heat and mass transfer processes and the initial droplet heat-up is allowed for. The entire fuel spray is constructed using a finite number of size ranges obeying a two parameter droplet size distribution. The results are found to be in close agreement with experimental data. An important feature of this analytical technique is that it permits the rational selection or specification of fuel nozzle design. (Author)

A81-20753 # On the derivation of universal indicial functions. D. Nixon (Nielsen Engineering and Research, Inc., Mountain View, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0328.* 9 p. 7 refs. Contract No. F49620-79-C-0054.

The accurate prediction of unsteady loads in transonic flow is essential to an adequate prediction of aeroelastic effects. A relatively inexpensive means of predicting the loads is by the indicial formulation, which in transonic flow is usually estimated by using an expensive numerical prediction method. The present work concerns the derivation of a universal indicial function which removes the need for a lengthy unsteady transonic flow computation. A theory is developed, using the concepts of the transonic integral equation technique, which effectively reparameterizes the time variable in a known indicial function to give the desired function. Results of the theory are presented. (Author)

A81-20761 * # Flight experiments with a slender cone at angle of attack. D. J. Peake (3-D Flowz, Inc., Moffett Field, Calif.), D. F. Fisher (NASA, Flight Research Center, Edwards AFB, Calif.), and D. S. McRae (USAF, Moffett Field, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0337.* 23 p. 17 refs. Contract No. NAS2-10578.

The three-dimensional leeward separation about a 5 deg semi-angle cone at an 11 deg angle of attack was investigated in flight, in the wind tunnel, and by numerical computations. The test conditions were Mach numbers of 0.6, 1.5, and 1.8 at Reynolds numbers between 7 and 10 million based on free-stream conditions and a 30-inch wetted length or surface. The surface conditions measured included mean static and fluctuating pressures; skin friction magnitudes and separation line positions were obtained using obstacle blocks. The mean static pressures from flight and wind tunnel were in good agreement. The computed results gave the same distributions, but were slightly more positive in magnitude. The experimentally measured primary and secondary separation line locations compared closely with computed results. There were substantial differences in level and in trend between the surface root-mean-square pressure fluctuations obtained in flight and in the wind tunnel, due, it is thought, to a relatively high acoustic disturbance level in the tunnel compared with the quiescent conditions in flight. (Author)

A81-20767 * # A model for the analysis of premixing-prevaporizing fuel-air mixing passages. O. L. Anderson, L. M. Chiappetta, and J. B. McVey (United Technologies Research Center, East Hartford, Conn.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0345.* 11 p. 16 refs. Contract No. NAS3-21269.

A model for predicting the distribution of liquid fuel droplets and fuel vapor in premixing-prevaporizing fuel-air mixing passages has been developed. The analysis involves successive application of computer codes which calculate the two dimensional or axisymmetric air flow field; calculate the three dimensional fuel droplet trajectories and evaporation rates; and calculate the fuel vapor diffusing through a moving air stream. A description of the more important features of the model and the results of a design study on two premixing fuel-air passages are presented. (Author)

A81-20768 # Non-isoenergetic turbulent jet mixing in a constant area duct. W. Tabakoff and J. H. Blasenak (Cincinnati, University, Cincinnati, Ohio). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0347.* 15 p. 23 refs. Grant No. DAHC04-69-C-0016.

A study of non-isoenergetic turbulent jet mixing between two streams has been conducted. Using a theoretical analysis for ducted mixing, an experimental investigation was performed to verify this theory and to determine the non-isoenergetic turbulent jet mixing characteristics in a constant area duct. Temperature profiles were measured at several axial locations in the duct for both a concentric and an eccentric configuration. It was determined that the theoretical and experimental temperature profiles agreed fairly well for both cases, although the concentric case showed better agreement than the eccentric case. It was concluded that the mixing theory introduced was good for a fairly simplified analysis. (Author)

A81-20775 # The aerodynamics of inverted leading edge flaps on delta wings. J. F. Marchman, III (Virginia Polytechnic Institute and State University, Blacksburg, Va.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0356.* 9 p. 5 refs.

Subsonic wind tunnel tests were conducted to determine the aerodynamic effects of leading edge flaps deflected upward from 60 and 75 deg sweep delta wings. Leading edge flaps of various sizes and shapes were tested at a range of flap deflection angles. It was found that inverted flaps cause a strong vortex lift at low to moderate angles of attack and give large increases in lift coefficient C(L) at those angles. The lift increase, accompanied by increased drag, suggests application to landing conditions where this combination may be desirable in certain classes of aircraft. Examination of pitching moment data reveals that the lift increases due to inverted flap use are not necessarily accompanied by the large changes in pitching moment which are associated with trailing edge flap deployment. With a properly shaped leading edge flap a negative flap deflection can give substantial increases in C(L) with no change in longitudinal stability. (Author)

A81-20776 * # Hinged strakes for enhanced maneuverability at high angles of attack. D. M. Rao (Vigyan Research Associates, Inc., Hampton, Va.) and J. K. Huffman (NASA, Langley Research Center, Hampton, Va.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0357.* 8 p. 7 refs. NASA-supported research.

A controllable-strake concept for alleviating the adverse effects of strake vortex breakdown and asymmetry on the longitudinal and lateral aerodynamics of strake-wing configurations at high angles of attack is presented. The concept aims to control the strake load independently of angle of attack and sideslip by varying the anhedral angle of strakes hinged along the root chord. The strakes may be deflected in a symmetrical or nonsymmetrical mode for a variety of control functions. Results are presented of an exploratory wind-tunnel investigation to evaluate the potential of the hinged-strake

concept for enhancing the three-axis controllability in post-stall flight. (Author)

A81-20783 # **An analysis of gap effects on wing-elevon aerodynamic characteristics.** J. M. Abernathy. *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0364.* 11 p. 21 refs. Research supported by the Auburn University; Grant No. DAAG29-78-G-0036.

An investigation of the aerodynamic characteristics of a wing-elevon lifting surface when an air gap exists between the wing trailing edge and the elevon leading edge is discussed. Analytical results are formulated using a lifting surface (Kernel function) method. The solution procedure allows closed form results to be obtained for the elevon hinge moments. Fuselage effects and leading edge suction are also used to apply results to a general configuration. Variation of the characteristics as a function of gap distance is studied. Of primary importance is the effect on hinge moments, which dictate control forces. Results indicate good agreement between theory and experiment for several general configurations. Also, it is shown that the loading on the elevon increases slightly with gap distance. (Author)

A81-20784 # **Initial development for a flutter analysis of damaged T-38 horizontal stabilators using NASTRAN.** J. O. Lassiter (USAF, Institute of Technology, Wright-Patterson AFB, Ohio). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0365.* 22 p. 16 refs.

This thesis demonstrates the development and response of a finite element model of the T-38 horizontal stabilator using the computer program NASTRAN. The model is to be used in a flutter analysis of damaged or repaired stabilators. The objective of the flutter analysis is to determine absolute values and degradations of the flutter speeds due to different types of damages or repairs. Verification of the model's static and dynamic response proved to be adequate. But a NASTRAN flutter speed different from previous studies shows that the finite element model needs more study with respect to modeling errors, convergence, and aerodynamic airload verification. (Author)

A81-20785 # **Structural weight comparison of a joined wing and a conventional wing.** M. F. Samuels. *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0366.* 9 p. 10 refs.

A structural weight comparison was made between a new concept wing design, called a joined wing, and a reference conventional wing-plus-horizontal tail (Boeing 727). The joined wing analysis includes two cases that differ only in minimum gage skin thickness. The comparison was accomplished by constructing finite computer models of each wing configuration, analyzing each for optimum skin thickness, then determining the structural weight of each wing. The optimizations were based on a fully stressed design concept using a von Mises criterion for maximum allowable stress. The joined wing was found to be lighter by 12-22%. (Author)

A81-20786 # **Prediction method for the overall performance of turbofan engines.** A. J. M. van der Hoeven (Kansas, University, Lawrence, Kan.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0367.* 15 p.

A method is presented for estimating the off-design performance of a turbofan engine with a coupled fan/low pressure compressor. The engine is fixed by a design-point condition; the calculation of the off-design performance is based on the assumption of a choked turbine which determines the operating conditions of the engine components upstream of this aerodynamic throat. The method uses gasdynamic relationships only and does not require detailed component information; the performance estimation of turbojet engines can utilize the same thermodynamic analyses. A.T.

A81-20788 * # **A computer graphics display technique for the examination of aircraft design data.** N. A. Talcott, Jr. (NASA, Langley Research Center, High-Speed Aerodynamics Div., Hampton, Va.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0370.* 9 p. 8 refs.

An interactive computer graphics technique has been developed for quickly sorting and interpreting large amounts of aerodynamic data. It utilizes a graphic representation rather than numbers. The geometry package represents the vehicle as a set of panels. These panels are ordered in groups of ascending values (e.g., equilibrium temperatures). The groups are then displayed successively on a CRT building up to the complete vehicle. A zoom feature allows for displaying only the panels with values between certain limits. The addition of color allows a one-time display thus eliminating the need for a display build up. (Author)

A81-20789 * # **A computer-aided design system geared toward conceptual design in a research environment.** S. H. Stack (NASA, Langley Research Center, High-Speed Aerodynamics Div., Hampton, Va.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0372.* 11 p. 7 refs.

A computer-aided design system has recently been developed specifically for the small research group environment. The system is implemented on a Prime 400 minicomputer linked with a CDC 6600 computer. The goal was to assign the minicomputer specific tasks, such as data input and graphics, thereby reserving the large mainframe computer for time-consuming analysis codes. The basic structure of the design system consists of GEMPAK, a computer code that generates detailed configuration geometry from a minimum of input; interface programs that reformat GEMPAK geometry for input to the analysis codes; and utility programs that simplify computer access and data interpretation. The working system has had a large positive impact on the quantity and quality of research performed by the originating group. This paper describes the system, the major factors that contributed to its particular form, and presents examples of its application. (Author)

A81-20794 # **Higher-accuracy finite-difference schemes for transonic airfoil flowfield calculations.** L.-T. Chen (McDonnell Douglas Corp., St. Louis, Mo.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0381.* 10 p. Research supported by the McDonnell Douglas Independent Research and Development Program.

Higher-order-accurate finite-difference schemes using a third-order element have been developed for transonic flowfield calculations about airfoils. The finite-difference approximations for velocity components and boundary conditions are one order higher than those obtained with the conventional five-point operator; therefore the flowfield solution is third-order accurate in subsonic regions. To stabilize the relaxation procedure, a second-order-accurate, nonconservative or conservative, artificial viscosity term is introduced in locally supersonic regions where the flowfield solution becomes second-order accurate. Solutions calculated with improved accuracy are compared with conventional finite-difference solutions obtained with relatively dense grids. (Author)

A81-20796 # **A cost-effective method for shock-free supercritical wing design.** P. Raj, L. R. Miranda (Lockheed-California Co., Burbank, Calif.), and A. R. Seebass (Arizona, University, Tucson, Ariz.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0383.* 10 p. 21 refs. Research supported by the Lockheed-California Independent Research and Development Program.

A computationally efficient procedure for the design of shock-free supercritical wings is described. The method utilizes the fictitious gas concept coupled with an improved version of the Jameson-Caughey full-potential finite-difference code, FLO 22, for analyzing three-dimensional wings. The computation of the velocity

components at the plane of symmetry in the analysis code is modified to simulate the flow on isolated wings more accurately. In addition, the improved version of FLO 22 is capable of handling the wing-fuselage interference effect. The present design method computes the surface-geometry beneath the supersonic region so as to eliminate the shock waves normally associated with transonic flight. Results for redesigned rectangular and swept wings are presented that indicate significant wave-drag reduction and improved aerodynamic characteristics when compared with the baseline wing. (Author)

A81-20798 * # **Microbursts as an aviation wind shear hazard.** T. T. Fujita (Chicago, University, Chicago, Ill.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0386.* 10 p. 12 refs. NSF Grant No. ATM-79-21260; Contract No. NOAA-NA-80AAD0001; Grant No. NGR-14-001-008.

The downburst-related accidents or near-misses of jet aircraft have been occurring at the rate of once or twice a year since 1975. A microburst with its field comparable to the length of runways can induce a wind shear which endangers landing or liftoff aircraft; the latest near miss landing of a 727 aircraft at Atlanta, Ga. in 1979 indicated that some microbursts are too small to trigger the warning device of the anemometer network at major U.S. airports. The nature of microbursts and their possible detection by Doppler radar are discussed, along with proposed studies of small-scale microbursts.

A.T.

A81-20799 # **Analysis of wind vector components in the lower troposphere - Applications to aircraft operations at terminals.** R. C. Goff (FAA, Technical Center, Atlantic City, N.J.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0387.* 10 p. 12 refs.

A long series of discrete vertical and horizontal wind observations from a 444m meteorological tower in Central Oklahoma have been analyzed. The characteristics of the three components of the wind in the tower layer have been determined for atmospheric scales at which potential degradation of aircraft flight quality is known to be high. Through inspection of frequency distributions and wind spectra, there is ample evidence that, in general, temporally long or spatially extensive vertical motions are virtually nonexistent. In thunderstorms and behind cold fronts much more kinetic energy is present in the horizontal wind field than in the vertical motion field at scales near representative aircraft phugoid frequencies. (Author)

A81-20800 * # **The effect of heavy rain on windshear attributed accidents.** J. K. Luers and P. A. Haines (Dayton, University, Dayton, Ohio). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0390.* 9 p. 16 refs. NASA-supported research.

In recent years several commercial aircraft accidents have occurred as an aircraft attempted landing in a thunderstorm cell. The horizontal and vertical windshear associated with the cell have been identified as the factors responsible for the accident. In addition to the wind shear encounter, several of these aircraft simultaneously penetrated a heavy rain cell. Heavy rain affects the aircraft by imparting a momentum penalty, and a drag penalty, due to the rain roughening of the airfoil. These penalties have been evaluated by a computer model that, when incorporated with a landing simulation program, was used to assess the relative influence of heavy rain versus wind shear. Using this model, an assessment was made of the influence of heavy rain on several wind shear attributed accidents.

(Author)

A81-20801 # **Sources and detection of atmospheric wind shear.** A. J. Bedard, Jr. (NOAA, Wave Propagation Laboratory, Boulder, Colo.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0391.* 11 p. 22 refs.

This paper reviews a range of phenomena producing significant atmospheric wind shears, providing more details on the shears related to thunderstorm gust fronts. A case study from a winter time, Colorado front-range experiment (Project AEOLUS) documents strong wind gradients that can occur in the lees of mountains. Strengths and weaknesses of some detection methods are discussed emphasizing evaluations of both remote sensor and in-situ sensor approaches for detecting atmospheric wind shear. (Author)

A81-20809 # **Computer simulation of airfoil icing without runback.** E. P. Lozowski (Alberta, University, Edmonton, Canada) and M. M. Oleskiw. *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0402.* 8 p. 12 refs. Grant No. DACA89-79-C-0004.

A numerical model has been developed to predict the time-dependent characteristics of ice accretion upon an arbitrarily shaped, longitudinally symmetric airfoil in subsonic incompressible flow. The surface vorticity method is employed to generate a potential flow field. Equations describing the accelerated motion of supercooled cloud droplets are integrated with a variable time step to yield the trajectories. Assuming that droplets freeze immediately upon airfoil impact, their collision locations lead to a determination of the accretion thickness via a collision efficiency calculation. The resulting airfoil shape modified by the accretion allows re-calculation of the airflow and trajectories thus incorporating a stepwise time-dependence of accretion. Collision efficiencies and accretion shapes and thicknesses are compared to other theoretical and experimental results. (Author)

A81-20810 * # **An analytical approach to airfoil icing.** M. B. Bragg, G. M. Gregorek (Ohio State University, Columbus, Ohio), and R. J. Shaw (NASA, Lewis Research Center, Cleveland, Ohio). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0403.* 18 p. 26 refs. Grant No. NAG3-28.

An analytical procedure has been developed to predict rime ice growth on unprotected airfoil sections and to evaluate the aerodynamic performance. A time stepping method is used in which: (1) water droplet trajectories are calculated, (2) a rime ice shape determined, (3) the flowfield around the iced airfoil is recalculated, and (4) the build-up process iterated upon until the desired icing time is reached. The performance of the iced airfoil shapes are then determined from existing analytic methods. Rime ice shapes determined in the NASA Lewis Icing Research Tunnel on a modified NACA 64 series airfoil agree well with the shapes predicted by the analytical method. Measured and predicted increases in drag due to the rime ice also agree favorably. A simplified scaling analysis is also presented and verified which provides the duplication of full scale results of rime ice accretions in small scale model tests. (Author)

A81-20811 * # **Simulated aircraft takeoff performance with frosted wings.** M. A. Dietenberger (Dayton, University, Dayton, Ohio). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0404.* 6 p. 12 refs. Contract No. NAS8-33369.

The absolute and relative safety of certain nocturnal frost formations on general aviation and transport type airfoils is evaluated by a computer simulation program. The frost layer aerodynamic penalty and takeoff program was used to calculate the frost thickness distribution on an airfoil with time, as well as the aerodynamic penalties associated with the frost layer during takeoff. The program was validated by nocturnal frost formation experiments on an inclined flat plate and by comparisons with documented aerodynamic penalties of an arbitrarily roughened airfoil. For various meteorological conditions and runway take-off velocities, a frost layer can be determined that produces no aerodynamic penalty, thus inferring the absolute safety of the airfoil with respect to frost. The relative safety of a frosted airfoil depends on the ability of the engine power reserve to overcome both as much as doubling of airfoil drag and an increased stall speed due to lift penalties. (Author)

A81-20812 # **United States Army helicopter icing qualification 1980.** C. E. Frankenberger (U.S. Army, Edwards AFB, Calif.).

American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0406. 4 p.

In the winter of 1980, the Army conducted tests to develop the operational envelope for operating in icing conditions for the UH-60A, the CH-47D, and the UH-1H with ice phobic coating. The envelope was to be defined by temperature and liquid water content. Tests were conducted in both artificial and natural icing clouds with the Helicopter Icing Spray System (HISS) furnishing the artificial cloud. The HISS is a CH-47C helicopter equipped with an 1800 gallon internal water tank and an external spray boom. HISS improvements performed prior to testing produced an 8 x 32-ft cloud with 30 micron water droplet mean volumetric diameter. Natural and artificial results were quite similar and both provided the basis for qualification. (Author)

A81-20813 # **40 years of helicopter ice protection experience at Sikorsky Aircraft.** K. M. Rosen and M. L. Potash (United Technologies Corp., Sikorsky Aircraft, Stratford, Conn.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0407.* 16 p. 6 refs.

Each area of helicopter ice protection is discussed, and the evolution of system analysis, design, fabrication techniques, and performance is traced from World War II to the present time. Specific design analysis procedures are described, which yield droplet trajectory solutions for inlets as well as for rotor blades and which lead to the definition of an optimized (minimum energy expenditure) inlet convective heat exchanger flow path. Recommendations are developed to use a modern four-bladed helicopter having an advanced airfoil and properly fitted with ice protection equipment for use as a research vehicle to systematically probe the effects of simulated and natural icing environments on helicopter operations. C.R.

A81-20814 # **A parametric study of the static longitudinal aerodynamic characteristics of parallel lift delta wing configurations at low Reynolds numbers.** J. A. Ham (U.S. Army, Military Academy, West Point, N.Y.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0409.* 8 p. 13 refs.

Wind tunnel tests have been conducted at the U.S. Military Academy on a proposed configuration for a second-generation Space Shuttle. The configuration is based on a NASA concept for a reusable, flyback horizontal-takeoff system. The test model consisted of a 60 deg delta main wing with two smaller 'booster' delta wings attached underneath. The results of the test showed that increasing vertical separation of the 'booster' wings from the main wing caused a significant increase in C(Lmax), a decrease in C(DOmin), and an increase in pitching stability. Static pitch stability was also enhanced. The proximity of the main wing to the 'booster' wings is believed to cause premature bursting of the leading-edge vortices of the 'booster' wings. It is concluded that the most promising configuration should have the most feasible vertical separation and rearward placement. (Author)

A81-20816 # **Flow visualization through the use of the smoke-wire technique.** B. J. Jansen, Jr. (Notre Dame, University, Notre Dame, Ind.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0412.* 7 p. 5 refs.

A technique for flow visualization in low speed wind tunnels, called the smoke-wire technique, is described. This technique allows for the introduction of very fine smoke streaklines into the flow field. These streaklines are generated through the resistive heating of a very small diameter wire which is coated with oil and which spans the wind tunnel test section upstream of the test object. The description of an electronic control circuit to aid in photography is given. Several practical applications for this technique are demonstrated and streakline data from still photography are presented. (Author)

A81-20817 # **The design, testing, certification and production of an emergency parachute for use in light aircraft.** M. C. Butler, Jr. (Texas, University, Austin, Tex.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0413.* 9 p.

This paper discusses the design, prototype construction, test program, and certification of an emergency parachute design for use in light aircraft and sport aviation. The process is traced from the origin of the concept, through the various design processes and prototypes, to the final production version of the parachute system. A short description of a basic parachute assembly is given (to familiarize the reader with the terminology) followed by a description and evaluation of several of the currently available emergency parachutes in order to contrast the features of the design project which are felt to be improvements on existing models. The test program is covered briefly and is intended to be supplemented by a slide and motion picture presentation. (Author)

A81-20818 # **Experiments on the linear and non-linear evolution of the double helical instability in jets.** R. E. Betzig (California Institute of Technology, Pasadena, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0415.* 7 p. 9 refs. Contract No. N00014-76-C-0260.

A unique magnetic deformation system was used to drive the second helical mode of jet instability. Extensive measurements were made of both linear and nonlinear effects. Near field measurements were found to be qualitatively consistent with existing models of linearized jet stability. A partial physical description was obtained of the subsequent nonlinear evolution of the disturbance vorticity. These are the first detailed measurements of the double helical mode, largely because of the limitations of past excitation systems. The data may aid in the development of numerical models of three dimensional flows. The mode itself is possibly relevant to the production of jet noise. (Author)

A81-20829 * # **Perspectives on jet noise.** H. S. Ribner (NASA, Langley Research Center, Hampton, Va.; Toronto, University, Downsview, Ontario, Canada). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0428.* 18 p. 73 refs. Research supported by the National Sciences and Engineering Research Council of Canada.

Jet noise is a byproduct of turbulence. Until recently turbulence was assumed to be known statistically, and jet noise was computed therefrom. As a result of new findings though on the behavior of vortices and instability waves, a more integrated view of the problem has been accepted lately. After presenting a simple view of jet noise, the paper attempts to resolve the apparent differences between Lighthill's and Lilley's interpretations of mean-flow shear, and examines a number of ad hoc approaches to jet noise suppression. R.S.

A81-20830 * # **Mean rotor wake characteristics of an aerodynamically loaded 0.5 m diameter fan.** L. M. Shaw and F. W. Glaser (NASA, Lewis Research Center, Cleveland, Ohio). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0208.* 16 p. 15 refs.

Mean rotor wake properties at several downstream distances behind the rotor of a loaded 1.2 pressure ratio fan were measured with a cross film anemometer in an anechoic wind tunnel. Mean wake characteristics in the midspan and near tip region were determined utilizing an ensemble averaging technique. The upwash and streamwise components of the velocity behind the rotor indicate a complex structure superimposed on the major velocity defects at a downstream spacing of 0.5 rotor chords. Spectral analysis indicates high levels of the second and fourth harmonics of the blade passage frequency in the midspan region while the blade passage frequency and its second and third harmonic are predominant in the tip region. (Author)

A81-20837 * # **Icing tunnel tests of a glycol-exuding porous leading edge ice protection system on a general aviation airfoil.** D. L.

Kohlman, W. G. Schweikhard (Kansas, University, Lawrence, Kan.), and P. Evanich (NASA, Lewis Research Center, Cleveland, Ohio). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0405.* 10 p.

Tests were conducted in the Icing Research Tunnel at the NASA Lewis Research Center to determine the characteristics of an ice protection system that distributes a glycol solution onto the leading edge of an airfoil through a porous surface material. Minimum fluid flow rates required to achieve anti-icing (no ice formation) were determined for various flight conditions and angles of attack. The ability of the system to remove ice formed on the airfoil before system activation was also investigated. (Author)

A81-20838 # **A computerized study of wave characteristics in a time dependent compressible flow.** F. W. Botero (U.S. Navy, Orlando, Fla.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0410.* 7 p.

A computerized application of Riemann's method of characteristics has been developed to study non-steady, time dependent flow behavior. The method of characteristics is shown to lend itself to computerization well as numerous calculations and precise graphing are required. System qualities of terminal oscillatory or damped behavior are analyzed and presented. The computerized method utilizing characteristics presents an alternative solution to the complex Navier-Stokes equations for non-steady flow engine design. A pulse jet engine is modeled and results indicate that the computerized method can be a flexible and useful tool for practical engine design which is capable of further refinement and application. (Author)

A81-20840 * # **Compressible boundary-layer stability calculations for sweptback wings with suction.** L. M. Mack (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0196.* 10 p. 18 refs. Contract No. NAS7-100.

The stability of the laminar boundary layers on two transonic wings of infinite span with distributed suction is investigated with the compressible, parallel-flow stability theory. Both wings have supercritical airfoil sections; one has a sweep angle of 23 deg, the other of 35 deg. Zero-frequency disturbances are used to represent cross-flow instability, and disturbances with the wavenumber vector aligned with the local flow direction represent traveling-wave instability. In both cases, the maximum spatial amplification rate is used as a measure of the instability. For the suction, distributions with constant mass flux downstream of the starting point are used. The main objective is to determine how the maximum amplification rate varies with the magnitude and starting point of the suction. It is found for both types of disturbances that the maximum amplification rate varies almost linearly with the suction magnitude up to at least the point where the amplification rate is halved. Different starting locations for the suction in the first 4% of the chord were found to affect cross-flow instability, but to have little influence on traveling-wave instability. (Author)

A81-20861 **High-solids coatings for exterior aircraft.** R. E. Wolf, C. J. Ray, G. McKay, and J. M. Butler (DeSoto, Inc., Des Plaines, Ill.). In: Resins for aerospace; Proceedings of the Symposium, Honolulu, Hawaii, April 3-6, 1979. Washington, D.C., American Chemical Society, 1980, p. 115-126.

The paper reports progress made toward the development of a sprayable high-performance 65%-volume-solids two-package polyurethane exterior coating for military aircraft in an effort to reduce solvent emissions from the application of large volumes of coatings and paints. In particular, data are given on one polyol component of a two-package urethane system, an oxazolidine supplied at 85% volume solids in ethoxy ethyl acetate. The data include viscosity-concentration profiles at varying shear rates and Casson plots. V.L.

A81-20873 **Acoustic fatigue strength of fiber-reinforced plastic panels.** T. Fujii, T. Fukuda (Osaka City University, Osaka, Japan), S. Iida, and M. Sano (National Aerospace Laboratory, Chofu, Tokyo, Japan). In: Resins for aerospace; Proceedings of the Symposium, Honolulu, Hawaii, April 3-6, 1979. Washington, D.C., American Chemical Society, 1980, p. 305-315. 5 refs.

Four kinds of FRP panels with three layers of roving glass and/or glass-fiber mat reinforced unsaturated polyester resin were acoustically excited and fatigue tested. The glass-fiber mat test panel was more isotropic in the failure mode than the roving glass reinforced specimens; the acoustic fatigue strength of FRP panels was much lower than that of FRP tested under constant stress. Laminating the carbon woven tapes simultaneously during fabrication resulted in greater increase in fatigue strength. A.T.

A81-20914 **Air traffic control problems - A pilot's view.** F. D. Fowler (Fowler, Fuehrer and Associates, Orlando, Fla.). *Human Factors,* vol. 22, Dec. 1980, p. 645-653. 11 refs.

Specific examples of crashes and near midair collisions are used to identify existing and potential human error sources. System-induced human errors caused by radar and information-processing limitations, inadequate communication capabilities, and Federal Aviation Administration policy decisions are discussed. An overall reconsideration of human error analysis and prevention is proposed. (Author)

A81-20915 **Bilingual air traffic control in Canada.** P. Stager (York University, Toronto, Canada), P. Proulx, B. Walsh, and T. Fudakowski (Transport Canada, Ottawa, Canada). *Human Factors,* vol. 22, Dec. 1980, p. 655-670. 17 refs.

Simulation exercises with bilingual controllers from Montreal Center were conducted in order to develop procedures for the safe implementation of bilingual communications for aircraft operating under instrument flight rules in the Province of Quebec. Representative pilots from professional and general aviation associations flew aircraft simulators linked to the Air Traffic Control simulator in order to evaluate the proposed bilingual system and to generate data on the party-line aspect of the listening watch in air-ground communications. The effects of language, type of sector, traffic characteristics, and exceptional conditions on communication characteristics and controller performance were observed in four different studies. In addition, data on controllers' communications in actual operations and on reported incidents involving the listening watch were obtained. Information from both the simulations and the real-world operations were then analyzed to determine the implications for control procedures and to assess the general impact of bilingual control on system safety. (Author)

A81-21010 * # **Economics of technological change - A joint model for the aircraft and airline industries.** J. T. Kneafsey and N. K. Taneja (MIT, Cambridge, Mass.). *Journal of Aircraft,* vol. 18, Jan. 1981, p. 35-42. 17 refs. Grant No. NsG-2129.

The principal focus of this econometric model is on the process of technological change in the U.S. aircraft manufacturing and airline industries. The problem of predicting the rate of introduction of current technology aircraft into an airline's fleet during the period of research, development, and construction for new technology aircraft arises in planning aeronautical research investments. The approach in this model is a statistical one. It attempts to identify major factors that influence transport aircraft manufacturers and airlines, and to correlate them with the patterns of delivery of new aircraft to the domestic trunk carriers. The functional form of the model has been derived from several earlier econometric models on the economics of innovation, acquisition, and technological change. (Author)

A81-21011 # **Spanwise distribution of control points in the method of finite elementary solutions.** J.-G. An. *(American Institute*

of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, New York, N.Y., Aug. 20-22, 1979, Paper 79-1879.) Journal of Aircraft, vol. 18, Jan. 1981, p. 59-61. 9 refs.

The method of finite elementary solutions (MFES) is widely used in the field of subsonic aerodynamics. The paper employs MFES to calculate induced drag in a problem involving complex wing geometry, concluding that correct induced drag cannot be obtained for certain planar wings with traditional midpanel control points. A projected spanwise location of control points, however, yields accurate calculations for both lift coefficient and planform factor, even with a small number of spanwise panels, and eliminates overload phenomena at wing-tip regions. R.S.

A81-21013 # **Effect of rear stagnation point position and trailing edge bluntness on airfoil characteristics.** V. Baskaran and V. S. Holla (Indian Institute of Science, Bangalore, India). *Journal of Aircraft,* vol. 18, Jan. 1981, p. 63, 64.

Calculation of the pressure distribution over an airfoil plays an important part in predicting the airfoil's aerodynamic characteristics. Using the Hess and Smith method, and assuming the flow to be steady, incompressible, and two-dimensional, calculations for the pressure distributions for various rear stagnation points on RAE 101 profiles with both sharp and blunt trailing edges are presented. It is found that as the rear stagnation point on the upper surface is moved away from the trailing edge, the static pressure on the upper surface increases (as a result of the deceleration of flow), whereas it decreases on the lower surface. The reverse is true when the stagnation point is on the lower surface. Lift and momentum coefficients also vary with stagnation point location, the change, in both cases, being more marked for the blunt profile than for the sharp one. When the rear stagnation point, however, is at the trailing edge, the momentum coefficient appears to be more sensitive to the bluntness than does the lift coefficient. R.S.

A81-21060 # **Damping of aircraft wing vibrations by automatically controlled internal forces (Dempfirovanie kolebanii kryla samoleta avtomaticheski upravliaemymi vnutrennimi silami).** V. I. Merkulov. *PMTF - Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki,* Sept.-Oct. 1980, p. 91-99. In Russian.

Various methods of damping elastic vibrations in aircraft wings include automatic control of amplitude, frequency, and phase of the acting forces. Weight shifting, internal tension, flexible shafts, and gyrometers were examined as controlling elements; these methods are effective in airport operations where aircraft is subjected to maximum dynamic loads. A.T.

A81-21075 **Bounds for the additional cost of near-optimal controls.** A. M. Steinberg (Technion - Israel Institute of Technology, Haifa, Israel) and I. Forte. *Journal of Optimization Theory and Applications,* vol. 31, July 1980, p. 385-395. 5 refs.

Near-optimal controls are considered for singular problems with a constrained control. These controls result in a higher cost than the optimal cost. Bounds for the additional cost are derived for problems with fixed terminal time or free terminal time and for minimal time problems. An illustrative example is solved of an optimal evasive control of an aircraft against a homing missile. (Author)

A81-21083 # **Longitudinal instability in braked landing gear.** R. R. Allen (California, University, Los Angeles, Calif.) and R. C. O'Massey (Douglas Aircraft Co., Long Beach, Calif.). *American Society of Mechanical Engineers, Winter Annual Meeting, Chicago, Ill., Nov. 16-21, 1980, Paper 80-WA/DSC-12.* 9 p. 14 refs. Members, $2.00; nonmembers, $4.00. Research sponsored by the Douglas Aircraft Co.

An instability in the form of a self-excited, bounded longitudinal oscillation may occur in aircraft landing gear when one or more wheels lock due to excessive braking. The instability usually appears at ground speeds below 40 knots (20 m/s) and results from interaction between structural elasticity and the nonlinear characteristics of tire-runway friction. A nonlinear mathematical model is developed to study the dynamics of this divergence in a braked, dual tire landing gear. Analytical methods are presented to determine critical ground speeds in terms of runway friction characteristics and to predict the amplitude of steady-state oscillations. The effect of design variables on longitudinal stability is evaluated and design guidelines are presented which insure reduction of the severity of this divergent dynamic behavior. (Author)

A81-21120 * # **Numerical techniques in linear duct acoustics - A status report.** K. J. Baumeister (NASA, Lewis Research Center, Cleveland, Ohio). *American Society of Mechanical Engineers, Winter Annual Meeting, Chicago, Ill., Nov. 16-21, 1980, Paper 80-WA/NC-2.* 16 p. 72 refs. Members, $2.00; nonmembers, $4.00.

A review is presented covering both finite difference and finite element analysis of small amplitude (linear) sound propagation in straight and variable area ducts with flow, as might be found in a typical turbojet engine duct, muffer, or industrial ventilation system. Both 'steady' state and transient theories are discussed. Emphasis is placed on the advantages and limitations associated with the various numerical techniques. Examples of practical problems are given for which the numerical techniques have been applied. (Author)

A81-21168 # **The linear instability due to the compressible crossflow on a swept wing.** S. G. Lekoudis (Georgia Institute of Technology, Atlanta, Ga.). *ASME, Transactions, Journal of Fluids Engineering,* vol. 102, Dec. 1980, p. 502-509. 14 refs. Research supported by the Lockheed-Georgia Independent Research and Development Program.

The problem of the propagation of three-dimensional laminar instabilities, due to crossflow, in a three-dimensional compressible boundary layer, is examined using linear theory. The theory is applied to the case of a transonic swept wing. It is shown that compressibility has a mild stabilizing effect in the regions where the crossflow is strong. The problem of defining the direction of propagation of the disturbances is discussed. (Author)

A81-21197 **Numerical solution of transonic flow through a cascade with slender profiles.** K. Kozel, J. Polasek, and M. Vavrincova (Ceske Vysoke Uceni Technicke, Prague, Czechoslovakia). In: International Conference on Numerical Methods in Fluid Dynamics, 6th, Tiflis, Georgian SSR, June 21-24, 1978, Proceedings. Berlin, Springer-Verlag, 1979, p. 333-338. 7 refs.

A solution for the plane steady inviscid transonic flow through a cascade with thin and low cambered profiles is presented. A weak solution of the boundary value problem and the difference method approximating the differential problem are formulated; the difference problem is solved by the successive line relaxation method. The numerical results determine a change of the flowfield in the cascade with the change attack angle, the upstream Mach number, the stagger angle, and present a numerical test of the influence of boundary layer effects. A.T.

A81-21201 **Calculation of supersonic gas flows about wings.** A. N. Minailos (Tsentral'nyi Aerogidrodinamicheskii Institut, Zhukovskiy, USSR). In: International Conference on Numerical Methods in Fluid Dynamics, 6th, Tiflis, Georgian SSR, June 21-24, 1978, Proceedings. Berlin, Springer-Verlag, 1979, p. 393-399. 12 refs.

A81-21366 **Use of speckle-holographic interferometry to study the strain-strain state of a gas-turbine engine disk close to the blade root fixing.** A. A. Rassokha (Khar'kovskii Aviatsionnyi Institut, Kharkov, Ukrainian SSR). *(Problemy Prochnosti,* May 1980, p. 116-118.) *Strength of Materials,* vol. 12, no. 5, Jan. 1981, p. 662-664. 5 refs. Translation.

The paper describes a method combining holographic interferometry and speckle interferometry for the investigation of the stress-strain state of a turbine disk near a scarf joint with a blade. Experimental results are presented and compared with finite element computations; good agreement is shown. B.J.

A81-21367 **Application of exoelectron emission for quality control of gas-turbine engine parts.** V. S. Kortov, A. M. Sulima, A. I. Slesarev, and V. V. Shorin (Ural'skii Politekhnicheskii Institut, Sverdlovsk, USSR). *(Problemy Prochnosti,* May 1980, p. 119-121.) *Strength of Materials,* vol. 12, no. 5, Jan. 1981, p. 665-667. 6 refs. Translation.

The paper deals with the application of exoelectron emission to the nondestructive testing of the physicochemical state of the surface layer of turbine engine blades and other components. The effectiveness of the method in detecting fatigue damage is demonstrated.

V.P.

A81-21505 **Semi-empirical correlations for gas turbine emissions, ignition, and flame stabilization.** A. M. Mellor (Purdue University, West Lafayette, Ind.). *(NATO, AGARD, Specialists Meeting on Combustor Modeling, 54th, Cologne, West Germany, Sept. 24-28, 1979.) Progress in Energy and Combustion Science,* vol. 6, no. 4, 1980, p. 347-358. 49 refs. Research supported by the U.S. Environmental Protection Agency, General Motors Corp., Ford Motor Co., General Electric Co., and U.S. Army; Contract No. F33615-77-C-2069.

A81-21552 * # **New approach to the solution of large, full matrix equations.** R. W. Clark (Douglas Aircraft Co., Long Beach, Calif.) and R. M. James (Boeing Co., Seattle, Wash.). *AIAA Journal,* vol. 19, Feb. 1981, p. 184-190. 5 refs. Contract No. NAS1-14892.

A new approach to the solution of matrix equations resulting from integral equations is presented and applied to the solution of two-dimensional Neumann problems describing the inviscid, incompressible flow past an airfoil. The problem is reformulated in terms of a preselected set of mode functions giving an equivalent matrix equation to be solved for the mode-function expansion coefficients. Because of the inherent smoothness of the original problem, the coefficient problem can be solved approximately without significantly affecting the accuracy of the final solution. Very promising two-dimensional results are obtained and the extension of the method to three-dimensional problems is investigated. On the basis of these results it is shown that the computing time for the matrix solution for a large three-dimensional panel method calculation could be reduced by an order of magnitude compared with that required for a direct solution. (Author)

A81-21555 # **Three-dimensional wing boundary layer calculated with eight different methods.** D. A. Humphreys (Flygtekniska Forsoksanstalten, Bromma, Sweden). *AIAA Journal,* vol. 19, Feb. 1981, p. 232-234. 15 refs. Air Materiel Department of Sweden Contracts No. AU-1283; No. AU-1379.

Eight different boundary-layer calculation methods were comparatively evaluated by application to the same three-dimensional wing boundary layer test case. Graphs of results obtained with the different methods illustrate the chordwise crossflow angle variation, total skin friction coefficient variation, and shape parameter variation at 0 and 8 deg incidence. It is concluded that much remains to be done in improving such calculations to reach concensus for even a straightforward case. T.M.

A81-21574 # **Developments at VFW/Rhein-Flugzeugbau GmbH, Mönchengladbach (Entwicklungen bei VFW/Rhein-Flugzeugbau GmbH, Mönchengladbach).** H. Fischer (Rhein-Flugzeugbau GmbH, Mönchengladbach, West Germany). *Internationale Luftfahrtausstellung, Hanover, West Germany, Apr. 24-May 1, 1980, Paper.* 22 p. In German.

A cost comparison for similar German and American aircraft is presented. The design of glider aircraft with fiber strengthened material is investigated in relation to aircraft with metal construction. Engine performance and cruising speed are examined in Fanliner and Traveler aircraft. Emphasis is placed on the level of noise, fuel consumption and the use of a rotary piston engine in aircraft with fan design. R.C.

A81-21575 # **Flight companies present new aircraft - Boeing 737-200 advanced (Fluggesellschaften präsentieren ihre neuen Flugzeuge - Boeing 737-200 advanced).** J. Weber (Deutsche Lufthansa AG, Hamburg, West Germany). *Internationale Luftfahrtausstellung, Hanover, West Germany, Apr. 24-May 1, 1980, Paper.* 24 p. In German.

Characteristics of the Boeing 737-200 advanced model are examined along with selection procedures for the Lufthansa fleet. Production improvements in the Boeing 737 leading to the 737-200 advanced model are discussed. The seating capacity is investigated in relation to the Boeing 727 fleet and the training cost for technical personnel and energy conservation are considered. Emphasis is placed on integration of the automatic pilot and automatic throttle systems, the CAT III landing system, and the navigation computer system.

R.C.

A81-21591 **Sound radiation from vortex systems.** T. Kambe and T. Minota (Kyushu University, Fukuoka, Japan). *Journal of Sound and Vibration,* vol. 74, Jan. 8, 1981, p. 61-72. 14 refs.

Sound radiation from a localized, weakly compressible flow in an inviscid fluid is investigated. A matching method enables the surrounding acoustic field to be related to the local eddy flow associated with a system of compact vortices. By using an asymptotic expansion of the velocity potential associated with the vorticity distribution, a general expression for the acoustic pressure is found to depend linearly on the vorticity, in accord with the theories of Möhring and Obermeier. This scheme is applied to an interacting system of coaxial circular vortex rings, and in particular two examples are presented of the time histories of the radiated acoustic pressures which are generated by interactions of two identical vortex rings, in 'head-on collision' and in 'mutual threading', respectively.

(Author)

A81-21595 **Convective amplification of gas turbine engine internal noise sources.** R. S. Larson (United Technologies Corp., Commercial Products Div., East Hartford, Conn.). *Journal of Sound and Vibration,* vol. 74, Jan. 8, 1981, p. 123-137. 12 refs.

A theoretical model is used to determine the convective amplification factor for the internal noise sources of a gas turbine engine, which factor is required to predict in-flight noise levels from engine noise measured in static tests. A general formulation is presented for calculating the propagation of sound in an arbitrary mean flow field, and applied to the static model problem, in which a porous sphere is placed in a radial mean flow field that decreases in magnitude with distance from the sphere, and the flight model problem, in which a spherical cap is placed in an axial flow field, with the same inlet mean flow boundary condition. It is found that convection amplification effects for the internal noise sources of a gas turbine engine depend on the characteristic frequency parameter, with low frequencies resulting in an amplification factor equal to the inverse fourth power of the difference between 1 and the product of the source Mach number with the cosine of the angle with the direction of motion of the source, and high frequencies resulting in a factor which depends on flight speed, radiation angle and inlet geometry. A.L.W.

A81-21673 # **Piloting techniques on the backside - Flight path angle control.** N. Goto and N. Morizumi. *Kyushu University, Technology Reports,* vol. 53, Aug. 1980, p. 413-421. 14 refs. In Japanese.

A81-21709 * **Operation and evaluation of the Terminal Configured Vehicle Mission Simulator in an automated terminal area metering and spacing ATC environment.** J. A. Houck (NASA, Langley Research Center, Hampton, Va.). In: Summer Computer Simulation Conference, Toronto, Canada, July 16-18, 1979, Proceedings. Montvale, N.J., AFIPS Press, 1980, p. 267-273. 9 refs.

This paper describes the work being done at the National Aeronautics and Space Administration's Langley Research Center on the development of a mission simulator for use in the Terminal Configured Vehicle Program. A brief description of the goals and objectives of the Terminal Configured Vehicle Program is presented. A more detailed description of the Mission Simulator, in its present configuration, and its components is provided. Finally, a description of the first research study conducted in the Mission Simulator is presented along with a discussion of some preliminary results from this study. (Author)

A81-21718 Air traffic simulation as a validation tool. D. K. Sakaguchi (Aerospace Corp., El Segundo, Calif.). In: Summer Computer Simulation Conference, Toronto, Canada, July 16-18, 1979, Proceedings. Montvale, N.J., AFIPS Press, 1980, p. 602-604.

A simulation of aircraft flying in an air traffic control environment has been developed. Included in the conditions simulated are aircraft characteristics, controller decision criteria, Air Traffic Control procedures, regulations, weather conditions, airport and airway geometry, and sophisticated approach modeling. The accuracy of the simulation has been demonstrated by comparing its output with actual radar tracking data, and the model has reached a level of acceptance such that it may now be used as a tool for validation. (Author)

A81-21721 A case study - Real time simulation and structured design. C. A. Vaccarino (USAF, Avionics Laboratory, Wright-Patterson AFB, Ohio). In: Summer Computer Simulation Conference, Toronto, Canada, July 16-18, 1979, Proceedings. Montvale, N.J., AFIPS Press, 1980, p. 629-634.

A set of programs used in real-time simulation to verify the F-15 Tactical Electronic Warfare System is described. The design approach was informal with structure and modularity established using an intuitive approach combined with engineering knowledge of the design concepts of decomposing a large problem into its component parts and solving each of the parts individually. The design methodology is compared to the formal discipline outlined by Yourdon and Constantine (1978). The improvements that may have been feasible to these programs in the light of subsequent training and experience are considered. B.J.

A81-21730 Effect of load spectrum variables on fatigue crack initiation and propagation; Proceedings of the Symposium, San Francisco, Calif., May 21, 1979. Symposium sponsored by the American Society for Testing and Materials. Edited by D. F. Bryan (Boeing Wichita Co., Wichita, Kan.) and J. M. Potter (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). Philadelphia, Pa., American Society for Testing and Materials (ASTM Special Technical Publication, No. 714), 1980. 244 p. $27.

The symposium focused on load spectra of engineering structures, gas turbines, windmill structures, analytical and experimental fatigue and fracture data, the effects of spectrum editing, time dependent changes in material characteristics, compression loads, and gust alleviation. Topics include 7XXX Al alloy fatigue crack growth resistance under constant amplitude and spectrum loading, crack retardation resulting from the load sequencing characteristic of military gas turbine operation, and the effects of fighter attack spectrum on crack growth. A.T.

A81-21737 An engineering model for assessing load sequencing effects. J. T. Wozumi, T. Spamer (Boeing Co., Seattle, Wash.), and G. E. Lambert (Boeing Co., Wichita, Kan.). In: Effect of load spectrum variables on fatigue crack initiation and propagation; Proceedings of the Symposium, San Francisco, Calif., May 21, 1979. Philadelphia, Pa., American Society for Testing and Materials, 1980, p. 128-142. 8 refs.

An engineering model of the effect of load spectrum variables on fatigue crack growth in metal structures based on the effective stress concept of Willenborg (1971) and Gallagher (1974) was extended to include the retardation/acceleration in transport spectra. The model can evaluate crack growth rates without resort to cycle-by-cycle integration. The predictive accuracy of the model was compared to crack propagation test data on center-cracked 7075 and 2024 Al specimens subjected to transport wing and fin load spectra; altitude, flight duration, speed, and touch-and-go landing parameters were investigated. The model provides greater accuracy than other currently used models. A.T.

A81-21738 Effect of transport aircraft wing loads spectrum variation on crack growth. P. R. Abelkis (Douglas Aircraft Co., Long Beach, Calif.). In: Effect of load spectrum variables on fatigue crack initiation and propagation; Proceedings of the Symposium, San Francisco, Calif., May 21, 1979. Philadelphia, Pa., American Society for Testing and Materials, 1980, p. 143-169. 9 refs. Research sponsored by the McDonnell Douglas Independent Research and Development Program; Contracts No. F33615-76-C-3116; No. F33700-78-C-0001.

The effects of spectrum loading variations on 7475, 2024, and 7075 Al alloys were assessed using C-15, KC-10A, and DC-10 transport aircraft wing loads. A total of 134 spectrum variations were produced in 13 categories including baseline spectra, mission mix, individual flight length, flight segments, and clipping of large loads. The largest effect on crack growth resulted from mission mix, flight length, design stress level or usage severity, high infrequent loads, load alleviation system, and a change from a wing type to a vertical tail type spectrum. A.T.

A81-21739 Effect of gust load alleviation on fatigue and crack growth in ALCLAD 2024-T3. J. B. de Jonge and A. Nederveen (Nationaal Lucht- en Ruimtevaartlaboratorium, Amsterdam, Netherlands). In: Effect of load spectrum variables on fatigue crack initiation and propagation; Proceedings of the Symposium, San Francisco, Calif., May 21, 1979. Philadelphia, Pa., American Society for Testing and Materials, 1980, p. 170-184. 8 refs.

Active controls can be used to reduce gust induced loads on transport aircraft wings. Fatigue tests under flight simulation loading were done on simply notched sheet specimens made of ALCLAD 2024-T3 to assess the fatigue life increase that can be obtained by gust alleviation. Test results did show an important increase in crack initiation life. However, crack propagation life was hardly affected. The observed effect on fatigue life could be reasonably well predicted by Miner type life calculations. Minor type calculations, however, are bound to fail in predicting the effect of spectrum-variations such as deletion of ground-air-ground cycle or small gust cycles. (Author)

A81-21741 Effects of fighter attack spectrum on crack growth. H. D. Dill, C. R. Saff (McDonnell Aircraft Co., St. Louis, Mo.), and J. M. Potter (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). In: Effect of load spectrum variables on fatigue crack initiation and propagation; Proceedings of the

Symposium, San Francisco, Calif., May 21, 1979.
Philadelphia, Pa., American Society for Testing and Materials, 1980, p. 205-217. 5 refs. Contract No. F33615-75-C-3112.

A systematical evaluation of the effect of variations in flight stress spectra on crack propagation is presented using analysis together with experimental correlations. More than 100 spectrum variations derived from four baseline spectra were generated; three constant amplitude and 30 spectrum tests were made to verify predictions of the effect of spectrum variations and to provide data for structural verification of future aircraft. Spectrum variations which have the greatest influence on crack growth life also affect the maximum peak stresses. A.T.

A81-21742 Evaluating spectrum effects in U.S. Air Force attack/fighter/trainer individual aircraft tracking. C. E. Larson, D. J. White, and T. D. Gray (Vought Corp., Dallas, Tex.). In: Effect of load spectrum variables on fatigue crack initiation and propagation; Proceedings of the Symposium, San Francisco, Calif., May 21, 1979. Philadelphia, Pa., American Society for Testing and Materials, 1980, p. 218-227. USAF-supported research.

An analysis is presented of damage rates at several points in an aircraft structure subjected to usage variations. The counting accelerometer (CA) devices are superior to the mechanical strain recorders (MSR) in providing a damage index; but a possible higher cost of data retrieval and processing could outweigh the accuracy limitations of the CA. It is also shown that an individual aircraft tracking program (IAT) can track damage at remote locations through a reference station; the locations associated with the aircraft wing track well, the fuselage not so well, and the tails do not track at all. It is concluded that the successful IAT can be accomplished with aircraft wing critical structures, but that aircraft with a wide distribution of critical locations may require multiple indicators. A.T.

A81-21825 In-flight calibration of aircraft antenna radiation patterns. H. Bothe (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Flugführung, Braunschweig, West Germany). *(IEEE, Volkswagenwerk AG, Siemens AG, and Helmholtz Fonds, Conference on Precision Electromagnetic Measurements, Braunschweig, West Germany, June 23-27, 1980.) IEEE Transactions on Instrumentation and Measurement,* vol. IM-29, Dec. 1980, p. 439-444. 5 refs.

A measuring system for the in-flight determination and calibration of aircraft antenna radiation patterns is outlined. Relative radiation pattern measurements and the calibration method are described. The radiation pattern measurements require a system with on-board transducers, a telemetry link, and data-processing facilities on the ground. Diagrams of the configuration of the measuring system are given and its installation is described. The total average error in calibrating aircraft antenna radiation patterns amounts to 1.6 dB for the horizontal and 2.2 dB for the vertical pattern. The main errors are caused by the amplitude characteristic of the logarithmic amplifier, which is specified to a plus or minus 1.5 dB error over a full range of 70 dB. L.S.

A81-21828 SPASYN - An electromagnetic relative position and orientation tracking system. J. B. Kuipers (Calvin College, Grand Rapids, Mich.). *(IEEE, Volkswagenwerk AG, Siemens AG, and Helmholtz Fonds, Conference on Precision Electromagnetic Measurements, Braunschweig, West Germany, June 23-27, 1980.) IEEE Transactions on Instrumentation and Measurement,* vol. IM-29, Dec. 1980, p. 462-466. Research supported by the Austin Co.

Two relatively remote independent body coordinate frames are related in both position and orientation (six degrees of freedom) using precise electromagnetic field measurements. Antenna triads are fixed in each body frame. Variously polarized excitations in one body are correlated with signals detected in the remote body. Near-field and far-field processing strategies are presented with applications. (Author)

A81-21869 Band sharing - A case study. A. L. Covitt and D. D. Neuman (Mitre Corp., Bedford, Mass.). In: NTC '79; National Telecommunications Conference, Washington, D.C., November 27-29, 1979, Conference Record. Volume 2.
Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 22.3.1-22.3.7.

Various aspects of the decision to allow the DOD Joint Tactical Information Distribution System (JTIDS) to operate in the 960-1215 MHz band simultaneously with existing TACAN/DME radio navigation services and Air Traffic Control Radar Beacon System (ATCRBS) air traffic control services are examined. Attention is given to the technical factors that must be considered in band sharing. It is pointed out that the desired signal power delivered to the receivers must, with high probability, exceed an acceptable threshold value to ensure high detection probability of the shortest unit signal element the receiver is capable of recognizing. Another requirement is that in the presence of interference the signal-to-interference ratio during an interval coincident with the time-of-arrival of a unit signal element must exceed an acceptable threshold with high probability. An account is given of an electromagnetic compatibility test program. It is stressed that this experiment in band sharing, the first for the U.S., will require continued attention within both the DOD and FAA to be successful. C.R.

A81-21880 An airborne integrated communications network utilizing fiber optics. C. R. Husbands (Mitre Corp., Bedford, Mass.). In: NTC '79; National Telecommunications Conference, Washington, D.C., November 27-29, 1979, Conference Record. Volume 3. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 42.1.1-42.1.5. Contract No. F19628-79-C-0001.

The use of fiber optics as an alternative to coaxial cable for the Airborne Integrated Communications installation is examined. Two multi-terminal fiber optic networks, designed and built as part of an alternative transmission medium study, are evaluated. It is noted that the fiber bundle system suffers from excessive transmission losses, which preclude its application to the aircraft problem under consideration. The single fiber system while low in system losses, requires high-power, temperature-dependent sources in order to achieve an adequate optical power margin for reliable operational performance. While these sources are found to be more than adequate for ground tactical systems, their temperature sensitivity poses a problem in avionics applications. It is concluded that the problem will be solved by recently developed low-loss, large-core glass-on-glass fibers. C.R.

A81-21912 Air traffic control and position location by satellite constellation in equatorial orbit. S. M. El-Sagir and C. R. Carter (McMaster University, Hamilton, Ontario, Canada). In: NTC '79; National Telecommunications Conference, Washington, D.C., November 27-29, 1979, Conference Record. Volume 3.
Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 58.4.1-58.4.6. 5 refs. Research supported by the Natural Sciences and Engineering Research Council of Canada.

One of the most important factors which must be considered in the design of a satellite system is the cost factor. This may be expressed in terms of the total number of satellites and satellite altitude. To date, no analytical approach has appeared for the optimization of satellite systems designed for multiple, continuous, partial or global coverage. In such a system, any user in the coverage area must observe continuously a specified minimum number of satellites, L. In this paper, a satellite constellation in an equatorial orbit is described for multiple, partial coverage excluding the polar regions. System design is optimized, applying a new analytical approach, according to the minimum number of satellites criterion. An algorithm has been developed for the general problem considering L as a variable. (Author)

A81-21913 GPS receiver simulation. J. D. Holmes (Texas Instruments, Inc., Dallas, Tex.). In: NTC '79; National Telecommuni-

cations Conference, Washington, D.C., November 27-29, 1979, Conference Record. Volume 3. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 58.5.1-58.5.5. Contract No. F04701-78-C-0021.

GPS Receiver Simulation is a receiver capable of tracking the signal from a Global Positioning System (GPS) satellite containing carrier and code tracking loops characterized by their bandwidth and order. A math model of a GPS receiver that uses Monte Carlo techniques to simulate the many effects to be modeled if one is to predict the performance of a GPS receiver when it is operating near its SNR threshold is described. Among these are: (1) predetection filter characteristics, (2) dynamic stress effects, (3) phase of frequency loop error characteristics, (4) envelope detector algorithm, (5) post detection filtering characteristics, (6) code loop error characteristics, (7) noise sample generation with proper degree of correlation, (8) effect on carrier and code loops when carrier oscillator has a frequency error, (9) effect on carrier and code loops when code loop has a phase error, (10) sampled data effects on carrier and code loop filters and digital oscillators, and (11) the threshold improvement as a result of narrower loop bandwidths when inertial aiding is possible. (Author)

A81-21917 # **Wind tunnel model support, controlled by four microprocessors.** R. Tisseau (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *(International Measurement Confederation and International Federation of Automatic Control, Symposium on Application of Microprocessors in Devices for Instrumentation and Automatic Control, London, England, Nov. 17-20, 1980.) ONERA, TP* no. 1980-149, 1980. 11 p.

A new test facility has been built by the French Aerospace Research Institute for advanced aircraft low speed aerodynamics studies. The facility consists of a pressurized subsonic wind tunnel of large dimensions which makes it possible to test models up to 3 m in span. The model holder is equipped with an advanced command/control system with on-line adaptive control capability. V.L.

A81-21922 The spectral analysis of nonstationary random processes - Applications to aircraft overflight-type noises (Analyse spectrale des processus aléatoires non stationnaires - Applications aux bruits de type 'survol d'avion'). M. Ernoult. Paris XI, Université, Docteur d'Etat Thesis, 1979. 181 p. 91 refs. In French. Research supported by the Direction Générale de l'Aviation Civile and Société Nationale d'Etude et de Construction de Moteurs d'Aviation.

Consideration is given to the study of the nonstationary noise detected by a fixed microphone during the passage of a moving sound source, such as in an aircraft overflight, as a problem of the spectral analysis of nonstationary random processes. The concept of the instantaneous spectrum of a nonstationary process is introduced and a definition of the time-frequency representation of the energy of nonstationary random processes is presented. The estimation of the spectral density of stationary random processes is reviewed, and the estimation of the power of an amplitude-modulated stationary Gaussian Markovian processes and of the instantaneous spectral density by means of filtering are considered. The spectral analysis of a microphone signal created by a moving source of jet noise by means of third-octave filters is then discussed. Knowledge of source motion is applied to the stationarization of microphone signals by the suppression of the Doppler effect and modulation due to the variation of the source-microphone distance, and theoretical results are verified for measurements of noise from a moving point source of known characteristics and moving jet noise. A brief description of a hybrid nonstationary noise generator is also presented. A.L.W.

A81-21966 # **Airline navigation planning.** D. M. Page (British Caledonian Airways, Ltd., Horley, Surrey, England). *Journal of Navigation,* vol. 34, Jan. 1981, p. 68-76; Discussion, p. 76, 77.

Advances in air navigation and flight planning techniques are discussed with emphasis on computer-controlled automatic systems. The importance of bringing aircraft navigation and air traffic control together into a single automated system is emphasized. V.L.

A81-21967 # **The evaluation of aircraft collision probabilities at intersecting air routes.** D. A. Hsu (Wisconsin, University, Milwaukee, Wis.). *Journal of Navigation,* vol. 34, Jan. 1981, p. 78-102. 13 refs. U.S. Department of Transportation Contract No. FA72NA-741.

Formulas useful for the calculation of aircraft mid-air collision probabilities at intersecting air routes are developed. The aircraft overlap density, a key parameter in the calculation, is expressed as a function of the intersection angle of air routes, aircraft speeds, the nominal separation, and parameters in the position-error distribution. Two representative probability models for position errors are used to illustrate the computational procedures suggested. A method of approximation over large navigation systems is also proposed. (Author)

A81-21968 # **The flight assessment and applications of DME/DME. I, II.** R. C. Rawlings (Royal Aircraft Establishment, Farnborough, Hants., England) and R. J. Talbot. *Journal of Navigation,* vol. 34, Jan. 1981, p. 103-130; Discussion, p. 130-133.

Computer simulation and flight trials have been undertaken to establish the aircraft navigation performance that can be achieved using the currently available ground aids - VHF omni-directional radio and distance measuring equipment (DME) - with noise reduction techniques which make use of velocity data from onboard sensors. Consideration is given to DME accuracy, DME/DME position fixing, frequency-scanning DME's, and multi-DME fixing. V.L.

A81-21969 # **Characterizing cross-track error distributions for continental jet routes.** N. W. Polhemus (Princeton University, Princeton, N.J.) and D. Livingston (FAA, Washington, D.C.). *Journal of Navigation,* vol. 34, Jan. 1981, p. 134-141. 8 refs. FAA-supported research.

Data collected as part of a study of navigational performance on high-altitude jet routes in the United States VOR environment are briefly reviewed. Distribution fitting results and their implications for jet route separation are discussed. V.L.

A81-22076 Survival and Flight Equipment Association, Annual Symposium, 17th, Las Vegas, Nev., December 2-6, 1979, Proceedings. Canoga Park, Calif., Survival and Flight Equipment Association, 1980. 283 p. $25.

Papers are presented on technologies and problems of flight safety and survival systems. Specific topics include a full-head enclosed breathing system for extended high-altitude exposure, a ram air emergency personnel parachute, the evolution of aircraft ejection systems, onboard oxygen generation, an automatic opening lap buckle for aircrew restraint, limb flail injuries and extremity restraints in aircraft ejections, the effectiveness of immersion hypothermia protection equipment, the computerized analysis of bird-resistant aircraft transparencies, and the design of gas-operated firing mechanisms. Attention is also given to an inflatable aircraft passenger seat, computerized assessment of crew station-crew member compatibility, inland search and rescue techniques, triage in airport disasters, piezoelectric polyvinylidene fluoride communications transducers, helicopter emergency underwater escape, and aircraft accident investigation as it relates to life support equipment. A.L.W.

A81-22078 Development of the first ram air emergency parachute for personnel applications. E. Puskas (Para-Flite, Inc., Pennsauken, N.J.). In: Survival and Flight Equipment Association, Annual Symposium, 17th, Las Vegas, Nev., December 2-6, 1979, Proceedings. Canoga Park, Calif., Survival and Flight Equipment Association, 1980, p. 24-27.

The principles, design and development of the first emergency parachute for personnel use utilizing a gliding ram air canopy are discussed. The statistical background demonstrating the extremely high reliability of ram air parachutes compared to conventional emergency parachutes is presented as the motivation for the development of ram air emergency parachutes, and the original

design of ram air parachutes is indicated. Improvements to the original design achieved by a reduction in wing area, the development of a lighter fabric and a smaller diameter suspension line and the reduction of the number of reinforcing tapes are discussed, and test results of the improved design which indicated areas of modification in deployment mechanism, the deployment brake system and suspension lines are indicated. Results of final design testing are then indicated, and it is concluded that the ram air emergency parachute is at least an order of magnitude more reliable than conventional emergency parachutes, while offering advantages in the areas of controllability, glide ratio and forward speed. A.L.W.

A81-22080 Ejection system evolution. R. C. Brashears (USAF, Aeronautical Systems Div., Wright-Patterson AFB, Ohio). In: Survival and Flight Equipment Association, Annual Symposium, 17th, Las Vegas, Nev., December 2-6, 1979, Proceedings. Canoga Park, Calif., Survival and Flight Equipment Association, 1980, p. 38-41.

The evolution of ejection systems for military aircraft since the early 1940s is outlined. Consideration is given to the development of catapult-type ejection seat systems based on German designs which were demonstrated in jet aircraft in the late 1940's, and to subsequent improvements in canopy removal systems, downward ejection seat systems, encapsulated seats and through-the-canopy ejection. Work on low-level on-the-runway capabilities in the 1950s is indicated, and the designs of the Convair B supersonic open ejection seat, the B-58 encapsulated seat, the F-111 ejectable crew module escape system and the B-1 escape capsule are discussed. Increases in cost and weight accompanying the increases in system complexity are pointed out, and the Advanced Concept Ejection Seat is described. Finally, areas for improvement in the design of ejection systems for future high-performance aircraft, including acceleration level reduction, stability, windblast protection and restraint, as well as life cycle costs, are indicated. A.L.W.

A81-22087 Computer analysis of bird-resistant aircraft transparencies. R. E. McCarty (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). In: Survival and Flight Equipment Association, Annual Symposium, 17th, Las Vegas, Nev., December 2-6, 1979, Proceedings. Canoga Park, Calif., Survival and Flight Equipment Association, 1980, p. 93-97. 13 refs.

The application of computerized structural analysis methods in the design and evaluation of aircraft transparent crew enclosures for resistance to bird impacts is discussed. Air Force aircraft and crew losses attributed to windshield birdstrikes since 1966 are briefly reviewed, and programs undertaken to improve the birdstrike resistance of existing transparencies are indicated, noting the high cost of these primarily empirical programs. The finite element method of structural analysis is then presented, and the development of the IMPACT program for transparency birdstrike analysis is discussed. Glass windshield studies performed with the linear program are shown to result in strains 50% less than those measured experimentally, due to nonlinear effects, and the development status of the adaptation of the nonlinear MAGNA program to transparency birdstrike analysis is discussed. It is concluded that the analysis capability currently undergoing validation tests will result in safer windshield and canopy systems at lower development costs. A.L.W.

A81-22088 Escape systems testing on the Holloman high speed test track. C. D. Gragg (USAF, Holloman AFB, N. Mex.) and J. E. Coulter (USAF, Instrumentation Branch, Holloman AFB, N. Mex.). In: Survival and Flight Equipment Association, Annual Symposium, 17th, Las Vegas, Nev., December 2-6, 1979, Proceedings. Canoga Park, Calif., Survival and Flight Equipment Association, 1980, p. 98-101. 6 refs.

An overview is given of 15 years of escape system tests at the High Speed Test Track at Holloman Air Force Base, New Mexico. The technique of this type of testing is discussed and a brief description given of the facility and its capabilities. A summary of the specific and general test objectives and military specifications which most tests attempt to meet is given. The scope of testing includes most of the escape systems now in the Air Force inventory and those planned for the immediate future as well as some presently in use by other governmental agencies and foreign governments. The testing has included module, ejection seat and extraction seat escape systems. (Author)

A81-22089 SAFEST computer simulation of ejection seat performance. L. A. Jines (USAF, Flight Dynamics Laboratory, Wright-Patterson, AFB, Ohio). In: Survival and Flight Equipment Association, Annual Symposium, 17th, Las Vegas, Nev., December 2-6, 1979, Proceedings. Canoga Park, Calif., Survival and Flight Equipment Association, 1980, p. 102-107.

Experimental data obtained from track tests of an advanced concept ejection seat are compared with the predictions of the Simulation and Analysis of In-Flight Escape System Techniques (SAFEST) computer program in a validation test of the program. The SAFEST program includes mathematical models which provide a six-degree-of-freedom simulation of aircraft maneuvers, flexible ejection seat guide rails, stabilization and deceleration devices and ejection seat rocket propulsion to calculate the trajectory dynamics of an ejection seat and crew member as the combination is catapulted into free flight along a set of flexible rails. For the preliminary correlation, performance data from high-speed (445 knots equivalent airspeed) and low-speed (165 knots equivalent airspeed) track tests of the ACES II ejection seat using a 95th percentile instrumented dummy crew member were compared with predictions of body axes translational accelerations, body axes angular rates, earth axes displacements, catapult pressure and dynamic response index. Correlations presented reveal the accuracy of dynamic response index and angular rate predictions, and indicate the need for further work in modeling and input parameters to improve the correlation of the remaining parameters. A.L.W.

A81-22091 An inflatable seat for aircraft passengers. D. C. Reader (USAF, School of Aerospace Medicine, Brooks AFB, Tex.). In: Survival and Flight Equipment Association, Annual Symposium, 17th, Las Vegas, Nev., December 2-6, 1979, Proceedings. Canoga Park, Calif., Survival and Flight Equipment Association, 1980, p. 129-131.

An inflatable passenger seat for use in military transport aircraft is presented. The seat consists of two separate airbags used as base and backrest made of rubberized neoprene similar to that used in crashworthy fuel tanks, and is intended to accommodate three passengers side by side. Experiments conducted with subjects encompassing a wide range of body sizes have demonstrated the seat to be comfortable to up to three soldiers in full battle kit, with comfort depending on seat inflation pressure. Vibration tests of the seat and one, two or three occupants revealed the natural frequencies of the seat to be between 2.7 and 3.8 Hz, and vibrations above 5 Hz were attenuated. Impact tests performed with 95th percentile dummies have demonstrated the resistance of the seat to deceleration forces, which, together with its comfort, light weight and ease of removal and installation, show the feasibility of the inflatable seat. Further development work is however required before the seat can be fitted to aircraft. A.L.W.

A81-22093 High 'Q' ejection protection device. C. C. Woodward and M. Schwartz (U.S. Naval Material Command, Naval Air Development Center, Warminster, Pa.). In: Survival and Flight Equipment Association, Annual Symposium, 17th, Las Vegas, Nev., December 2-6, 1979, Proceedings. Canoga Park, Calif., Survival and Flight Equipment Association, 1980, p. 148-152.

The development, status and future plans for a passive-type restraint system to protect aviator limbs from windblast exposure during aircraft ejection are discussed. The system, which consists of straps, netting and deployment bladders packaged within the sides of the seat and can be deployed within 250 msec, was tested statically and dynamically on an ejection tower and in a windblast facility. Dummy and human tests demonstrated system deployment and restraining effectiveness during simulated ejection, and restraint effectiveness in windblasts from 413 to 614 knots at seven different

seat attitudes. Results of the tests have shown the feasibility of the system in providing necessary protection and in meeting the requirement of passive operation. Current efforts are being undertaken to prepare for additional testing a refined prototype with better performance, increased reliability, and simplified packaging, with the ultimate objective of developing a restraint system which will reduce crew member exposure to aerodynamic and deceleration forces and assure his physical well-being following ejection. A.L.W.

A81-22094 Low level, adverse attitude escape using a vertical seeking ejection seat. J. J. Tyburski, L. A. D'Aulerio (U.S. Naval Material Command, Naval Air Development Center, Warminster, Pa.), and G. D. Frish (U.S. Naval Aerospace Medical Center, Naval Aerospace Medical Research Laboratory, New Orleans, La.). In: Survival and Flight Equipment Association, Annual Symposium, 17th, Las Vegas, Nev., December 2-6, 1979, Proceedings. Canoga Park, Calif., Survival and Flight Equipment Association, 1980, p. 153-158. 5 refs.

The development of the Maximum Performance Ejection Seat (MPES), a vertical-seeking seat applicable to escape at low altitudes and adverse attitudes, by flight tests and computerized simulation is discussed. The MPES is a significant advance in escape system technology, incorporating a structural subsystem with soft pack survival kit, a survival subsystem containing an oxygen accumulator for emergency breathing, occupant positioning and restraint by a series of active and passive components, recovery subsystem, and propulsion and control subsystem providing seat steering and stabilization to allow ejection from inverted aircraft at 50 feet altitude and ground level escape at up to 90 deg roll attitude. Ejection tests have demonstrated the feasibility of the vertical-seeking capability at 90 and 175 deg roll attitude with acceptable linear and angular acceleration levels. Mathematical modeling of occupant dynamic response is currently under way to determine the effects of crew member initial position relative to the crew station and initial inertial aircraft conditions, and define an idealized seating position. A.L.W.

A81-22096 Escape from military fighters - A modern perspective. R. J. Dobbek (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). In: Survival and Flight Equipment Association, Annual Symposium, 17th, Las Vegas, Nev., December 2-6, 1979, Proceedings. Canoga Park, Calif., Survival and Flight Equipment Association, 1980, p. 171-175. 6 refs.

A discussion relating the currently new and early future fighter aircraft, their designs and their performance, to certain performance characteristics and design features of the open ejection seat type of escape system is presented. Against these criteria critical areas of emphasis are uncovered where escape capabilities are currently lacking and the understanding is yet low. Particular areas of discussion include ejection seat stability, high dynamic pressure operation and ejection under an impressed G field. Conclusions are drawn bringing critical approaches to bear that offer possibilities for successful ejection seat designs. (Author)

A81-22097 Extension of ejection seat capability for high speed conditions. J. M. Peters (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). In: Survival and Flight Equipment Association, Annual Symposium, 17th, Las Vegas, Nev., December 2-6, 1979, Proceedings. Canoga Park, Calif., Survival and Flight Equipment Association, 1980, p. 176-179. 6 refs.

The high percentage of major injuries and fatalities which occur as a result of ejection at speeds above 400 KEAS requires that a new look be taken at concepts to reduce these injuries. A current contracted effort sponsored by the Air Force Flight Dynamics Laboratory will address the problems of escape in an ejection seat at dynamic pressures up to 1600 psf. The goal of the program is to provide a stable seat which incorporates provision for protection of the occupant from windblast, high accelerations and limb flail. Flow diverters, windblast screens, stabilizer/drag reducer located aft of the seat, vectoring of the main escape rocket, and total restraint systems are examples of concepts which will be evaluated. The program will encompass wind tunnel testing, performance assessment, preliminary design and construction of a functional ejection seat/crew station mockup. (Author)

A81-22098 Ejection experience in F/FB-111 aircraft - 1967-1978. W. D. Harrison (USAF, San Antonio Air Logistics Center, Kelly AFB, Tex.). In: Survival and Flight Equipment Association, Annual Symposium, 17th, Las Vegas, Nev., December 2-6, 1979, Proceedings. Canoga Park, Calif., Survival and Flight Equipment Association, 1980, p. 180-182.

The ejectable cockpit module used on F/FB-111 aircraft is briefly described and ejection results over a 12-year period are summarized. Although the system takes 11 seconds to operate, the ejection success rate is found to be 81%, which is comparable to that of open ejection seats. V.L.

A81-22099 A new technology - Piezoelectric polyvinylidene fluoride communications transducers. J. W. Castine, R. Loewenstern (U.S. Naval Material Command, Naval Air Development Center, Warminster, Pa.), and D. Mackiernan (JMR Systems Corp., Derry, N.H.). In: Survival and Flight Equipment Association, Annual Symposium, 17th, Las Vegas, Nev., December 2-6, 1979, Proceedings. Canoga Park, Calif., Survival and Flight Equipment Association, 1980, p. 197-200.

The development of microphones and earphones based on polyvinylidene fluoride technology is reported. The development involves maximizing of the material activity through poling techniques without degradation of the mechanical structure. This will be accomplished by optimizing the poling voltages and temperature for a given film thickness. V.L.

A81-22100 The influence of beards on the efficiency of aviators' oxygen masks. D. deSteiguer and K. E. Hudson (FAA, Protection and Survival Laboratory, Oklahoma City, Okla.). In: Survival and Flight Equipment Association, Annual Symposium, 17th, Las Vegas, Nev., December 2-6, 1979, Proceedings. Canoga Park, Calif., Survival and Flight Equipment Association, 1980, p. 207-210. 5 refs.

A81-22101 Helicopter emergency underwater escape. S. G. Maness (U.S. Coast Guard, Washington, D.C.). In: Survival and Flight Equipment Association, Annual Symposium, 17th, Las Vegas, Nev., December 2-6, 1979, Proceedings. Canoga Park, Calif., Survival and Flight Equipment Association, 1980, p. 211-213.

The problems of egress from a capsized aircraft are identified with an emphasis on the provision of oxygen. The development of a dual cell inflatable life preserver-survival vest that incorporates oxygen enriched gas instead of carbon dioxide for the inflation of one cell is evaluated. The rebreather cell is equipped with a valve mouthpiece and a breathing tube in place of an oral inflation valve. The breathing air cell is also used for flotation and provides 42 pounds of buoyancy. L.S.

A81-22102 Delayed ejection. R. H. Shannon (Talley Industries, Inc., Highland, Calif.). In: Survival and Flight Equipment Association, Annual Symposium, 17th, Las Vegas, Nev., December 2-6, 1979, Proceedings. Canoga Park, Calif., Survival and Flight Equipment Association, 1980, p. 219-221.

The decision factor, that is, the aspect of pilot escape that depends on the actions of the pilot, is discussed. It is noted that the decision to eject is often delayed until it is too late and that despite system refinements and training programs, the problem persists. It is pointed out that the crewman often fails to recognize that he has reached a point of no return. It is felt that a device is needed to give the pilot information regarding the minimum height at which escape action may be taken. C.R.

A81-22103 Aircraft accident investigation as it relates to life support equipment. R. W. Bailey (JABAL, Inc., Enterprise, Ala.) and G. L. Johnson (U.S. Army, Aeromedical Research Laboratory, Fort Rucker, Ala.). In: Survival and Flight Equipment Association,

Annual Symposium, 17th, Las Vegas, Nev., December 2-6, 1979, Proceedings. Canoga Park, Calif., Survival and Flight Equipment Association, 1980, p. 230-232.

The need for a maintenance program for life support equipment is stressed. Attention is given to a study carried out on protective helmets in 1977 in which it was found that more than 90% of the helmets were compromised by defects that in some cases were so severe that the helmet was nonfunctional and could not have performed properly if involved in an accident. It is recommended that life support equipment be monitored during use and that improvements be made in the components of the equipment whenever necessary. The need for a program of destructive and nondestructive testing is also stressed. C.R.

A81-22104 The apparent ignoring of pilot fatigue by the NTSB in airline crashes. W. J. Price (United Air Lines, Inc., Redwood City, Calif.). In: Survival and Flight Equipment Association, Annual Symposium, 17th, Las Vegas, Nev., December 2-6, 1979, Proceedings. Canoga Park, Calif., Survival and Flight Equipment Association, 1980, p. 241-247. 8 refs.

The trip sequence of a United Airlines DC-8 freighter which crashed near Kaysville, Utah on Dec. 18, 1977 is examined. A model demonstrating how fatigue could have been a contributing factor in the accident is presented with a view toward sleep disruption, circadian desynchronosis and sleep reversal. The symptoms attending sleep loss and desynchronosis include short term memory loss, forgetfulness, inattention to detail, relaxation of personal standards and irritability. In normal human circadian rhythm, the zenith should occur between the 1500 to 1700 home domicile. It is noted that of the 81 human factor items outlined by the National Transportation Safety Board for accident investigation, not one pertains to pilot fatigue. L.S.

A81-22115 Death and injury in aerial spraying - Pre-crash, crash, and post-crash prevention strategies. E. D. Richter (Jerusalem, Hebrew University; Ministry of Health, Jerusalem, Israel), M. Gordon, M. Halamish (Ministry of Transport, Civil Air Examiner's Office, Jerusalem, Israel), and B. Gribetz (City University, New York, N.Y.). *Aviation, Space, and Environmental Medicine,* vol. 52, Jan. 1981, p. 53-56. 13 refs.

The high risk of death and injury faced by pilots carrying out agricultural spraying is discussed. It is noted that the nature of the work is such that crashes cannot be completely eliminated. Therefore, crash proof cockpits are felt to be essential. It is suggested that power and cable lines adjacent to sprayed areas be buried. Measures are also proposed to prevent the chemical being sprayed from affecting the pilot. It is suggested that an international convention or code of practices may be advisable. C.R.

A81-22167 New navigation systems for helicopters (Neue Navigationssysteme für Hubschrauber). D. Wurster. *Elektronik,* vol. 30, Jan. 30, 1981, p. 77-84. 10 refs. In German.

The physical principles of Doppler radar navigation are reviewed along with some current developments in this field. Particular attention is given to the design of the AN/ASN-128 Doppler navigation system; the integrated system for helicopters is described. B.J.

A81-22182 # Evaluation of compressor blade endurance limits by an accelerated method (K voprosu ob otsenke vynoslivosti lopatok kompressora uskorennym metodom). R. S. Bekbulatov, M. E. Kolotnikov, and I. G. Sipukhin. *Problemy Prochnosti,* Jan. 1981, p. 68-70. 5 refs. In Russian.

The Locati accelerated testing method for compressor blades is examined. Analytical procedures for computing endurance limits using accelerated test results are proposed; these methods are based on linear and corrected hypotheses of damage accumulation. The results of fatigue studies of a heat resistant alloy turbine blades are presented; the proposed analytical methods are compared with semigraphical data processing techniques. A.T.

A81-22192 Standardisation - An alternative approach to ATC automation. H. Westermark (Datasaab AB, Jarfalla, Sweden). *The Controller,* vol. 19, 4th Quarter, 1980, p. 14, 15.

The Airwatch series of ATC equipment is described with a view to major components and operational features. Modular design allows adaptation to individual needs over a wide range. Potential advantages of the standardized system include simplified maintenance and lower costs. L.S.

A81-22193 Maximizing the capacity of a single-runway airport. T. K. Vickers. *The Controller,* vol. 19, 4th Quarter, 1980, p. 30, 31.

Simple low-cost changes to the airport layout are discussed. These are based on the concepts of reducing the average runway interval, minimizing runway occupancy time, and separating the arrival and departure taxi routes. Illustrations demonstrating layouts and techniques are provided. L.S.

A81-22203 # Comparison of systems of power generation during emergencies /aboard aircraft/ (Confronto tra sistemi per generazione di potenza in condizioni di emergenza /a bordo di velivoli/). S. Chiesa (Torino, Politecnico, Turin, Italy). *Ingegneria,* Nov.-Dec. 1980, p. 337-348. In Italian.

Two aircraft power generation systems for use during emergencies are described and compared: a battery-based system and a RAT (ram air turbine) based system. A parametric analysis is carried out, and the two systems are compared in terms of weight and operating time. B.J.

A81-22344 Analytical methods for store separation flight test. V. S. Ritchey (USAF, Flight Test Center, Edwards AFB, Calif.). *Society of Flight Test Engineers, Journal,* vol. 3, Jan. 1981, p. 2-34.

This paper presents mathematical specifications and describes applications for an integrated computer analysis tool/method for store separation flight tests. This package includes a computer-generated sketch for output, various analog and digital computer inputs, a comprehensive, but simplified, state variable model of the store separation physics, and a Kalman filter optimal estimator for the store trajectory and the aircraft flow field. This combination can provide fast computer-aided data processing; point-to-point clearance analyses; planning analyses for parameter sensitivity studies and test point selection; and aircraft flow-field maps for subsequent separation tests. Instrumentation requirements consist of conventional separation cameras and time-correlated aircraft parameters. The state vector estimates derived from the flight test data should be adequate for weapon delivery accuracy analyses. (Author)

A81-22374 * # Civil aviation applications of Navstar/GPS through differential techniques. W. E. Howell, W. T. Bundick, and W. F. Hodge (NASA, Langley Research Center, Hampton, Va.). *Institute of Electrical and Electronics Engineers, National Telecommunications Conference, Houston, Tex., Nov. 30-Dec. 4, 1980, Paper.* 28 p. 10 refs.

Prior studies implying significant benefits from using Navstar/GPS in civil aviation are seen as meriting further technical evaluation. While an uncorrupted C/A code and a P-code are seen as highly desirable in civil aviation, the differential GPS using C/A code only that is considered here and that also takes into account rather significant intentional degradation is found to hold promise. It is noted that such a technique may even approach the requirements associated with the conventional ILS window. It is stressed that since the receiver sequencing period/update rate appears to be an important parameter in differential GPS, sophisticated algorithms should be developed and evaluated in order to determine the full potential of the differential technique. C.R.

A81-22493 LPI, short-range communications between aircraft in rendezvous. L. B. Stotts, R. T. Kihm, R. L. Mather, M. E. Hyde, and G. C. Mooradian (U.S. Naval Ocean Systems Center, San Diego, Calif.). In: Electro-Optics/Laser 79 Conference and Exposition, Anaheim, Calif., October 23-25, 1979, Proceedings.

Chicago, Industrial and Scientific Conference Management, Inc., 1979, p. 166-171. 5 refs.

The paper examines the tradeoffs between two distinct communication systems designed to allow LPI (low probability of intercept) hand-over between aircraft: one based on millimeter-wave technology and the other based on electrooptical technology. It is shown that under ideal interception conditions, both systems have the potential to provide at the appropriate wavelengths significantly better LPI than the current UHF systems. Both systems have comparable performance levels under identical source divergence and receiver field-of-view conditions. V.L.

A81-22495 Tri-bar reading correction for oblique imagery. E. L. Gliatti and T. Stanzione (USAF, Avionics Laboratory, Wright-Patterson AFB, Ohio). In: Electro-Optics/Laser 79 Conference and Exposition, Anaheim, Calif., October 23-25, 1979, Proceedings. Chicago, Industrial and Scientific Conference Management, Inc., 1979, p. 191-204. 7 refs.

A laboratory experiment set up to simulate oblique imagery in order to determine what effects the changing aspect ratio has on the accuracy of tri-bar readings after the insertion of normal geometrical corrections is discussed. It is shown that changes in aspect ratio significantly affect the accuracy of tri-bar resolution readings in the inline direction when imaging targets at particularly large oblique angles. It is pointed out that this finding contradicts the previous assumptions that no geometric or other correction need be applied in this direction. The experimentally determined aspect ratio correction factor can be represented by a third order polynomial equation. It is noted that oblique imaged crossline target resolution readings require the use of only the normal geometric (cosine) correction factor since the normalized data were not found to differ significantly with angle. Over the contrast ratio range examined, the geometric and aspect ratio correction factors were found to be independent of contrast ratio. For the two orientations tested, inline correction factors are found to differ slightly due to the apparent crowding of the elements in the one orientation. This suggests that different type targets may have different correction factors. C.R.

A81-22503 Fiber optics study technology for military aircraft. M. K. Zaman (Lockheed-California Co., Burbank, Calif.). In: Electro-Optics/Laser 79 Conference and Exposition, Anaheim, Calif., October 23-25, 1979, Proceedings. Chicago, Industrial and Scientific Conference Management, Inc., 1979, p. 351-363. 10 refs.

Fiber optics interconnect technology is discussed with emphasis on its feasibility for use in the data bus of military aircraft. Consideration is given to the effect of radiation on fiber optics, mechanical and environmental test results, data bus design, and performance characteristics. It is shown that the high tensile strength and environmental endurance make the optical cables well suited not only for the installation on military aircraft but also for retrofit, stand alone applications where the cable is not harnessed with other cables. V.L.

A81-22526 * # Stability of large horizontal-axis axisymmetric wind turbines. M. S. Hirschbein (NASA, Lewis Research Center, Cleveland, Ohio) and M. I. Young (Delaware, University, Newark, Del.). *Miami International Conference on Alternative Energy Sources, 3rd, Miami, Fla., Dec. 15-17, 1980, Paper.* 35 p. 19 refs.

The stability of large horizontal-axis, axisymmetric, power producing wind turbines is examined within the framework of an analytical model which includes dynamic coupling of the rotor, tower, and power generating system. The aerodynamic loading is derived from blade element theory. Stability is determined by the eigenvalues of a set of linearized constant-coefficient differential equations. All results presented are based on a 3-bladed, 300-ft diameter, 2.0-MW wind turbine. It is shown that unstable or weakly stable behavior can be caused by aerodynamic forces due to motion of the rotor blades and tower in the plane of rotation or by mechanical coupling between the rotor system and the tower. V.L.

A81-22527 * # New interpretations of shock-associated noise with and without screech. U. von Glahn (NASA, Lewis Research Center, Cleveland, Ohio). *Acoustical Society of America, Meeting, 100th, Los Angeles, Calif., Nov. 17-21, 1980, Paper.* 23 p. 14 refs.

Anomalous trends in present convergent nozzle (Mach 1) shock-associated noise analyses and predictions, with particular emphasis on the roles of screech and jet temperature, are discussed. Experimentally measured values of shock-associated noise are used to reassess data trends, including both frequency and sound pressure level. The data used includes model-scale nozzles, varying in nominal diameter from 5 cm to 13 cm, and full-scale engine nozzles up to 48 cm. All data were obtained at static conditions. From this reassessment of the measured data, new empirical methods for the prediction of shock-associated noise are developed. Separate procedures are presented for screech-free and screech-contaminated shock-associated noise. In the present approach, shock-associated noise spectra are developed from considerations that include the peak sound pressure level and its frequency, the low frequency sound pressure level slope, and the high frequency sound pressure level slope or roll-off; the latter is shown to vary with directivity angle. (Author)

A81-22531 * # Core noise measurements from a small, general aviation turbofan engine. M. Reshotko and A. Karchmer (NASA, Lewis Research Center, Fluid Mechanics and Acoustics Div., Cleveland, Ohio). *Acoustical Society of America, Meeting, 100th, Los Angeles, Calif., Nov. 17-21, 1980, Paper.* 27 p. 10 refs.

As part of a program to investigate combustor and other core noises, simultaneous measurements of internal fluctuating pressure and far field noise were made with a JT15D turbofan engine. Acoustic waveguide probes, located in the engine at the combustor, at the turbine exit and in the core nozzle wall, were used to measure internal fluctuating pressures. Low frequency acoustic power determined at the core nozzle exit corresponds in level to the far-field acoustic power at engine speeds below 65% of maximum, the approach condition. At engine speeds above 65% of maximum, the jet noise dominates in the far-field, greatly exceeding that of the core. From coherence measurements, it is shown that the combustor is the dominant source of the low frequency core noise. The results obtained from the JT15D engine were compared with those obtained previously from a YF102 engine, both engines having reverse flow annular combustors and being in the same size class. (Author)

A81-22532 * # Effect of a semi-annular thermal acoustic shield on jet exhaust noise. J. Goodykoontz (NASA, Lewis Research Center, Cleveland, Ohio). *Acoustical Society of America, Meeting, 100th, Los Angeles, Calif., Nov. 17-21, 1980, Paper.* 19 p. 13 refs.

The effect of a semi-annular acoustic shield on jet exhaust noise is investigated with the rationale that such a configuration would reduce or eliminate the multiple reflection mechanism. A limited range of flow conditions for one nozzle/shield configuration were studied at model scale. Noise measurements for a 10 cm conical nozzle with a semi-annular acoustical shield are presented in terms of lossless free field data at various angular locations with respect to the nozzle. Measurements were made on both the shielded and unshielded sides of the nozzle. Model scale overall sound pressure level directivity patterns and comparisons of model scale spectral data are provided. The results show that a semi-annular thermal acoustic shield consisting of a low velocity, high temperature gas stream partially surrounding a central jet exhibits lower noise levels than when the central jet is operated alone. The results are presented parametrically, showing the effects of various shield and central system velocities and temperatures. L.S.

A81-22534 * # Effect of facility variation on the acoustic characteristics of three single stream nozzles. O. A. Gutierrez (NASA, Lewis Research Center, Cleveland, Ohio). *Acoustical Society of America, Meeting, 100th, Los Angeles, Calif., Nov. 17-21, 1980, Paper.* 36 p. 12 refs.

The characteristics of the jet noise produced by three single stream nozzles have been investigated statically at the NASA-Lewis Research Center outdoor jet acoustic facility. The nozzles consisted

of a 7.6 cm diameter convergent conical, a 10.2 cm diameter convergent conical and an 8-lobe daisy nozzle with 7.6 cm equivalent diameter flow area. The acoustic experiments at NASA covered pressure ratios from 1.4 to 2.5 at total temperatures of 811 K and ambient. The data obtained with four different microphone arrays are compared. (Author)

A81-22535 * # **NASA's activities in the conservation of strategic aerospace materials.** J. R. Stephens (NASA, Lewis Research Center, Cleveland, Ohio). *American Society for Metals, Fall Meeting, Cleveland, Ohio, Oct. 28-30, 1980, Paper.* 22 p. 7 refs.

The United States imports 50-100 percent of certain metals critical to the aerospace industry, namely, cobalt, columbium, chromium, and tantalum. In an effort to reduce this dependence on foreign sources, NASA is planning a program called Conservation of Strategic Aerospace Materials (COSAM), which will provide technology minimizing strategic metal content in the components of aerospace structures such as aircraft engines. With a proposed starting date of October 1981, the program will consist of strategic element substitution, process technology development, and alternate materials research. NASA's two-fold pre-COSAM studies center on, first, substitution research involving nickel-base and cobalt-base superalloys (Waspaloy, Udimet-700, MAE-M247, René 150, HA-188) used in turbine disks, low-pressure blades, turbine blades, and combustors; and, second, alternate materials research devoted initially to investigating possible structural applications of the intermetallic alloys nickel aluminide and iron aluminide. R.S.

A81-22549 * # **Flight test evaluation of a digital controller used in a VTOL automatic approach and landing system.** D. R. Downing and W. H. Bryant (NASA, Langley Research Center, Flight Electronics Div., Hampton, Va.). *Institute of Electrical and Electronics Engineers, Conference on Decision and Control, Fort Lauderdale, Fla., Dec. 12-14, 1979, Paper.* 9 p. 9 refs.

As part of the NASA Langley Research Center's effort to develop technology for VTOL operation in the air transportation system in the late 1980's and beyond, research has been conducted aimed at developing digital controller design procedures. This paper describes the verification of one design procedure by the flight evaluation of an advanced digital control algorithm. The control algorithm, operating at 10 iterations per second, follows step guidance commands with zero steady state error and thus provides an autotrim capability for the nonlinear vehicle. Changes in vehicle dynamics are accounted for using a gain scheduling technique. This control algorithm is combined with sensor filters, a trajectory generator, and a closed loop guidance algorithm to form a VTOL autoland system. A CH-47 tandem rotor helicopter which contains a set of sensors, onboard digital flight computers and electro-hydraulic actuators is used in the evaluation. All software, except input-output routines, is coded in FORTRAN using floating point arithmetic and executed in the flight computer. This autoland system is exercised by automatically flying straight-in descending decelerating trajectories typical of VFR manual approaches to a predetermined landing pad. (Author)

A81-22568 * **A discrete vortex method for the non-steady separated flow over an airfoil.** J. Katz (NASA, Ames Research Center, Moffett Field, Calif.). *Journal of Fluid Mechanics,* vol. 102, Jan. 1981, p. 315-328. 23 refs.

A discrete vortex method was used to analyze the separated non-steady flow about a cambered airfoil. The foil flow modelling is based on the thin lifting-surface approach, where the chordwise location of the separation point is assumed to be known from experiments or flow-visualization data. Calculated results provided good agreement when compared with the post-stall aerodynamic data of two airfoils. Those airfoil sections differed in the extent of travel of the separation point with increasing angle of attack. Furthermore, the periodic wake shedding was analyzed and its time-dependent influence on the airfoil was investigated. (Author)

A81-22603 * # **Qualification of HiMAT flight systems.** A. F. Myers and S. G. Sheets (NASA, Flight Research Center, Edwards AFB, Calif.). In: Association for Unmanned Vehicle Systems, Annual Technical Symposium, 7th, Dayton, Ohio, June 16-18, 1980, Proceedings. Dayton, Ohio, Association for Unmanned Vehicle Systems, 1980, p. 1-10.

The highly maneuverable aircraft technology (HiMAT) remotely piloted research vehicle is discussed with emphasis on the advanced composite and metallic structures, digital fly-by-wire controls, and digitally implemented integrated propulsion control systems. Techniques used to qualify the systems for flight are examined. Computation and simulation of the HiMAT system are investigated in relation to Cyber-Varian simulation. The techniques used in flight qualification are complicated by ground based flight critical systems and severe onboard volume constraints imposed by the scale design. R.C.

A81-22608 # **High altitude launch of the Cruise Missile.** J. H. Denovchek (General Dynamics Corp., Convair Div., San Diego, Calif.). In: Association for Unmanned Vehicle Systems, Annual Technical Symposium, 7th, Dayton, Ohio, June 16-18, 1980, Proceedings. Dayton, Ohio, Association for Unmanned Vehicle Systems, 1980, p. 38-43.

From the high altitudes of the launch envelope, Air Launched Cruise Missile (ALCM) survivability considerations require that the time from launch to insertion into low cruise or terrain following altitudes be minimized while remaining within design Mach number limits of the air vehicle. All requirements have been achieved through the implementation of a constant high Mach descent logic developed around the aerodynamic characteristics of the AGM-109 ALCM. The constant high Mach descent logic is derived using relations of power off glide lift-drag ratio in combination with drag rise Mach data. B.J.

A81-22611 # **The BQM-74C target as a flying computer - Its language and its peripherals.** M. G. Krebs (Northrop Corp., Ventura Div., Newbury Park, Calif.). In: Association for Unmanned Vehicle Systems, Annual Technical Symposium, 7th, Dayton, Ohio, June 16-18, 1980, Proceedings. Dayton, Ohio, Association for Unmanned Vehicle Systems, 1980, p. 85-91. 5 refs.

A microprocessor Avionics Control High Level Language, MACH 1, has been implemented for mission programming of the Navy's BQM-74C Mobile Sea Range target. The language is a high level one which accomodates complex real-time sequencing and air vehicle peripheral device interactions. The statements of the language are those necessary to control each independent function implemented in air vehicle hardware. The mission specification written in MACH 1 is directly executed during the mission on the BQM-74C Digital Avionics Processor, DAP. The DAP is a microprocessor based central computer that performs stabilization, preprogrammed flight, and interfacing functions between the air vehicle and its many peripheral devices, including sensors, actuators, and command links. B.J.

A81-22612 # **QF-100 Full-Scale Aerial Target program.** R. C. Eslinger (Sperry Flight Systems, Phoenix, Ariz.). In: Association for Unmanned Vehicle Systems, Annual Technical Symposium, 7th, Dayton, Ohio, June 16-18, 1980, Proceedings.
Dayton, Ohio, Association for Unmanned Vehicle Systems, 1980, p. 102-108.

The QF-100 Full-Scale Aerial Target (FSAT) program involves the use of a multiservice interim target to provide air-to-air and ground-to-air missile evaluation and combat crew training. This paper examines the overall FSAT program, with a specific discussion of the digital flight control system and how it is applied to the QF-100. B.J.

A81-22613 # **A low cost multiple drone command and tracking system.** I. B. Moore (Pacific Aerosystem, Inc., San Diego, Calif.). In: Association for Unmanned Vehicle Systems, Annual Technical Symposium, 7th, Dayton, Ohio, June 16-18, 1980, Proceedings. Dayton, Ohio, Association for Unmanned Vehicle Systems, 1980, p. 109-115.

The paper describes ALAMAK, a unified command, tracking, and telemetry system. In its basic configuration, ALAMAK is a single land, sea, or air drone tracking system; but it can be configured for multiple vehicle operation. The system is low cost and can be implemented quickly and reliably because of the large extent to which presently available equipment is utilized. Both the single-vehicle and multiple-vehicle concepts are described. B.J.

A81-22615 # The ANK - A four dimensional navigation/ flight management system for today. P. A. Hicks (Pacific Aerosystem, Inc., San Diego, Calif.). In: Association for Unmanned Vehicle Systems, Annual Technical Symposium, 7th, Dayton, Ohio, June 16-18, 1980, Proceedings. Dayton, Ohio, Association for Unmanned Vehicle Systems, 1980, p. 123-130.

The ANK (Automatic Navigation Kit) uses differential omega to fly a drone aircraft over a preprogrammed path with up to 99 waypoints; expected accuracy is 400 meter CEP. At each waypoint it is possible to command a new heading, speed, and altitude, to actuate cameras or other sensors, activate or deactivate data links, and provide other commands. A dead reckoning return to a recovery point is possible in the case of navigation system failure. B.J.

A81-22618 # A distributed airborne surveillance system. J. B. Fuller (Mitre Corp., Bedford, Mass.). In: Association for Unmanned Vehicle Systems, Annual Technical Symposium, 7th, Dayton, Ohio, June 16-18, 1980, Proceedings.
Dayton, Ohio, Association for Unmanned Vehicle Systems, 1980, p. 149-155.

A quck-look study to assess the feasibility of a drone-borne distributed radar surveillance system is presented. Both coherent and noncoherent monostatic and bistatic approaches to radar systems are considered. The noncoherent system offers the advantage of simplicity and low technical risk as compared to a coherent system. The bistatic system has the advantage of eliminating a data link from beyond the FEBA. Example radar parameters are summarized for each case. B.J.

A81-22619 # Mini-RPV radar test program. L. Kosowsky, D. Pratt, K. Koester (United Technologies Corp., Norden Systems, Norwalk Conn.), and W. Johnson (U.S. Army Electronics Research and Development Command, Fort Monmouth, N.J.). In: Association for Unmanned Vehicle Systems, Annual Technical Symposium, 7th, Dayton, Ohio, June 16-18, 1980, Proceedings.
Dayton, Ohio, Association for Unmanned Vehicle Systems, 1980, p. 156-162. 12 refs. Grant No. DAAB07-76-C-0843.

A millimeter wave radar operating at 95 GHz has been developed and tested for potential use in the Mini-RPV. The merits of the radar sensor are discussed in the context of the RPV artillery support mission. Results of a ground based measurements program are presented to demonstrate the salient features of high resolution ground map, fixed target enhancement, and moving target detection. (Author)

A81-22620 # A versatile miniature solid state television camera /CCD/. L. Klementowski (USAF, Aeronautical Systems Div., Wright-Patterson AFB, Ohio) and M. Vicars-Harris (Fairchild Camera and Instrument Corp., Syosset, N.Y.). In: Association for Unmanned Vehicle Systems, Annual Technical Symposium, 7th, Dayton, Ohio, June 16-18, 1980, Proceedings. Dayton, Ohio, Association for Unmanned Vehicle Systems, 1980, p. 163-167.

The Cockpit Television Sensor System (CTVS) is an all solid-state TV camera which uses a silicon CCD sensor. CTVS has the advantages of small size, versatility, and ruggedness, combined with 'hands-off' dawn-to-dusk performance. This paper describes the current application of the CTVS in fighter aircraft as well as pending applications in unmanned vehicles and space. A technical description of the camera is provided, and future developments are discussed. B.J.

A81-22623 Helicopter fatigue qualification. G. P. Pisso (Costruzioni Aeronautiche Giovanni Agusta S.p.A., Gallarate, Italy). In: Conference on Fatigue in Aerospace Structures, Turin, Italy, February 22, 23, 1978, Proceedings. Turin, Editrice Levrotto e Bella, 1979, p. 17-30. 12 refs.

Procedures involved in the fatigue qualification of civil aircraft are reviewed with emphasis on helicopters. The key points examined include: adopted fatigue philosophy and regulations, test techniques and analysis of test results, airworthiness requirements, instrumentation, operational spectrum, flight tests, flight data analysis, and damage and fatigue life calculation. V.L.

A81-22624 Fatigue design criteria and fleet fatigue life survey at Aeronautica Macchi. G. L. De Otto (Aeronautica Macchi S.p.A., Varese, Italy). In: Conference on Fatigue in Aerospace Structures, Turin, Italy, February 22, 23, 1978, Proceedings. Turin, Editrice Levrotto e Bella, 1979, p. 31-40.

The approach to the aircraft fatigue problem adopted by Aeronautica Macchi is examined with reference to the stages of fatigue design, fatigue testing, and control of expended fatigue life. It is shown that fatigue tests on complete structures are the basis for verifying mathematical fatigue life prediction models developed during the design phase. V.L.

A81-22625 Project and experimental fatigue test of the wing of a modern combat aircraft. L. Casalegno (Aeritalia S.p.A., Turin, Italy). In: Conference on Fatigue in Aerospace Structures, Turin, Italy, February 22, 23, 1978, Proceedings.
Turin, Editrice Levrotto e Bella, 1979, p. 41-58.

Classic criteria of fatigue design and fracture mechanics have been applied to the design of a new multimission combat aircraft with variable wing geometry in order to develop a method for rational assessment of structural inspections during service. The damage tolerance approach is emphasized. V.L.

A81-22626 Definition of loading sequence for full scale fatigue test. A. Del Core and G. Terracciano (Aeritalia S.p.A., Naples, Italy). In: Conference on Fatigue in Aerospace Structures, Turin, Italy, February 22, 23, 1978, Proceedings. Turin, Editrice Levrotto e Bella, 1979, p. 59-65. 12 refs.

Representative full-scale fatigue test loads are defined with reference to G 222 test. Load spectra are presented in a graphical form for different flight segments (departure, takeoff, climb, cruise, descent, approach, and arrival) and sequences of load cycles are shown for four different flight types. V.L.

A81-22628 Ductile fracture mechanic assessments of 2219-T851, 2024-T3 and 7075-T6 aluminum alloys. A. Frediani (Pisa, Università, Pisa, Italy). In: Conference on Fatigue in Aerospace Structures, Turin, Italy, February 22, 23, 1978, Proceedings. Turin, Editrice Levrotto e Bella, 1979, p. 83-100. 14 refs.

A81-22629 Crack propagation in lugs. A. Nappi (SIAI-Marchetti S.p.A., Sesto Calende, Italy). In: Conference on Fatigue in Aerospace Structures, Turin, Italy, February 22, 23, 1978, Proceedings. Turin, Editrice Levrotto e Bella, 1979, p. 101-109. 17 refs.

Several theoretical approaches to the problem of crack growth rate determinations are examined with particular reference to crack growth in lugs. A computer program written in FORTRAN is presented which allows easy insertion of new subroutines for the calculation of stress intensity factors and crack growth rates (computed by the Froman equation) and for including the retardation effect (introduced through the Willenborg model). V.L.

A81-22631 Fatigue life evaluation of a helicopter main rotor hub. A. Russo, G. Biassoni, and A. Brivio (Costruzioni Aeronautiche Giovanni Agusta S.p.A., Gallarate, Italy). In: Conference on Fatigue in Aerospace Structures, Turin, Italy, February 22, 23, 1978, Proceedings. Turin, Editrice Levrotto e Bella, 1979, p. 121-153. 9 refs.

A finite element model is presented for analytical evaluation of the fatigue life of a helicopter rotor hub. The validity of the proposed model is verified against experimental results. V.L.

A81-22632 Crack growth propagation under variable amplitude loading in aerospace structures. G. Cavallini (Pisa, Università, Pisa, Italy). In: Conference on Fatigue in Aerospace Structures, Turin, Italy, February 22, 23, 1978, Proceedings. Turin, Editrice Levrotto e Bella, 1979, p. 155-164. Research sponsored by the Consiglio Nazionale delle Ricerche.

Methods for predicting fatigue crack growth in aerospace structures under operating conditions are evaluated. An evaluation procedure is proposed which is based on statistical analysis of experimental and calculation results and comparison with the corresponding data for constant-amplitude loading. The application of the procedure is demonstrated using a set of crack propagation data. V.L.

A81-22633 Study of a crack propagation on the flap rail of a transport aircraft. N. Giani and S. Peyronel (Aeronautica Macchi S.p.A., Varese, Italy). In: Conference on Fatigue in Aerospace Structures, Turin, Italy, February 22, 23, 1978, Proceedings. Turin, Editrice Levrotto e Bella, 1979, p. 165-174. 6 refs.

The theoretical determination of the propagation of cracks in structural members with complex geometry, is of the utmost importance to evaluate the dependability of the different theories and of the factors by which they are governed. In the preceding work, the lack of data regarding the overstress coefficients was compensated by the setting up of an analysis method which, while yielding appreciable results, permitted complex calculations to be avoided as well as the costs that the application of more refined methods would have inevitably involved. To the effects of the results, attention is also laid on the importance of the initial length of the assumed crack and of the choice of the propagation law and relevant coefficients. The theoretical results thus obtained are then compared to the experimental measurements taken during a series of fatigue tests carried out at Aeronautica Macchi. (Author)

A81-22635 Mathematical aspects of the probabilistic evaluations of structural safety and NDI capabilities. E. Antona (Torino, Politecnico, Turin, Italy). In: Conference on Fatigue in Aerospace Structures, Turin, Italy, February 22, 23, 1978, Proceedings. Turin, Editrice Levrotto e Bella, 1979, p. 181-198. 6 refs.

It is noted that probability considerations are coming to play a greater role in aeronautics and astronautics in the analysis of structure failure loads, crack propagation, and nondestructive inspection method capabilities. Probabilistic fundamentals, including probability distributions, analytical tools, and practical assumptions, are discussed. Applications are given, among them an interpretation of nondestructive inspection methods capability tests and a probabilistic interpretation of safety in static load failure. The influence of the loaded zone extension on fatigue behavior is discussed, and attention is given to certain statistical considerations regarding the validity of Miner's rule. C.R.

A81-22636 The 1980's - Payoff decade for advanced materials; Proceedings of the Twenty-fifth National Symposium and Exhibition, San Diego, Calif., May 6-8, 1980. Symposium sponsored by the Society for the Advancement of Material and Process Engineering. Azusa, Calif., Society for the Advancement of Material and Process Engineering (Science of Advanced Materials and Process Engineering Series. Volume 25), 1980. 786 p. $55.

The symposium focuses on recent developments in advanced structural materials and adhesive formulations, material characterization, processing techniques, design and fabrication of composite structures, testing methods, and applications. Papers are presented on the advanced composite hardware utilized on the Intelsat V spacecraft, the development of advanced structural materials for fusion power, an instrumented tensile impact method for composite materials, and prospects for bonding primary aircraft structures in the 80's. V.L.

A81-22641 Progress in P/M superalloy and titanium for aircraft applications. E. J. Dulis, J. H. Moll, V. K. Chandhok (Colt Crucible Research Center, Pittsburgh, Pa.), and J. C. Hebeisen (Colt Industries, Oakdale, Pa.). In: The 1980's - Payoff decade for advanced materials; Proceedings of the Twenty-fifth National Symposium and Exhibition, San Diego, Calif., May 6-8, 1980. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1980, p. 75-89. 8 refs.

High-quality powder metallurgy shaped parts with excellent strength and ductility levels and room- and elevated-temperature tensile properties are being developed for a range of aircraft products. The use of inert (argon) gas and vacuum systems for powder making, handling, and containerization and the use of hot isostatic pressing for compaction produce parts for gas turbine engines that require fewer processing steps, less starting material, and less energy. An array of tables and figures illustrate the ceramic mold process for making complex near-net shapes from superalloy which is being adapted for use with titanium. The P/M process for titanium alloy shapes is similar to that described for the superalloy except that the starting prealloyed powder is produced by the rotating electrode method. L.S.

A81-22646 Adhesive bonding of avionic structures. R. W. Malarik (Lear Siegler, Inc., Instrument Div., Grand Rapids, Mich.). In: The 1980's - Payoff decade for advanced materials; Proceedings of the Twenty-fifth National Symposium and Exhibition, San Diego, Calif., May 6-8, 1980. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1980, p. 167-175.

This paper examines adhesive bonding as an alternative assembly method for avionics chassis. Attention is given to an epoxy paste adhesive which eliminates the need for elaborate fixturing and curing facilities. Characteristics of an aluminum filled epoxy, an asbestos filled epoxy, and a general purpose epoxy are compared. Tests for moisture and temperature resistance are reported along with vibration in commercial and fighter aircraft. R.C.

A81-22647 Development program for a graphite/PMR 15 polyimide duct for the F404 engine. C. L. Stotler (General Electric Co., Aircraft Engine Group, Evendale, Ohio). In: The 1980's - Payoff decade for advanced materials; Proceedings of the Twenty-fifth National Symposium and Exhibition, San Diego, Calif., May 6-8, 1980. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1980, p. 176-187.

It is noted that this development program will produce efficient autoclave processing techniques that will permit the major portion of the duct structure of the F404 engine to be fabricated using woven graphite cloth in a PMR 15 resin matrix. The four ducts to be produced during the program will be used for a variety of static, fatigue, and environmental testing as well as ground testing. Some of the background work that led to the selection of the materials to be used for the program is discussed, and the preliminary design of the duct emerging from this background work is defined. It is noted that this preliminary design indicates that an advanced composite F404 outer duct would be 20% lighter than the current titanium duct and would achieve significant cost savings. C.R.

A81-22648 Composite fuselage development for Naval aircraft. J. J. Minecci and T. E. Hess (U.S. Naval Material Command, Naval Air Development Center, Warminster, Pa.). In: The 1980's - Payoff decade for advanced materials; Proceedings of the Twenty-fifth National Symposium and Exhibition, San Diego, Calif., May 6-8, 1980. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1980, p. 188-201. 8 refs.

A summary is presented of current Navy programs for the development of composite fuselage structures. Included are the cost

and weight payoffs which are expected for these design applications. Supporting technology programs which are being pursued to complement this work are also indicated. (Author)

A81-22664 * Design, durability and low cost processing *technology for composite fan exit guide vanes*. S. S. Blecherman (United Technologies Corp., Pratt and Whitney Aircraft Group, Middletown, Conn.). In: The 1980's - Payoff decade for advanced materials; Proceedings of the Twenty-fifth National Symposium and Exhibition, San Diego, Calif., May 6-8, 1980.
Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1980, p. 403-417. 5 refs. Contract No. NAS3-21037.

A program was conducted to design, fabricate and test a durable, low cost, lightweight composite fan exit guide vane for high bypass ratio gas turbine engine application. Eight candidate material/design combinations were evaluated by NASTRAN finite element analysis. Four of these candidate systems were selected for composite vane fabrication by two vendors. A core and shell vane design was chosen in which the unidirectional graphite core fiber was the same for all candidates. The shell material, fiber orientation and ply configuration were varied. Material tests were performed on raw material and composite specimens to establish specification requirements. Composite vanes were nondestructively inspected and subsequently fatigue tested in both dry and 'wet' conditions. The program provided relevant data with respect to design analysis, materials properties, inspection standards, improved durability, weight benefits and part price of the composite fan exit guide vane. (Author)

A81-22665 * Graphite polyimide fabrication research for supersonic cruise aircraft. W. T. Freeman, Jr. (Kentron International, Inc., Hampton, Va.) and R. M. Baucom (NASA, Langley Research Center, Hampton, Va.). In: The 1980's - Payoff decade for advanced materials; Proceedings of the Twenty-fifth National Symposium and Exhibition, San Diego, Calif., May 6-8, 1980.
Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1980, p. 418-432. 5 refs.

Advanced fabrication processes and adhesive bonding methods have been developed for the fabrication of full scale fiberglass-polyimide honeycomb stiffened HTS-1 graphite/PMR-15 polyimide panels that meet the design criteria for an upper wing panel of the NASA YF-12 aircraft. Detailed manufacturing, bonding, and autoclave cure procedures are presented. Nondestructive test methods including pulse echo and through-transmission ultrasonic C-scan and laser holography were developed to detect flaws in components and the completed panels. Panels were tested in shear at room temperature and 533 K (500 F) following a variety of thermal exposures to obtain load, deflection and failure analysis data. (Author)

A81-22676 Effect of impact damage on the XFV-12A composite wing box. L. W. Gause, M. S. Rosenfeld, and R. E. Vining, Jr. (U.S. Naval Material Command, Naval Air Development Center, Warminster, Pa.). In: The 1980's - Payoff decade for advanced materials; Proceedings of the Twenty-fifth National Symposium and Exhibition, San Diego, Calif., May 6-8, 1980.
Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1980, p. 679-690. 8 refs.

Impact tests were performed on a graphite/epoxy wing box structure. Both sub-visual and visual level impact damage were studied; the structure experienced no effect from the impact damage under spectrum fatigue loading to 150 per cent of Design Limit Load (D.L.L.). Failure originated from an approximately 2 inch diameter impact induced delamination at a static load of 164 per cent D.L.L. (Author)

A81-22678 Experiences with composite aircraft structures. S. J. Dastin and H. A. Erbacher (Grumman Aerospace Corp., Bethpage, N.Y.). In: The 1980's - Payoff decade for advanced materials; Proceedings of the Twenty-fifth National Symposium and Exhibition, San Diego, Calif., May 6-8, 1980.
Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1980, p. 706-715. 6 refs.

The inherent damage-tolerance of composite structures renders them suitable for use in military aircraft. Grumann Aerospace has developed fabrication techniques in which controlled orientation of fibers reduces the brittleness of a composite and reinforces it in the short transverse, with crack control provided by the placement of S glass-fiber strips within the graphite/epoxy laminate. Translaminar reinforcement (TLR) and the application of hybrid epoxy mixtures have been found to retard local delamination, a rapid-degradation fracture mode caused by impact and resulting from the inhomogeneous layered structures of composites. Small delaminations are repaired in-shop with catalyzed-resin injections, whereas through-holes and large-scale damage are relaminated, the orientation of the new layers matching that of the layers removed. A field-repair methodology has also been developed for highly loaded boron-epoxy structures based on load introduction and shear lag. Through-skin damage is corrected in this case by applying titanium-bonded foils to two plies of fiberglass-epoxy oriented plus or minus 45 degrees to the major axis over a film epoxy adhesive. With the completion of fatigue studies, composite repair methodology and technology should be throughly established. R.S.

A81-22679 Prospects for bonding primary aircraft structure in the 80's. E. W. Thrall, Jr. (Douglas Aircraft Co., Long Beach, Calif.). In: The 1980's - Payoff decade for advanced materials; Proceedings of the Twenty-fifth National Symposium and Exhibition, San Diego, Calif., May 6-8, 1980. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1980, p. 716-727. 6 refs.

It is noted that corrosion/disbond problems long associated with bonded joints are understood and controllable. The Primary Adhesively Bonded Structure Technology (PABST) program has validated the metal bonding technology so that it can be used with confidence. Technical problems which remain and which are discussed include repeatable optimum surface treatment control, prebonding adhesive moisture control, and cure monitoring. C.R.

A81-22681 * Effects of commercial aircraft operating environment on composite materials. A. J. Chapman (NASA, Langley Research Center, Hampton, Va.), D. J. Hoffman (Boeing Commercial Airplane Co., Renton, Wash.), and W. T. Hodges (U.S. Army, Structures Laboratory, Hampton, Va.). In: The 1980's - Payoff decade for advanced materials; Proceedings of the Twenty-fifth National Symposium and Exhibition, San Diego, Calif., May 6-8, 1980. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1980, p. 737-751.

Long term effects of commercial aircraft operating environment on the properties and durability of composite materials are being systematically explored. Composite specimens configured for various mechanical property tests are exposed to environmental conditions on aircraft in scheduled airline service, on racks at major airports, and to controlled environmental conditions in the laboratory. Results of tests following these exposures will identify critical parameters affecting composite durability, and correlation of the data will aid in developing methods for predicting durability. Interim results of these studies show that mass change of composite specimens on commercial aircraft depends upon the regional climate and season, and that mass loss from composite surfaces due to ultraviolet radiation can be largely prevented by aircraft paint. (Author)

A81-22692 Controls of aeronautical structures under fatigue testing by holographic pulsed lasers interferometry. H. Fagot, F. Albe, P. Smigielski, A. Stimpfling (Institut Franco-Allemand de Recherches, Saint-Louis, Haut-Rhin, France), and J. L. Arnaud (Société Nationale Industrielle Aérospatiale, Suresnes, Hauts-de-Seine, France). In: European Congress on Optics Applied to Metrology (METROP), 2nd, Strasbourg, France, November 26-30, 1979, Proceedings. Bellingham, Wash., Society of Photo-Optical Instrumentation Engineers, 1980, p. 154-158. Re-

search supported by the Direction des Recherches, Etudes et Techniques.

A compact, mobile holographic camera with two ruby lasers has been developed for the fatigue testing of aeronautical structures subjected to periodic tensile stress. The lasers may be triggered with respect to the phase of a periodic signal by adjusting the delays and accounting for pumping time. Tests have been conducted with a mechanical traction machine that applies periodic traction constraints on the order of one ton at a resonance frequency of about 100 Hz. The resulting deformations vary considerably, and clear visualizations have been obtained for time lapses between two laser impulses from 20 microsec to 1 millisec during a cycle. Lapses of the order of 100 millisec may be used to follow the evolution of a fissure. The technique has many aeronautical applications including the visualization of loosenings, disbondings, inhomogeneities and surface defaults. S.C.S.

A81-22973 # **Design of guidance and control digital autopilots.** W. Albanes (Computer Sciences Corp., Defense Systems Div., Huntsville, Ala.). *Journal of Guidance and Control,* vol. 4, Mar.-Apr. 1981, p. 126-133. 8 refs. Army-supported research.

The miniaturization, availability, and low cost of digital hardware has made possible a digital autopilot package for antitank homing missiles comparable in size and cost to existing analog controllers. The paper discusses the design, implementation, and validation of a digital guidance and control autopilot based upon current sampled-data techniques and methodologies. This controller is considered state-of-the-art technology, performing as well as or better than analog versions, and having been flown in small homing antitank missiles. It performs the classical flight control autopilot functions of attitude stabilization and gyro filtering, and provides actuator control, seeker signal filtering, and guidance shaping. The digital guidance and control autopilot uses a laser seeker to automatically pursue and impact its target without operator guidance intervention. (Author)

A81-22984 Analysis of a symmetric transonic aerofoil with the finite element method - A new upwinding technique. J. E. Marsh and F. E. Eastep (USAF Institute of Technology, Wright-Patterson AFB, Ohio). *International Journal for Numerical Methods in Engineering,* vol. 16, Oct. 1980, p. 137-148. 16 refs.

The nonlinear small-disturbance velocity-potential equation for steady flow over a thin symmetric nonlifting airfoil is solved by the finite element method. Pressure distributions are computed for flow regimes ranging from incompressible flow to transonic flow with weak shocks. Convergence of solution algorithms occurs rapidly for all subsonic flows, but fails for transonic or mixed flows when the supersonic bubble is larger than one-half of an element. For transonic flows, a new upwinding scheme is used to modify the formulations for elements within the supersonic bubble. B.J.

A81-23034 A solid-state airborne sensing system for remote sensing. R. M. Hodgson, F. M. Cady, and D. Pairman (Canterbury, University, Christchurch, New Zealand). *Photogrammetric Engineering and Remote Sensing,* vol. 47, Feb. 1981, p. 177-182. 12 refs. Research supported by the University of Canterbury and University Grants Committee.

Currently most non-satellite multispectral remote sensing in the visible and near infrared is carried out using clusters of conventional photographic cameras. A project is in progress which exploits microcomputer and solid-state technology in the development of a multispectral scanner to be flown in light aircraft. Such systems offer the potential advantages of improved linearity and dynamic range, extended spectral response, the direct generation of digital data, and the real time display of captured images. The problems of sensor selection, stored array size, and pixel quantization are discussed. A prototype single camera system based on the use of a 100 by 100 element charge coupled device area sensor has recently been flight tested. A four-camera system that will allow the simultaneous capture and storage of 128 by 128 element images in four spectral bands in the 400-1100 nm range is under development. (Author)

A81-23095 Development of a shadow mask type high-resolution color picture tube for cockpit display. K. Hayashi, K. Nakamura, M. Matsushita (Mitsubishi Electric Corp., Kyoto Works, Nagaokakyo, Japan), and F. Kishimoto (Mitsubishi Electric Corp., Central Research Laboratory, Amagasaki, Japan). In: Biennial Display Research Conference, 6th, Cherry Hill, N.J., October 21-23, 1980, Conference Record. Conference sponsored by IEEE, SID, and DOD. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1980, p. 120, 121.

A81-23359 Multipath and interference effects in secondary surveillance radar systems. M. C. Stevens (Cossor Electronics, Ltd., Harlow, Essex, England). *IEE Proceedings, Part F - Communications, Radar and Signal Processing,* vol. 128, pt. F, no. 1, Feb. 1981, p. 43-53. 7 refs.

Secondary surveillance radar for air traffic control is compared with primary radar for improved performance. System problems associated with SSR are less easily tolerated because of increasing reliance being placed on SSR by air traffic control. Problems arising from multipath and mutual line interference effects are examined. Many deficiencies can be overcome by adopting improved antennas and using more impulse direction finding techniques. R.C.

A81-23366 # **Critical field length calculations for preliminary design.** S. A. Powers (Vought Corp., Dallas, Tex.). *Journal of Aircraft,* vol. 18, Feb. 1981, p. 103-107. 6 refs.

Two methods are presented for determining the critical field length for multiple-engine jet aircraft during the preliminary design process. The first method includes the effects of thrust deflection, thrust variation with velocity, and head or tail winds. The second approximation is based upon zero wind and constant thrust values, and has been programmed on a personal calculator. While the principal application of this method has been to military aircraft, the method can be applied to civil aircraft performance when suitably modified. (Author)

A81-23367 # **Transonic flow calculations over two-dimensional canard-wing systems.** V. Shankar, N. D. Malmuth (Rockwell International Science Center, Thousand Oaks, Calif.), and J. D. Cole (California, University, Los Angeles, Calif.). *(American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 12th, Williamsburg, Va., July 23-25, 1979, Paper 79-1565.) Journal of Aircraft,* vol. 18, Feb. 1981, p. 108-114. 12 refs. Contract No. F744620-76-C0044.

As a prototype for the three-dimensional interaction problem, the transonic interference flowfields over two-dimensional canard-wing systems are computed using transonic small disturbance theory. In the calculation, the two airfoils comprising the lifting 'biplane' system are placed in separate computational planes with an overlapped region across which information from one airfoil to the other is transferred at the end of each relaxation cycle. Results showing the favorable interference in overall lift are presented and compared with linear theory calculations. Far field expressions for solid, slotted, and free jet wind tunnel wall cases that correspond to the canard-wing arrangement are also described. (Author)

A81-23368 # **Stochastic modeling of an aircraft traversing a runway using time series analysis.** C. Venkatesan and V. Krishnan (Indian Institute of Science, Bangalore, India). *Journal of Aircraft,* vol. 18, Feb. 1981, p. 115-120. 9 refs.

Time series analysis is applied to problems concerning runway-induced vibrations of an aircraft. A simple mathematical model based on this technique is fitted to obtain the impulse response coefficients of an aircraft system considered as a whole for a particular type of operation. By using this model, the output which is the aircraft response can be obtained with lesser computation time for any runway profile as the input. (Author)

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STAR ENTRIES

N81-15970*# National Aeronautics and Space Administration, Washington, D. C.
THE HIGH-SPEED AIRFOIL PROGRAM
In its The High-Speed Frontier 1980 p 3-60

Avail: NTIS MF A01; SOD HC $6.50 CSCL 01A

A case history is presented of the work done in the field of supersonic flow and aerodynamics. Emphasis is placed on the development of supercritical wings and the study of the effects of supersonic speeds on propeller blades for aircraft. A review is presented of important milestones in the development of supercritical and transonic aerodynamic theory. T.M.

N81-15971*# National Aeronautics and Space Administration, Washington, D. C.
TRANSONIC WIND TUNNEL DEVELOPMENT (1940 - 1950)
In its The High-Speed Frontier 1980 p 61-118

Avail: NTIS MF A01; SOD HC $6.50 CSCL 14B

A case history is presented for the wind tunnel program of the National Advisory Committee for Aeronautics. The choking problem is discussed and the development of the repowered 8-foot high speed tunnel is described. Transonic airfoil facilities of interest include the annular transonic tunnel and the slotted transonic tunnel. High speed research airplanes used for wind tunnel testing and wing-flow and bump methods are also discussed. T.M.

N81-15972*# National Aeronautics and Space Administration, Washington, D. C.
THE HIGH-SPEED PROPELLER PROGRAM
In its The High-Speed Frontier 1980 p 119-138

Avail: NTIS MF A01; SOD HC $6.50 CSCL 01A

A case history is presented for the propeller program of the National Advisory Committee for Aeronautics. The work was concerned with the development of supersonic airfoils for aircraft applications. Propeller blade pressure distributions at high speeds were investigated. High speed flight tests of various propeller configurations were conducted and a high speed dynamometer was developed. T.M.

N81-15973*# National Aeronautics and Space Administration, Washington, D. C.
HIGH-SPEED COWLINGS, AIR INLETS AND OUTLETS, AND INTERNAL-FLOW SYSTEMS
In its the High-Speed Frontier 1980 p 139-165

Avail: NTIS MF A01; SOD HC $6.50 CSCL 01C

A case history is presented of the National Advisory Committee on Aeronautics' program of aircraft engine development. The ramjet engine is described and its development is traced through work done in the field of supersonic inlets. The effects of heat and compressibility on internal flow systems in engines are discussed. T.M.

N81-15974*# Kansas Univ., Lawrence.
A FEASIBILITY STUDY FOR ADVANCED TECHNOLOGY INTEGRATION FOR GENERAL AVIATION Final Report, 10 Apr. 1979 - 9 Apr. 1980
David L. Kohlman, Garey T. Matsuyama, Kevin E. Hawley, and Paul T. Meredith Nov. 1980 533 p refs
(Contract NAS1-15770)
(NASA-CR-159381; KU-FRL-414-1) Avail: NTIS HC A24/MF A01 CSCL 01B

An investigation was conducted to identify candidate technologies and specific developments which offer greatest promise for improving safety, fuel efficiency, performance, and utility of general aviation airplanes. Interviews were conducted with general aviation airframe and systems manufacturers and NASA research centers. The following technologies were evaluated for use in airplane design tradeoff studies conducted during the study: avionics, aerodynamics, configurations, structures, flight controls, and propulsion. Based on industry interviews and design tradeoff studies, several recommendations were made for further high payoff research. The most attractive technologies for use by the general aviation industry appear to be advanced engines, composite materials, natural laminar flow airfoils, and advanced integrated avionics systems. The integration of these technologies in airplane design can yield significant increases in speeds, ranges, and payloads over present aircraft with 40 percent to 50 percent reductions in fuel used. T.M.

N81-15975# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
A FEASIBILITY STUDY FOR ADVANCED TECHNOLOGY INTEGRATION FOR GENERAL AVIATION Ph.D. Thesis - Kansas Univ. Final Report
Garey T. Matsuyama May 1980 529 p refs
(AD-A092437; AFIT-CI-80-22D) Avail: NTIS HC A23/MF A01 CSCL 01/3

A study directed toward the identification and evaluation of applicable advanced technologies for general aviation was performed. An extensive data base was generated through visits to 31 general aviation manufacturers and 3 NASA research centers as well as through an exhaustive literature search. An evaluation technique was developed which allowed candidate technologies to be ranked according to potential benefit. Finally, design studies were performed for a 6-passenger personal/business airplane and a 19-passenger commuter airplane. The General Aviation Synthesis Program (GASP) was utilized during the design studies for propulsion system and vehicle sizing as well as mission performance analysis. GRA

N81-15976*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
EFFECTS OF SIDEWALL GEOMETRY ON THE INSTALLED PERFORMANCE OF NONAXISYMMETRIC CONVERGENT-DIVERGENT EXHAUST NOZZLES
Jeffery A. Yetter (George Washington Univ., Hampton, Va.) and Laurence D. Leavitt Dec. 1980 119 p refs
(NASA-TP-1771; L-13826) Avail: NTIS HC A06/MF A01 CSCL 01A

The investigation was conducted at static conditions and over a Mach number range from 0.6 to 1.2. Angle of attack was held constant at 0 deg. High pressure air was used to simulate jet exhaust flow at ratios of jet total pressure to free-stream static pressure from 1 (jet off) to approximately 10. Sidewall cutback appears to be a viable way of reducing nozzle weight and cooling requirements without compromising installed performance. T.M.

N81-15977*# Boeing Co., Seattle, Wash.
A SYSTEM FOR AERODYNAMIC DESIGN AND ANALYSIS OF SUPERSONIC AIRCRAFT. PART 4: TEST CASES Final Report, Sep. 1978 - Aug. 1980
W. D. Middleton and J. L. Lundry Washington NASA Dec. 1980 225 p refs 4 Vol.
(Contract NAS1-15534)
(NASA-CR-3354; D6-41840-4) Avail: NTIS HC A10/MF A01 CSCL 01A

An integrated system of computer programs was developed for the design and analysis of supersonic configurations. The system uses linearized theory methods for the calculation of surface pressures and supersonic area rule concepts in combination with linearized theory for calculation of aerodynamic force coefficients. Interactive graphics are optional at the user's request. Representative test cases and associated program output are presented. T.M.

N81-15978*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

EFFECT OF WING LOCATION AND STRAKES ON STABILITY AND CONTROL CHARACTERISTICS OF A MONOPLANAR CIRCULAR MISSILE WITH LOW-PROFILE TAIL FINS AT SUPERSONIC SPEEDS

A. B. Blair, Jr. Dec. 1980 200 p refs

(NASA-TM-81878; L-13852) Avail: NTIS HC A10/MF A01 CSCL 01A

A wind tunnel test was conducted at Mach numbers from 1.70 to 2.86 to extend the aerodynamic data base for wing tail effect on stability and control characteristics of monoplanar missiles. The results are summarized to show the effects of tail fin dihedral angle, wing location, and nose body strakes. The results indicate that an increase in tail fin dihedral angle produces positive increments in directional stability that allow greater trimmed lift coefficient values (maneuver potential) to be obtained. An increase in wing tail gap for the Mach number range reduces the aerodynamic center travel and produces reductions in directional stability at the lower angles of attack. A change in wing height (vertical location) strongly influences the angle of attack at which pitch up and the most directional stability occur. The addition of strakes to the baseline configuration increases directional stability, which allows a significant increase in stable trimmed maneuver capability. The tail fins of the baseline configuration are effective in producing roll and yaw control that are accompanied by favorable yaw and roll, respectively. R.C.T.

N81-15982*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

A FLIGHT INVESTIGATION OF PERFORMANCE AND LOADS FOR A HELICOPTER WITH RC-SC2 MAIN-ROTOR BLADE SECTIONS

Charles E. K. Morris, Jr., Robert L. Tomaine, and Dariene D. Stevens Dec. 1980 140 p Prepared in cooperation with Army Aviation Research and Development Command, Hampton, Va.

(NASA-TM-81898; AVRADCOM-TM-81-B-1) Avail: NTIS HC A07/MF A01 CSCL 01A

The test envelope included hover, forward-flight speed sweeps from 33 to 74 m/sec (65 to 144 knots), and collective-fixed maneuvers at about 0.25 tip-speed ratio. The data set for each test point describes vehicle flight states, control positions, rotor loads, power requirements and blade motions. Rotor loads were reviewed primarily in terms of peak-to-peak and harmonic content. Lower frequency components predominated for most loads and generally increased with increased airspeed, but not necessarily with increased maneuver load factor. T.M.

N81-15983*# National Aeronautics and Space Administration, Washington, D. C.

FLOW PHENOMENA ALONG FUSELAGES AND WING-FUSELAGE SYSTEMS OF GLIDERS

Jerzy Ostrowski, Mieczyslaw Litwinczyk, and Lukasz Turkowski Dec. 1980 16 p refs Transl. into ENGLISH from Arch. Budowy Maszyn (Poland), v. 25, no. 1, 1978 p 91-104 Original language document was announced as A78-36203 Transl. by Kanner (Leo) Associates, Redwood City, Calif.

(NASA-TM-75401) Copyright. Avail: NTIS HC A02/MF A01 CSCL 01A

The results are presented for visualization tests and measurements of the velocity field in diffusion regions (with a positive pressure gradient) for fuselages and transition regions between the wing and the fuselage. Wind tunnel and flight tests were performed. Specific emphasis was placed on examining the secondary flow influencing separation acceleration and the influence of the geometrical form of the wing fuselage system manifested by the occurrence of secondary flows of various types. R.C.T.

N81-15984*# National Aeronautics and Space Administration, Washington, D. C.

DISCUSSION OF TEST RESULTS IN THE DESIGN OF LAMINAR AIRFOILS FOR COMPETITION GLIDERS

Jerzy Ostrowski, Stanislaw Skrzynski, and Mieczyslaw Litwinczyk Dec. 1980 21 p refs Transl. into ENGLISH from Arch. Budowy Maszyn (Poland), v. 25, no. 1, 1978 p 105-120 Original language document was announced as A78-36204 Transl. by Kanner (Leo) Associates, Redwood City, Calif.

(NASA-TM-75402) Avail: NTIS HC A02/MF A01 CSCL 01A

The deformation of flow in the boundary layer and the local separation of a laminar layer (laminar bubbles) from various airfoils were investigated. These phenomena were classified and their influence is discussed. Various aerodynamic characteristics are discussed and the principles for prescribing pressure distribution to attain a high value of c sub z max with a possibly low drag coefficient are described. T.M.

N81-15985*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

SOME WAKE-RELATED OPERATIONAL LIMITATIONS OF ROTORCRAFT

Harry H. Heyson Dec. 1980 53 p refs Presented at the Fourth Midwest Helicopter Safety Seminar, Joliet, Ill., 3-5 Feb. 1981; sponsored by the Illinois Dept. of Transportation and the FAA

(NASA-TM-81920) Avail: NTIS HC A04/MF A01 CSCL 01B

Wind tunnel measurements show that the wake of a rotor, except at near hovering speeds, is not like that of a propeller. The wake is more like that of a wing except that, because of the slow speeds, the wake velocities may be much greater. The helicopter can produce a wake hazard to following light aircraft that is disproportionately great compared to an equivalent fixed wing aircraft. This hazard should be recognized by both pilots and airport controllers when operating in congested areas. Ground effect is generally counted as a blessing since it allows overloaded takeoffs; however, it also introduces additional operation problems. These problems include premature blade stall in hover, settling in forward transition, shuddering in approach to touchdown and complicatons with yaw control. Some of these problems were treated analytically in an approximate manner and reasonable experiment agreement was obtained. An awareness of these effects can prepare the user for their appearance and their consequences. T.M.

N81-15986*# Mississippi Univ., University. Engineering and Industrial Research Station.

AN APPLICATION OF WAKE SURVEY RAKES TO THE EXPERIMENTAL DETERMINATION OF THRUST FOR A PROPELLER DRIVEN AIRCRAFT Final Report

K. R. Hall, S. J. Miley, and H. J. Tsai Feb. 1981 76 p refs (Grant NsG-1454)

(NASA-CR-163920; MSSU-EIRS-ASE-81-3) Avail: NTIS HC A05/MF A01 CSCL 01A

The lack of slipstream static pressure distribution seriously affected the results but recommendations for removing the deficiency are discussed. The wake survey rake is shown to be a valuable tool in aircraft flight testing. Flow characteristics in the wake of the propeller were examined. T.M.

N81-15992# Flow Research, Inc., Kent, Wash.

APPLICATION OF TRANSONIC POTENTIAL CALCULATIONS TO AIRCRAFT AND WIND TUNNEL CONFIGURATIONS

John E. Mercer and Earll M. Murman *In* AGARD Subsonic/Transonic Configuration Aerodyn. Sep. 1980 15 p refs

(Contract N00014-78-C-0079; F4D600-79-C-0001)

Avail: NTIS HC A19/MF A01

The computation of inviscid transonic flow modeled by the full potential equation is presented for two geometrical configurations. The Jameson-Caughey finite volume method is used to solve the governing equations in conservative form. The development of suitable computational meshes together with computed results are presented for a swept wing in a wind tunnel and for a wing body configuration. Author

N81-15994# Avions Marcel Dassault, Saint-Cloud (France). Dept. des Etudes Theoriques Aerodyn.

FINITE ELEMENT METHOD STUDY OF WING-FUSELAGE-NACELLE INTERACTIONS OF A FALCON 20 TYPE AIRCRAFT AT MACH = 0.79 [ETUDE PAR LA METHODE DES ELEMENTS FINIS DES INTERACTIONS VOILURE FUSELAGE-NACELLE D'UN AVION DU TYPE FALCON A MACH = 0,79]

Gilbert Heckmann *In* AGARD Subsonic/Transonic Configuration Aerodyn. Sep. 1980 11 p refs In FRENCH

Avail: NTIS HC A19/MF A01

Adaptation of the Garrett ATF3-6 engine on the twin engine Falcon 20, equipped in series with a General Electric CF 700 engine, revealed an important and predicted growth of drag in transonic flow. Wind tunnel tests of the new configuration showed shocks on the front of the engine nacelle and on the back of the wing at the top face of the socket at Mach = 0.79. Air flow between the wing and the nacelle was locally supersonic. The shape and position of the nacelle and mast were modified. This complex fuselage wing mast nacelle configuration should be studied in supercritical flow while considering the flow from the engine. The finite element method permits calculation in three dimensional and transonic flow with shock waves in a geometric domain under conditions of the required limits. It is shown that the matrix from a transonic calculation method provides solutions to aerodynamic problems previously detectable only by flight and wind tunnel tests. Mathematical tools are described and results obtained on the original nacelle and on the definitive nacelle with modified shape and position are discussed. Transl. by A.R.H.

N81-15996# Aircraft Research Association Ltd., Bedford (England).

PROSPECTS FOR EXPLOITING FAVOURABLE AND MINIMIZING ADVERSE AERODYNAMIC INTERFERENCE IN EXTERNAL STORE INSTALLATIONS

A. B. Haines *In* AGARD Subsonic/Transonic Configuration Aerodyn. Sep. 1980 25 p refs

Avail: NTIS HC A19/MF A01

External store installations are frequently a source of considerable adverse aerodynamic interference giving large increases in drag, reductions in usable lift, and poor store release characteristics. Research has shown how this adverse interference can be greatly alleviated or even transformed into favorable interference. Some of the available evidence for a wide variety of arrangements are reviewed. The nature of the interference, both adverse and favorable, is described, particular emphasis being placed on the major adverse interference in standard multiple carriers and in some underwing installations. The possible benefits of wing tip carriage and carefully arranged underfuselage arrays are noted. The fact that dramatic improvements might be possible by adopting a radical approach to store carriage is stressed. E.D.K.

N81-15997# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).

EVALUATION OF AIRCRAFT INTERFERENCE EFFECTS ON EXTERNAL STORES AT SUBSONIC AND TRANSONIC SPEEDS

Ronald Deslandes *In* AGARD Subsonic/Transonic Configuration Aerodyn. Sep. 1980 11 p refs

Avail: NTIS HC A19/MF A01

In order to analyse the separation behavior of external stores from a combat aircraft, the store loads must be evaluated at all times after release. The resulting forces and moments are highly unsteady and depend upon the nonuniform flow field around the aircraft and the store motion itself. The exact evaluation of unsteady aerodynamics of such complicated configurations is nearly impossible, due to the required computer capacity and cost effectiveness. Simplificating assumptions leads to the quasilinearization of the time dependence to omit unsteady calculations and to the use of the flow angularity technique to minimize computational time. The MBB store separation program system is presented as a possible solution. The mixed experimental analytical approach is not restricted by compressibility effects, but is mainly described at subsonic flows. However, the transonic and supersonic extensions are mentioned, as well as the application of the program system to realistic combat aircraft missions under realistic conditions, such as jettison at high g maneuver, multiple jettison, and rail and drop launch of missiles. E.D.K.

N81-15998# Nielsen Engineering and Research, Inc., Mountain View, Calif.

STUDY OF TRANSONIC FLOW FIELDS ABOUT AIRCRAFT: APPLICATION TO EXTERNAL STORES

Stephen S. Stahara *In* AGARD Subsonic/Transonic Configuration Aerodyn. Sep. 1980 18 p refs

(Contract F44620-75-C-0047)

Avail: NTIS HC A19/MF A01

A review is presented of an extensive experimental/theoretical program directed toward establishing a predictive method for determining (1) three dimensional transonic flow fields about parent aircraft and (2) loading distributions on external stores located in these nonuniform flow fields. The work represents several stages in the systematic development of a theoretical capability for enabling aircraft/store compatibility studies at transonic speeds with applications to aircraft/store design optimization and store certification programs. The objectives are two fold: (1) to describe the extensive companion experimental program and present highlights of those results, which include detailed measurements of both flow fields and surface pressures (parent and external store), taken in a systematic component buildup; and (3) to discuss the development of the associated theoretical method, describe its application to a class of idealized fighter bomber configurations, and display comparisons with data from the parallel experimental programs, including both flow field and store loading distribution results. E.D.K.

N81-15999# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany). Theoretical Aerodynamics Dept.

AERODYNAMIC SUBSONIC/TRANSONIC AIRCRAFT DESIGN STUDIES BY NUMERICAL METHODS

Wolfgang Schmidt *In* AGARD Subsonic/Transonic Configuration Aerodyn. Sep. 1980 26 p refs

Avail: NTIS HC A19/MF A01

The need and use of computational aerodynamics in the design of aircraft and missile configurations in steady flow conditions is explored through several examples. These include aircraft and missile synthesis programs for predesign and evaluation work of aircraft and missile weapon systems, subsonic and transonic airfoil and high lift design, subsonic and transonic jnviscid and viscous wing and aircraft design including leading edge vortex flows, aircraft engine integration, and three dimensional flows with separation. Use of these numerical and semiempirical methods can substantially increase airplane performance capabilities while reducing risk, flow time, and testing requirements and thus total cost. The capabilities of current aerodynamic methods are demonstrated by comparison with windtunnel results and by case studies. Author

N81-16000# Institut fuer Theoretische Stroemungsmechanik, Goettingen (West Germany).

DESIGN OF ADVANCED TECHNOLOGY TRANSONIC AIRFOILS AND WINGS

H. Sobieczky *In* AGARD Subsonic/Transonic Configuration Aerodyn. Sep. 1980 13 p refs

Avail: NTIS HC A19/MF A01

A systematic method to design supercritical shock free 2D and 3D configurations is described. Simplified examples were chosen from airfoils and wings which are used in advanced technology aerodynamic concepts. With the outlined methods theoretical tools are presented to extend essentially subsonic design aerodynamic into the transonic regime. T.M.

N81-16001# British Aerospace Aircraft Group, Hertfordshire (England). Fluid Dynamics Dept.
INTERFERENCE ASPECTS OF THE A310 HIGH SPEED WING CONFIGURATION
J. A. Jupp *In* AGARD Subsonic/Transonic Configuration Aerodyn. Sep. 1980 16 p refs

Avail: NTIS HC A19/MF A01
The effect of the fuselage representation on the inboard wing transonic design and the influence of the tailplane in the optimization of the wing twist for minimium drag are discussed. Highlights from the wind tunnel testing program are presented and include the development of the wing root leading edge fillet to improve wing/fuselage viscous interference, and the optimization of the flap support fairings for the minimum high speed interference. T.M.

N81-16002# Vereinigte Flugtechnische Werke G.m.b.H., Bremen (West Germany).
TRANSONIC WING TECHNOLOGY FOR TRANSPORT AIRCRAFT
G. Krenz and B. Ewald *In* AGARD Subsonic/Transonic Configuration Aerodyn. Sep. 1980 p 12 refs

Avail: NTIS HC A19/MF A01
The Aircraft Energy Efficiency Program is described. Results from the program are presented which describe the standard transonic wing aerodynamics, taking into account impacts on structure and aeroelastics. The main objectives of the program are the development of high aspect ration wings, better wing engine integration, and the development of active control with movable wing parts. T.M.

N81-16003# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Entwurfsaerodynamik.
DESIGN AND EXPERIMENTAL VERIFICATION OF A TRANSONIC WING FOR A TRANSONIC AIRCRAFT
G. Redeker, N. Schmidt, and R. Mueller *In* AGARD Subsonic/Transonic Configuration Aerodyn. Sep. 1980 p 14 refs

Avail: NTIS HC A19/MF A01
Force, moment, and wing surface pressure measurements were made on a half scale model of a wing fuselage configuration. Drag reduction was the major design concept and thus the basis for all modifications to the slender wing. Modifications include: increasing average wing thickness from 10.5% to 12.5%; reducing the leading edge sweep angle from 30 deg to 27 deg; and increasing the cruising lift coefficient to c sub L = 0.5. T.M.

N81-16004# National Research Council of Canada, Ottawa (Ontario).
THE TALE OF TWO WINGS
E. Atraghji, L. Thornquist (Saab-Scania), and L. Torngren (Aeronautical Res. Inst. of Sweden) *In* AGARD Subsonic/Transonic Configuration Aerodyn. Sep. 1980 p 10 refs

Avail: NTIS HC A19/MF A01
Two design philosophies for a wing for an attack aircraft were investigated experimentally. In the first case, the wing was equipped with a leading edge that could be deflected mechanically to cope with leading and maneuvering cases without suffering extensive drag. In the second case, the wing leading edge profile is permanently set as a compromise for all flight conditions. Results indicate that, using the second concept, a carefully tailored wing can be generated which need not suffer a drag penalty or a reduction in maneuver capability. Such a wing has the advantage of simplicity and lighter weight also. T.M.

N81-16005# British Aerospace Aircraft Group, Brough (England). Aerodynamics Dept.
SOME PARTICULAR CONFIGURATION EFFECTS ON A THIN SUPERCRITICAL VARIABLE CAMBER WING
D. R. Holt and B. Probert *In* AGARD Subsonic/Transonic Configuration Aerodyn. Sep. 1980 p 18 refs

Avail: NTIS HC A19/MF A01
Variable camber devices were shown to represent a powerful means of matching a variety of disparate transonic points for a thin wing if designed into the wing from the outset. In particular, trailing edge devices allow for the provision of good high lift performance without degrading the sea level dash capability. Strakes were designed with only a small drag penalty by matching the strake to the wing streamlines at particular incidences. T.M.

N81-16006# National Aerospace Lab., Amsterdam (Netherlands). Theoretical Aerodynamics Dept.
A CONSTRAINED INVERSE METHOD FOR THE AERODYNAMIC DESIGN OF THICK WINGS WITH GIVEN PRESSURE DISTRIBUTION IN SUBSONIC FLOW
J. M. J. Fray and J. W. Slooff *In* AGARD Subsonic/Transonic Configuration Aerodyn. Sep. 1980 p 9 refs

Avail: NTIS HC A19/MF A01
The method combines well established linear techniques for the analysis of thick wing configurations, and for the design of asymptotically thin wings. These techniques are used in an iterative way. The design codes were constructed in such a way that constraints on the spanwise distributions of thickness, twist, leading edge radius, and trailing edge angle can be taken into account. In this way the designer may execute control over the geometry at the cost of a penalty in the pressure distribution. Examples of application to a swept wing and a wing body configuration are presented. T.M.

N81-16007# British Aerospace Aircraft Group, Warton (England).
JET WING INTERACTION TO GIVE IMPROVED COMBAT PERFORMANCE
A. Vint *In* AGARD Subsonic/Transonic Configuration Aerodyn. Sep. 1980 p 12 refs

Avail: NTIS HC A19/MF A01
Prediction techniques showed that a conventional propulsive jet at the wing trailing edge gives a significant improvement in the high lift characteristics of the wing providing deflections of up to 30 deg can be provided. Application of the predicted effects to a projected aircraft showed that the best configuration would be the canard, to provide beneficial trim effects of the deflected thrust, and that large improvements in sustained turn rate at low speed and in peak attained turn rate at low level would be obtained. Weight penalties associated with the required deflecting nozzles are presented. T.M.

N81-16008# Salford Univ. (England).
JET WING INTERFERENCE FOR AN OVERWING ENGINE CONFIGURATION
R. A. Sawyer and M. P. Metcalfe (British Aerospace, Manchester, England) *In* AGARD Subsonic/Transonic Configuration Aerodyn. Sep. 1980 p 10 refs

Avail: NTIS HC A19/MF A01
Detailed pressure distributions over the wing are presented for jet to free stream velocity ratios of 2:1, 3:1, and 5:1, over a range of incidence. The configuration of the jet nozzle, wing section, and the relative positions of the engine and the wing, correspond to a moderate by-pass ratio engine mounted over the wing of a low wing feeder liner aircraft. Entrainment rates into the jet and the path of the jet relative to the wing were established by flow measurement and flow visualization. Theoretical considerations showed that it is the bound vorticity associated with jet curvature which produces the pressure increments on the wing surface. T.M.

N81-16009# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).
INTERFERENCE EFFECTS OF CONCENTRATED BLOWING AND VORTICES ON A TYPICAL FIGHTER CONFIGURATION

W. Staudacher /n AGARD Subsonic/Transonic Configuration Aerodyn. Sep. 1980 p 13 refs

Avail: NTIS HC A19/MF A01

Generation and/or stabilization and control of these vortex systems was obtained by planform variation (such as strakes, short coupled canards); modifications of wing section (shape and camber of leading edges and leading edge flaps); and concentrated spanwise blowing for arbitrary planforms. Specific and combined results of these modifications are presented. Optimum jet positions, in respect of various criteria applied, were derived. The effects of strakes and/or spanwise blowing on performance, stability and control, dynamic characteristics, and flow distributions are discussed. T.M.

N81-16010# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

EXPERIMENTAL STUDY OF THE INTERACTION BETWEEN THE WING OF A SUBSONIC AIRCRAFT AND A NACELLE OF A HIGH BY-PASS RATIO ENGINE [ETUDE EXPERIMENTALE DE L'INTERACTION ENTRE UNE VOILURE L'AVION SUBSONIQUE RAPIDE ET UNE NACELLE DE MOTEUR A HAUT TAUX DE DILUTION]

P. Levant /n AGARD Subsonic/Transonic Configuration Aerodyn. Sep. 1980 11 p refs In FRENCH; ENGLISH summary

Avail: NTIS HC A19/MF A01

The oncoming of a new generation of subsonic transport aircraft (with supercritical wing and high by-pass ratio turbofans) has led to an experimental study of wing nacelle jet pylon interference in transonic flow. To this end, a test set-up was developed at the ONERA S3Ch wind tunnel. The nacelle models represent a turbofan by means of two compressed air jets. The scale is 1/18,5. The nacelles are fixed on a thrust balance measuring afterbody thrust and discharge coefficients. The wing is located between the sidewalls of the test section. Pressures are measured through 456 holes located on 8 airfoils. Drag coefficient of the wing is obtained by wake survey. The following parameters can vary: (1) wing/nacelle position; (2) upstream Mach number (from 0.3 to 0.8); (3) jet pressure ratio; (4) with/without pylon; and (5) type of nacelle. Wing nacelle interference can be studied by means of total thrust drag analysis, as a function of the various parameters. The test set-up is described, and examples of results are presented illustrating the possibilities of this set-up. Author

N81-16011# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio. Flight Dynamics Lab.

A WIND TUNNEL INVESTIGATION OF THE AERODYNAMIC CHARACTERISTICS OF FORWARD SWEPT WINGS

T. M. Weeks, G. C. Uhuad, and R. Large /n AGARD Subsonic/Transonic Configuration Aerodyn. Sep. 1980 15 p

Avail: NTIS HC A19/MF A01

An experimental investigation of a forward swept wing and a state of the art equivalent aft swept wing was conducted to compare the relative performance of both wings at identical transonic maneuver design conditions and to determine any associated drag penalty of the forward swept wing for a high supersonic cruise condition. At the transonic maneuver design condition, the results indicate a significant reduction in the profile drag of the forward swept wing relative to the aft swept wing. The forward swept wing drag exhibited extreme sensitivity to wing root height and incidence variations. A relocation of the FSW root from a mid to high body position and an increase in incidence of 0.8 degrees resulted in a two hundred count drag reduction at C sub L = 0.9. A drag penalty was recorded at M = 2.0 for the forward swept 'cruise wing' which had the same sweep and 'box geometry' as the transonic maneuver wing but with reduced camber and twist accomplished by flap deflection. The drag penalty decreased at lower supersonic Mach numbers. The results indicate that aft swept wing transonic aerodynamic design methods can be used to design and analyze forward swept wings with only minor modifications. Author

N81-16012# Aeronautical Research Inst. of Sweden, Bromma. Aerodynamics Dept.

AN INVESTIGATION OF A SWEPT WING-BODY CONFIGURATION WITH DROOPED LEADING EDGE AT LOW AND TRANSONIC SPEEDS

Georg Drougge /n AGARD Subsonic/Transonic Configuration Aerodyn. Sep. 1980 10 p refs

Avail: NTIS HC A19/MF A01

A basic, non-drooped wing was designed (using an inverse transonic small disturbance method) to have a critical Mach Number of around M = 0.85 at C sub L = 0.2. The sweep angle is 25 deg, the aspect ratio 4 and the taper ratio 0.4. Several drooped leading edges, about 15 percent of the local chord and also including spanwise variation, were designed and tested. Numerical calculations were done for the low speed high lift case using a vortex lattice panel method and for the transonic speed case, first using a small disturbance method, later a full potential equation method (Jameson's FL022) and finally also a full Euler equations method (Rizzi). The experimental investigations were performed at low speeds at FFA (Re approximately 3 x 10 to the 6th power) at transonic speeds at FFA (Re approximately 1.5 to 4 x 10 to the 6th power) and at NAE, Canada (Re approximately 12 to 18 x 10 to the 6th power). These are mainly balance measurements but also some pressure distribution measurements have been obtained. The results indicate that it is possible to design a wing which has no transonic cruise drag penalty but which has a higher maximum coefficient of left and also better maneuver performance than the wing without droop. Author

N81-16013# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

AERODYNAMIC INTERACTION BETWEEN A CLOSE-COUPLED CANARD AND A SWEPTBACK WING IN TRANSONIC FLOW [INTERACTION AERODYNAMIQUE ENTRE UN CANARD PROCHE ET UNE AILE EN FLECHE EN ECOULEMENT TRANSSONIQUE]

Yves Brocard and Volker Schmitt /n AGARD Subsonic/Transonic Configuration Aerodyn. Sep. 1980 23 p refs In FRENCH

Avail: NTIS HC A19/MF A01

A swept wing model was tested with and without a canard in the transonic wind tunnel S2MA to study the effects of a closed coupled canard on the flow around the main wing. The most significant results in terms of force and pressure measurements on the main wing and wall flow visualizations are presented. The compressibility effect analysis for the wing alone configuration shows that the Mach number has a marked effect on the lift gradient at low incidence and on the vortex onset angle of attack. In transonic flow, the canard changes the flow field on the wing in a similar way as it does in incompressible flow: a decrease in the lift gradient and a delay in the vortex development. But the vortex lift decay is delayed so that the maximum lift is about the same with or without canard. The canard attenuates the discontinuity due to the vortex breakdown migration but increases two other discontinuities which occur at higher angles of attack and which are connected with the formation and the bursting of a quite strong secondary vortex. A.R.H.

N81-16014# Royal Aircraft Establishment, Farnborough (England).

SOME AERODYNAMIC INTERFERENCE EFFECTS THAT INFLUENCE THE TRANSONIC PERFORMANCE OF COMBAT AIRCRAFT

D. Treadgold and K. H. Wilson /n AGARD Subsonic/Transonic Configuration Aerodyn. Sep. 1980 17 p refs

Avail: NTIS HC A19/MF A01

The magnitude of the effects of viscous interactions, aeroelasticity and the aerodynamic interaction between the wing and fuselage are discussed in the context of a swept wing planform typical of some designs of combat aircraft. Illustrations drawn from experimental measurements and theoretical calculations show the significant influence of these factors on the form of the supercritical flow development at high subsonic speeds. Some

experimental measurements are given which indicate how small changes to the contour of the fuselage can produce significant changes in the drag measured at high subsonic speeds. The example shows that fuselage shaping can contribute to the development of a desirable form of supercritical flow on the wing with consequential benefit in drag levels at these speeds.
Author

N81-16015# Royal Netherlands Aircraft Factories Fokker, Schiphol-Oost. Aerodynamics Dept.
DESIGN STUDY FOR THE INNER WING OF A TRANSONIC WING-BODY COMBINATION OF ASPECT RATIO 8
N. Voogt and J. Th. v. d. Kolk *In* AGARD Subsonic/Transonic Configuration Aerodyn. Sep. 1980 11 p refs

Avail: NTIS HC A19/MF A01
A transonic design procedure for wing body combinations combines direct and inverse panel type computations and is based on the relationship between the exact transonic solution and an equivalent subsonic pressure distribution. The latter can be obtained by applying the subsonic panel method at the design condition for a shock free airfoil designed by hodograph theory. Several problems arise in the design of the inner wing because of the three dimensional character of the flow, which prevents a unique determination of the equivalent subsonic pressure distribution. Two essentially different approaches were followed by prescribing either a subcritical or a supercritical flow condition at the wing root. It is shown that the subcritical flow condition at the wing root can be achieved for a range of wing geometries with leading edge extensions on the inner wing or alternatively, by applying extensive body contouring to a wing originally designed to have supercritical flow at the root. A.R.H.

N81-16016*# Grumman Aerospace Corp., Bethpage, N.Y.
COMPLEX CONFIGURATION ANALYSIS AT TRANSONIC SPEEDS
C. W. Boppe and P. V. Aidala *In* AGARD Subsonic/Transonic Configuration Aerodyn. Sep. 1980 13 p refs

(Contracts NAS1-14732; F33615-78-C-3014)
Avail: NTIS HC A19/MF A01 CSCL 01A
Advanced performance requirements of new combat and transport aircraft together with design time constraints intensify the development and application of three dimensional computational analyses. A computational method which was developed for the specific purpose of providing an engineering analysis of complex aircraft configurations at transonic speeds. Particular attention is given to the recently incorporated wing viscous interaction and canard capabilities. The treatment of fuselage fairings, nacelles, and pylons is reviewed. The means for keeping computing resources at reasonable levels are identified. Three configurations were selected for correlations with experimental data. Taken together, the comparisons illustrate the full extent of current analysis capabilities. The configurations include: (1) a wing fuselage canard fighter; (2) a transport with fuselage fairings, four nacelles, four pylons; and (3) a space vehicle which includes an external fuel tank and rocket boosters (transonic launch configuration). A.R.H.

N81-16017*# Boeing Military Airplane Development, Seattle, Wash. Advanced Airplane Branch.
THEORETICAL AND EXPERIMENTAL STUDIES OF AERODYNAMIC INTERFERENCE EFFECTS
I. H. Rettie *In* AGARD Subsonic/Transonic Configuration Aerodyn. Sep. 1980 19 p refs Supported in part by NASA and USAF
Avail: NTIS HC A19/MF A01 CSCL 01A
Theoretical studies of aerodynamic forces on winglets shed considerable light on the mechanism by which these devices can reduce drag at constant total lift and on the necessity for proper alignment and cambering to achieve optimum favorable interference. Results of engineering studies, wind tunnel tests and performance predictions are reviewed for installations proposed for the AMST YC-14 and the KC-135 airplanes. The other major area of aerodynamic interference discussed is that of engine nacelle installations. Slipper and overwing nacelles have received much attention because of their potential for noise reduction, propulsive lift and improved ground clearance. A major challenge is the integration of such nacelles with the supercritical flow on the upper surface of a swept wing in cruise at high subsonic speeds. A.R.H.

N81-16018*# Nielsen Engineering and Research, Inc., Mountain View, Calif.
DATA BASE FOR THE PREDICTION OF INLET EXTERNAL DRAG
O. J. McMillan, E. W. Perkins, and S. C. Perkins, Jr. *In* AGARD Subsonic/Transonic Configuration Aerodyn. Sep. 1980 23 p refs
(Contracts NAS2-8874; NAS2-9513)
Avail: NTIS HC A19/MF A01 CSCL 01A
Results are presented from a study to define and evaluate the data base for predicting an airframe/propulsion system interference effect shown to be of considerable importance, inlet external drag. The study is focused on supersonic tactical aircraft with highly integrated jet propulsion systems, although some information is included for supersonic strategic aircraft and for transport aircraft designed for high subsonic or low supersonic cruise. The data base for inlet external drag is considered to consist of the theoretical and empirical prediction methods as well as the experimental data identified in an extensive literature search. The state of the art in the subsonic and transonic speed regimes is evaluated. The experimental data base is organized and presented in a series of tables in which the test article, the quantities measured and the ranges of test conditions covered are described for each set of data; in this way, the breadth of coverage and gaps in the existing experimental data are evident. Prediction methods are categorized by method of solution, type of inlet and speed range to which they apply, major features are given, and their accuracy is assessed by means of comparison to experimental data. Author

N81-16019# Vereinigte Flugtechnische Werke G.m.b.H., Bremen (West Germany).
PHILOSOPHY AND RESULTS OF STEADY AND UNSTEADY TEST TECHNIQUES ON A LARGE SCALE TRANSPORT AIRCRAFT MODEL IN THE ONERA TRANSONIC TUNNEL S1 MA. PART 1: PHILOSOPHY AND RESULTS OF STEADY TESTS. PART 2: INTEREST OF LARGE MODELS IN UNSTEADY AERODYNAMICS
G. Anders, A. Giacchetto (ONERA, Modane, France), and A. Gravelle (ONERA, Paris) *In* AGARD Subsonic/Transonic Configuration Aerodyn. Sep. 1980 25 p refs Partly in ENGLISH and FRENCH
Avail: NTIS HC A19/MF A01
Steady and unsteady wind tunnel tests with a large scale half model performed in the large ONERA transonic wind tunnel S1 MA within the German technology program ZKP and the development phase of the A 310 Airbus are considered. Various test techniques are introduced, their advantages and problems are discussed. The test arrangement concept is described and typical results for each of the investigated items are presented. Test results are compared with those on a complete model at lower Reynolds numbers. Stationary measurements are described and discussed. Characteristic results from unsteady tests are also presented and correlations are shown. A.R.H.

N81-16020*# Douglas Aircraft Co., Inc., Long Beach, Calif.
CABIN FIRE SIMULATOR LAVATORY TESTS Final Report, Jun. 1978 - Jun. 1980
Kenneth J. Schutter and David M. Klinck May 1980 344 p refs
(Contract NAS9-15591)
(NASA-CR-160909; MDC-J4649) Avail: NTIS HC A15/MF A01 CSCL 01C
All tests were conducted in the Douglas Cabin Fire Simulator under in-flight ventilation conditions. All tests were allowed to continue for a period of one hour. Data obtained during these tests included: heat flux and temperatures of the lavatory; cabin temperature variations; gas analyses for O2, CO2, CO, HF, HCl, and HCN; respiration and electrocardiogram data on instrumented animal subjects (rats) exposed in the cabin; and color motion pictures. All tests resulted in a survivable cabin condition;

however, occupants of the cabin would have been subjected to noxious fumes. T.M.

N81-16021*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
OZONE CONTAMINATION IN AIRCRAFT CABINS: RESULTS FROM GASP DATA AND ANALYSES
J. D. Holdeman and G. D. Nastrom (Control Data Corp., Minneapolis, Minn.) 1981 15 p refs Presented at the 19th Aerospace Sci. Meeting, St. Louis, 12-15 Jan. 1981; sponsored by the American Inst. of Aeronautics and Astronautics
(NASA-TM-81671; E-693) Avail: NTIS HC A02/MF A01 CSCL 01C

The global atmospheric sampling program pertaining to the problem of ozone contamination in commercial airplane cabins is described. Specifically, analyses of GASP data have: confirmed the occurrence of high ozone levels in aircraft cabins and documented the ratio of ozone inside and outside the cabins of two B747 airliners, including the effects of air conditioning modifications on that ratio; defined ambient ozone climatology at commercial airplane cruise altitudes, including tabulation of encounter frequency data which were not available before GASP; and outlined procedures for estimating the frequency of flights encountering high cabin ozone levels using climatological ambient ozone data, and verified these procedures against cabin measurements. Author

N81-16022*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
HUMAN FACTORS OF FLIGHT-DECK AUTOMATION: NASA/INDUSTRY WORKSHOP
Deborah A. Boehm-Davis, Renwick E. Curry, Earl L. Wiener (Miami Univ., Coral Gables, Fla.), and R. Leon Harrison Jan. 1981 26 p refs Workshop held at Burlingame, Calif., 17-18 Jul. 1980
(NASA-TM-81260; A-8432) Avail: NTIS HC A03/MF A01 CSCL 01C

The scope of automation, the benefits of automation, and automation-induced problems were discussed at a workshop held to determine whether those functions previously performed manually on the flight deck of commercial aircraft should always be automated in view of various human factors. Issues which require research for resolution were identified. The research questions developed are presented. A.R.H.

N81-16023# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. Dept. of Industrial and Systems Engineering.
AIRCREW COMPLIANCE WITH STANDARD OPERATING PROCEDURES AS A COMPONENT OF AIRLINE SAFETY Ph.D. Thesis - Ohio State Univ.
Jeffrey Edward Schofield 1980 183 p refs
(AD-A092443; AFIT-CI-80-30D) Avail: NTIS HC A09/MF A01 CSCL 01/2

Improving the safety of complex human-machine systems is a continuing challenge. Available information concerning system failures, which are usually called accidents, incidents, or mishaps, regularly points to human operators as the 'brittle elements.' The need for greater understanding of operator behavior is recognized in a variety of technologically sophisticated systems, for example, industrial processes, health care, public utilities and national defense; but nowhere is it more obvious than in the aftermath of a commerical airline accident. Following the November 1979 crash of an Air New Zealand DC-10 which killed 257 people in Antarctica, United Press International noted that the ten worst disasters in aviation history have all occurred since October 1972. Although the degree of operator culpability varies, the fact that the five deadliest accidents have occurred since March 1974 is particularly significant. At least one commercial airliner was completely destroyed and over 200 people were killed in each of the five crashes. Wide-body jetliners, either Boeing 747 or McDonnell Douglas DC-10 aircraft, were involved in each instance. The sheer size of such vehicles portends grave consequences in case of system failure, be it human mechanical or a combination of the two. GRA

N81-16024# Federal Aviation Administration, Washington, D.C. Office of Aviation Safety.
SPECIAL AVIATION FIRE AND EXPLOSION REDUCTION (SAFER) ADVISORY COMMITTEE, VOLUME 1 Final Report, 26 Jun. 1978 - 26 Jun. 1980
J. H. Enders and E. C. Wood 26 Jun. 1980 86 p refs
(AD-A092016; FAA-ASF-80-4-Vol-1) Avail: NTIS HC A05/MF A01 CSCL 13/12

The Special Aviation Fire and Explosion Reduction (SAFER) Advisory Committee and its technical supporting groups spent nearly 13 months from May 1979 through June 1980 examining the factors affecting the ability of the aircraft cabin occupant to survive in the post-crash fire environment and the range of solutions available. Having only a limited amount of time available, the Committee confined its examination to large transport category aircraft reasoning that recommendations developed could provide the necessary guidance for the FAA to address the broader spectrum of airplane and rotorcraft fire safety improvement. During the course of this assignment, certain topics that were outside the scope of the Committee, yet have some bearing on aircraft fire in general, were identified but not discussed by the Committee. Some of these topics were felt to be worthy of further examination by the FAA or by some other body of advisors constituted for that purpose. These topics are not addressed in this report. Presentations were made to the SAFER Committee by Committee members, technical supporting groups, the FAA, citizens and private firms. The broadly-constituted body of information developed and presented to the Committee formed the basis for Committee Findings and Recommendations. The Committee focused its recommendations on solutions or interim improvements. GRA

N81-16025# Naval Air Development Center, Warminster, Pa. Aircraft and Crew Systems Technology Directorate.
DESIGN, FABRICATION, AND TESTING OF THE MAXIMUM PERFORMANCE EJECTION SYSTEM (MPES) SEAT STRUCTURE
Thomas J. Zenobi and William C. Ward Nov. 1980 106 p
(AD-A092292; NADC-80208-60) Avail: NTIS HC A06/MF A01 CSCL 01/3

Navy has undertaken an effort to utilize an ejection seat structure composed of aluminum honeycomb sandwich composite material. This report documents the design, fabrication procedures and acceptance testing of the seat structure. Due to higher fabrication costs, tradeoffs between strength, weight and cost will have to be addressed. GRA

N81-16026# Rose-Hulman Inst. of Tech., Terre Haute, Ind. Civil and Mechanical Engineering Div.
COMPUTER CODE FOR THE DETERMINATION OF EJECTION SEAT/MAN AERODYNAMIC PARAMETERS Final Report
Donald C. Chiang 28 Aug. 1980 59 p refs
(Grant AF-AFOSR-0147-80; AF Proj. 2307)
(AD-A092721; AFOSR-80-1254TR) Avail: NTIS HC A04/MF A01 CSCL 01/2

The first phase of an effort concerning adaptation of Mark IV computer program (1) as an engineering tool to be used in day-by-day design and development work by the members of Air Crew Escape Group (AFWAL/FIER) was carried out. This research effort consisted of the following two parts: (1) modeling the ejection seat/man configuration, namely, representing its surface with a finite number of rectangular elements and inputting the geometry data of the model into the computer in a format acceptable to the Mark IV computer program, (2) computing the six aerodynamic coefficients using an appropriate pressure law option provided by the Mark IV computer program, and comparing the values predicted by the computer with those obtained from wind tunnel test. A total of five computer models patterned after the models used in wind tunnel test were created. Aerodynamic coefficients were computed for each model over an angle-of-attack range of -40 to 60 degrees and a yaw angle range of 0 to 30 degrees. By adjusting various factors which affect the outcome of computation, an attempt was made to identify an optimum computation method. GRA

N81-16027# *Federal Aviation Administration, Washington, D.C.* Office of Aviation Safety.
SUMMARY OF AVIATION SAFETY PROGRAM RESUMES. CABIN SAFETY
J. H. Harrison et al Oct. 1980 27 p
(AD-A091938; FAA-ASF-80-3) Avail: NTIS HC A03/MF A01 CSCL 01/2

This report contains a Program Activity Resume and a Project Details listing of those activities supporting the FAA Cabin Safety Program. The Cabin Safety Activity Resume identifies three sub-programs relating to Inflight, Crashworthiness and Post Crash safety activities. The sub-programs are identified and reported in the Project Details listing which includes: Inflight Fire, Operational Hazards, Training Duties, Crash Scenario Definition, Structural Load Analysis, Crashworthy Fuel Tanks, Fuel Fire Hazard, Cabin Interior Materials, Crew Considerations, Crash Rescue, SAFER Advisory Committee and Evacuation Systems. GRA

N81-16028# National Transportation Safety Board, Washington, D. C. Bureau of Technology.
BRIEFS OF FATAL ACCIDENTS INVOLVING WEATHER AS A CAUSE/FACTOR, US GENERAL AVIATION, 1978
5 Aug. 1980 313 p
(PB81-110827; NTSB-AMM-80-5) Avail: NTIS HC A14/MF A01 CSCL 01B

Included are 322 fatal accidents in the brief format. This format presents the facts, conditions, circumstances, and probable cause(s) for each accident. Additional statistical information was tabulated on all accidents involving weather as a cause/factor by types of accident, phase of operation, injury index, aircraft damage, pilots certificate, injuries and cause/factor(s). The publication is published annually. GRA

N81-16029# Naval Postgraduate School, Monterey, Calif.
RADIO DIRECTION FINDING ON HIGH FREQUENCY SHORT DURATION SIGNALS M.S. Thesis
Dennis Dean Sheppard Jun. 1980 175 p refs
(AD-A092136) Avail: NTIS HC A08/MF A01 CSCL 17/3

The feasibility of accomplishing high frequency direction finding against short duration (100-1000 ms) HF skywave signals using narrow aperture antennas is investigated. Two statistical procedures for estimating the signal bearing are proposed and compared. These procedures employ time averaging to reduce the large instantaneous bearing error caused by the phase and amplitude distortion of the wavefront due to scattering and multipath interference. Results are presented using data collected with the Southwest Research Institute Coaxial Spaced Loop HFDF system. It is shown that for a limited sample of data from this system the standard deviation of the bearing estimate for a 200 ms signal varied from 15 to 59 degrees. GRA

N81-16030# Analytic Sciences Corp., Reading, Mass.
OMEGA SIGNAL COVERAGE PREDICTION DIAGRAMS FOR 10.2 KHz. VOLUME 1: TECHNICAL APPROACH Final Report, Sep. 1979 - Oct. 1980
Radha R. Gupta, Stephen F. Donnelly, Paul M. Creamer, and Suzanne Sayer Oct. 1980 57 p refs
(Contract DOT-CG-951480-A)
(AD-A092741; TASC-TR-3077-2-Vol-1) Avail: NTIS HC A04/MF A01 CSCL 17/7

Individual Omega station and composite (Omega Navigation System) 10.2 kHz signal coverage prediction diagrams have been developed for eight times. The diagrams show the global accessibility of 'usable' 10.2 kHz signals at eight fixed diurnal/seasonal times for two usable signal access criteria. Criterion I requires: signal-to-noise ratio (SNR) > or = -20 dB (in a 100 Hz noise bandwidth) and delta phi < or = 20 centicycles (cen), where delta phi is the modal interference-induced phase deviation in the signal phase relative to the reference signal phase. Criterion II differs from Criterion I in that the SNR > or = -30 dB. Volume I presents the diagram development methodology and contains individual station nighttime modal interference diagrams. Each modal interference diagram identifies regions throughout the world where delta phi < or = 20 cec for nighttime *propagation conditions.* GRA

N81-16031# Analytic Sciences Corp., Reading, Mass.
OMEGA SIGNAL COVERAGE PREDICTION DIAGRAMS FOR 10.2 KHz. VOLUME 2: INDIVIDUAL STATION DIAGRAMS Final Report, Sep. 1979 - Oct. 1980
Radha R. Gupta, Stephen F. Donnelly, Paul M. Creamer, and Suzanne Sayer Oct. 1980 72 p 4 Vol.
(AD-A092742; TASC-TR-3077-2-Vol-2) Avail: NTIS HC A04/MF A01 CSCL 17/7

Individual Omega station and composite (Omega Navigation System) 10.2 kHz signal coverage prediction diagrams have been developed for eight times. The diagrams show the global accessibility of 'usable' 10.2 kHz signals at eight fixed diurnal/seasonal times for two usable signal access criteria. Criterion I requires: signal-to-noise ratio (SNR) = to or < -20 dB (in a 100 Hz noise bandwidth) and delta phi + or - 20 centicycles (cen), where delta phi is the modal interference-induced phase deviation in the signal phase relative to the reference signal phase. Criterion II differs from Criterion I in that the SNR = to or < -30 dB. Volume II presents 64 individual Omega station diagrams (Mercator projection): eight selected coverage times for each of eight stations. Each diagram displays the SNR and delta phi contours for a designated signal access criterion and coverage time. GRA

N81-16032# Analytic Sciences Corp., Reading, Mass.
OMEGA SIGNAL COVERAGE PREDICTION DIAGRAMS FOR 10.2 kHz. VOLUME 4: BEARING ANGLE TABLES Final Report, Sep. 1979 - Oct. 1980
Radha R. Gupta, Stephen F. Donnelly, Paul M. Creamer, and Suzanne Sayer Oct. 1980 56 p 4 Vol.
(Contract DOT-CG-951480-A)
(AD-A092744; , TASC-TR-3077-2-Vol-4) Avail: NTIS HC A04/MF A01 CSCL 17/7

Individual Omega station and composite (Omega Navigation System) 10.2 kHz signal coverage prediction diagrams have been developed for eight times. The diagrams show the global *accessibility of 'usable' 10.2 kHz signals at eight fixed diurnal/* seasonal times for two usable signal access criteria. Criterion 1 requires: signal-to-noise ratio (SNR) = to or < -20 dB (in a 100 Hz noise bandwidth) and delta phi + or - 20 centicycles (cen), where delta phi is the modal interference-induced phase deviation in the signal phase relative to the reference signal phase. Criterion 2 differs from Criterion 1 in that the SNR = to or < -30 dB. Volume 4 tabulates the bearing angles of great circles to each Omega station. These angles are computed at latitude/longitude grid points having a uniform spacing of four degrees. GRA

N81-16033# Naval Training Equipment Center, Orlando, Fla.
GLIDESLOPE DESCENT-RATE CUING TO AID CARRIER LANDINGS Final Report
Charles E. Kaul, Stanley C. Collyer, and Gavan Lintern Oct. 1980 62 p refs
(AD-A092193; NAVTRAEQUIPC-IH-322) Avail: NTIS HC A04/MF A01 CSCL 01/2

Two techniques for providing descent rate information to pilots making carrier landings were evaluated and shown to be effective in a flight simulator. Landing performance of experienced Naval aviators was tested with a conventional Fresnel lens optical landing system (FLOLS) and with a simple modification to the FLOLS to include variable length vertical light arrays, or arrows. Aircraft system dynamics can create substantial lags between an incorrect control input and the resulting error indication from the FLOLS. The techniques that were evaluated compensated for that lag by providing first order or rate information to the pilot. One system, designated the RATE display, showed the difference between the aircraft's actual descent rate and the descent rate that would maintain its present glideslope angle with respect to the FLOLS. The other, designated the COMMAND display, showed the magnitude of descent rate correction needed, and indicated a no error condition when the pilot was tracking the glideslope or returning to it at an appropriate rate of closure. Both displays improved glideslope tracking performance signifi*cantly throughout the approach.* *Author*

N81-16034# Federal Aviation Administration, Atlantic City, N.J.
CONSOLIDATED CAR DISPLAY: A SUMMARY REPORT OF THE PROCESS AND THE RESULTS OF THE CONSOLIDATION OF CRITICAL AND SUPPLEMENTARY TERMINAL AREA AIR TRAFFIC CONTROL INFORMATION FOR DISPLAY PRESENTATION Final Report, Jan. 1978 - Jun. 1979
Gerard Spanier Sep. 1980 49 p refs
(AD-A092450; FAA-CT-80-20; FAA-RD-80-73) Avail: NTIS HC A03/MF A01 CSCL 17/7

This report describes the work performed within the Systems Simulation and Analysis Division, ACT-200, to produce an engineering requirement for a terminal area display system for field implementation by the Airway Facilities Service. The report details the basic project efforts to define a data display system to consolidate many of the Terminal Radar Approach Control Facility (TRACON) and tower cab controller's indicators, displays, alarms, controls, status lights, weather data presentations, etc., to reduce physical size, improve work station efficiency and enhance the management and use of Air Traffic Control (ATC) oriented data. The report covers the data collection process; the requirements determination process; the technology assessment performed; the design development and validation of certain hardware/software components; a risk assessment of the unique aspects of the system design; and the engineering requirement form. GRA

N81-16035# Army Missile Command, Redstone Arsenal, Ala. Guidance and Control Directorate.
FIELD EVALUATION OF THE LR80 LAND NAVIGATION SYSTEM
L. J. Little Apr. 1980 81 p
(AD-A091885; AD-E950035; DRSMI/RG-80-22) Avail: NTIS HC A05/MF A01 CSCL 17/7

This report contains the results of a field evaluation of the Litton Industries LR80 Land Navigation System conducted by the Guidance and Control Directorate at Redstone Arsenal, Al. The overall performance of the system established a north alignment with .021 deg, a position accuracy of .33 percent of the distance traveled and the elevation variation was so great that an accuracy value was not considered. GRA

N81-16036# Human Engineering Labs., Aberdeen Proving Ground, Md.
A PRELIMINARY HUMAN FACTORS FLIGHT ASSESSMENT OF A MARCONI AUTOMATIC MAP Final Report
Thomas L. Frezell Oct. 1980 20 p refs
(AD-A092585; HEL-TN-14-80) Avail: NTIS HC A02/MF A01 CSCL 17/7

A Marconi Automatic Map Reader was flight tested in low level, enroute, and nap-of-the-earth flight profiles to determine its suitability for navigation. The results obtained from these flights demonstrated a viable potential of the Marconi AMR as an interim navigation system. GRA

N81-16037# Sandia Labs., Albuquerque, N. Mex.
A SINGLE GIMBAL/STRAPDOWN INERTIAL NAVIGATION SYSTEM FOR USE ON SPIN STABILIZED FLIGHT TEST VEHICLES
Alfred C. Watts and Ronald D. Andreas 1980 7 p refs Sponsored by DOE
(SAND-80-2479C; CONF-801211-1) Avail: NTIS HC A02/MF A01

A hybrid strapdown inertial navigation system intended for use on spin stabilized flight test vehicles is described. The configuration of the navigator consists of three floated rate integrating gyros, one of which is used in conjunction with the remaining two operated in a rate gyro mode. Outputs from the two strapdown gyros and three accelerometers are digitized and processed by a high performance computer. The navigation algorithms utilize a direction cosine matrix formulation for the attitude computation implemented in the digital computer. The implementation of this algorithm for the single gimbal configuration is described. An accuracy model and results for a reentry vehicle flight test trajectory are presented. Finally, the flight test performance from launch to reentry is presented. M.G.

N81-16038# National Technical Information Service, Springfield, Va.
COLLISION AVOIDANCE SYSTEMS. CITATIONS FROM THE NTIS DATA BASE Progress Report, 1964 - Jul. 1980
Guy E. Habercom, Jr. Aug. 1980 425 p Supersedes NTIS/PS-79/0960; NTIS/PS-78/0883
(PB80-815020; NTIS/PS-79/0960; NTIS/PS-78/0883) Avail: NTIS HC $30.00/MF $30.00 CSCL 01B

Collision avoidance systems in three modes of transportation (i.e. air, surface, marine) are investigated in these research reports. Section 1 pertains to air transportation. Traffic scheduling, automatic ground based stations, and onboard warning systems are researched. Contains 300 abstracts. Section 2 delineates sensors and detectors relative to marine transportation collision avoidance. Contains 68 abstracts. Section 3 relates to engineering research relative to highway and rail collision avoidance. Contains 46 abstracts. This updated bibliography contains 416 citations, 33 of which are new entries to the previous edition. GRA

N81-16039*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
USE OF CONSTRAINED OPTIMIZATION IN THE CONCEPTUAL DESIGN OF A MEDIUM-RANGE SUBSONIC TRANSPORT
Steven M. Sliwa Dec. 1980 38 p refs
(NASA-TP-1762; L-13946) Avail: NTIS HC A03/MF A01 CSCL 01C

Constrained parameter optimization was used to perform the optimal conceptual design of a medium range transport configuration. The impact of choosing a given performance index was studied, and the required income for a 15 percent return on investment was proposed as a figure of merit. A number of design constants and constraint functions were systematically varied to document the sensitivities of the optimal design to a variety of economic and technological assumptions. A comparison was made for each of the parameter variations between the baseline configuration and the optimally redesigned configuration. Author

N81-16040*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SAMPLE DATA EFFECTS OF HIGH-PASS FILTERS
David O. Chin Jan. 1981 32 p refs
(NASA-TP-1797; A-8361) Avail: NTIS HC A03/MF A01 CSCL 01C

Four mathematical models of linear first and second order high pass washout filters were analyzed. These models were Euler's Integration, Zero-Order Hold, Bilinear Transformation, and Second-Order Adams-Bashforth Integration. Bode responses for each model at various sample rates were compared to the continuous filter response. Higher sample rates produced Bode responses approaching the continuous response and the Bilinear Transformation model produced the best responses over the frequency spectrum and sample rates. Pole location analysis of each model in the z-plane showed the Bilinear Transformation and Zero-Order Hold models gave stable poles regardless of time step size, whereas the other models did not display stable poles. A near constant gain error over the entire frequency spectrum was discovered in the Zero-Order Hold cases and a correction gain was calculated for the first-order high-pass filter case. S.F.

N81-16041*# Lockheed-Georgia Co., Marietta.
TURBOPROP CARGO AIRCRAFT SYSTEMS STUDY, PHASE 1
J. C. Muehlbauer, James G. Hewell, Jr., Stephen P. Lindenbaum, Charles C. Randall, Norm Searle, and F. Robert Stone, Jr. Nov. 1980 192 p refs
(Contract NAS1-15708)
(NASA-CR-159355; LG80ER0112) Avail: NTIS HC A09/MF A01 CSCL 01C

The effects of advanced propellers (propfan) on aircraft direct operating costs, fuel consumption, and noiseprints were determined. A comparison of three aircraft selected from the results with competitive turbofan aircraft shows that advanced turboprop

aircraft offer these potential benefits, relative to advanced turbofan aircraft: 21 percent fuel saving, 26 percent higher fuel efficiency, 15 percent lower DOCs, and 25 percent shorter field lengths. Fuel consumption for the turboprop is nearly 40 percent less than for current commercial turbofan aircraft. Aircraft with both types of propulsion satisfy current federal noise regulations. Advanced turboprop aircraft have smaller noiseprints at 90 EPNdB than advanced turbofan aircraft, but large noiseprints at 70 and 80 EPNdB levels, which are usually suggested as quietness goals. Accelerated development of advanced turboprops is strongly recommended to permit early attainment of the potential fuel saving. Several areas of work are identified which may produce quieter turboprop aircraft. Author

N81-16042*# Boeing Aerospace Co., Seattle, Wash. Engineering Technology.

DESIGN, FABRICATION AND TEST OF GRAPHITE/POLYIMIDE COMPOSITE JOINTS AND ATTACHMENTS FOR ADVANCED AEROSPACE VEHICLES Quarterly Technical Progress Report, 1 Feb. - 30 Apr. 1980

19 May 1980 31 p refs
(Contract NAS1-15644)
(NASA-CR-159112; QTPR-5) Avail: NTIS HC A03/MF A01 CSCL 01C

Principal program activities dealt with the literature survey, design of joint concepts, assessment of GR/PI material quality, fabrication of test panels and specimens, and small specimen testing. Bonded and bolted designs are presented for each of the four major attachment types. Quality control data are presented for prepreg Lots 2W4651 and 3W2020. Preliminary design allowables test results for tension tests and compression tests of laminates are also presented. T.M.

N81-16043# Air Force Academy, Colo. Dept. of Engineering Mechanics.

MODAL ANALYSIS FOR AIRCRAFT RESPONSE TO RUNWAY SURFACE ROUGHNESS Final Report, 1 Jun. 1978 - 30 Jun. 80

Ralph R. Gajewski Jun. 1980 42 p refs
(AF Proj. 2104)
(AD-A092057; AFESC/ESL-TR-80-32) Avail: NTIS HC A03/MF A01 CSCL 01/3

This report develops one and three degree-of-freedom linear vibration models for the prediction of aircraft response to runway surface roughness. The equations of motion are integrated in principal coordinates using modal analysis. The modal parameters required are natural frequency, damping ratio, and mode shape for each degree of freedom. Comparison of results is made with the TAXI code that has a nonlinear strut model. Results are presented for asymmetric motion due to spall profiles in the runway. GRA

N81-16044# Naval Ship Research and Development Center, Bethesda, Md. Aviation and Surface Effects Dept.

P-3 ORION FUEL-SAVING MODIFICATION WIND TUNNEL STUDY

Andrew G. Lee Jun. 1980 66 p
(AD-A091906; DTNSRDC/ASED-80/14) Avail: NTIS HC A04/MF A01 CSCL 20/4

A joint investigation was conducted on the potential drag reduction of the P-3 Orion aircraft through various modifications to the engine nacelles. A 1/16-scale model was used in the 7- by 10-foot transonic wind tunnel experiments conducted over an angle of attack range of -4 to 7 deg. Force data were taken on 14 different model configurations with all modifications in the engine nacelle areas. The experiments were conducted as part of the P-3 Fuel-Saving Modifications Program. GRA

N81-16045# Army Aviation Engineering Flight Activity, Edwards AFB, Calif.

PRELIMINARY AIRWORTHINESS EVALUATION AH-1S (PROD) HELICOPTER EQUIPPED WITH A SUBSTITUTE STRAIGHT EXHAUST PIPE Final Report

Patrick M. Morris, Ralph Woratschek, John R. Niemann, and Charles E. Frankenberger, Jr. Jun. 1980 36 p
(AD-A092614; USAAEFA-79-09) Avail: NTIS HC A03/MF A01 CSCL 01/3

A limited performance and handling qualities evaluation and an engine and transmission cooling survey of an AH-1S (PROD) Helicopter equipped with a substitute straight exhaust pipe was performed at Edwards Air Force Base between 20 and 23 August 1979. A total of 8 hours, 6.3 of which were productive, was required. No significant changes in performance or handling qualities were found as a result of the substitute straight exhaust pipe installation. The engine and transmission cooling characteristics were similar to those of a production AH-1S and were satisfactory. No previously unreported shortcomings or deficiencies were identified. GRA

N81-16046# Army Aviation Engineering Flight Activity, Edwards AFB, Calif.

PRELIMINARY AIRWORTHINESS EVALUATION (PAE 1) OF THE YCH-47D HELICOPTER Final Report, Sep. - Dec. 1979

Grady W. Wilson, Charles F. Adam, Stuart F. Arthur, John R. Niemann, and Frame J. Bowers May 1980 150 p refs
(AD-A092633; USAAEFA-79-06) Avail: NTIS HC A07/MF A01 CSCL 01/3

The Preliminary Airworthiness Evaluation of the YCH-47D helicopter was conducted between 11 September and 6 December 1979. Seventeen flights were required for a total of 41.4 hours, of which 32.8 hours were productive. Testing was conducted at the Boeing Flight Test Facility at Wilmington, Delaware. The YCH-47D exhibits improved lift capability at a hover (both in and out of ground effect) when compared to the CH-47C with fiberglass rotor blades and T55-L-712 engines. Higher airspeeds are also possible at high gross weights. The AFCS was found to be an enhancing characteristic. Twenty shortcomings and one deficiency were also documented during the test. The deficiency of delay in power steering activation should be corrected prior to operational deployment. The noise level in the cockpit and cabin showed no apparent improvement over previous models and was of sufficient magnitude to induce temporary hearing loss without adequate protection. The vibration levels became excessive above 145 KIAS, increasing to unacceptable prior to V sub H, with 6 per rev vibrations being predominant. GRA

N81-16047# Environmental Research Inst. of Michigan, Ann Arbor. Radar and Optics Div.

AN ASSESSMENT OF TECHNICAL FACTORS INFLUENCING THE POTENTIAL USE OF RPVS FOR MINEFIELD DETECTION

Yuji Morita and Henry McKenney Jul. 1980 65 p refs
(Contract DAAK70-78-C-0198)
(AD-A092682; ERIM-138300-57-T) Avail: NTIS HC A04/MF A01 CSCL 17/8

An assessment is made of the use of television and FLIR sensors carried on RPVs as remote minefield detection systems, based on four major scenarios for Soviet mine warfare operations involving the use of TM-46 metallic and PM-60 plastic antivehicular mines. The RPV system minefield detection capability, response time and search rate are functions of the sensor resolution, field of view and sensitivity capabilities; the obscuration due to vegetation, atmospheric attenuation, terrain and weather; the radiance contrast existing between mines and background; the airborne platform characteristics; data link characteristics; the man/machine interface; and command, control and communication system characteristics. These factors are considered in this study to initially define the minefield detection capability of currently planned RPVs, to indicate areas where additional data is needed to provide a better definition of RPV minefield detection capabilities and to indicate parameters for an improved next generation sensor system. GRA

N81-16048# Air Force Packaging Evaluation Agency, Wright-Patterson AFB, Ohio.

EVALUATION/REDESIGN OF THE F-105 PITCH RATE GYRO PACK

James D. Heck Oct. 1980 10 p
(AFPEA Proj. 80-P7-21)
(AD-A092109; PTPT-80-16) Avail: NTIS HC A02/MF A01 CSCL 13/4

The F-105 Pitch Rate Gyro Pack was subjected to rough handling tests in compliance with Federal Test Method Standard 101B. The objective of this testing was to determine the level of shock protection provided for the Pitch Rate Gyro and to redesign the container if the current pack does not provide a 15 G level of protection, the rated fragility value for the item. It was determined that the pack presently used does not provide the required level of protection, therefore the pack was redesigned to provide a 15 G level of protection. GRA

N81-16049# Systems and Applied Sciences Corp., Riverdale, Md.

A SURVEY OF COMPUTER SIMULATIONS OF DIGITAL AVIONICS SYSTEMS Final Report, 1 Jul. 1979 - 1 Feb. 1980

James Watson, J. Davis, and R. Satterfield Wright-Patterson AFB, Ohio AFWAL Sep. 1980 82 p refs
(Contract F33615-79-C-1870; AF Proj. 2003)
(AD-A091943; AFWAL-TR-80-1057) Avail: NTIS HC A05/MF A01 CSCL 09/2

Three simulation systems (GCSS, DSDS and DAS/DDPM) can meet AFWAL's requirements for flexible, all-software, engineering tool. All factors considered, GCSS can meet those needs best for the short-term, and in so doing, serve as a test vehicle for better definition of AFAL's long-term requirements. GRA

N81-16050*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

COLD-AIR INVESTIGATION OF FIRST STAGE OF 4-1/2-STAGE, FAN DRIVE TURBINE WITH AVERAGE STAGE-LOADING FACTOR OF 4.66

Warren J. Whitney, Thomas P. Moffitt, and Frank P. Behning Jan. 1981 15 p refs
(NASA-TP-1780; E-461) Avail: NTIS HC A02/MF A01 CSCL 21E

The design procedure and the development of the blading geometry for the 4 and 1/2 stage turbine are discussed. Results obtained with the first stage, operated as a single stage turbine, are presented. A free vortex design meets the design requirements without incurring problems such as excessive turning, negative reaction, or high Mach number. Cold air tests of the single stage turbine showed that the turbine developed design work (stage loading factor of 5.26) at an efficiency of 0.86, which was the efficiency predicted by a reference method. The mass flow at this condition was 0.88, which occurred at design speed and a pressure ratio of 1.407, corresponding to a stage loading factor of 4.35. The efficiency at this condition was 0.003 higher than that predicted by the reference method. Author

N81-16051*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.

CORE COMPRESSOR EXIT STAGE STUDY. VOLUME 2: DATA AND PERFORMANCE REPORT FOR THE BASELINE CONFIGURATION

D. C. Wisler Nov. 1980 178 p refs
(Contract NAS3-20070)
(NASA-CR-159498; R80AEG312-Vol-2) Avail: NTIS HC A09/MF A01 CSCL 21E

The objective of the program is to develop rear stage blading designs that have lower losses in their endwall boundary layer regions. The overall technical approach in this efficiency improvement program utilized General Electric's Low Speed Research Compressor as the principal investigative tool. Tests were conducted in two ways: using four identical stages of blading so that test data would be obtained in a true multistage environment and using a single stage of blading so that comparison with the multistage test results could be made. T.M.

N81-16052*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

AN OVERVIEW OF GENERAL AVIATION PROPULSION RESEARCH PROGRAMS AT NASA LEWIS RESEARCH CENTER

Edward A. Willis and William C. Strack 1981 48 p refs Proposed for presentation at the Natl. Business Aircraft Meeting, 13-15 Apr. 1981, Wichita, Kansas; sponsored by SAE
(NASA-TM-81666; E-686) Avail: NTIS HC A03/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.

N81-16053*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

MEAN ROTOR WAKE CHARACTERISTICS OF AN AERODYNAMICALLY LOADED 0.5 m DIAMETER FAN

L. M. Shaw and F. W. Glaser 1981 18 p refs Presented at 19th Aerospace Sci. Meeting, St. Louis, 12-15 Jan. 1981; sponsored by AIAA
(NASA-TM-81657; E-674) Avail: NTIS HC A02/MF A01 CSCL 01A

Mean rotor wake properties at several downstream distances behind the rotor of a loaded 1.2 pressure ratio fan were measured with a cross film anemometer in an anechoic wind tunnel. Mean wake characteristics in the midspan and near tip region were determined utilizing an ensemble averaging technique. The upwash and streamwise components of the velocity behind the rotor indicate a complex structure superimposed on the major velocity defects at a down stream spacing of 0.5 rotor chords. Spectral analysis indicates high levels of the second and fourth harmonics of the blade passage frequency in the midspan region while the blade passage frequency and its second and third harmonic are predominant in the tip region. Author

N81-16054*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EXPERIMENTAL ANALYSIS OF IMEP IN A ROTARY COMBUSTION ENGINE

H. J. Schock, W. J. Rice, and P. R. Meng 1981 44 p refs Presented at Intern. Symp. of Automotive Engr., Detroit, 23-27 Feb. 1981
(NASA-TM-81662; E-680) Avail: NTIS HC A03/MF A01 CSCL 21E

A real time indicated mean effective pressure measurement system is described which is used to judge proposed improvements in cycle efficiency of a rotary combustion engine. This is the first self-contained instrument that is capable of making real time measurements of IMEP in a rotary engine. Previous methods used require data recording and later processing using a digital computer. The unique features of this instrumentation include its ability to measure IMEP on a cycle by cycle, real time basis and the elimination of the need to differentiate volume function in real time. Measurements at two engine speeds (2000 and 3000 rpm) and a full range of loads are presented, although the instrument was designed to operate to speeds of 9000 rpm. Author

N81-16055*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

PROPULSION SYSTEM MATHEMATICAL MODEL FOR A LIFT/CRUISE FAN V/STOL AIRCRAFT

Gary L. Cole, James F. Sellers, and Bruce E. Tinling (NASA. Ames Research Center) Dec. 1980 48 p refs
(NASA-TM-81663; E-681) Avail: NTIS HC A03/MF A01 CSCL 21E

A propulsion system mathematical model is documented that allows calculation of internal engine parameters during transient operation. A non-realtime digital computer simulation of the model is presented. It is used to investigate thrust response and modulation requirements as well as the impact of duty cycle on engine life and design criteria. Comparison of simulation results with steady-state cycle deck calculations showed good agreement. The model was developed for a specific 3-fan subsonic V/STOL aircraft application, but it can be adapted for use with any similar lift/cruise V/STOL configuration. Author

N81-16056*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
TWO-STAGE COMBUSTION FOR REDUCING POLLUTANT EMISSIONS FROM GAS TURBINE COMBUSTORS
Richard M. Clayton and David H. Lewis 1 Feb. 1981 86 p refs
(Contract NAS7-100)
(NASA-CR-163877; JPL-Pub-80-63) Avail: NTIS HC A05/MF A01 CSCL 21E

Combustion and emission results are presented for a premix combustor fueled with admixtures of JP5 with neat H2 and of JP5 with simulated partial-oxidation product gas. The combustor was operated with inlet-air state conditions typical of cruise power for high performance aviation engines. Ultralow NOx, CO and HC emissions and extended lean burning limits were achieved simultaneously. Laboratory scale studies of the non-catalyzed rich-burning characteristics of several paraffin-series hydrocarbon fuels and of JP5 showed sooting limits at equivalence ratios of about 2.0 and that in order to achieve very rich sootless burning it is necessary to premix the reactants thoroughly and to use high levels of air preheat. The application of two-stage combustion for the reduction of fuel NOx was reviewed. An experimental combustor designed and constructed for two-stage combustion experiments is described. T.M.

N81-16057*# Avco Lycoming Div., Stratford, Conn.
DESIGN AND EVALUATION OF AN INTEGRATED QUIET CLEAN GENERAL AVIATION TURBOFAN (QCGAT) ENGINE AND AIRCRAFT PROPULSION SYSTEM Final Report, Dec. 1976 - Apr. 1980
Jon German, Philip Fogel, and Craig Wilson Apr. 1980 226 p refs
(Contract NAS3-20584)
(NASA-CR-165185; LYC-80-27) Avail: NASA Industrial Application Center CSCL 21E

The engine and nacelle system design was to demonstrate the applicability of large turbofan engine technology to small turbofans suitable for the general aviation market. The design was based on the LTS-101 engine family for the core engine. A high bypass fan design (BPR = 9.4) was incorporated to provide reduced fuel consumption for the design mission. All acoustic and pollutant emissions goals were achieved. A discussion of the preliminary design of a business jet suitable for the developed propulsion system is also included. Large engine technology can be successfully applied to small turbofans, and noise or pollutant levels need not be constraints for the design of future small general aviation turbofan engines. T.M.

N81-16058*# Mississippi State Univ., Mississippi State. Engineering and Industrial Research Station.
PROPELLER PROPULSION INTEGRATION, PHASE 1 Final Report
George Bennett, Keith Koenig, Stan J. Miley, John McWhorter, and Graham Wells Feb. 1981 131 p refs
(Grant NsG-1402)
(NASA-CR-163921; MSSU-EIRS-ASE-81-4) Avail: NTIS HC A07/MF A01 CSCL 01C

A bibliography was compiled of all readily available sources of propeller analytical and experimental studies conducted during the 1930 through 1960 period. A propeller test stand was developed for the measurement of thrust and torque characteristics of full scale general aviation propellers and installed in the LaRC 30 x 60 foot full scale wind tunnel. A tunnel entry was made during the January through February 1980 period. Several propellers were tested, but unforseen difficulties with the shaft thrust torque balance severely degraded the data quality. T.M.

N81-16060# Naval Postgraduate School, Monterey, Calif.
VALIDATION OF A TWO DIMENSIONAL PRIMITIVE VARIABLE COMPUTER CODE FOR FLOW FIELDS IN JET ENGINE TEST CELLS M.S. Thesis
Paul Joseph Mallon Jun. 1980 76 p refs
(AD-A092138) Avail: NTIS HC A05/MF A01 CSCL 21/5

Pressure and velocity data were collected in a full scale jet engine test cell in order to validate the predictive accuracy of a two dimensional and axisymmetric primitive variable computer code. It was found that the model reasonably predicted the velocity profiles in the augmentor tube. Inaccuracy increased at higher engine thrust settings at positions far downstream in the augmentor tube. Predicted pressure profiles were reasonable but the magnitudes were in considerable error at high flow rates. GRA

N81-16062# Virginia Univ., Charlottesville. Dept. of Mechanical and Aerospace Engineering.
NONLINEAR ANALYSIS OF SQUEEZE FILM DAMPERS APPLIED TO GAS TURBINE HELICOPTER ENGINES Final Report, 15 Jan. 1977 - 31 May 1980
E. J. Gunter, L. E. Barrett, and P. E. Allaire Nov. 1980 13 p
(Contract DAAG29-77-C-0009)
(AD-A091905; ARO-14100.1-E) Avail: NTIS HC A02/MF A01 CSCL 21/5

Application of the finite length correction factor for the analysis of the finite length squeeze film bearings has been made, and a method has been found to be highly efficient. The modal transient program, to include linear rotor acceleration, has been developed and various analyses of rotor systems have been done. A rapid method to calculate the load capacity and dynamics characteristics of a journal or squeeze film bearing has been developed using a finite element approach coupled with an end leakage correction factor. A procedure has been developed to balance a multistage turbine without having to first apply trial weights to generate a set of influence coefficients. This procedure represents a major advance in the technology of flexible rotor balancing. It is incorporated into a minicomputer system which can collect and analyze the rotor data. GRA

N81-16063# Calspan Advanced Technology Center, Buffalo, N.Y.
NUCLEAR BLAST RESPONSE OF AIRBREATHING PROPULSION SYSTEMS. LABORATORY MEASUREMENTS WITH AN OPERATIONAL J-85-5 TURBOJET ENGINE Final Report, 1 Feb. 1979 - 31 Mar. 1980
Michael G. Dunn 31 Mar. 1980 67 p refs
(Contract DNA001-79-C-0155)
(AD-A092229; CALSPAN-6486-A-1; DNA-5268F) Avail: NTIS HC A04/MF A01 CSCL 21/5

The work discussed in this report represents a technology development program in which an experimental technique has been developed for the performance of controlled laboratory measurements of simulated nuclear blast response of airbreathing propulsion systems. The technology program utilized an available J-85-5 turbojet engine located in the test section of the Calspan Ludwieg-tube facility. Significant modifications, described herein, were made to this facility in order to adapt it to the desired configuration. The J-85-5 engine had previously been used at Calspan for other purposes and thus came equipped with a total of eight pressure transducers at four axial locations along with compressor section. These transducers have a frequency response on the order of 40 KHz. Preliminary comparisons have been made between the measured pressure histories at selected compressor locations and predicted pressure histories using a simple computer code. The development of the code was initiated under this contract and completed as part of an ongoing IR D effort at Calspan in computational fluid dynamics and problem areas related to engine dynamics. GRA

N81-16064# Federal Aviation Administration, Atlantic City, N.J.
EXHAUST EMISSION CHARACTERISTICS AND VARIABILITY FOR MAINTAINED GENERAL ELECTRIC CF6-50 TURBOFAN ENGINES Final Report, Jul. - Oct. 1979
Gary Frings Sep. 1980 57 p refs
(FAA Proj. 201-521-100)
(AD-A092291; FAA-CT-80-36) Avail: NTIS HC A04/MF A01 CSCL 21/5

Five General Electric (GE) CF6-50 turbofan engines were tested at the GE overhaul facility in Ontario, California, to quantify and determine the variability of the exhaust emission levels. The effects of heavy maintenance on these emission levels were also studied. Only two of the engines tested actually received major maintenance. Consequently, the data collected is limited in quantity. Conclusions, observations and recommendations are

presented based on this limited data base. No correlation of exhaust emission levels and type of maintenance was possible. The exhaust emission levels of carbon monoxide (CO) and oxides of nitrogen (NOx) have been determined; total hydrocarbon (THC) levels are not quantified. The variability of the CO and NOx species is less than five percent. THC variability is almost 30 percent. The engine emissions did not meet the current or proposed federal standards. Ninety percent of the turbine engine exhaust emissions are produced at the idle power mode. The operational parameters for this important (from the standpoint of emission data collection) mode are vague and should be more defined. The type of fuel used for emission testing has a significant effect on the resultant exhaust emission levels. GRA

N81-16065# Cincinnati Univ., Ohio. Dept. of Aerospace Engineering and Applied Mechanics.

THREE DIMENSIONAL INTERNAL FLOWS IN TURBOMACHINERY, VOLUME 1 Final Report, Jan. 1978 - Jun. 1980

Awatef A. Hamed Jun. 1980 51 p refs

(Contract F49620-78-C-0041; AF Proj. 2307)

(AD-A092737; AFOSR-80-1214TR) Avail: NTIS HC A04/MF A01 CSCL 20/4

This report describes an efficient numerical scheme developed for investigating secondary flows, and outlines the design of an experimental set-up for obtaining detail in channel three dimensional secondary flow measurements. The analysis applies to inviscid internal rotational flow fields and leads to a very efficient numerical scheme for predicting the secondary flow phenomena. The analysis is applied to the rotational flow in a 90 deg bend with rectangular cross section and then compared with the experimental data. It is concluded from the comparison that the physics of the secondary flow problem are well represented in the analysis. The analysis can be adapted with some modifications to variable area ducts, and turbomachinery passages. GRA

N81-16066*# Kansas Univ. Center for Research, Inc., Lawrence.

THE STATE OF THE ART OF GENERAL AVIATION AUTOPILOTS

Michael J. See and David Levy Aug. 1980 95 p refs

(Contract NAS1-16255)

(NASA-CR-159371) Avail: NTIS HC A05/MF A01 CSCL 01C

The study is based on the information obtained from a general literature search, product literature, and visitations and interviews with manufacturers, users, and service centers. State of the art autopilots are documented with respect to total systems, components, and functions. Recommendations concerning potential areas of further research are also presented. T.M.

N81-16067# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. Dept. of Industrial Engineering.

THE EFFECTS OF THE DIRECTION OF CONTROL LOADING ON A ONE-DIMENSIONAL TRACKING TASK M.S. Thesis - Georgia Institute of Technology

James Michael Carlin Mar. 1980 70 p refs

(AD-A092459; AFIT-CI-80-10T) Avail: NTIS HC A04/MF A01 CSCL 01/2

Modern fighter aircraft flight controls are activated by the pilot through a joystick. Because of heavy loads on the control surfaces, the flight controls are finally actuated by powerful hydraulic actuators. Artificial feel systems of varying complexity are utilized to give some feedback to the pilot to aid in control. Regardless of the system, virtually all are equipped with thumb-actuated pitch and roll trim. This feature allows the pilot to quickly and easily change the fore and aft or lateral stick force required to control the pitch and roll of the aircraft. During precise tracking tasks such as flying close formation maneuvers, or tracking an air or ground target in an aiming device, many pilots desire to trim the stick forward. A smaller proportion constantly strive for zero pressure in a precise tracking situation. Virtually none trim aft stick pressure in this environment. This study is strictly concerned with uni-directional control loading. GRA

N81-16068# Grumman Aerospace Corp., Bethpage, N.Y.

DEMONSTRATION OF A METHOD FOR DETERMINING CRITICAL STORE CONFIGURATIONS FOR WING STORE FLUTTER Final Report

Richard R. Chipman and Edward J. Laurie May 1980 132 p refs

(Contract N00019-79-C-0062)

(AD-A092257; ADCR-80-1) Avail: NTIS HC A07/MF A01 CSCL 20/4

The A-6E aircraft and its extensive store inventory were analyzed. Searches of the inventory singled out the potentially critical configurations that gave flutter speeds well within the flight envelope for low assumed values of structural damping. Comparisons were made with previous results from A-6 studies and possible explanations for the apparent anomaly were explored. The method offers an efficient alternative to existing practices for determining potentially flutter critical store combinations from the many thousands of store loadings that can occur on attack aircraft. T.M.

N81-16069# European Space Agency, Paris (France).

GRAVIMETRIC INVESTIGATION OF THE PARTICLE NUMBER DENSITY DISTRIBUTION FUNCTION IN THE HIGH SPEED CASCADE WIND TUNNEL FOR LASER ANEMOMETRY MEASUREMENTS

Harro Bessling and Torsten Hinz Sep. 1980 34 p refs Transl. into ENGLISH of "Gravimetrische Untersuchung der Partikelzahldichteverteilungsfunktionen im Hochgeschwindigkeits Gitterwindkamal fuer laser anemometrische Messungen", DFVLR-FB 79-12, Brunswick, Jan. 1979 38 p Original report in GERMAN previously announced as X80-75089 Original German report available from DFVLR, Cologne DM 8.50

(ESA-TT-625; DFVLR-FB-79-12) Avail: NTIS HC A03/MF A01

Laser anemometry requires a minimum concentration of scattering particles in the flow. Before an L2F velocimeter could be used, the natural dust content in the low pressure tank of the high speed cascade wind tunnel had to be evaluated for this type of measurement. A Coulter counter was used for the necessary dust analysis by the gravimetric method. The result showed that the behavior of the particle number density distribution functions is dynamic and particularly dependent upon the flow velocity. A self cleaning effect, which is very important for laser anemometry, was found to make the tunnel dust free in the minimum amount of time, and a model concept was developed to explain the loss mechanism. Author

N81-16070# IIT Research Inst., Chicago, Ill. Guidance and Control Information and Analysis Center.

EVALUATION OF RF ANECHOIC CHAMBER FIRE PROTECTION SYSTEMS Final Report

Thomas E. Waterman, John A. Campbell, Larry D. Paarmann, Irving N. Indel, and Charles W. Smoots Jul. 1980 177 p refs

(Contract DSA900-77-C-3840)

(AD-A092478; AD-E900032; GACIAC-SR-80-02; NWC-TP-6211) Avail: NTIS HC A09/MF A01 CSCL 14/2

The increasing use of microwave anechoic chambers plus several recent chamber fires was the impetus for this special study. The report identifies and collects in one document the various issues and problems associated with the fire protection of anechoic chambers. It also addresses the interfaces between personnel groups including the chamber designers, operators, maintenance and the fire department. It is not a design report; i.e., it does not contain enough detail to design either a chamber or the fire protection system. Instead, it presents the pros and cons of the various fire protection options available to the designers (smoke and heat detectors, alarm systems, sprinkler heads, preferred physical locations, fire suppressant agents, etc.) and relates these to the chamber operation. The report also identifies several areas where additional investigation is required such as detection of deep-seated combustion, testing of new more fire-resistant absorber materials, and analysis of the combustion products of halogen-type suppressants. An extensive list of references is included. GRA

N81-16071# Oklahoma State Univ., Stillwater. School of Civil Engineering.

POTENTIAL USE OF GEOTECHNICAL FABRIC IN AIRFIELD RUNWAY DESIGN Final Report

T. Allen Haliburton, Jack D. Lawmaster, and John K. King Oct. 1980 130 p refs

(Contract AF-AFOSR-0087-79; AF Proj. 2307)

(AD-A092686; AFOSR-80-1192TR) Avail: NTIS HC A07/MF A01 CSCL 13/3

A state-of-the-art literature review and laboratory experimental study of the mechanisms of geotechnical fabric separation and lateral restraint reinforcement were performed. Fabrics of dissimilar physical properties were evaluated for use in lateral restraint reinforcement of a cohensionless soil mass. Though considerable increases in strength and load-deformation modulus were obtained for the fabric-reinforced soil systems, no significant difference in behavior was noted among the four fabrics tested, despite wide variations in their physical properties. Fabric prestressing had little effect on behavior. Lateral restraint reinforcement occurred as a result of fabric interference with development of zones of radial shear, underneath and adjacent to the loaded area. The effect is to produce horizontal restraint and confinement, which increases the applied soil stress necessary to develop plastic equilibrium and increases the initial deformation modulus and ultimate load capacity of the system. Lateral confinement induces initial elasto-plastic behavior of the reinforced mass which approximates the classic general shear failure conditions postulated by Terzaghi. An optimum depth of placement for fabric was determined which provides maximum deformation modulus and initial strength and minimizes soil yielding necessary to develop strain hardening effects. The optimum depth is related to the width of the loaded contact area and frictional properties of the reinforced soil. GRA

N81-16072# Canyon Research Group, Inc., Westlake Village, Calif.

CRITICAL RESEARCH ISSUES AND VISUAL SYSTEM REQUIREMENTS FOR A V/STOL TRAINING RESEARCH SIMULATOR Final Technical Report, 15 Jun. 1978 - 14 Jun. 1979

Robert T. Hennessy, Dennis J. Sullivan, and Herbert D. Cooles Oct. 1980 153 p refs

(Contract N61339-78-C-0076)

(AD-A092561; RTH-0180; NAVTRAEQUIPC-78-C-0076-1) Avail: NTIS HC A08/MF A01 CSCL 14/2

Critical research issues for Vertical/Short Takeoff and Landing (V/STOL) flight simulator visual systems and the functional requirements for a visual system necessary to support the research were developed. It was concluded from analyses of mission and training requirements that the V/STOL unique tasks, those performed during thrust-borne flight, are the most likely candidates for simulator training. A task analysis was subsequently performed for these tasks to determine the visual information requirements. It became apparent, however, that there is no logical way to derive displayed scene requirements from the information requirements and what is known about visual perception. Consideration of general visual requirements for flying, the ecological role of visual perception and the purpose of flight training in a simulator, led to the formulation of four categories of critical research issues. These four categories are: (1) scene content, (2) perceptual learning, (3) use of visual augmentation, and (4) display characteristics. GRA

N81-16073# IIT Research Inst., Chicago, Ill.

SHIELDED ENCLOSURE TEST BED REQUIREMENT Final Report, 29 Jan. 1979 - 29 Feb. 1980

L. Valcik 30 Apr. 1980 40 p refs

(Contract DNA001-79-C-0205)

(AD-A092589; DNA-5341F) Avail: NTIS HC A03/MF A01 CSCL 14/2

A shielded enclosure Test Bed Facility is recommended for obtaining data relating EMP shield design to the internal fields and internal cable coupling. The facility should accommodate a shielded enclosure approximately 10 ft high x 20 ft wide x 50 ft long, to study a variety of shield design parameters, e.g., shield panel material and thickness, joint construction, and penetrant configurations. It should provide for excitation by CW injected current and a radiated pulse. Several analytical and laboratory tasks are recommended in support of the test bed experiments. GRA

N81-16114*# National Aeronautics and Space Administration, Washington, D. C.

ANNUAL REPORT TO THE NASA ADMINISTRATOR BY THE AEROSPACE SAFETY ADVISORY PANEL ON THE SPACE SHUTTLE PROGRAM. PART 2: SUMMARY OF INFORMATION DEVELOPED IN THE PANEL'S FACT-FINDING ACTIVITIES Annual Report

Jun. 1976 312 p refs

(NASA-TM-82252) Avail: NTIS HC A14/MF A01 CSCL 22A

Safety management areas of concern include the space shuttle main engine, shuttle avionics, orbiter thermal protection system, the external tank program, and the solid rocket booster program. The ground test program and ground support equipment system were reviewed. Systems integration and technical 'conscience' were of major priorities for the investigating teams. T.M.

N81-16137*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

LARGE-SCALE CARBON FIBER TESTS

Richard A. Pride Dec. 1980 104 p refs

(NASA-TM-80218) Avail: NTIS HC A06/MF A01 CSCL 11D

A realistic release of carbon fibers was established by burning a minimum of 45 kg of carbon fiber composite aircraft structural components in each of five large scale, outdoor aviation jet fuel fire tests. This release was quantified by several independent assessments with various instruments developed specifically for these tests. The most likely values for the mass of single carbon fibers released ranged from 0.2 percent of the initial mass of carbon fiber for the source tests (zero wind velocity) to a maximum of 0.6 percent of the initial carbon fiber mass for dissemination tests (5 to 6 m/s wind velocity). Mean fiber lengths for fibers greater than 1 mm in length ranged from 2.5 to 3.5 mm. Mean diameters ranged from 3.6 to 5.3 micrometers which was indicative of significant oxidation. Footprints of downwind dissemination of the fire released fibers were measured to 19.1 km from the fire. E.D.K.

N81-16139*# Boeing Commercial Airplane Co., Seattle, Wash. Advanced Structural Concepts Organization.

ENVIRONMENTAL EXPOSURE EFFECTS ON COMPOSITE MATERIALS FOR COMMERCIAL AIRCRAFT Quarterly Technical Progress Report, 1 Nov. 1979 - 30 Aug. 1980

Daniel J. Hoffman Aug. 1980 56 p refs

(Contract NAS1-15148)

(NASA-CR-165649; D6-44815-9; QTPR-9) Avail: NTIS HC A04/MF A01 CSCL 11D

The test program concentrates on three major areas: flight exposure; ground based exposure; and accelerated environmental effects and data correlation. Among the parameters investigated were: geographic location, flight profiles, solar heating effects, ultraviolet degradation, retrieval times, and test temperatures. Data from the tests can be used to effectively plan the cost of production and viable alternatives in materials selection. T.M.

N81-16145*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

CURRENT AND PROJECTED USE OF CARBON COMPOSITES IN UNITED STATES AIRCRAFT

Robert Leonard and Daniel R. Mulville (Naval Air Systems Command, Washington, D.C.) *In* AGARD Electromagnetic Effects of (Carbon) Composite Mater. Upon Avionics Systems Oct. 1980 19 p refs

Avail: NTIS HC A16/MF A01 CSCL 11D

Carbon composite materials are finding limited use in both civil and military aircraft structures to exploit their weight saving potential for improved performance or fuel efficiency. Since these needs are growing, and a manufacturing cost savings potential

is also recognized, wider use of composites in the near future may be expected. Carbon composites generally involve fiber volume fractions in excess of 60 percent in a variety of orthotropic sandwich or solid laminates. Bidirectional woven carbon cloth, common in recently designed structure, may provide higher, more uniform laminate conductivities than tape. E.D.K.

N81-16146# Societe Nationale Industrielle Aerospatiale, Paris (France).
THE EFFECT OF THE IN-SERVICE ENVIRONMENT ON COMPOSITE MATERIALS (RESUME OF THE APRIL 1980 ATHENS CONFERENCE) [EFFET DE L'ENVIRONMENT EN SERVICE SUR LES MATERIAUX COMPOSITES (RESUME DUE CONGRES D'ATHENES-AVRIL 80)]
George Jube *In its* Electromagnetic Effects of (Carbon) Composite Mater. Upon Avionics Systems Oct. 1980 4 p In FRENCH

Avail: NTIS HC A16/MF A01

Reported experience of the effect of physical and mechanical aggressions (environment) on composite materials and structures is summarized. Topics covered include: (1) the physical chemistry of the environment and the sensitivity of the composite materials to humidity; (2) the behavior of composite materials in spatial ambience, particularly in vacuum; (3) rules for predicting damage to composite structures and the effect of accidental impact; (4) atmospheric physical phenomena, particularly lightning and rain erosion; and (5) the in service behavior of helicopter blades, NASA experience with transport aircraft structures, and USAF and Navy experience with boron and carbon fiber composites.
Transl. by A.R.H.

N81-16147# British Aerospace Aircraft Group, Preston (England).
APPLICATION OF CARBON FIBRE COMPOSITES TO MILITARY AIRCRAFT STRUCTURES
T. Sharples *In* AGARD Electromagnetic Effects of (Carbon) Composite Mater. Upon Avionics Systems Oct. 1980 17 p

Avail: NTIS HC A16/MF A01

The high specific strength of CFC offers weight saving potential to the aircraft structural engineers. Design and manufacturing studies have shown that this potential can be realized and that a maximum utilization, where 40 percent of the aircraft structure is made from CFC, mass savings of about 12 percent can be expected. These savings can be increased to as much as 20 percent if the aircraft is resized for constant performance. Cost studies indicate that, if full advantage is taken of automated techniques and the weight reductions structures containing CFC should cost less than for the metal equivalents. Work is continuing to assess the EMC problems in order to ensure that full advantage can be taken of these potential weight and cost savings on future military aircraft. E.D.K.

N81-16152# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany).
EMC, LIGHTNING AND NEMP-PROTECTION-NEW REQUIREMENTS FOR APPROVED SPECIFICATIONS WHEN USING CFRP
D. Jaeger and K. H. Rippl *In* AGARD Electromagnetic Effects of (Carbon) Composite Mater. Upon Avionics Systems Oct. 1980 18 p refs
Avail: NTIS HC A16/MF A01

The use of carbon fiber reinforced plastics (CFRP) in modern aircraft achieves good advantages for mechanical strength and is weightsaving, compared with aluminum structures. In spite of the advantages there are disadvantages in using CFRP materials. These are mainly unwanted electromagnetic effects on electronic equipment, caused by electromagnetic interference lightning, electrostatic discharges, and nuclear electromagnetic pulse (NEMP). The reason for these problems is lower shielding effectiveness of the aircraft structure as compared to aluminum. Specifications used for aircraft today do not pay regard to the requirements of these materials. Proposals are made as to how the specifications should be modified. E.D.K.

N81-16153# Allen Clark Research Centre, Towcester (England).
THE ELECTRICAL EFFECTS OF JOINTS AND BONDS IN CARBON FIBER COMPOSITES
J. Brettle, K. J. Lodge, and R. Poole (Plessey Electronic Systems Research, Havant, England) *In* AGARD Electromagnetic Effects of (Carbon) Composite Mater. Upon Avionics Systems Oct. 1980 17 p refs
Avail: NTIS HC A16/MF A01

The types of joint investigated include dry compression joints, bolted joints, and adhesively bonded structures. Their electrical properties were evaluated from dc up to 50 MHz, as well as certain specific higher frequencies. A variety of pretreatments and assembly methods were investigated. All the joints as initially produced to current aircraft practice had too high an impedance for the electrical requirements of an airframe. Various methods of reducing the joint impedance were proposed and subjected to electrical and environmental tests. It is now possible to produce electrically invisible bolted joints and adhesive joints with much improved conductivity. It was found possible to permanently alter the joint impedance by the passage of a current through the joint. This effect was investigated and a possible mechanism of this effect suggested. The investigation of the possible production of radio frequency intermodulation products at joints were carried out, but few intermodulation products were found from any of the joints examined other than butt joints made with exposed carbon fibers in the joint. E.D.K.

N81-16154# Royal Aircraft Establishment, Farnborough (England).
THE UK MINISTRY OF DEFENCE PROGRAMME ON THE ELECTROMAGNETIC PROPERTIES OF CARBON FIBER COMPOSITES
J. M. Thomson and R. H. Evans *In* AGARD Electromagnetic Effects of (Carbon) Composite Mater. Upon Avionics Systems Oct. 1980 9 p refs

Avail: NTIS HC A16/MF A01

With some exceptions, work on the electrical properties of carbon fiber composites (CFV) is regarded as part of an overall program on electromagnetic effects (EMC, EMP, lightning, etc.). The relationship of the CFC work to the remainder of the program is discussed, and the principal investigations outlined and reviewed. One particular package, shielding measurements on a cockpit section is described in detail. It is shown that the major areas of concern are the bonding and jointing of the material and its characteristics at HF and below. This latter topic has an impact on shielding (including EMP and lightning sources) and aerial installation. Finally, the use which is to be made of the information from these programs is discussed. E.D.K.

N81-16155# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
A FRENCH FLIGHT TEST PROGRAM ON THE ELECTROMAGNETIC EFFECTS OF LIGHTNING [PROGRAMME FRANCAIS D'ESSAIS EN VOL SUR LES EFFETS ELECTROMAGNETIQUES DE LA FOUDRE]
J. C. Alliot and D. Gall (Centre d'Essasis Aeronautiques, Toulouse) *In* AGARD Electromagnetic Effects of (Carbon) Composite Mater. Upon Avionics Systems Oct. 1980 9 p refs In FRENCH

Avail: NTIS HC A16/MF A01

Under the aegis of the French Aeronautical Technical Service, a flight test program for evaluating electromagnetic perturbations of lightning has been operating since 1978. This test program, conducted by CEAT, CEV, and ONERA, uses an Air Force TRANSALL C160 carrying instrumentation for detecting phenomena associated with direct or near lightning strikes. These include the current of the lightning (impulsive and continuous components) the current on the skin of different parts of the structure; the internal and external electromagnetic fields; and the overvoltages on diverse equipment and circuits on board. Various sensors allow characterization of the electric state of the aircraft at the time of the lightning strikes (equilibrium potential, current of the charge of the triboelectric origin, external atmospheric electric field). The behavior of panel structures made of composite materials are studied with regard to electromagnetic radiation in order to define protection systems. Following diverse modifica-

tions and additions to the instrumentation used in tests since 1978, a new experimental program begins in 1980.
Transl. by A.R.H.

N81-16156# Westland Helicopters Ltd., Yeovil (England).
AIRCRAFT MANUFACTURERS APPROACH TO THE E.M.C./AVIONICS PROBLEMS ASSOCIATED WITH THE USE OF COMPOSITE MATERIALS
G. Barton and I. P. MacDiarmid (British Aerospace, Warton, England) *In* AGARD Electromagnetic Effects of (Carbon) Composite Mater. Upon Avionics Systems Oct. 1980 23 p refs
Avail: NTIS HC A16/MF A01

Detailed examples are given of the approach taken by the U.K. aircraft manufacturers to the EMC/avionic problems associated with the use of carbon fiber composites (CFC). Examples of structures that required flight clearance within relatively short timescales are discussed. These are the fitting of CFC panels to Jaguar and lightning strike investigations on composite demonstrator rotor blades. The work undertaken to address the long term problems of composite aircraft and their effects on avionic systems is outlined. This includes CFC fuselage investigations, conductivity measurements, and an Earth return study. E.D.K.

N81-16158# Centre d'Essai Aeronautique, Toulouse (France).
TENSION INDUCED IN THE CABLES INSIDE CLOSED METAL STRUCTURES AND IN CARBON EPOXY SUBMITTED TO A LIGHTNING-TYPE IMPULSE CURRENT [TENSION INDUITE DANS LES CABLES A L'INTERIEUR DE STRUCTURES FERMEES METALLIQUES ET EN CARBONE EPOXY SOUMISES A UNE IMPULSION DE COURANT TYPE FOUDRE]
Denis Gall *In* AGARD Electromagnetic Effects of (Carbon) Composite Mater. Upon Avionics Systems Oct. 1980 11 p In FRENCH
Avail: NTIS HC A16/MF A01

Results are presented of theoretical and experimental studies on the mechanics of the induction of overvoltages in electric cables located in the interior of closed structures when they are surrounded by an impulse current of the lightning type. The contribution of two parameters, the diffusion of current on the skin and the internal magnetic field, is considered and compared for a structure made of an aluminum alloy and one made of carbon fibers. Transl. by A.R.H.

N81-16159# McDonnell Aircraft Co., St. Louis, Mo.
ELECTROMAGNETIC INTEGRATION OF COMPOSITE STRUCTURE IN AIRCRAFT
G. L. Weinstock *In* AGARD Electromagnetic Effects of (Carbon) Composite Mater. Upon Avionics Systems Oct. 1980 16 p

Avail: NTIS HC A16/MF A01

Certain U.S. Navy and Marine Corps aircraft are being designed and produced which have significant portions of the skin and substructure fabricated from graphite/epoxy composite material. The F-18 Hornet has approximately 50% of its surface area composite and the AV-8B V/STOL utilizes composite material for its wing, tail, and forward fuselage. Extensive analysis and testing was performed during the last seven years to define those parameters necessary for successful electromagnetic integration of graphite/epoxy composite into these aircraft. Descriptions of the tests, analyses, and design processes including procedures, methods, results, and design improvements are presented in this paper. The specific investigations addressed are: (1) basic material properties; (2) inherent electromagnetic shielding; (3) intermodulation effects; (4) effects on antennas; (5) panel shielding; (6) joint effects and improvements; (7) joint impedance; (8) access door design and improvements; (9) bonding; (10) large fuselage section shielding; and (11) complete wing shielding. The above tests and supporting analyses were performed on different types of composite construction, thickness, and size and were usually related to comparable aluminum articles. Some of the variations assessed and described in the paper are aluminum honeycomb, syntactic core and monolithic materials, combinations of lap and shear joints, and selected metallic coatings. E.D.K.

N81-16160# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
FLIGHT TESTS FOR STUDYING RADIOELECTRIC PERTURBATIONS OF AN ELECTROSTATIC ORIGIN [ESSAIS EN VOL POUR L'ETUDE DES PERTURBATIONS RADIOELECTRIQUES D'ORIGINE ELECTROSTATIQUE]
P. Laroche, R. Weber (Societe Nationale Industrielle Aerospatiale, Suresnes, France), and D. Gall (Centre d'Essais Aeronautiques Toulouse) *In* AGARD Electromagnetic Effects of (Carbon) Composite Mater. Upon Avionics Systems Oct. 1980 11 p refs In FRENCH
Avail: NTIS HC A16/MF A01

The French Official Aeronautical Services originated a flight test program using the METEOR NF11 aircraft. The program is designed to reduce the radioelectric perturbations of an electrostatic origin. Antistatic protection of an aircraft consists of making the insolated parts of the structure conductive on the surface and installing dissipators of the potential. The flight experiments were preceeded by ground tests of high tension polarization in order to simulate the effects of triboelectricity. Dissipation of the potential was tested by making the entire aircraft conductive. Some instrumented dielectric panels were then put into place by detecting the eventual appearance of rampant electric discharges. Some general results from these tests are presented. Transl. by A.R.H.

N81-16166# Syracuse Research Corp., N. Y.
ELECTROMAGNETIC COUPLING TO ADVANCED COMPOSITE AIRCRAFT WITH APPLICATION TO TRADE-OFF AND SPECIFICATION DETERMINATION
R. Wallenberg, E. Burt, and G. Dike *In* AGARD Electromagnetic Effects of (Carbon) Composite Mater. Upon Avionics Systems Oct. 1980 22 p refs

Avail: NTIS HC A16/MF A01

A major concern with the increasing use of composite materials and low voltage electronics is the amount of electromagnetic coupling to the interior of an aircraft and to the cables and electronic devices within it. Simple methods are described for determining the shielding provided by an aircraft's exterior surface and the coupling of the interior fields to cables and transmission lines within aircraft cavities. The results can be used to determine tradeoffs between electromagnetic shielding, weight, and cost. E.D.K.

N81-16213# Rockwell International Corp., El Segundo, Calif. North American Div.
SUPERPLASTIC FORMED AND DIFFUSION BONDED TITANIUM LANDING GEAR COMPONENT FEASIBILITY STUDY Final Report, Mar. 1979 - Jul. 1980
Vernon E. Wilson Wright-Patterson AFB, Ohio AFFDL Jul. 1980 80 p
(Contract F33615-79-C-3401; AF Proj. 2402)
(AD-A092788; NA-80-333) Avail: NTIS HC A05/MF A01 CSCL 11/6

This report describes the development, fabrication and testing of a section of a main landing gear outer cylinder. The program demonstrated the feasibility of using the SuperPlastic Forming with concurrent Diffusion Bonding (SPF/DB) fabrication process to build a titanium cylindrical sandwich structure with a weight savings of 8-1/2 percent over the baseline steel cylinder. The development of joints, stop-off application and tooling is described. Structural analysis and subsequent structural testing proved that the cylindrical sandwich design is capable of meeting the loads that the outer cylinder of the landing gear would be subjected to in a current first line fighter aircraft. GRA

N81-16253* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
THE 17TH JANNAF COMBUSTION MEETING, VOLUME 1
Debra Sue Eggleston, ed. Nov. 1980 669 p refs Meeting held at Hampton, Va., 22-26 Sep. 1980 Prepared in cooperation with APL, Laurel, Md. 4 Vol.
(Contract N00024-78-C-5384)
(NASA-TM-82238; AD-A094820; CPIA-Publ-329-Vol-1) Avail:

Chemical Propulsion Information Agency, Laurel, Md. CSCL 21D

The combustion of solid rocket propellants and combustion in ramjets is addressed. Subjects discussed include metal burning, steady-state combustion of composite propellants, velocity coupling and nonlinear instability, vortex shedding and flow effects on combustion instability, combustion instability in solid rocket motors, combustion diagnostics, subsonic and supersonic ramjet combustion, characterization of ramburner flowfields, and injection and combustion of ramjet fuels.

N81-16357# Ohio State Univ., Columbus. ElectroScience Lab.

AIRBORNE ANTENNA PATTERN CODE: USER'S MANUAL Interim Report

W. D. Burnside Griffiss AFB, N.Y. RADC Sep. 1980 108 p refs

(Contracts F30602-79-C-0068; N62269-78-C-0379; AF Proj. 4519)

(AD-A092316; ESL-711679-2; RADC-TR-80-302) Avail: NTIS HC A06/MF A01 CSCL 20/14

This report describes the use of a computer code to analyze antenna mounted on aircraft fuselage. Ram jet configurations can be handled as a special case by this code. The pattern can be taken in terms of an arbitrary conical cut. The organization of the code, definition of input and output data, multiple finite plate approach to simulate the structures on aircraft and various examples are presented. The analysis is based on the geometrical theory of diffraction, and various computed patterns are compared with experimental results. GRA

N81-16375# Army Test and Evaluation Command, Aberdeen Proving Ground, Md.

FUNCTIONAL TESTING COMMUNICATION EQUIPMENT (AVIONICS) Final Report

31 Jul. 1980 35 p refs Supersedes MTP-6-3-025 and MTP-6-3-024

(AD-A092825; TOP-6-3-025; MTP-6-3-025; MTP-6-3-024) Avail: NTIS HC A03/MF A01 CSCL 17/2

This document provides guidance and procedures for performance testing airborne communication equipment. The document addresses the following: Communication Range, Transmission Pattern, Homing, Retransmission, Effects of Atmospheric Conditions and Durability. It provides the test project officer with general information and guidance in test preparation, test controls, test conduct and data reduction. GRA

N81-16388*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

HIGH TEMPERATURE ELECTRONIC REQUIREMENTS IN AEROPROPULSION SYSTEMS

William C. Nieberding and J. Anthony Powell 1981 5 p refs Proposed for presentation at High-Temp. Electron. Conf., Tucson, Ariz., 25-27 Mar. 1981; sponsored by NASA, DOE and IEEE (NASA-TM-81682; E-708) Avail: NTIS HC A02/MF A01 CSCL 09C

This paper discusses the needs for high temperature electronic and electrooptic devices as they would be used on aircraft engines in either research and development applications, or operational applications. The conclusion reached is that the temperature at which the devices must be able to function is in the neighborhood of 500 to 600 C either for research and development or for operational applications. In research and development applications, the devices must function in this temperature range when in the engine but only for a moderate period of time. On an operational engine, the reliability requirements dictate that the devices be able to be burned-in at temperatures significantly higher than those at which they will function on the engine. The major point made is that semiconductor technology must be pushed well beyond the level at which silicon will be able to function. Author

N81-16416*# Lockheed Missiles and Space Co., Huntsville, Ala.

HYPERBOLIC/PARABOLIC DEVELOPMENT FOR THE GIM-STAR CODE Progress Report

L. W. Spradley, J. F. Stalnaker, and A. W. Ratliff Dec. 1980 177 p refs

(Contracts NAS1-15783; NAS1-15795)

(NASA-CR-3369; LMSC-HREC-TR-D697882) Avail: NTIS HC A09/MF A01 CSCL 20D

Flow fields in supersonic inlet configurations were computed using the eliptic GIM code on the STAR computer. Spillage flow under the lower cowl was calculated to be 33% of the incoming stream. The shock/boundary layer interaction on the upper propulsive surface was computed including separation. All shocks produced by the flow system were captured. Linearized block implicit (LBI) schemes were examined to determine their application to the GIM code. Pure explicit methods have stability limitations and fully implicit schemes are inherently inefficient; however, LBI schemes show promise as an effective compromise. A quasiparabolic version of the GIM code was developed using elastical parabolized Navier-Stokes methods combined with quasitime relaxation. This scheme is referred to as quasiparabolic although it applies equally well to hyperbolic supersonic inviscid flows. Second order windward differences are used in the marching coordinate and either explicit or linear block implicit time relaxation can be incorporated. A.R.H.

N81-16430# Aeronautical Research Labs., Wright-Patterson AFB, Ohio.

AN IMPROVED FLIGHT DATA TRANSCRIBER

A. J. Farrell Feb. 1980 30 p refs

(AD-A091981; ARL/AERO-TM-318) Avail: NTIS HC A03/MF A01 CSCL 14/3

A unit is described which converts serial data recorded on the MKI or MKII Aero. Division Airborne Data Acquisition Package into a form suitable for recording on 7 track computer compatible tape. It is an improved version of a previous unit designed to work with the MKI Data Acquisition Package. GRA

N81-16627# Federal Aviation Agency, Washington, D.C. Office of Environment and Energy.

THE NEED FOR AIRPORT NOISE MONITORING SYSTEMS. THEIR USES, AND VALUE IN PROMOTING CIVIL AVIATION Final Report

J. Steven Newman Sep. 1980 41 p refs

(AD-A092240; FAA-EE-80-40) Avail: NTIS HC A03/MF A01 CSCL 05/1

The need for airport noise monitoring systems is addressed from a variety of perspectives focusing on potential benefits to airport proprietors, the airlines, noise impacted airport communities, and civil aviation in general. The operation and cost of typical noise monitoring systems is discussed. Various techniques for noise data presentation are also reviewed. The uses of radar tracking data in providing aircraft identification, position and ground track information is explored. Legal requirements for monitoring are specified and airport use restrictions are discussed. A list of U.S. and foreign airports with noise monitoring systems is presented. FAA research efforts pertaining to airport noise monitoring systems are also outlined. GRA

N81-16628# Argonne National Lab., Ill. Energy and Environmental Systems Div.

IMPACT OF AIRCRAFT EMISSIONS ON AIR QUALITY IN THE VICINITY OF AIRPORTS. VOLUME 1: RECENT AIRPORT MEASUREMENT PROGRAMS, DATA ANALYSES, AND SUBMODEL DEVELOPMENT Final Report, Jan. 1978 - Jul. 1980

R. J. Yamartino, D. G. Smith, S. A. Bremer, D. Heinold, D. Lamich, and B. Taylor Jul. 1980 168 p refs

(Contract DOT-FA77WAI-736)

(AD-A089962; FAA-EE-80-09A) Avail: NTIS HC A08/MF A01 CSCL 01/5

This report documents the results of the Federal Aviation Administration (FAA)/Environmental Protection Agency (EPA) air quality study which has been conducted to assess the impact of aircraft emissions of carbon monoxide (CO), hydrocarbons (HC), and oxides of nitrogen (NOx) in the vicinity of airports. This assessment includes the results of recent modeling and monitoring

efforts at Washington National (DCA), Los Angeles International (LAX), Dulles International (IAD), and Lakeland, Florida airports and an updated modeling of aircraft generated pollution at LAX, John F. Kennedy (JFK) and Chicago O'Hare (ORD) airports. The Airport Vicinity Air Pollution (AVAP) model which was designed for use at civil airports was used in this assessment. In addition the results of the application of the military version of the AVAP model and the Air Quality Assessment Model (AQAM), are summarized. GRA

N81-16629# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
A GUIDANCE DOCUMENT ON AIRPORT NOISE CONTROL Final Report
Andrew S. Harris, Robert L. Miller, and Joan M. Mahoney Aug. 1980 173 p
(Contract DOT-FA78WA-4105)
(AD-A092228; BBN-10667-10676; FAA-EE-80-37) Avail: NTIS HC A08/MF A01 CSCL 01/5

This guidance document contains a general discussion of noise and noise control. Also given are sections on how humans respond to noise, noise control planning, noise descriptors that are used in the FAA's Integrated Noise MOdel, airport noise contours and land use planning, and citizen involvement in noise control planning. This document describes noise control actions and their benefits and costs; it reflects the Department of Transportation/Federal Aviation Administration Airport Noise Abatement Policy of 1976, a detailed, straightforward statement of the problems of airport noise and the shared responsibilities of those who must work to control it. The Federal legislature and administrative mandates for noise control are also reviewed. GRA

N81-16677*# National Aeronautics and Space Administration. Pasadena Office, Calif.
CAT ALTITUDE AVOIDANCE SYSTEM Patent Application
Bruce L. Gary, inventor (to NASA) (JPL, California Inst. of Technology, Pasadena) Filed 12 Jan. 1981 21 p
(Contract NAS7-100)
(NASA-Case-NPO-15351-1; US-Patent-Appl-SN-224231) Avail: NTIS HC A02/MF A01 CSCL 04B

A method and apparatus are described for indicating the altitude of the tropopause or of an inversion layer in which clear air turbulence (CAT) may occur and the likely severity of any such CAT. A plot of altitude (with respect to an aircraft) versus temperature of the air at that altitude can indicate when an inversion layer is present and can indicate the altitude of the tropopause or of such an inversion layer. The plot can also indicate the severity of any CAT in an inversion layer. If CAT was detected in the general area, then the aircraft can be flown at an altitude to avoid the tropopause or inversion layer. The detection method can also be utilized to enable an aircraft to fly at an altitude at which the winds are most favorable for reducing fuel consumption. T.M.

N81-16681*# MCS, Inc., Boulder, Colo.
AN AIRPORT WIND SHEAR DETECTION AND WARNING SYSTEM USING DOPPLER RADAR: A FEASIBILITY STUDY
John McCarthy, Edward F. Blick, and Kim L. Elmore Jan. 1981 95 p refs
(Contract NAS8-33458)
(NASA-CR-3379) Avail: NTIS HC A05/MF A01 CSCL 04B

A feasibility study was conducted to determine whether ground based Doppler radar could measure the wind along the path of an approaching aircraft with sufficient accuracy to predict aircraft performance. Forty-three PAR approaches were conducted, with 16 examined in detail. In each, Doppler derived longitudinal winds were compared to aircraft measured winds; in approximately 75 percent of the cases, the Doppler and aircraft winds were in acceptable agreement. In the remaining cases, errors may have been due to a lack of Doppler resolution, a lack of co-location of the two sampling volumes, the presence of eddy or vortex like disturbances within the pulse volume, or the presence of point targets in antenna side lobes. It was further concluded that shrouding techniques would have reduced the side lobe problem. A ground based Doppler radar operating in the optically clear air, provides the appropriate longitudinal winds along an aircraft's intended flight path. E.D.K.

N81-16699# Air Weather Service, Scott AFB, Ill. Forecasting Services Div.
THE WC-130 METEOROLOGICAL SYSTEM AND ITS UTILIZATION IN OPERATIONAL WEATHER RECONNAISSANCE
Rodney S. Henderson Aug. 1980 91 p refs
(AD-A092637; AWS/TR-80-002) Avail: NTIS HC A05/MF A01 CSCL 04/2

This report discusses the U.S. Air Force WC-130 weather reconnaissance system. It starts with a brief history of weather reconnaissance, then describes the Air Force WC-130 weather reconnaissance system including descriptions of the instrumentation used. The discussion of data dissemination and quality control is followed by discussion of the applications of weather reconnaissance in watching tropical cyclones and in weather modification. GRA

N81-16770# Naval Research Lab., Washington, D. C.
ABSTRACT INTERFACE SPECIFICATIONS FOR THE A-7E DEVICE INTERFACE MODULE
Robert A. Parker, Kathryn L. Heininger, David L. Parnas, and John E. Shore 20 Nov. 1980 177 p refs
(ZF21242001)
(AD-A092696; NRL-MR-4385) Avail: NTIS HC A09/MF A01 CSCL 09/2

As part of the experimental redesign of the flight software for the Navy's A-7 aircraft, software modules were designed to encapsulate the characteristics of hardware devices connected to the computer. The purpose of these device interface modules is to allow the remainder of the software to remain unchanged when devices are changed or replaced. To achieve this purpose, the modules were designed according to the abstract interface principle, documented according to a standard organization and reviewed by a systematic procedure based on the properties expected of abstract interfaces. This report contains: (1) an explanation of the abstract interface approach, (2) a description of the standard organization for inteface specifications, (3) a description of the review procedure, and (4) interface specifications for all the device interface modules in the A-7 software. As well as serving as development and maintenance documentation for the A-7 redesign, this document is intended to serve as a model for the other people interested in applying the abstract interface approach on other software projects. GRA

N81-16825# Naval Postgraduate School, Monterey, Calif. Dept. of Operations Research.
METHODOLOGY FOR DETERMINING SAMPLING INTERVALS
H. J. Larson and T. Jayachandran Nov. 1980 35 p refs
(AD-A092591; NPS53-81-001) Avail: NTIS HC A03/MF A01 CSCL 12/1

A new methodology for the determination of sampling intervals to be used with the spectrometric oil analysis program has been developed. The methodology has been tested with preliminary data and appears to perform well. GRA

N81-16853*# Pratt and Whitney Aircraft Group, East Hartford, Conn. Commercial Products Div.
STUDIES ON PROPER SIMULATION DURING STATIC TESTING OF FORWARD SPEED EFFECTS ON FAN NOISE Final Report
A. A. Peracchio, U. W. Ganz, M. R. Gedge, and K. Robbins Sep. 1980 103 p refs Prepared in cooperation with Boeing Commercial Airplane Co., Seattle
(Contract NAS1-15085)
(NASA-CR-165626) Avail: NTIS HC A06/MF A01 CSCL 20A

Significant differences exist in the noise generated by engines in flight and engines operating on the test stand. It was observed that these differences can be reduced by the use of an inflow

control structure (ICS) in the static test configuration. The results of the third phase of a three phase program are described. The work performed in the first two phases which dealt with the development of a model for atmospheric turbulence, studies of fan noise generated by rotor turbulence interaction, and the development of an inflow control structure design system are summarized. The final phase of the program covers procedures for performing static testing with an ICS projecting the resulting static test data to actual flight test data. Included is a procedures report which covers the design system and techniques for static testing and projecting the static data to flight. E.D.K.

N81-16854*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.

ACOUSTIC AND AERODYNAMIC PERFORMANCE INVESTIGATION OF INVERTED VELOCITY PROFILE COANNULAR PLUG NOZZLES Final Report

P. R. Knott, J. T. Blozy, and P. S. Staid Washington NASA Feb. 1981 259 p refs
(Contract NAS3-19777)
(NASA-CR-3149; R79AEG388) Avail: NTIS HC A12/MF A01 CSCL 20A

The results of model scale parametric static and wind tunnel aerodynamic performance tests on unsuppressed coannular plug nozzle configurations with inverted velocity profile are discussed. The nozzle configurations are high-radius-ratio coannular plug nozzles applicable to dual-stream exhaust systems typical of a variable cycle engine for Advanced Supersonic Transport application. In all, seven acoustic models and eight aerodynamic performance models were tested. The nozzle geometric variables included outer stream radius ratio, inner stream to outer stream ratio, and inner stream plug shape. When compared to a conical nozzle at the same specific thrust, the results of the static acoustic tests with the coannular nozzles showed noise reductions of up to 7 PNdB. Extensive data analysis showed that the overall acoustic results can be well correlated using the mixed stream velocity and the mixed stream density. Results also showed that suppression levels are geometry and flow regulation dependent with the outer stream radius ratio, inner stream-to-outer stream velocity ratio and inner stream velocity ratio and inner stream plug shape, as the primary suppression parameters. In addition, high-radius ratio coannular plug nozzles were found to yield shock associated noise level reductions relative to a conical nozzle. The wind tunnel aerodynamic tests showed that static and simulated flight thrust coefficient at typical takeoff conditions are quite good - up to 0.98 at static conditions and 0.974 at a takeoff Mach number of 0.36. At low inner stream flow conditions significant thrust loss was observed. Using an inner stream conical plug resulted in 1% to 2% higher performance levels than nozzle geometries using a bent inner plug. M.G.

N81-16952# Committee on Science and Technology (U. S. House).

POSTURE HEARINGS (NASA AND FAA)

Washington GPO 1980 110 p Hearing before the Comm. on Sci. and Technol., 96th Congr., 2nd Sess., no. 112, 29 Jan. 1980
(GPO-65-265) Avail: Committee on Science and Technology

Highlights of NASA activities in the 1960's and 1970's are assessed and plans for the 1980's are examined in the light of the President's proposed NASA budget of $5.737 billion for fiscal year 1981 and a supplemental fiscal year 1980 approximation of $300 million for space shuttle development. Planning for other programs, in addition to the space transportation system, is described. The status of the FAA engineering and developing program is also reviewed. Difficulties in maintaining adequate staffing are discussed. A.R.H.

N81-16953# Committee on Science and Technology (U. S. House).

NASA AUTHORIZATION, 1981

Washington GPO 1980 204 p Index for Hearings on H. R. 6413 before the Comm. on Sci. and Technol., 96th Congr., 2nd Sess., no. 158, for v. 1-5
(GPO-71-290) Avail: Committee on Science and Technology

A subject and name index is provided for testimony delivered and statements received in support of NASA's request for funding for research and development, program management and construction of facilities. A.R.H.

N81-16983# Army Research and Technology Labs., Moffett Field, Calif. Aeromechanics Lab.

VISCOUS-INVISCID INTERACTION ON OSCILLATING AIRFOILS IN SUBSONIC FLOW

W. J. McCroskey (NASA Ames) and S. L. Pucci 15 Jan. 1981 17 p refs Presented at the 19th AIAA Aerospace Sci. Meeting, St. Louis, 12-15 Jan. 1981
(AD-A093970; AIAA-81-0051) Avail: NTIS HC A02/MF A01 CSCL 20/4

Selected results from an extensive oscillating airfoil experiment are analyzed and reviewed. Four distinct regimes of viscous-inviscid interaction are identified corresponding to varying degrees of unsteady flow separation. The dominant fluid dynamic phenomena are described for each regime. Ten specific test cases, including the appropriate flow conditions and experimental results, are proposed for evaluating unsteady viscous theories and computational methods. GRA

N81-16984# California Univ., Berkeley. Dept. of Mechanical Engineering.

SUPERCRITICAL FLOW PAST SYMMETRICAL AIRFOILS Ph.D. Thesis. Interim Report

Kon-Ming Li Dec. 1980 50 p refs
(Grant AF-AFOSR-0230-80; AF Proj. 2307)
(AD-A093300; AFOSR-80-1357TR) Avail: NTIS HC A03/MF A01 CSCL 20/4

A numerical method is developed for computing steady supercritical flow about an ellipse at zero angle to attack. The flow is assumed to be two dimensional, inviscid, isentropic, and irrotational. The free stream Mach number lies in the high subsonic range so that a shock wave occurs locally near the body. The full potential equations are solved by Telenin's Method and the Method of Lines. Smooth interpolating functions are assumed for the unknown flow variables in selected coordinate directions. The resulting set of ordinary differential equations is then integrated away from or along the body depending upon whether the flow is smooth or discontinuous. Jump conditions of the governing equations are applied across the shock wave so that it is perfectly sharp. A doublet solution for flow past a closed body is used as the far field boundary condition. Supercritical flow calculations have been performed for ellipses with thickness ratio of 0.2 and 0.4 at various free stream Mach numbers. The present results are compared with the shock-capturing method, and good agreement is obtained. GRA

N81-16987# Messerschmidt-Boelkow G.m.b.H., Ottobrunn (West Germany). Unternehmensbereich Flugzeuge.

A THEORETICAL METHOD FOR THE SIMULATION OF SEPARATION BEHAVIOR OF AIRCRAFT EXTERNAL STORES [EIN THEORETISCHES VERFAHREN ZUR SIMULATION DES ABGANGSVERHALTENS VON AUSSENLASTEN VOM TRAEGER]

R. Deslandes 26 Nov. 1979 16 p refs In GERMAN Presented at DGLR Wehrtech. Symp. on der Abgang von Lasten u. Waffen vom Traeger, Bad Neuenahr, West Germany, 26-27 Nov. 1979
(MBB-FE-122/S/PUB/16; DGLR-79-091) Avail: NTIS HC A02/MF A01

A computer program which predicts store separation trajectories for fighter aircraft configurations is presented. The calculation method is based on finite elements and takes into account drag and other aerodynamic interference effects on stores. It includes a mathematical model of jettison (or launch/drop) forces and portrays store behavior as equations of motion with six degrees of freedom. Interference calculation results for a typical wing-fuselage stores configuration are compared with wind tunnel captive trajectory measurements and are shown to be satisfactory. Author (ESA)

N81-16988# Messerschmidt-Boelkow G.m.b.H., Ottobrunn (West Germany). Unternehmensbereich Flugzeuge.

STORE SEPARATION SIMULATION IN SUBSONIC WIND

TUNNELS [AUSSENLASTTECHNIKEN IN UNTERSCHALL-WINDKANAELEN]
R. Leistner 21 Nov. 1979 37 p refs In GERMAN Presented at DGLR Wehrtech. Symp. on der Abgang von Lasten u. Waffen vom Traeger, Bad Neuenahr, West Germany, 26-27 Nov. 1979 (MBB-FE-123/S/PUB/20; DGLR-79-098) Avail: NTIS HC A03/MF A01

Wind tunnel simulation techniques for studying the ejection behavior and trajectories of fighter aircraft external stores are considered. The aerodynamics of a fixed store model in a subsonic flow are examined. The dynamic case of a free model is covered in detail. Scaling methods, particularly Froude scaling, are discussed. The construction and calibration of a dynamically similar model is described. The setup of a store separation wind tunnel study is outlined, emphasizing immediately necessary measurements as well as measurements which could be useful in aircraft design. Author (ESA)

N81-16989# Centre d'Essai Aeronautique, Toulouse (France).
UNSTEADY WAKES DOWNSTREAM FROM A PROFILE OSCILLATING IN INCIDENCE [SILLAGES INSTATIONNAIRES A L'AVAL D'UN PROFIL EN OSCILLATIONS D'INCIDENCE]
J. Coulomb and J. Verriere Paris Association Aeronautique et Astronautique de France 1980 33 p refs In FRENCH Presented at 16th Colloq. d'Aerodyn. Appl., Lille, 13-15 Nov. 1979 (AAAF-NT-80-10; ISBN-2-7170-0606-0) Avail: NTIS HC A03/MF A01; CEDOCAR, Paris FF 40 (France and EEC) FF 45 (others)

Velocity profiles in a turbulent wake downstream from a wing model oscillating in incidence were determined by hot wire anomometry in a rectangular wind tunnel at a flow speed of 50 m/sec. A Fourier analysis of measurements was made. Results show a considerable modification of the velocity distribution in the wakes outside the quasistationary domain. Motion in the wake structure also perturbs the potential flow. It results that calculation of drag coefficients by the Betz method becomes uncertain. The evolution of velocity profiles in function of oscillating frequency is illustrated. Author (ESA)

N81-16992# Association Aeronautique et Astronautique de France, Paris.
EXAMINATION OF THE VORTEX REGIME FOR HIGHLY SWEPT WINGS BY EXTRAPOLATION OF THE JONES METHOD [ESSAI D'ETUDE DU REGIME TOURBILLONNAIRE DES AILES DE FORTE FLECHE PAR EXTRAPOLATION DE LA METHODE DE JONES]
R. Hirsch 1980 24 p In FRENCH; ENGLISH summary Presented at 16th Colloq. d'Aerodyn. Appl., Lille, 13-15 Nov. 1979 (AAAF-NT-80-25; ISBN-2-7170-0621-4) Avail: NTIS HC A02/MF A01; CEDOCAR, Paris FF 25 (France and EEC) FF 30 (others)

The formation of vortex sheets along the surface of a separated flow over the leading edge of a sweptback wing is discussed. A phenomenological explanation based on representations and hypotheses from simplifying calculations inspired by Jones approximation is offered. Four conditions for fixing vortex sheet configurations and their intensity are defined. A correction algorithm for the Jones approximation is also given. Calculations were done on a HP-97 computer and are compred with various experimental measurements (delta wings, ducktail, strakes, etc.); results are satisfactory. Author (ESA)

N81-16994*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THE USE OF TOTAL SIMULATOR TRAINING IN TRANSITIONING AIR-CARRIER PILOTS: A FIELD EVALUATION
Robert J. Randle, Jr., Trieve A. Tanner, Joy A. Hamerman (Ford Aerospace and Communications Corp., Sunnyvale, Calif.), and Thomas H. Showalter (Stanford Univ., Calif.) Jan. 1981 99 p refs
(NASA-TM-81250; A-8411) Avail: NTIS HC A05/MF A01 CSCL 05I

A field study was conducted in which the performance of air carrier transitioning pilots who had landing training in a landing maneuver approved simulator was compared with the performance of pilots who had landing training in the aircraft. Forty-eight trainees transitioning to the B-727 aircraft and eighty-seven trainees transitioning to the DC-10 were included in the study. The study results in terms of both objectively measured performance indicants and observer and check-pilot ratings did not demonstrate a clear distinction between the two training groups. The results suggest that, for these highly skilled transitioning pilots, a separate training module in the aircraft may be of dubious value. T.M.

N81-16995# Dayton Univ., Ohio. Research Inst.
EVALUATION OF BIRD LOAD MODELS FOR DYNAMIC ANALYSIS OF AIRCRAFT TRANSPARENCIES Final Report, Jan. 1978 - Dec. 1979
Blaine S. West and Robert A. Brockman Aug. 1980 87 p refs
(Contract F33615-76-C-3103; AF Proj. 2202)
(AD-A092909; UDR-TR-80-59; AFWAL-TR-80-3092) Avail: NTIS HC A05/MF A01 CSCL 01/3

The objective of the program was to experimentally and analytically examine the range of applicability of existing bird loading models. The program consisted of two primary tasks: (1) the design of an experiment and the collection of experimental data for actual bird impact on a flexible target, and (2) the computation of the response to the experimental impact conditions using the MAGNA code and existing bird loading models. Projectiles made of bird simulant material were launched at specially designed aluminum targets at velocities in the range of 60 to 300 m/sec. Impacts were at angles of 90 (normal), 45, and 25 degrees for nominal bird weights of 77 and 560 grams. Time history of target out-of-plane surface displacement was measured for all impacts and strain gage data was collected for selected impacts. Calculated response data is compared to experimental data for selected impact conditions. It is demonstrated that good results can be obtained with an uncoupled loading model using a priori information to modify the loading model. GRA

N81-16996# Honeywell Systems and Research Center, Minneapolis, Minn.
TWO-AXIS, FLUIDICALLY CONTROLLED THRUST VECTOR CONTROL SYSTEM FOR AN EJECTION SEAT Final Report, 1 Apr. 1976 - 1 Oct. 1979
Robert B. Beale, Robert V. Burton, and Norman E. Miller Wright-Patterson AFB, Ohio AFWAL Jul. 1980 150 p refs
(Contract F33615-76-C-3070; AF Proj. 2402)
(AD-A093888; HONEYWELL-80SRC22; AFWAL-TR-80-3080) Avail: NTIS HC A07/MF A01 CSCL 01/3

A two-axis, hydrofluidic, thrust vector control (TVC) system was designed to stabilize an ejection seat during the critical rocket burn portion of the trajectory which should reduce the g loads on the crewmember and result in higher trajectories. The dynamic performance of a seat with a fluidic TVC system was analytically evaluated against established ejection seat requirements and physiological limits. This analysis showed that pitch rates were reduced by 60 percent and yaw rates by 90 percent when compared with a seat with no stabilizing system. Breadboard hardware was fabricated and tested with the components meeting requirements. A prototype integrated fluidic circuit and a moveable nozzle was then designed, fabricated and tested. The prototype system did not meet all the requirements due to a null bias instability in the fluidic amplifier which was caused by a nozzle asymmetry in the fluidic amplifier mold. The FTVC System included a vortex rate sensor, fluidic lag-lead compensator, and a four-stage fluidic servovalve. These components will use hot gas pressurized oil to drive a hydrostatically supported, piston actuated ball and socket nozzle with 20 deg of deflection of a 3500 lb thrust rocket. Initial nozzle breakaway friction was 170 in-lb. Operating friction was 135 in-lb and running friction was 80 in-lb. GRA

N81-16997# Simula, Inc., Tempe, Ariz.
AIRCRAFT CRASH SURVIVAL DESIGN GUIDE. VOLUME 1: DESIGN CRITERIA AND CHECKLISTS, REVISION Final Report

S. P. Desjardins, D. H. Laananen, and G. T. Singley, III Dec. 1980 272 p refs
(Contract DAAJ02-77-C-0021; DA Proj. 1L1-62209-AH-79)
(AD-A093784; TR-7927; USARTL-TR-79-22A) Avail: NTIS HC A12/MF A01 CSCL 01/2

This five-volume document has been assembled to assist design engineers in understanding the problems associated with the development of crashworthy U. S. Army aircraft. Contained herein are not only a collection of available information and data pertinent to aircraft crashworthiness but suggested design conditions and criteria as well. The five volumes of the Aircraft Crash Survival Design Guide cover the following topics: Volume 1 - Design Criteria and Checklists; Volume 2 - Aircraft Crash Environment and Human Tolerance; Volume 3 - Aircraft Structural Crashworthiness; Volume 4 - Aircraft Seats, Restraints, Litters, and Padding; and Volume 5 - Aircraft Postcrash Survival. This volume contains concise criteria drawn from Volumes 2 - 5, supplemented by checklists intended to assist designers in implementation of the criteria. GRA

N81-16998# Human Engineering Labs., Aberdeen Proving Ground, Md.
AN INVESTIGATION OF THE FIVE POINT RESTRAINT SYSTEM FOR AVIATORS Final Report
William B. DeBellis Oct. 1980 29 p
(AD-A093065; HEL-TM-21-80) Avail: NTIS HC A03/MF A01 CSCL 01/2

This report investigated a purported restriction on aircrew leg movements due to the anchor point location of the five point restraint system in the Advanced Attack helicopter (AAH). The system was investigated with aviators wearing both body armor and survival vest. An adjustable AAH crew seat mock-up was used which contained production cushions with anti-torque pedals with toe brakes. Results showed that the current configuration would not restrict the leg motion of the pilot. However, the restraint system did interfere with the body armor and survival vest. This effect confounded the results. GRA

N81-16999# National Transportation Safety Board, Washington, D. C. Bureau of Technology.
LISTING OF ACCIDENTS/INCIDENTS BY AIRCRAFT MAKE AND MODEL, UNITED STATES CIVIL AVIATION, 1978
5 Aug. 1980 210 p
(PB81-110280; NTSB-AMM-80-1) Avail: NTIS HC A10/MF A01 CSCL 01B

Included are the file number, aircraft registration number, date and location of the accident, aircraft make and model and injury index for all 4,675 accidents/incidents occurring in this period. This publication is published annually. GRA

N81-17010# North Atlantic Treaty Organization, Bodo (Norway).
SEAT PACK FOR FIGHTER AIRCRAFT OPERATING ON THE NATO NORTHERN FLANK
T. M. Arestol *In* AGARD Aircrew Safety and Survivability (Ltd. to Combat Aircraft) Oct. 1980 3 p

Avail: NTIS HC A08/MF A01

The survival seatpack for fighter aircraft is discussed. The seatpack is suited for arctic survival in winter as well as in summer and can sustain life for weeks when used effectively. The kit contains signaling and protective equipment, survival tools, and rations. M.G.

N81-17011# Centre d'Essais en Vol, Bretigny-Air (France). Lab. de Medecine Aerospatiale.
ERGONOMETRIC STUDY OF EJECTION THROUGH A BREAKABLE CANOPY [ETUDE ERGONOMIQUE L'EJECTION A TRAVERS VERRIERE FRAGILISEE]
B. Vettes *In* AGARD Aircrew Safety and Survivability (Ltd. to Combat Aircraft) Oct. 1980 9 p In FRENCH

Avail: NTIS HC A08/MF A01

In order to do away with the delay necessary for ejecting the canopy before seat separation in classic systems, tests of passage directly through the canopy have been conducted at the Brittany Flight Test Center's Aerospace Medicine Laboratory since 1962. Although it presents some risks such as acceleration, deterioration of equipment, and impact on the pilot, this method of evacuation can be seen as being of value for canopies whose thickness does not exceed 9 mn. The systemization of a means for preliminary breakage can be considered. Some static and dynamic tests (between 0 and 600 kt) performed on Mirage F.1 and Delta 2000 dummies gave satisfactory results. However, the application of the system to aircraft with freely falling canopies involves a certain number of difficulties. Aerodynamic forces are such that some pieces of plexiglass fall back on the pilot, which creates important risks. To overcome these inconveniences, a number of breakage devices were tested. Those giving the greatest satisfaction involve a two cycle breaking. In the first cycle, a pyrotechnic decoupling of the dome above the pilot takes place; in the second cycle, the rest breaks away from the canopy just before the knees pass. Transl. by A.R.H.

N81-17012# Milan Univ. (Italy). Inst. of Neurosurgery.
NEUROTRAMATOLOGICAL ASPECTS IN EJECTED PILOTS
V. A. Sironi, P. M. Rampini, E. Guerrisi (Italian Air Force, Milan), and U. Vitale (Italian Air Force, Milan) *In* AGARD Aircrew Safety and Survivability (Ltd. to Combat Aircraft) Oct. 1980 7 p refs
Avail: NTIS HC A08/MF A01

Neurological and neurosurgical aspects in injured jet pilots after ejection are considered. Observations were carried out on 108 military and civil jet pilots, that from 1958 to 1978 performed a total of 110 ejections (80 from R84, and G91 and 30 from F104). The injuries were classified into none, minor, major, and fatal. The analysis of results shows that 42.% had no injuries, 19% had minor injuries, 25.5% had major injuries, and 12.8% had fatal injuries. In 24 cases (21.8%) vertebral injuries were present: in 16 cases vertebral fractures (62.% in dorso-lumbar tract and 25% in dorsal tract), in 2 cases dislocations and in 10 cases sprains and strains. Neurological signs were present in 12 cases: spinal cord injuries in 5 cases, head trauma in 6 cases, and peripheral nerve injuries in 3 cases. The importance of the correct diagnosis and treatment, the follow-up of these cases in relation to the pathogenetic mechanisms and the prevention of the permanent neurological deficits are presented and discussed. M.G.

N81-17016# Institute of Aviation Medicine, Farnborough (England).
THE EVOLUTION OF THE HELICOPTER SEAT PAN MOUNTED PERSONAL SURVIVAL PACK (PSP)
A. Steele-Perkins *In* AGARD Aircrew Safety and Survivability (Ltd. to Combat Aircraft) Oct. 1980 3 p refs

Avail: NTIS HC A08/MF A01

A seat pan mounted personal survival pack of glass reinforced fiber construction was developed for use in all military helicopters. This offers much improved crashworthiness and increased comfort. These improvements are discussed, as well as the evolution of the survival pack through experience and application of ergonomics. R.C.T.

N81-17017# Army Aviation Research and Development Command, Fort Eustis, Va. Applied Technology Lab.
TEST AND EVALUATION OF IMPROVED AIRCREW RESTRAINT SYSTEMS FOR COMBAT HELICOPERS
George T. Singley, III *In* AGARD Aircrew Safety and Survivability (Ltd. to Combat Aircraft) Oct. 1980 16 p refs

Avail: NTIS HC A08/MF A01

US Army aviation accident data shows that a majority of all injuries in attack helicopters could have been avoided if these aircraft had been equipped with crashworthy seat and restraint systems. The compactness of the cockpit and the close proximity of mission equipment to the crew in attack and scout helicopters pose serious crash impact hazards. Although not desirable from a crashworthiness standpoint, operational considerations may dictate that mission equipment and structure be located within the occupant's crash impact motion envelope. Given this situation,

it is critical to the occupant's crach impact survival chances that he be provided with a restraint system that minimizes his crash impact motion envelope, particularly for his head. The cockpit can be delethalized further when the improved restraint is complemented by padding potential strike surfaces in the cockpit, making contact surface frangible, and providing weapon system sights with frangibility, telescoping, and/or swing-away features. T.M.

N81-17024# Federal Aviation Administration, Atlantic City, N.J. Technical Center.
MICROWAVE LANDING SYSTEM (MLS) CLEARANCE FORMAT ASSESSMENT TESTS Data Report, Jan. - Feb. 1980
Robert McFadden Dec. 1980 55 p
(AD-A093553; FAA-CT-80-46) Avail: NTIS HC A04/MF A01 CSCL 17/7

The purpose of this experiment was to provide static and flight test data with the proposed Microwave Landing System (MLS) clearance format to support the MLS International Standards and Recommended Practices (SARPS) development by the International Civil Aviation Organization (ICAO) working group. GRA

N81-17025# IIT Research Inst., Annapolis, Md.
ANALYTIC DETERMINATION OF INTERFERENCE THRESHOLDS FOR MICROWAVE LANDING SYSTEM EQUIPMENT AND TACAN/DME EQUIPMENT Interim Report
Ved P. Nanda Aug. 1980 150 p refs
(Contracts F19628-78-C-0006; DOT-FA76WAI-612)
(AD-A093448; ECAC-PR-80-008; FAA-RD-80-89) Avail: NTIS HC A07/MF A01 CSCL 17/7

This report analytically estimates the interference thresholds of the Time Reference Scanning Beam (TRSB) Microwave Landing System (MLS) which is comprised of the C-Band angle guidance and the L-Band PDME range guidance equipments. Furthermore, interference thresholds and separation distance requirements of the coexisting TACAN/DME L-Band equipment are determined. GRA

N81-17026# IIT Research Inst., Annapolis, Md.
MLS CHANNEL ASSIGNMENT MODEL Interim Report
Thomas Hensler and Andrew Koshar Aug. 1980 108 p refs
(Contracts F19628-78-C-0006; DOT-FA76WAI-612)
(AD-A093449; ECAC-PR-80-012; FAA-RD-80-91) Avail: NTIS HC A06/MF A01 CSCL 17/7

An automated channel assignment model was constructed in response to an FAA need to assess the assignment feasibility of planned MLS angle-guidance equipment in C-band, and its associate L-band Precision Distance Measurement Equipment (PDME). The intersite interference analysis and channel-assignment algorithm capabilities are described. A trial assignment of MLS equipments was performed for a Southwest United States airport environment and the results are summarized. GRA

N81-17027# Defense Mapping Agency Hydrographic and Topographic Center, Washington, D.C. Electronic Navigation Div.
DMAHTC'S SUPPORT TO NATIONAL OCEAN SURVEY LORAN-C-CHARTING
John J. Speight and Edwin O. Danford Dec. 1980 41 p Presented at the 8th Natl. Ocean Survey Hydrographic Survey Conf.
(AD-A093748) Avail: NTIS HC A03/MF A01 CSCL 17/7

The selection of LORAN-C as the primary Radionavigation System for the U.S. Coastal Confluence Zone requires by, joint agreement, that DMAHTC, USCG, and NOS provide corrections to LORAN-C Lattices overprinted on NOS Charts. This paper reviews the techniques used to compute these corrections. It also gives the status of the LORAN-C System. GRA

N81-17028# Defense Mapping Agency Hydrographic and Topographic Center, Washington, D.C. Electronic Navigation Div.
PRODUCTION OF LORAN-C RELIABILITY DIAGRAMS AT THE DEFENSE MAPPING AGENCY
Clarence L. Worrell 20 Nov. 1980 11 p refs Presented at the Inst. of Navigation Natl. Marine Meeting, New Orleans
(AD-A093749) Avail: NTIS HC A02/MF A01 CSCL 17/7

LORAN-C reliability diagrams depict two types of data, the maximum usable groundwave signal limit, which aids the LORAN-C user in determining which transmitters provide coverage in his area of operation, and the predicted uncertainty of a LORAN-C hyperbolic fix. Signal limits are computed using Bremmer's field prediction formula and an algorithm that predicts the range for a signal of predetermined signal-to-noise ratio propagating along an electrically inhomogeneous transmission path. Fix uncertainty predictions are based on a formula relating fix uncertainty to crossing angle between lines of position, system standard deviation, and the divergence of hyperbolic lines of position. Actual range and fix uncertainty may differ from values shown on reliability diagrams, depending on such factors as weather, the occurrence of geomagnetic disturbances, and the user's direction of travel. Reliability diagrams currently produced show signal limits and fix uncertainties for LORAN-C chains at a scale of 1:5,000,000; a new generation of reliability diagrams could show data at a reduced scale (1:10,000,000) for each LORAN-C triad (one master and two slave transmitters), making more chain and transmitter selection information available to the user. GRA

N81-17029# Defense Mapping Agency Hydrographic and Topographic Center, Washington, D.C.
HYDROGRAPHIC APPLICATIONS OF THE GLOBAL POSITIONING SYSTEM
Penny D. Dunn and John W. Rees, II Dec. 1980 8 p refs Presented at the 8th Natl. Ocean Survey Hydrographic Survey Conf. Prepared in cooperation with Naval Oceanographic Office, Bay St. Louis, Miss.
(AD-A093750) Avail: NTIS HC A02/MF A01 CSCL 17/7

Global Positioning satellites have been tested under a variety of conditions and demonstrated exceptional accuracy. The most portable of the Phase 1 development equipment is the manpack/vehicle user equipment (MVUE of manpack). The purpose of this study was to determine if a manpack is suitably accurate for large scale coastal hydrographic surveying. The manpack was placed aboard in the Naval Postgraduate School Research Vessel, R/V ACANIA. This objective required the testing of the manpack under varying survey conditions to determine the degradation of positional accuracy. The limit of the survey scale to which the unprocessed manpack data could be employed in a real-time operation was found to be 1:80,000 and smaller by the positioning error criteria of 0.5mm to the scale of the survey. Applications of differential techniques during the post-processing of the manpack position data increased the limit of the survey scale to 1:60,000 using the same position criteria. GRA

N81-17030# Department of Transportation, Washington, D. C. Office of Assistant Secretary for Systems Development and Technology.
FEDERAL RADIONAVIGATION PLAN. VOLUME 1: RADIONAVIGATION PLANS AND POLICY Final Report, Dec. 1979 - Jun. 1980
Jul. 1980 90 p Prepared in cooperation with DOD, Washington, D.C. 4 Vol.
(AD-A093774; DOT-TSC-RSPA-80-16-Vol-1; DOD-4650.4-P-Vol-1) Avail: NTIS HC A05/MF A01 CSCL 17/7

The Federal Radionavigation Plan (FRP) has been jointly developed by the U.S. Departments of Defense and Transportation to ensure efficient use of resources and full protection of National interests. The plan sets forth the Federal interagency approach to the implementation and operation of radionavigation systems. The Federal Radionavigation Plan delineates policies and plans for Government-provided radionavigation services. The document describes respective areas of authority and responsibility, and provides a management structure by which the individual operating agencies will define requirements and meet them in a cost-effective manner. It replaces the DOT National Plan for Navigation, and those sections of the DOD Joint Chiefs of Staff (JCS) Master Navigation Plan dealing with common user systems. Volume 1 is

a summary document which delineates plans, policies, and authority and responsibility for providing radionavigation services. An integrated management plan describing how DOT and DOD will determine requirements and coordinate research, development, and implementation of radionavigation systems is provided. GRA

N81-17031# Department of Transportation, Washington, D. C. Office of Assistant Secretary for Systems Development and Technology.
FEDERAL RADIONAVIGATION PLAN. VOLUME 2: REQUIREMENTS Final Report, Dec. 1979 - Jun. 1980
Jul. 1980 50 p Prepared in cooperation with DOD, Washington, D.C. 4 Vol.
(AD-A093775; DOT-TSC-RSPA-80-16-Vol-2; DOD-4650.4-P-Vol-2) Avail: NTIS HC A03/MF A01 CSCL 17/7

The user requirements and the processes that were used to determine them are described. Both general and specific requirements related to various applications and phases of navigation are discussed. Present and future anticipated needs are also discussed. The requirements of civil and military users defined for radio navigational services are based upon the technical and operational performance needed for military missions, transportation safety, and economic efficiency. T.M.

N81-17032# Department of Transportation, Washington, D. C. Office of Assistant Secretary for Systems Development and Technology.
FEDERAL RADIONAVIGATION PLAN. VOLUME 3: RADIONAVIGATION SYSTEM CHARACTERISTICS Final Report, Dec. 1979 - Jun. 1980
Jul. 1980 46 p Prepared in cooperation with DOD, Washington, D.C. 4 Vol.
(AD-A093776; DOT-TSC-RSPA-80-16-Vol-3; DOD-4650.4-P-Vol-3) Avail: NTIS HC A03/MF A01 CSCL 17/7

Present and planned navigation systems are described in terms of nine major parameters: signal characteristics, accuracy, availability, coverage, reliability, fix rate, fix dimensions, capacity, and ambiguity. The characteristics, capabilities, and limitations of existing and proposed major radio navigation systems are discussed. All of the systems considered are defined in terms of system performance parameters which determine the utilization and limitations of the individual systems. T.M.

N81-17033# Department of Transportation, Washington, D. C. Office of Assistant Secretary for Systems Development and Technology.
FEDERAL RADIONAVIGATION PLAN. VOLUME 4: RADIONAVIGATION RESEARCH, ENGINEERING AND DEVELOPMENT Final Report, Dec. 1979 - Jun. 1980
Jul. 1980 120 p Prepared in cooperation with DOD, Washington, D.C. 4 Vol.
(AD-A093777; DOT-TSC-RSPA-80-16-Vol-4; DOD-4650.4-P-Vol-4) Avail: NTIS HC A06/MF A01 CSCL 17/7

The federal radio navigation R,E&D plan together with individual R,E&D plans for military and civil air, land, marine applications are summarized. Open issues and the means for their resolution are discussed. A key feature is a discussion on how the individual agency R,E&D plans will be coordinated to help assure that all aspects of each system are thoroughly evaluated while avoiding duplication of activitites. T.M.

N81-17035# Federal Aviation Administration, Atlantic City, N.J. Technical Center.
OMEGA TRANSMITTER OUTAGES, JANUARY TO DECEMBER 1979
Lorraine Rzonca Oct. 1980 18 p
(FAA Proj. 043-311-520)
(AD-A093425; FAA-CT-80-196; FAA-RD-80-113) Avail: NTIS HC A02/MF A01 CSCL 17/7

An investigation of Omega transmitter outages during 1979 was conducted with emphasis on the occurrence of simultaneous downtimes. Data presented includes frequency and duration of outages and total yearly percentage shutdown for each transmitter, with scheduled outages specifically noted. The most significant dual outage lasted more than 5 days when Norway antenna repairs were coincident with Argentina annual maintenance.GRA

N81-17036# Federal Aviation Administration, Atlantic City, N.J.
DETECTION OF MILITARY AIRCRAFT IN AN AIR TRAFFIC CONTROL RADAR BEACON SYSTEM (ATCRBS) ENVIRONMENT Final Report, period ending Jun. 1980
Carl Hazelwood Dec. 1980 28 p refs
(AD-A093427; FAA-CT-80-37) Avail: NTIS HC A03/MF A01 CSCL 17/7

An initial survey and analysis of military Air Traffic Control Radar Beacon System (ATCRBS) transponder problems was conducted as a result of transponder performance analyzer (TPA) measurement difficulties encountered at Dobbins Air Force Base, Georgia, and from field problem reports from the Atlanta Terminal, New York and Washington Centers, and other areas. The information assembled and presented in this report demonstrates potential ATCRBS problems with high performance military aircraft in fringe areas of coverage and particularly with the Automated Radar Terminal Systems (ART's). Aircraft antenna patterns and switching are of primary concern. GRA

N81-17037# National Technical Information Service, Springfield, Va.
AIR TRAFFIC CONTROL SIMULATION MODELS. CITATIONS FROM THE NTIS DATA BASE Progress Report, 1976 - Sep. 1980
Guy E. Habercom, Jr. Oct. 1980 208 p Supersedes NTIS/PS-79/0799; NTIS/PS-78/0788
(PB81-800104; NTIS/PS-79/0799; NTIS/PS-78/0788) Avail: NTIS HC $30.00/MF $30.00 CSCL 17G

Enroute and terminal air traffic control facilities are investigated by use of mathematical models and computerized simulations. Ground based and satellite navigational aids are modeled for present and predicted air traffic requirements. Worldwide networks for traffic scheduling are simulated. This updated bibliography contains 203 citations, 34 of which are new entries to the previous edition. GRA

N81-17038*# Kansas Univ. Center for Research, Inc., Lawrence.
THE DAST-1 REMOTELY PILOTED RESEARCH VEHICLE DEVELOPMENT AND INITIAL FLIGHT TESTING Final Report
Alexandros Kotsabasis Feb. 1981 229 p refs
(Grant NsG-4017)
(NASA-CR-163105) Avail: NTIS HC A11/MF A01 CSCL 01C

The development and initial flight testing of the DAST (drones for aerodynamic and structural testing) remotely piloted research vehicle, fitted with the first aeroelastic research wing ARW-I are presented. The ARW-I is a swept supercritical wing, designed to exhibit flutter within the vehicle's flight envelope. An active flutter suppression system (FSS) designed to increase the ARW-I flutter boundary speed by 20 percent is described. The development of the FSS was based on prediction techniques of structural and unsteady aerodynamic characteristics. A description of the supporting ground facilities and aircraft systems involved in the remotely piloted research vehicle (RPRV) flight test technique is given. The design, specification, and testing of the remotely augmented vehicle system are presented. A summary of the preflight and flight test procedures associated with the RPRV operation is given. An evaluation of the blue streak test flight and the first and second ARW-I test flights is presented. R.C.T.

N81-17039*# Rensselaer Polytechnic Inst., Troy, N. Y. School of Engineering.
COMPOSITE STRUCTURAL MATERIALS Semiannual Progress Report, May - Sep. 1980
George S. Ansell, Robert G. Loewy, and Stephen E. Wiberley Jan. 1981 214 p refs
(Grant NGL-33-018-003)

(NASA-CR-163946; SAPR-39) Avail: NTIS HC A10/MF A01 CSCL 11D

The development of composite materials for aircraft applications is addressed with specific consideration of physical properties, structural concepts and analysis, manufacturing, reliability, and life prediction. The design and flight testing of composite ultralight gliders is documented. Advances in computer aided design and methods for nondestructive testing are also discussed. M.G.

N81-17040# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).

AGARD FLIGHT TEST INSTRUMENTATION SERIES. VOLUME 10 ON HELICOPTER FLIGHT TEST INSTRUMENTATION

K. R. Ferrell (Army Aviation Research and Development Command, Edwards AFB, Calif.), A. Pool, ed., and K. C. Sanderson, ed. Jul. 1980 63 p refs

(AGARD-AG-160-Vol-10; AGARDograph-160-Vol-10; ISBN-92-835-1367-3) Avail: NTIS HC A04/MF A01

The helicopter characteristics with which the instrumentation must contend is discussed and the typical tests that are conducted are outlined. Major aircraft components and systems which may be instrumented are listed and suggestions are made for sensors, locations, and installation. Details are provided for instruments peculiar to helicopters. Interface of the test instrumentation with data recording systems and ground support facilities were also considered. A summary of instrumentation requirements is provided along with recommended range, accuracy, and resolution. A sample instrumentation management technique is also included. T.M.

N81-17041# Naval Aerospace Medical Research Lab., Pensacola, Fla.

ENERGY MANEUVERABILITY DISPLAY FOR THE AIR COMBAT MANEUVERING RANGE/TACTICAL TRAINING SYSTEM (ACMR/TACTS) Final Report

V. R. Pruitt, W. F. Moroney, and C. Lau Aug. 1980 69 p refs

(AD-A092974; NAMRL-SR-80-4) Avail: NTIS HC A04/MF A01 CSCL 01/2

This report describes the development of an integrated analog display (turn rate vs calibrated airspeed) for use as a debriefing aid on the Air Combat Maneuvering Range (ACMR). The ACMR gathers in-flight data from aircraft while they are engaged in air combat maneuvering. Upon returning from the ACMR, aircrew are presented with (1) a pictorial display of the engagement, and (2) a digital printout of selected encounter parameters (e.g., velocity 'g', altitude of each aircraft, range between aircraft). The display integrates these relevant energy maneuverability data into an analog format, thus providing an immediate comparison of the performance of each aircraft with respect to the maneuvering envelope of that aircraft and that of the opponent. The display also allows the aircrew to recognize very rapidly whether they are gaining or loosing energy and the rate of gain or loss. The maneuvering envelopes of the F-14, F-4, A-4 and F-5 aircraft can be displayed in this dynamic format. It is expected that this new format (1) will provide a better means for pilots to determine how well they have maximized the performance of their aircraft, and (2) may serve as an aid in tactics development. A brief discussion of the nature of energy maneuverability is contained in an Appendix. GRA

N81-17042# Naval Air Development Center, Warminster, Pa. Aircraft and Crew Systems Technology Directorate.

ZDRAFT-A GRAPHITE CODE FOR VTOL AIRCRAFT GROUND FOOTPRINT VISUALIZATION Final Report, Oct. 1978 - Jan. 1980

J. J. Zanine and K. A. Green Jan. 1980 115 p refs Sponsored by the Navy Dept.

(AD-A093311; NADC-80109-60) Avail: NTIS HC A06/MF A01 CSCL 01/3

The computer program, entitled 'ZDRAFT,' generates a graphic display of VTOL aircraft and their associated ground flow fields. The actual flow field data is calculated by another computer program. The 'ZDRAFT' computer code rapidly assimilates and displays this flow field data. The display consists of pertinent flow field characteristics, such as stagnation lines, upwash flow and ground plane wall jet conditions, superimposed over a scaled aircraft planform. This visual form allows easy assessment of various configurations and operating conditions. GRA

N81-17043# National Aeronautical Establishment, Ottawa (Ontario).

A METHOD FOR THE PREDICTION OF WING RESPONSE TO NONSTATIONARY BUFFET LOADS

B. H. K. Lee Jul. 1980 74 p In ENGLISH; FRENCH summary

(AD-A093037; NAE-LR-601; NRC-18629) Avail: NTIS HC A04/MF A01 CSCL 01/3

A method for the prediction of the response of a wing to nonstationary buffet loads is presented. The time history of the applied load is segmented into a number of time intervals. In each time segment, the nonstationary load is represented by the produce of a deterministic shaping function and a statistically stationary random function. An approximate modelling of the load on the wing is given. The wing is divided into panels or elements, and the load is computed from measured or estimated pressure fluctuations at the center of each panel. A series representation, with terms of the correlated noise type, is used to curve fit the experimentally determined complex buffet pressure power spectral densities. Using the correlated noise form of power spectral density for the random part of the applied load, analytic expressions are derived for the mean square displacement and acceleration response of the wing. An illustration using data available for the F-4E aircraft is included. Author (GRA)

N81-17044# Aeronautical Systems Div., Wright-Patterson AFB, Ohio.

COMPARISON OF FLIGHT LOAD MEASUREMENTS OBTAINED FROM CALIBRATED STRAIN GAGES AND PRESSURE TRANSDUCERS Final Report, Nov. 1976 - Feb. 1979

John W. Rustenburg Oct. 1980 52 p refs

(AD-A093758; ASD-TR-80-5038) Avail: NTIS HC A04/MF A01 CSCL 20/11

Net shear, bending moment, and torsion at one wing station derived from concurrent strain gage and pressure transducer measurements are compared. Comparisons are made for results from normal and abrupt symmetrical pullup/pushdown, and rolling pullout maneuvers at subsonic and supersonic speeds and four wing sweeps. With few exceptions good to very good correlation is shown. GRA

N81-17045# Southampton Univ. (England). Dept. of Electrical Engineering.

STATIC CHARGE IN AIRCRAFT FUEL TANKS Final Technical Report, 1 Jul. 1977 - 30 Sep. 1979

Charles R. Martel Sep. 1980 38 p refs

(Grant AF-AFOSR-3373-77; AF Proj. 2301; AF Proj. 3048) (AD-A093552; AFWAL-TR-80-2049) Avail: NTIS HC A03/MF A01 CSCL 01/2

This program investigates electrostatic hazards associated with aircraft fueling. The tribo electric phenomena of reticulated polyurethane foam charging was examined using JP-4. An attempt was made to understand the basic electrostatic phenomena involved when fuel is pumped into aircraft fuel tanks containing reticulated, polyurethane foam. The investigation also involved the development and study of alternative foam materials having enhanced electrical and charge dissipation characteristics as a means of eliminating the electrostatic hazards during refueling. GRA

N81-17046# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio. Fire Protection Branch.

FLAME TUBE AND BALLISTIC EVALUATION OF EXPLOSAFE ALUMINUM FOIL FOR AIRCRAFT FUEL TANK EXPLOSION PROTECTION Final Report, Aug. 1977 - Mar. 1979

Thomas A. Hogan and Charles Pedriani Apr. 1980 107 p refs

(AF Proj. 3048; DA Proj. 1L1-62209-AH-76)
(AD-A093542; AFWAL-TR-80-2031) Avail: NTIS HC A06/MF A01 CSCL 11/6

This report presents the combustion and gunfire testing conducted by the AFWAL/PO and the AVRADCOM/Applied Technology Laboratory in support of a joint USAF/Army and Canadian Government project to evaluate an advanced metal foil explosion suppressor called Explosafe for potential use in protecting aircraft fuel tanks. This material is manufactured by Vulcan Industrial Packaging Limited, (VIPL), Explosafe Division, and is processed by slitting, expanding and stacking aluminum foil into batts. The density is varied either by changing the foil thickness at a constant expansion width or by changing the expansion width at a constant foil thickness. The scope of this in-house program was to determine: (1) the material's ability to suppress combustion overpressures through small scale laboratory testing and through full scale ballistic testing, (2) to establish an optimum material density versus performance and (3) to compare the results to the reticulated polyurethane foam. The AFWAL/PO conducted the laboratory tests in a flame tube over several densities of 3 foil thicknesses and the Army conducted the ballistic tests in a heavy structural fuel tank over 3 densities of 3 foil thicknesses. Results of these tests indicated that a 2.0 mil foil around the 2.0 no./cu ft region was an optimum foil thickness and weight density to be used in the remaining tests of the joint program. GRA

N81-17047# Vulcan Industrial Packaging Ltd., Rexdale (Ontario). EXPLOSAFE Div.

EVALUATION OF EXPLOSAFE. EXPLOSION SUPPRESSION SYSTEM FOR AIRCRAFT FUEL TANK PROTECTION Final Report, Jul. 1977 - Jul. 1 1980

Andrew Szego, Karim Premji, and Robert D. Appleyard Wright-Patterson AFB, Ohio AFWAL Jul. 1980 465 p
(Contract F33615-77-C-3115; AF Proj. 3048)
(AD-A093125; EDR-010-047; AFWAL-TR-80-2) Avail: NTIS HC A20/MF A01 CSCL 01/3

A joint USAF/Canadian government development program conducted to evaluate the fuel tank ullage explosion suppression performance and to qualify the airborne military use of EXPLOSAFE void filler material, is reported. The material was subjected to laboratory testing to characterize its performance with regard to the manufacturing variables and subsequently exposed to typical ballistic threats up to 23mm HEI-T. The material properties are extensively defined together with the operational penalties associated with its use. Operational and environmental tests are described which determined the tolerance of the material to static loading, fuel slosh vibration, and exposure to fuel, fuel and additives, and corrosive fuel contaminants. Further tests demonstrate that the material does not affect fuel system operation with regard to flow, free motion of fuel during aircraft inversion and fuel tank venting. Installation studies were conducted on fuel tanks of varying complexity to demonstrate feasibility of assembly using existing apertures. GRA

N81-17048# Texas Univ. at Austin. Center for Aeronautical Research.

THE EFFECTS OF WARHEAD-INDUCED DAMAGE ON THE AEROELASTIC CHARACTERISTICS OF LIFTING SURFACES. VOLUME 2: AERODYNAMIC EFFECTS Final Report, 1 Feb. 1979 - 1 Mar. 1980

J. C. Westkaemper and R. M. Chandrasekharan Jul. 1980 116 p refs
(Grant AF-AFOSR-3569-78; AF Proj. 2301)
(AD-A093063; AFOSR-80-1040TR) Avail: NTIS HC A06/MF A01 CSCL 20/4

Tests were made in a subsonic wind tunnel to determine the effects of damage on the aerodynamic characteristics of a T-38 aircraft stabilator half. Six damage configurations were used, one circular and the remainder trapezoidal in planform, with areas of up to 2 percent of the stabilator area. The damage holes were all ahead of the 50 percent chord line, with centers at 43, 60, and 75 percent span. Surface pressure distributions and lift and drag coefficients were measured. The 65A004 airfoil used is subject to leading edge separation which strongly influenced the results. In the absence of separation, damage effects tended to be localized and aerodynamic degradation was modest. With extensive separation, the damage influence propagated completely across the span, with more substantial degradation. There was up to 300 percent increase on CD sub o, but at moderate lift coefficients the drag increase was generally insignificant. The decrease in C sub L was more consistent, ranging up to 10 percent for the larger damage holes. GRA

N81-17049# Technische Hochschule, Aachen (West Germany). Lehrstuhl fuer Luft- und Raumfahrt.

ON THE FLIGHT MECHANICS OF REMOTELY PILOTED VEHICLES [ZUR FLUGMECHANIK VON RPV'S]

R. Staufenbiel Bonn Bundesministerium fuer Verteidigung 1979 71 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Verteidigung
(BMVg-FBWT-79-28) Avail: NTIS HC A04/MF A01

The dynamic characteristics which are important for the design of small remotely piloted vehicles (RPVs; MINI-RPVs) are considered. In particular, the influence of vehicle size on longitudinal motion stability, vehicle response to vertical and longitudinal gusts, and on performance are examined. Results show that longitudinal motion can be scaled for vehicles of different size by introducing a suitable reference length and a relative mass parameter. Gust sensitivity and landing technique are shown to be important aspects for small RPVs. A special configuration, based on a circular wing, was developed for a MINI-RPV and was successfully in a wind tunnel as well as during remotely controlled test flights. Author (ESA)

N81-17050# Societe Nationale Industrielle Aerospatiale, Cannes (France).

EVOLUTION OF MATERIALS AND ASSOCIATED TECHNOLOGIES IN THE MAKEUP OF AEROSPACE MATERIALS, PART 1 [EVOLUTION DES MATERIAUX ET DES TECHNOLOGIES ASSOCIEES DANS LES STRUCTURES DE MATERIELS AEROSPATIAUX. PREMIERE PARTIE]

G. Sertour and G. Hilaire Paris Association Aeronautique et Astronautique de France 1979 29 p In FRENCH Presented at 14th Intern. AAAF Aeron. Congr., Paris, 6-8 Jun. 1979 2 Vol.
(AAAF-NT-79-22-Pt-1; ISBN-2-7170-0569-2) Avail: NTIS HC A03/MF A01; CEDOCAR, Paris FF 34 (France and EEC) FF 39 (others)

A historical survey of the aerospace construction industry is presented. Emphasis is on the development of aluminum alloys and on laboratory techniques for testing their in service behavior. Crack propagation studies and results concerning stress corrosion cracking are covered. Manufacturing techniques, notably press forming, are examined. Recent results in the use of plastics, mainly carbon epoxy composites, are mentioned and their development, is seen as opening a new era in aerospace technology. Author (ESA)

N81-17051# Societe Nationale Industrielle Aerospatiale, Cannes (France).

EVOLUTION OF MATERIALS AND ASSOCIATED TECHNOLOGIES IN THE MAKEUP OF AEROSPACE MATERIALS. PART 2: EXAMPLES [EVOLUTION DES MATERIAUX ET DES TECHNOLOGIES ASSOCIEES DANS LES STRUCTURES DE MATERIELS AEROSPATIAUX. DEUXIEME PARTIE]

G. Sertour and G. Hilaire Paris Association Aeronautique et Astronautique de France 1979 31 p In FRENCH Presented at 14th Intern. AAAF Aeron. Congr., Paris, 6-8 Jun. 1979 2 Vol.
(AAAF-NT-79-22-Pt-2; ISBN-2-7170-0570-6) Avail: NTIS HC A02/MF A01; CEDOCAR, Paris FF 34 (France and EEC) FF 39 (others)

As part of a historical survey of the aerospace construction industry, examples of the use of technological advances in materials sciences and process engineering are offered. These include an overview of the fabrication of first stage fuel tanks for ARIANE as well as of the development of a double payload launch system (SYLDA) for the same vehicle. Also covered are in exhaust nozzle housing (MIRAGE 2000), a swing wing tip

(CONCORDE), a lift dumper (AIRBUS A 300 B), and a light alloy casing (INTELSAT 5). The MARECS satellite antenna, a rigid solar generator, carbon carbon composites, and the use of Kevlar are discussed as well. Author (ESA)

N81-17052# Societe Nationale Industrielle Aerospatiale, Marignane (France.) Dept. Scientifique.
NEW MATERIALS AND HELICOPTER CERTIFICATION [MATERIAUX NOUVEAUX ET CERTIFICATION DES HELICOPTERES]
F. Liard Paris Association Aeronautique et Astronautique de France 1979 25 p In FRENCH Presented at 14th Intern. AAAF Aeron. Congr., Paris, 6-8 Jun. 1979
(AAAF-NT-79-26; ISBN-2-7170-0574-9) Avail: NTIS HC A02/MF A01; CEDOCAR, Paris FF 22 (France and EEC) FF 27 (others)

Citing the AS 350 series helicopter as an example, problems posed for the certification of an aircraft whose structure is made up of newly developed or experimental materials, mainly fiber reinforced plastic composites or laminates, are discussed. Defining the resistance of a sturcture as to static strength and fatigue strength is dealt with. The influence of aging, either artificially for test purposes or natural aging, is also considered. Quality control, crash behavior, reaction to fire, and vibration stress behavior of helicopter structures are mentioned. Comparison with metallic materials is made. Author (ESA)

N81-17053# Avions Marcel Dassault-Breguet Aviation, Saint-Cloud (France).
A CONVERSATIONAL TOPOLOGICAL GRID METHOD AND OPTIMIZATION OF STRUCTURAL CALCULATIONS INVOLVING FINITE ELEMENTS [MAILLAGE PAR METHODE TOPOLOGIQUE CONVERSATIONNELLE ET OPTIMISATION DANS LES CALCULS DE STRUCTURE PAR ELEMENTS FINIS]
C. Petiau Paris Association Aeronautique et Astronautique de France 1979 32 p refs In FRENCH Presented at 14th Intern. AAAF Aeron. Congr., Paris, 6-8 Jun. 1979
(AAAF-NT-79-30; ISBN-2-7170-0578-I) Avail: NTIS HC A03/MF A01; CEDOCAR, Paris FF 34 (France and EEC) FF 39 (others)

A finite element code used in the structural analysis and design of MIRAGE aircraft is studied. Particular attention is given to two modules of this program: (1) the elaboration of a three dimensional grid representation, based on a topological method; and (2) a linear optimization of the structural stability parameters. A progressive shift in data input techniques towards a man machine conversational mode is also discussed. Stress concentration results, including aeroelasticity data, and associated computer graphics are shown, using the MIRAGE 2000 aircraft as an example. Author (ESA)

N81-17054# Avions Marcel Dassault-Breguet Aviation, Saint-Cloud (France). Bureau de Calculs des Structures.
LIMITING APPLICATION OF THE CONCEPT 'DAMAGE TOLERANCE' WITH REGARD TO FIGHTER AIRCRAFT [LES LIMITES DE L'APPLICATION DE LA CONCEPTION TOLERANCE AUX DOMMAGES AUX AVIONS D'ARMES]
D. Chaumette Paris Association Aeronautique et Astronautique de France 1979 29 p In FRENCH Presented at 14th Intern. AAAF Aeron. Congr., Paris, 6-8 Jun. 1979
(AAAF-NT-79-32; ISBN-2-7170-0580-3) Avail: NTIS HC A03/MF A01; CEDOCAR, Paris FF 34 (France and EEC) FF 39 (others)

The safety standard concepts fail safe, safe life, and damage tolerance as defined by civil norms and military specifications are examined. Specifically, their application to a coherent maintenance program for military aircraft is considered. Experience gained with MIRAGE aircraft justifies using damage tolerance norms, however, this concept as detailed in US MIL 83444 is seen as too rigid. A more pragmatic approach, making use of fatigue tests in designing structures that are both reasonably resistant to fabrication defects and easily inspected in service, is suggested. Author (ESA)

N81-17055# Lille Univ. (France). Inst. de Mecanique des Fluides.
LABORATORY STUDIES OF FLIGHT MECHANICS USING CATAPULT LAUNCHED MODELS [ETUDES DE MECANIQUE DU VOL PAR MAQUETTES CATAPULTEES EN LABORATOIRE]
J. L. Cocquerez Paris Association Aeronautique et Astronautique de France 1980 51 p In FRENCH Presented at 16th Colloq. d'Aerodyn. Appl., Lille, 13-15 Nov. 1979
(AAAF-NT-80-15; ISBN-2-7170-0611-7) Avail: NTIS HC A04/MF A01; CEDOCAR, Paris FF 40 (France and EEC) FF 45 (others)

A laboratory installation for the free flight testing of aircraft scale models is described. Models two to three meters in length and weighing up to 40 kg can be handled. The use of miniaturized high performance sensors and flight controls associated with numerical systems for telemetry and remote control is also shown. Results obtained using catapult launched models of commercial and fighter aircraft are given as examples of typical test programs. These include aircraft response to lateral gusts simulated in a wind tunnel, impact study of a belly landing, and flight characteristics at high angle of incidence for the Mirage 2000 as well as aircraft response to vertical turbulence for the same aircraft model. Author (ESA)

N81-17056# Lille Univ. (France). Inst. de Mecanique des Fluides.
MODELING, ACQUISITION AND PROCESSING DURING LARGE DISPLACEMENTS [MODELISATION - ACQUISITION - TRAITEMENT LORS DE GRANDS MOUVEMENTS]
W. Charon and P. Coton Paris Association Aeronautique et Astronautique de France 1980 24 p In FRENCH Presented at 16th Colloq. d'Aerodyn. Appl., Lille, 13-15 Nov. 1979
(AAAF-NT-80-16; ISBN-2-7170-0612-5) Avail: NTIS HC A02/MF A01; CEDOCAR, Paris FF 25 (France and EEC) FF 30 (others)

Data conditioning and analysis methods, generally downline from data collection on experiments in flight mechanics, are briefly described. An optimal PCM telemetry data acquisition chain is outlined. The restitution of experimental parameters from raw data through the use of sampling windows is discussed. Numerical filtering techniques are cited. Mathematical modeling, especially of nonlinear systems, is treated and the possibility of a model which covers the entire domain of dynamic response of an aircraft in flight is considered. Experimental error detection and the setting of confidence limits relative to the calculation of aerodynamic coefficients are also covered. Author (ESA)

N81-17057* National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.
SKIN FRICTION MEASURING DEVICE FOR AIRCRAFT Patent
Lawrence C. Montoya and Donald R. Bellman, inventors (to NASA) Issued 23 Dec. 1980 8 p Filed 7 Aug. 1979 Supersedes N79-31139 (17 - 22, p 2895)
(NASA-Case-FRC-11029-1; US-Patent-4,240,290; US-Patent-Appl-SN-164617; US-Patent-Class-73-178R; US-Patent-Class-73-147) Avail: US Patent and Trademark Office CSCL 01D

A skin friction measuring device for measuring the resistance of an aerodynamic surface to an airstream is described. It was adapted to be mounted on an aircraft and is characterized by a friction plate adapted to be disposed in a flush relationship with the external surface of the aircraft and be displaced in response to skin friction drag. As an airstream is caused to flow over the surface, a potentiometer connected to the plate for providing an electrical output indicates the magnitude of the drag.
Official Gazette of the U.S. Patent and Trademark Office

N81-17058# Crew Systems Consultants, Yellow Springs, Ohio.
OPERATIONAL PROBLEMS ASSOCIATED WITH HEAD-UP DISPLAYS DURING INSTRUMENT FLIGHT Final Report
Richard L. Newman Oct. 1980 231 p refs
(Contract F33615-79-C-0521; AF Proj. 7184)
(AD-A092992; AFAMRL-TR-80-116) Avail: NTIS HC A11/MF A01 CSCL 05/8

Because of the interest in using head-up displays (HUDs) as primary flight references in instrument meteorological conditions (IMC), a survey of operational pilots flying HUD-equipped airplanes was undertaken. This survey revealed several problem areas that were common to most of the HUDs used. These common problem areas were: the HUDs were too bright at night; the field of view was too limited; and the location of the design eye reference point does not correspond to the typical pilot practice of sitting as high as possible to maintain good visibility. Other problem areas were reported, including: the response of the HUD symbols is not adequately controlled by existing specifications; pilots have an increased tendency toward disorientation while flying by reference to the HUD; the instrument landing system (ILS) displays in use are not satisfactory; and the balance between presenting necessary information and presenting too much is not always achieved on today's HUDs. Concurrently with the review of operational problems, a review of HUD-related training was undertaken. This review shows that very little attention is being paid to initial and recurrent HUD training or to the development of HUD procedures for flight in IMC. GRA

N81-17059# Simmonds Precision Products, Inc., Vergennes, Vermont. Instrument Systems Div.
EFFECTS ON ANTI-STATIC ADDITIVES ON AIRCRAFT CAPACITANCE FUEL GAGING SYSTEMS Final Report, May - Nov. 1979
P. Weitz and D. Slade Jun. 1980 58 p
(Contract F33657-79-C-0378; AF Proj. 3048)
(AD-A092907; E-2239; AFWAL-TR-80-2058) Avail: NTIS HC A04/MF A01 CSCL 21/4

The effects of increasing the electrical conductivity of JP-4 and Jet A jet fuels on aircraft capacitance fuel guaging systems were determined. Fuel tank capacitance probes from the KC-135, A-7, F-15, and F-16 aircraft were tested in JP-4 and Jet A fuels having electrical conductivities ranging from less than 20 pS/m to 5,000 pS/m. Additives ASA-3 (Shell Chemical Company) and Stadis 450 (E.I. Du Pont de Nemours and Company) were used to increase the conductivity of the fuel. The fuel tank capacitance guaging system parameters of accuracy, sensitivity, speed of response, and High Z null voltage were measured. The F-15 and the F-16 systems were unaffected by fuel conductivities up to 5,000 pS/m. The A-7 and KC-135 systems indicated negligible effects at fuel conductivities up to 500 pS/m, and increasing system degradation at higher conductivity levels. GRA

N81-17060# McDonnell Aircraft Co., St. Louis, Mo.
ENVIRONMENTAL BURN-IN EFFECTIVENESS Final Report, May 1979 - Aug. 1980
J. R. Anderson Wright-Patterson AFB, Ohio AFWAL Aug. 1980 168 p refs
(Contract F33615-79-C-3411; AF Proj. 2402)
(AD-A093307; AFWAL-TR-80-3086) Avail: NTIS HC A08/MF A01 CSCL 14/2

This report considers the effectiveness of current industry practice in the burn-in of avionics equipment. The burn-in test results for six avionics systems are analyzed using the chance Defective Exponential model for the failure rate. Based on the mode, effectiveness measures for burn-in are developed. Flight test results are also evaluated to determine the adequacy of current burn-in techniques. Cost effectiveness considerations for the burn-in process are addressed. Results of an industry survey on current practice and opinions concerning various issues in the burn-in of avionics are presented. GRA

N81-17061# Perceptronics, Inc., Woodland Hills, Calif.
ANALYSIS AND MODELING OF INFORMATION HANDLING TASKS IN SUPERVISORY CONTROL OF ADVANCED AIRCRAFT Annual Technical Report
Yee-Yee Chu, Randall Steeb, and Amos Freedy Jun. 1980 123 p refs
(Contract F49620-79-C-0130; AF Proj. 2313)
(AD-A092906; PATR-1080-80-6; AFOSR-80-1190TR) Avail: NTIS HC A06/MF A01 CSCL 01/2

This report describes research and development centered on evaluation of information needs and automated management of information displays in advanced aircraft operations. Techniques for information selection were developed based on Multi-Attribute Utility (MAU) models and queueing theory formulations. These techniques take into account both subjective factors and objective situational conditions, as well as the immediate information monitoring and control needs of the operator and the impact on other unattended processes. The combined MAU/queueing model was tested in a Monte Carlo simulation. The experiment compared performance of the MAU-based policy to other priority policies both in event selection and information source selection. Initial results suggest that the value-based model is suitable for concurrent evaluation of information source and event sequence. The information management concept based on the MAU model seems to be superior to those based on traditional priority assignment. Possible applications of the approaches and the plan for further validation are also discussed. GRA

N81-17062# Dynamics Research Corp., Wilmington, Mass.
DIGITAL AVIONICS INFORMATION SYSTEM (DAIS): LIFE CYCLE COST IMPACT MODELING SYSTEM (LCCIM). A MANAGERIAL OVERVIEW Final Report
John C. Goclowski and H. Anthony Baran Brooks AFB, Tex. AFHRL Nov. 1980 41 p refs
(Contract F33615-75-C-5218; AF Proj. 2051)
(AD-A093281; AFHRL-TR-79-4) Avail: NTIS HC A03/MF A01 CSCL 05/1

This report provides an overview of the Life Cycle Cost Impact Modeling System (LCCIM). The LCCIM can be used to assess the impact of weapon system characteristics on system support resource requirements and life cycle cost (LCC). It was developed to enhance present Air Force capability to conduct tradeoffs between competing design, manpower, and ligistics alternatives early in the weapon systems acquisition process. This report also contains a general description of the initial application of the LCCIM an analysis of the potential impacts of the Digital Avionics Information System (DAIS) Concept of avionics integration on LCC and system support personnel requirements. References are provided for other related reports which describe that application, document the development of LCCIM components and provide user's guide information and computer program listings. GRA

N81-17063# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
ADVANCEMENT ON VISUALIZATION TECHNIQUES
Walter M. Hollister, ed. (MIT) Oct. 1980 217 p refs
(AGARD-AG-255; AGARDograph-255; ISBN-920835-1371-1)
Avail: NTIS HC A10/MF A01

Principles, technology, and applications in the field of visualization and display in aircraft cockpits are discussed. Topics include liquid crystals, light emitting diodes, electroluminescent displays, and gas plasma panels, as well as, helmet mounted display devices and human factors engineering.

N81-17064# Cranfield Inst. of Tech., Bedfordshire (England).
THE PRESENTATION OF STATIC INFORMATION ON AIR TRAFFIC CONTROL DISPLAYS Ph.D. Thesis
R. J. G. Edwards *In* AGARD Advan. on Visualization Tech. Oct. 1980 44 p refs

Avail: NTIS HC A10/MF A01

The physical characteristics of display consistent with human performance are defined. Eight display characteristics were selected as critically important, they are: (1) frame rate; (2) contrast ratio; (3) ambient illumination; (4) symbol characteristics; (5) resolution; (6) bandwidth; (7) registration; and (8) phosphor type. The exact priority of each characteristics and the specific result of their interrelationships is a function of the particular application and is considered with respect to an ATC display environment. E.D.K.

N81-17065# Naval Air Development Center, Warminster, Pa.
FLAT PANEL DISPLAY TECHNOLOGY REVIEW
James Brindle, Brad Gurman (Army Avionics Res. and Develop. Activity, Ft. Monmouth.). Joseph Redford (Army Aviation

Res. and Develop. Command, St. Louis), Elliot Schlam (Army Electron. Res. and Develop. Command, Ft. Monmouth), William Mulley, Parviz Soltan (Naval Ocean Systems Center, San Diego), George Tsaparas (Naval Air Systems Command, Arlington), Keith B. Urnette (AFFDL, Wright-Patterson AFB), John Coonrod (AFAL, Wright-Patterson AFB), and Walter Melnick (AFFDL, Wright-Patterson AFB) *In* AGARD Advan. on Visualization Tech. Oct. 1980 5 p

Avail: NTIS HC A10/MF A01

There are three display media presently receiving the most attention and which appear to be the most promising. These are: (1) electroluminescence (EL); (2) light emitting diode (LED); and (3) liquid crystal (LC). There are other technologies that also appear promising but that have not advanced in development to the point where they are receiving serious consideration for aircraft use or that have serious limitations, some of which may be eliminated in time. These include plasma, electrochromic, electrophoretic, ferroelectric, magnetic particle, and microchannel playe display technologies. In order to exploit flat panel display media, development of suitable addressing techniques is required. Three representative methods of addressing display media (silicon, thin-film transistor (TFT) and crossed electrodes) are discussed. E.D.K.

N81-17066# Royal Aircraft Establishment, Farnborough (England).

THE ELECTRO-OPTICAL DISPLAY/VISUAL SYSTEM INTERFACE: HUMAN FACTORS CONSIDERATIONS

J. Laycock and R. A. Chorley (Aerospace & Defence Systems Co., Cheltenham, England) *In* AGRAD Advan. on Visualization Tech. Oct. 1980 15 p refs

Avail: NTIS HC A10/MF A01

Display systems are currently developed by a cyclical two stage process. Equipment is developed, and there is then a period in which its suitability for use by an operator is assessed. The results of the evaluation determine the modifications to be introduced into the next cycle of the process. This paper considers the possibility of adopting a design strategy which initially asseses operator performance and then uses the result of this assessment to determine what equipment development would best meet the requirements of the operator. As the subject under consideration is visual display systems, the text considers only the visual aspects of human performance and relates these attributes to display parameters. Author

N81-17067# Ferranti Ltd., Edinburgh (Scotland). Electronics Systems Dept.

INTEGRATION OF SENSORS WITH DISPLAYS

Alan C. Wesley and Ian T. B. Blackie *In* AGARD Advan. on Visualization Tech. Oct. 1980 25 p

Avail: NTIS HC A10/MF A01

The sensors commonly found on military aircraft often provide information for display. The various categories of displays available are described with their signal characteristics, cockpit location, and operational uses, together with a discussion on their particular suitability to provide integrated sensor/display systems. Author

N81-17068# Royal Signals and Radar Establishment, Malvern (England).

LIQUID CRYSTAL DISPLAYS

A. J. Hughes *In* AGARD Advan. on Visualization Tech. Oct. 1980 15 p refs

Avail: NTIS HC A10/MF A01

An introduction is given to the physical properties of liquid crystals and the electro-optic effects that may be used for display purposes. A more detailed description follows of both the twisted nematic effect, as used in the vast majority of current liquid crystal displays, and of the dyed phase-change effect, which is a likely candidate eventually to supercede the twisted nematic display. The performance and limitations of simple, directly driven displays are analyzed, and the problems and difficulties associated with more complex, matrix addressed displays are described. Finally, a brief description is given of a selection of laboratory prototypes and drive methods that demonstrate the progress of liquid crystal research towards solving the various problems associated with high complexity displays. Author

N81-17069# Thorn-Brimar Ltd., Chadderton (England).

CATHODE RAY TUBES AND PLASMA PANELS AS DISPLAY DEVICES FOR AIRCRAFT DISPLAYS

Stewart Woodcock *In* AGARD Advan. on Visualization Tech. Oct. 1980 8 p refs

Avail: NTIS HC A10/MF A01

The various types of electronic display presently being incorporated in aircraft and the displays being proposed for future use are reviewed and their technical requirements examined. These include head-up displays, helmet mounted displays, and various head-down displays which can be generated by TV techniques. The state of the art of CRT and d.c. plasma technology is described and the suitability of these two devices for the different displays is discussed, along with possible future improvements in performance. Author

N81-17070# Thomson-CSF, Paris (France). Div. Tubes Electroniques.

LARGE AREA GAS DISCHARGE DISPLAYS

J. P. Michel *In* AGARD Advan. on Visualization Tech. Oct. 1980 6 p refs

Avail: NTIS HC A10/MF A01

Gas discharge displays or plasma displays are generally classed as a.c. displays, and d.c. displays. In d.c. displays the electrodes or resistive extension of these are immersed in the gas (ac operation would be possible but almost always discharge currents are unidirectional). In a.c. displays, a dielectric surface isolates the electrodes from the gas with which they only have an electrostatic coupling and only a.c. operation is possible. Both can be operated in a storage or nonstorage mode (storage meaning that the memory is inherent to the display device, whereas in the nonstorage or cyclic mode the memory is external to the display and the image information is transferred to the display device sequentially and refreshed frequently enough to avoid flicker). E.D.K.

N81-17071# Air Force Human Resources Lab., Wright-Patterson AFB, Ohio. Operational Training Div.

OPTICAL INFINITY LENS DEVELOPMENT FOR FLIGHT SIMULATOR VISUAL DISPLAYS

William B. Albery and Joseph A. LaRussa *In* AGARD Advan. on Visualization Tech. Oct. 1980 9 p refs Prepared in cooperation with Farrand Optical Co., Inc., Valhalla, N.Y.

Avail: NTIS HC A10/MF A01

A very fast, large aperture magnifying optical package was developed which can present to the observer a displayed image at optical infinity. The Pancake Window, so called because of its minimal depth and relatively flat appearance, is currently being used in two Air Force flight simulator visual displays. The optical quality of this magnifier is due to the fact that it is comprised of reflective, and not refractive elements. The advantages of its configuration as an on-axis reflective system and the optical properties of its elements are presented. The latest improvement to its development, incorporation of a spherical holographic beamsplitter mirror, is discussed. This development holds promise for reducing both the cost and weight of the package. A technique for reducing unwanted optical effects by tilting the birefringent package of the window is also discussed. E.D.K.

N81-17072# Ferranti Ltd., Edinburgh (Scotland). Inertial Systems Dept.

EVOLUTION OF TACTICAL AND MAP DISPLAYS FOR HIGH PERFORMANCE AIRCRAFT

W. H. McKinlay *In* AGARD Advan. on Visualization Tech. Oct. 1980 8 p refs

Avail: NTIS HC A10/MF A01

The operational problems which determine the display characteristics of high performance military aircraft are particularly exacting in tactical operations flown at low altitudes over land.

Because these operations are related to the terrain, situation displays having map like characteristics have become important and are now being embodied in full electronic display systems for aircraft. In such aircraft, the need to conserve display area and handle sensor data in the context of the terrain has led to combined display techniques. The display requirements and the available technologies are considered. It is suggested that the optically combined display based on film storage is the most notable solution available today although several different electronic solutions are being or could be developed. Some conclusions as to the relative significance of the difference alternative solutions are given. E.D.K.

N81-17073# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio. Visual Display Systems Branch.
HELMET MOUNTED DISPLAYS: DESIGN CONSIDERATIONS
H. Lee Task, Dean F. Kocian, and James H. Brindle *In* AGARD Advan. on Visualization Tech. Oct. 1980 13 p refs Prepared in cooperation with Naval Air Development Center, Warminster, Pa.
Avail: NTIS HC A10/MF A01

Several parameters that must be considered in the design of a helmet mounted display (HMD) are described. The parameters discussed include: size, weight, exit pupil, eye relief, field of view, collimation, distortion, and image quality. Detailed discussion and specific related equations are provided for many of these variables. Optical design approaches to HMD's are discussed with reference to specific systems. A summary table is included that shows the values of many HMD design parameters for six HMD's. The HMD image sources, both present and future, are presented. E.D.K.

N81-17074*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AN ADVANCED ELECTRONIC COCKPIT INSTRUMENTATION SYSTEM: THE COORDINATED COCKPIT DISPLAY
D. L. Baty and M. L. Watkins *In* AGARD Advan. on Visualization Tech. Oct. 1980 11 p refs Prepared in cooperation with San Jose State University Foundation, Calif.

Avail: NTIS HC A10/MF A01 CSCL 01D

Cathode ray tube (CRT) and computer technologies have reached the stage where current flight and engine instruments can economically be replaced by computer controlled CRT displays. This provides a tremendous opportunity for flexibility to the cockpit display designer, but the use of this flexibility should stay within the realities of the flight environment. One approach to the replacement of flight instruments is described, using three separate color CRT's. Each CRT displays information pertinent to one of the three orthogonal projections of the aircraft flight situation. Three airline pilots made a preliminary assessment of this display set. Comments, rankings, and ratings show that, in general, the pilots accepted the concept of pictorial flight displays. E.D.K.

N81-17075# British Aerospace Aircraft Group, Brough (England). Kingston-Brough Div.
THE INFLUENCE OF VISUAL REQUIREMENTS ON THE DESIGN OF MILITARY COCKPITS
J. W. Lyons and G. Roe *In* AGARD Advan. on Visualization Tech. Oct. 1980 29 p refs

Avail: NTIS HC A10/MF A01

The effect of visual requirements for combat aircraft is discussed with emphasis on the next generation of fighters. External vision is vital for success in air to air engagements, hence the need to define canopy lines with extreme care. The criteria for doing this are discussed in some detail. Problems of internal vision are discussed next. Cockpit display layout is considered from the point of view of moding and presentation of information as well as the more human factors problems of search. An insight into the workload aspects of cockpit assessment is included. E.D.K.

N81-17076# Grumman Aerospace Corp., Bethpage, N.Y. Guidance and Control Dept.
DISPLAY CONCEPTS FOR CONTROL CONFIGURED VEHICLES
Robert W. Klein and Walter M. Hollister *In* AGARD Advan. on Visualization Tech. Oct. 1980 13 p refs Prepared in cooperation with MIT, Cambridge

(Grant AF-AFOSR-3260-78)
Avail: NTIS HC A10/MF A01

The unique flight modes of a control configured vehicle (CCV) need to be taken into account in the design of displays for these craft. Several compensatory displays are suggested and evaluated using a fixed base, F-16 CCV simulation. The displays were found to enhance the improved tracking performance available when CCV modes are used in comparison to conventional flight. Author

N81-17077# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va. Flight Mechanics Div.
EXPERIMENTS USING ELECTRONIC DISPLAY INFORMATION
Samuel A. Morello *In* AGARD Advan. on Visualization Tech. Oct. 1980 10 p refs

Avail: NTIS HC A10/MF A01 CSCL 01D

The results of research experiments concerning pilot display information requirements and visualization techniques for electronic display systems are presented. Topics deal with display related piloting tasks in flight controls for approach-to-landing, flight management for the descent from cruise, and flight operational procedures considering the display of surrounding air traffic. Planned research of advanced integrated display formats for primary flight control throughout the various phases of flight is also discussed. E.D.K.

N81-17078*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
TURBINE MODELING TECHNIQUE TO GENERATE OFF-DESIGN PERFORMANCE DATA FOR BOTH SINGLE AND MULTISTAGE AXIAL-FLOW TURBINES Contractor Report, Aug. 1979 - Aug. 1980
G. L. Converse Feb. 1981 46 p refs
(Contract NAS3-21999)
(NASA-CR-165244; R81AEG219) Avail: NTIS HC A03/MF A01 CSCL 21E

This technique is applicable to larger axial flow turbines which may or may not incorporate variable geometry in the first stage stator. A user specified option will also permit the calculation of design point cooling flow levels and the corresponding change in turbine efficiency. The modeling technique was incorporated into a time sharing computer program in order to facilitate its use. Because this report contains a description of the input output data, values of typical inputs, and example cases, it is suitable as a user's manual. T.M.

N81-17079*# Pratt and Whitney Aircraft Group, East Hartford, Conn.
COMBUSTOR LINER DURABILITY ANALYSIS Final Report
V. Moreno Feb. 1981 84 p refs
(Contract NAS3-21836)
(NASA-CR-165250; PWA-5684-19) Avail: NTIS HC A05/MF A01 CSCL 21E

An 18 month combustor liner durability analysis program was conducted to evaluate the use of advanced three dimensional transient heat transfer and nonlinear stress-strain analyses for modeling the cyclic thermomechanical response of a simulated combustor liner specimen. Cyclic life prediction technology for creep/fatigue interaction is evaluated for a variety of state-of-the-art tools for crack initiation and propagation. The sensitivity of the initiation models to a change in the operating conditions is also assessed. A.R.H.

N81-17080*# Pratt and Whitney Aircraft Group, East Hartford, Conn. Commercial Products Div.
JT8D-15/17 HIGH PRESSURE TURBINE ROOT DISCHARGED BLADE PERFORMANCE IMPROVEMENT Contractor Report, Sep. 1979 - Aug. 1980
A. S. Janus 18 Feb. 1981 60 p refs
(Contract NAS3-20630)
(NASA-CR-165220; PWA-5515-138) Avail: NTIS HC A04/MF A01 CSCL 21E

The JT8D high pressure turbine blade and seal were modified, using a more efficient blade cooling system, improved airfoil aerodynamics, more effective control of secondary flows, and improved blade tip sealing. Engine testing was conducted to determine the effect of these improvements on performance. The modified turbine package demonstrated significant thrust specific fuel consumption and exhaust gas temperature improvements in sea level and altitude engine tests. Inspection of the improved blade and seal hardware after testing revealed no unusual wear or degradation. R.C.T.

N81-17081*# Pratt and Whitney Aircraft Group, East Hartford, Conn. Commercial Products Div.
MODEL AERODYNAMIC TEST RESULTS FOR TWO VARIABLE CYCLE ENGINE COANNULAR EXHAUST SYSTEMS AT SIMULATED TAKEOFF AND CRUISE CONDITIONS. COMPREHENSIVE DATA REPORT. VOLUME 1: DESIGN LAYOUTS
D. P. Nelson Jan. 1981 40 p refs
(Contract NAS3-20061)
(NASA-CR-159819-Vol-1; PWA-5550-50-Vol-1) Avail: NTIS HC A03/MF A01 CSCL 21E

The design layouts and detailed design drawings of coannular exhaust nozzle models for a supersonic propulsion system are presented. The layout drawings show the assembly of the component parts for each configuration. A listing of the component parts is also given. M.G.

N81-17082*# Pratt and Whitney Aircraft Group, East Hartford, Conn. Commercial Products Div.
MODEL AERODYNAMIC TEST RESULTS FOR TWO VARIABLE CYCLE ENGINE COANNULAR EXHAUST SYSTEMS AT SIMULATED TAKEOFF AND CRUISE CONDITIONS. COMPREHENSIVE DATA REPORT. VOLUME 2: TABULATED AERODYNAMIC DATA BOOK 1
D. P. Nelson Jan. 1981 400 p refs
(Contract NAS3-20061)
(NASA-CR-159819-Vol-2-Bk-1; PWA-5550-50-Vol-2-Bk-1) Avail: NTIS HC A17/MF A01 CSCL 21E

Tabulated data from wind tunnel tests conducted to evaluate the aerodynamic performance of an advanced coannular exhaust nozzle for a future supersonic propulsion system are presented. Tests were conducted with two test configurations: (1) a short flap mechanism for fan stream control with an isentropic contoured flow splitter, and (2) an iris fan nozzle with a conical flow splitter. Both designs feature a translating primary plug and an auxiliary inlet ejector. Tests were conducted at takeoff and simulated cruise conditions. Data were acquired at Mach numbers of 0, 0.36, 0.9, and 2.0 for a wide range of nozzle operating conditions. At simulated supersonic cruise, both configurations demonstrated good performance, comparable to levels assumed in earlier advanced supersonic propulsion studies. However, at subsonic cruise, both configurations exhibited performance that was 6 to 7.5 percent less than the study assumptions. At takeoff conditions, the iris configuration performance approached the assumed levels, while the short flap design was 4 to 6 percent less. Data are provided through test run 25. M.G.

N81-17083*# Pratt and Whitney Aircraft Group, East Hartford, Conn. Commercial Products Div.
MODEL AERODYNAMIC TEST RESULTS FOR TWO VARIABLE CYCLE ENGINE COANNULAR EXHAUST SYSTEMS AT SIMULATED TAKEOFF AND CRUISE CONDITIONS. COMPREHENSIVE DATA REPORT. VOLUME 2: TABULATED AERODYNAMIC DATA BOOK 2
D. P. Nelson Jan. 1981 446 p refs
(Contract NAS3-20061)
(NASA-CR-159819-Vol-2-Bk-2; PWA-5550-50-Vol-2-Bk-2) Avail: NTIS HC A19/MF A01 CSCL 21E

Tabulated aerodynamic data from coannular nozzle performance tests are given for test runs 26 through 37. The data include nozzle thrust coefficient parameters, nozzle discharge coefficients, and static pressure tap measurements. M.G.

N81-17084*# Pratt and Whitney Aircraft Group, East Hartford, Conn. Commercial Products Div.
MODEL AERODYNAMIC TEST RESULTS FOR TWO VARIABLE CYCLE ENGINE COANNULAR EXHAUST SYSTEMS AT SIMULATED TAKEOFF AND CRUISE CONDITIONS. COMPREHENSIVE DATA REPORT. VOLUME 2: TABULATED AERODYNAMIC DATA BOOK 3
D. P. Nelson Jan. 1981 467 p refs
(Contract NAS3-20061)
(NASA-CR-159819-Vol-2-Bk-3; PWA-5550-5-Vol-2-Bk-3) Avail: NTIS HC A20/MF A01 CSCL 21E

Tabulated data from wind tunnel tests evaluating the aerodynamic performance of coannular exhaust nozzles are given for test runs 37 through 65. M.G.

N81-17085*# Pratt and Whitney Aircraft Group, East Hartford, Conn. Commercial Products Div.
MODEL AERODYNAMIC TEST RESULTS FOR TWO VARIABLE CYCLE ENGINE COANNULAR EXHAUST SYSTEMS AT SIMULATED TAKEOFF AND CRUISE CONDITIONS. COMPREHENSIVE DATA REPORT. VOLUME 3: GRAPHICAL DATA BOOK 1
D. P. Nelson Jan. 1981 411 p refs
(Contract NAS3-20061)
(NASA-CR-159819-Vol-3-Bk-1; PWA-5550-50-Vol-3-Bk-1) Avail: NTIS HC A16/MF A01 CSCL 21E

A graphical presentation of the aerodynamic data acquired during coannular nozzle performance wind tunnel tests is given. The graphical data consist of plots of nozzle gross thrust coefficient, fan nozzle discharge coefficient, and primary nozzle discharge coefficient. Normalized model component static pressure distributions are presented as a function of primary total pressure, fan total pressure, and ambient static pressure for selected operating conditions. In addition, the supersonic cruise configuration data include plots of nozzle efficiency and secondary-to-fan total pressure pumping characteristics. Supersonic and subsonic cruise data are given. M.G.

N81-17086*# Pratt and Whitney Aircraft Group, East Hartford, Conn. Commercial Products Div.
MODEL AERODYNAMIC TEST RESULTS FOR TWO VARIABLE CYCLE ENGINE COANNULAR EXHAUST SYSTEMS AT SIMULATED TAKEOFF AND CRUISE CONDITIONS. COMPREHENSIVE DATA REPORT. VOLUME 3: GRAPHICAL DATA BOOK 2
D. P. Nelson Jan. 1981 482 p
(Contract NAS3-20061)
(NASA-CR-159819-Vol-3-Bk-2; PWA-5550-50-Vol-3-Bk-2) Avail: NTIS HC A21/MF A01 CSCL 21E

Graphical data from wind tunnel tests of variable cycle engine coannular exhaust nozzles are given. Specifically, aerodynamic data for takeoff conditions are presented. M.G.

N81-17087# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
SAMARIUM COBALT (SMCO) GENERATOR/ENGINE INTEGRATION STUDY Final Report, Aug. 1977 - Sep. 1979
Herbert F. Demel, Eike Richter, Charles F. Triebel, Robert C. Webb, and Max Baumgardner Wright-Patterson AFB, Ohio AFWAL Apr. 1980 348 p refs
(Contract F33615-77-C-2018; AF Proj. 3145)
(AD-A092904; R79AEG123; AFWAL-TR-80-2022) Avail: NTIS HC A15/MF A01 CSCL 21/5

This study consists of integrating a generator/starter internally on the engine rotor shaft, providing both secondary electric power and engine starting. The integrated engine generator/starter (IEG/S) has been analyzed and conceptually designed for three

power levels and three engine categories. The preliminary layouts and supporting analysis of the rate earth, permanent magnet machine indicate that the IEG/S concept is a technically feasible approach to secondary power extraction and engine starting. GRA

N81-17088# Systems Control, Inc., Palo Alto, Calif.
TURBINE ENGINE FAULT DETECTION AND ISOLATION PROGRAM, PHASE 1. VOLUME 2: REQUIREMENTS DEFINITION FOR AN INTEGRATED ENGINE MONITORING SYSTEM Final Report, 15 Nov. 1978 - 15 Aug. 1979
Laura E. Baker, Ronald L. DeHoff, and W. Earl Hall, Jr. Wright-Patterson AFB, Ohio AFWAL Apr. 1980 270 p
(Contract F33615-78-C-2162; AF Proj. 3066)
(AD-A093226; AFWAL-TR-80-2053-Vol-2) Avail: NTIS HC A12/MF A01 CSCL 21/5

Contents: Appendix A: Orientation Interview Analysis; Appendix B: Survey Design and Analysis; Appendix C: Engine Maintenance Support System Survey Responses; Appendix D: Task Force Review Transcripts. GRA

N81-17089# Systems Control, Inc., Palo Alto, Calif.
TURBINE ENGINE FAULT DETECTION AND ISOLATION PROGRAM, PHASE 1. VOLUME 1: REQUIREMENTS DEFINITION FOR AN INTEGRATED ENGINE MONITORING SYSTEM Final Report, 15 Nov. 1978 - 15 Aug. 1979
Laura E. Baker, Ronald L. Dehoff, and W. Earl Hall, Jr. Wright-Patterson AFB, Ohio AFWAL Apr. 1980 124 p refs
(Contract F33615-78-C-2062)
(AD-A093225; AFWAL-TR-80-2053-Vol-1) Avail: NTIS HC A06/MF A01 CSCL 21/5

Automated engine monitoring has emerged as an important element in the Air Force's strategy to reduce propulsion system support costs and to improve aircraft operational availability. There has been a long history of development activity directed towards engine monitoring. These systems have demonstrated that sensor and automated data acquisition can be implemented effectively in both prototype and operational applications. Historically, however, no Air Force system has resulted in validated improvement in the engine maintenance and logistics process nor in a substantial cost savings. This situation is due in part to the fact that the performance data were not reduced to a concise, usable format relevant to the decision process of the maintenance personnel. Moreover, there was no procedure developed for integrating the performance data into the maintenance framework. This report presents the results of an intensive study of the Air Force maintenance/logistics process based on a selected sample of tactical bases, depots, and major commands. The objective is to define the requirements that the Air Force engine management structure imposes on automated data integration, in general, and engine performance monitoring, in particular. Such an automated integration of turbine engine monitoring system data with current data systems requries coordination between a variety of sources, both manual and automated. The results of this study are the requirements for such integration based on typical Air Force maintenance needs. GRA

N81-17090# Cincinnati Univ., Ohio. Dept. of Aerospace Engineering and Applied Mechanics.
THREE-DIMENSIONAL INTERNAL FLOWS IN TURBOMACHINERY, VOLUME 2 Final Report, Jan. 1978 - Jun. 1980
Kirti N. Ghia and Urmila Ghia Jun. 1980 70 p refs
(Contract F49520-78-C-0041; AF Proj. 2307)
(AD-A093130; AFOSR-80-1215TR) Avail: NTIS HC A04/MF A01 CSCL 20/4

Several aspects of viscous internal flows, related to turbomachinery applications, are examined and studied with the use of appropriate model problems. Laminar as well as turbulent flows are considered. In particular, duct flows are studied in detail so as to better understand the physical phenomena occurring therein. This enables their appropriate formulation and, consequently, permits accurate numerical solutions to be obtained efficiently. Configurations involving complex geometry, transverse curvature, longitudinal curvature and streamwise flow separation are studied in detail. Turbulent flows through regular cross-section ducts are studied via the use of a two-equation model for the turbulence kinetic energy and its dissipation rate. Two approaches for treating the wall regions are examined and compared. Detailed results are obtained for flow through curved ducts of polar cross section. Some effort is also made towards modelling anisotropy and compressibility in turbulent flow using simple model problems. In the entire study, emphasis is given to the accuracy and efficiency of the numerical solutions. This has involved the study and implementation of implicit and semi-implicit numerical schemes of higher-order accuracy and higher efficiency. GRA

N81-17091# Pratt and Whitney Aircraft Group, East Hartford, Conn. Commercial Products Div.
JT8D ENGINE INTERNAL EXHAUST MIXER TECHNOLOGY PROGRAM Final Report
F. H. Pond and R. A. Heinz Washington FAA Apr. 1980 147 p Sponsored by FAA
(AD-A093057; PWA-5584-33; FAA-RD-80-69) Avail: NTIS HC A07/MF A01 CSCL 21/5

This technology program was directed towards demonstrating the reduction in jet noise achieved by the use of an internal exhaust mixer. The effort focused on static engine acoustic testing of different mixer configurations suitable for JT8D-powered commercial aircraft. A series of 12 lobe mixers with different lobe geometries was evaluated for performance and acoustic characteristics. On the basis of test results, the final mixer configuration selected for JT8D-17-powered DC-9 aircraft showed a reduction in jet noise of 2.0 PNdB at static takeoff power with an attendant 0.3 percent improvement in fuel consumption. A second mixer configuration, define on a preliminary basis for JT8D-powered 727 aircraft, demonstrated a 4.7 PNdB reduction in jet noise at takeoff power. However, a penalty of 1.3 percent in fuel consumption was incurred, and this, combined with an incompatibility in the reverse thrust mode, indicated that significant additional development work is required to demonstrate a viable configuration for 727 aircraft. Testing was also successful in demonstrating the structural integrity of the mixer. In addition, the presence of the mixer did not impart any adverse interactive effects on the stress levels of other engine components. GRA

N81-17092# Teledyne CAE, Toledo, Ohio.
MULTI-PLANE HIGH SPEED BALANCING TECHNIQUES AND THE USE OF A HIGH SPECIFIC STIFFNESS Ti-BORSIC MATERIAL FOR VIBRATION CONTROL
Glenn Hamburg and W. Pentek Wright-Patterson AFB, Ohio AFWAL Feb. 1980 116 p refs Prepared in cooperation with Mechanical Technology Inc.
(Contract F33615-79-C-2018; AF Proj. 3066)
(AD-A093122; TCAE-1701; AFWAL-TR-80-2056) Avail: NTIS HC A06/MF A01 CSCL 21/5

This report documents results of multi-plane high-speed balancing demonstration of a flexible rotor and a preliminary design analysis for a high specific stiffness composite material shaft. Both studies had as their objective the management of small turbofan engine low pressure shaft bending critical speeds. The prototype flexible rotor was successfully balanced through 3 critical speeds reaching a maximum of 28,000 rpm, which was 74% of the maximum intended rotor speed of 38,000 rpm. Balancing for operation above the 4th critical speed, which was predicted to occur at 33,000 rpm, was prevented due to a sub-synchronous rotor instability. Causes of the instability were attributed to the configuration of the squeeze film bearing damper and the engine rotor support structure as opposed to any limitation of the balancing techniques employed. The preliminary composite shaft design was completed assuming that a Ti-Borsic metal matrix composite with 60% fiber volume and 40% metal matrix would be used. This 'stiff' shaft was designed as a direct substitute for the multi-plane high speed balancing demonstrator rotor. Analytical studies indicate that the composite rotor will have a 24% third critical speed margin when operating at 38,00 rpm. GRA

N81-17093# General Electric Co., Lynn, Mass. Aircraft Engine Group.
HIGH BYPASS TURBOFAN COMPONENT DEVELOPMENT,

MODIFICATION 2 Final Report, Aug. - Nov. 1979
G. W. Armstrong, J. A. Palladino, and L. I. Zirin Wright-Patterson AFB, Ohio AFWAL Mar. 1980 94 p
(Contract F33615-78-C-2060; AF Proj. 3066)
(AD-A093156; AFWAL-TR-80-2032) Avail: NTIS HC A05/MF A01 CSCL 21/5

The assembly, instrumentation, and test of a fan shaft dynamics simulation vehicle was completed under this contract. Testing included low speed mechanical checkout, followed by operation up to 45,000 RPM using high speed model balancing, as required. The procedure was repeated for two sets of bearing support stiffness values. Balance sensitivity of the rotor system was investigated by creating various amounts of unbalance in the fan disk, the turbine disk, and the shaft, and recording the vibratory response up to 45,000 RPM. Finally, a ten hour endurance test was conducted, completing the requirements of the contract. GRA

N81-17094# Naval Air Development Center, Warminster, Pa. Aircraft and Crew Systems Technology Directorate.
PREDICTION AND EVALUATION OF THRUST AUGMENTING EJECTOR PERFORMANCE AT THE CONCEPTUAL DESIGN STAGE Final Report, Oct. 1978 - Sep. 1978
K. A. Green 30 Apr. 1980 59 p refs
(WF41400000)
(AD-A093953; NADC-80094-60) Avail: NTIS HC A04/MF A01 CSCL 21/5

The performance characteristics of thrust augmenting ejectors, based on a computerized one dimensional analysis technique, are shown. Various loss mechanisms within the ejector are described and the sensitivity of the ejector performance to these loss mechanisms are illustrated. Performance estimates have been made for several ejector configurations for which experimental data are available. Despite the assumptions that have to be made, in order that the problem be tractable for the one dimensional analysis, good agreement between the predicted and experimental values have been obtained. Other more complex (2D and 3D) codes have also been examined but were found to be expensive to run and in some cases limited in application. GRA

N81-17095# Systems Control, Inc., Palo Alto, Calif.
MULTIVARIABLE CONTROL SYNTHESIS PROGRAM: CONTROL ASPECTS OF THE F100 ALTITUDE DEMONSTRATION OF THE MULTIVARIABLE CONTROL SYSTEM Final Report, 1 Apr. 1978 - 31 Mar. 1979
Ronald L. Dehoff, Stephen Rock, W. Earl Hall, Jr., and Richard J. Adams Wright-Patterson AFB, Ohio AFWAL Mar. 1980 80 p refs
(Contract F33615-75-C-2053; AF Proj. 3066)
(AD-A093868; AFWAL-TR-80-2010) Avail: NTIS HC A05/MF A01 CSCL 21/5

This report describes the engine test demonstration phase of the F100 multivariable control synthesis program. Details of the control system design procedure and results of the hybrid simulation tests are described in AFAPL-TR-77-35, Volumes 1 and 2. The analytical design of the F100 multivariable control system included a validation of the controller performance using a hybrid simulation. The hybrid simulation represented an 'average' F100 turbofan engine and assumed a one dimensional flow path. Of course, real engine test hardware, which includes the engine, sensing, and control actuator hardware, will behave differently. These differences are recognized by the control designers and, prior to extensive testing at critical design points, these differences and their impact on the controller performance must be quantified. This report describes the results of the activities to determine the base line engine and sensor/actuator hardware performance. The validation of the engine reference point and trim schedules are included. An analysis of the Delta P/P (Fan exit Mach number) instrumentation, the response characteristics of the basic fuel delivery system, and the contributions due to the response rate of the test facility are presented. GRA

N81-17096# Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Suresnes (France).
MATERIAL AND STRUCTURAL PROBLEMS IN AIRCRAFT ENGINE TECHNOLOGY [PROBLEMES NOUVEAUX DE MATERIAUX ET DE STRUCTURE DANS LA TECHNOLOGIE DES MOTEURS D'AVIONS]
J. F. Chevalier Paris Association Aeronautique et Astronautique de France 1979 24 p In FRENCH Presented at 14th Intern. AAAF Aeron. Congr., Paris, 6-8 Jun. 1979
(AAAF-NT-79-23; ISBN-2-7170-0571-4) Avail: NTIS HC A02/MF A01; CEDOCAR, Paris FF 22 (France and EEC) FF 27

Citing the CFM-56 turbofan engine as an example, the development and improvement of jet aircraft engine structures and materials is discussed. Increasing engine operating temperature in order to diminish developing better high temperature alloys, and dimensioning of blades by photoelastic methods are treated. Metallurgical problems related to casting, forging, and machining of materials in other engine parts is also suggested. Author (ESA)

N81-17097*# Technion - Israel Inst. of Tech., Haifa. Dept. of Aeronautical Engineering.
ACTIVE CONTROLS FOR FLUTTER SUPPRESSION AND GUST ALLEVIATION IN SUPERSONIC AIRCRAFT Final Report
E. Nissim Nov. 1980 269 p refs
(Grant NsG-7373)
(NASA-CR-163934) Avail: NTIS HC A12/MF A01 CSCL 01C

Results of work done on active controls on the modified YF-17 flutter model are summarized. The basic derivation of a suitable control law is discussed. It is shown that discrepencies found between analysis and wind tunnel tests originate from the lack of proper implementation of the desired control law. Program capabilities are described. A.R.H.

N81-17098# Committee on Science and Technology (U. S. House).
SPIN RECOVERY TRAINING
Washington GPO 1980 242 p refs Hearings before the Subcomm. on Invest. and Oversight of the Comm. on Sci. and Technol., 96th Congr., 2nd Sess., no. 172, 17-19 1980
(GPO-67-439) Avail: Subcommittee on Investigations and Oversight

Regulations for licensing of private aircraft pilots are discussed. The major area of focus is on spin recovery training and whether it contributes significantly to flight safety. Statistical and economical analyses are presented. The FAA substitute pilot stall awareness program is described. T.M.

N81-17099# Naval Postgraduate School, Monterey, Calif.
A STUDY OF STATE FEEDBACK IMPLICIT MODEL FOLLOWING CONTROL FOR VSTOL AIRCRAFT M.S. Thesis
Lawrence Ernest Epley Sep. 1980 158 p refs
(AD-A093253) Avail: NTIS HC A08/MF A01 CSCL 01/4

The State Rate Feedback Implicit Model Follower control concept is examined in detail from a classical and modern control theory viewpoint. State Rate Feedback Implicit Model Following (SRFIMF) is a concept whereby control of the dynamic response of a system is achieved by the measurement and feedback of a state rate, normally acceleration. In addition to a basic description of the concept, emphasis is placed on the effect of noise in the measurement of the required feedback quantities. Control of the pitch attitude of the AV-8A Harrier VTOL aircraft is used as an example of the application of the control concept. The model of the Harrier used in this study includes the effect of both sensor measurement errors and gust load inputs. GRA

N81-17100# Bell Helicopter Co., Fort Worth, Tex.
FAULT-TOLERANT ACTUATION CONCEPT FOR A RESEARCH TEST AIRCRAFT Final Report, Sep. 1979 - Jul. 1980
Delbert E. Haskins Oct. 1980 99 p
(Contract N62269-79-C-0292)
(AD-A093113; NADC-79125-60) Avail: NTIS HC A05/MF A01 CSCL 13/7

The fault-tolerant actuation system uses 4 active electrical control paths to control a dualized hydraulic actuator. A simple failure management system operates in conjunction with some of the inherent features of the basic system to provide a failure tolerance level of dual fail-operate for the electrical control paths. The concept is characterized by its fundamental simplicity and inherent ability to tolerate failures. The concept has application to fixed wing as well as rotary wing aircraft. GRA

N81-17101# Auburn Univ., Ala. Engineering Experiment Station.
AUTOMATIC HANDOFF OF MULTIPLE TARGETS Final Technical Report, 18 Dec. 1979 - 30 Sep. 1980
J. S. Boland, III and H. S. Ranganath 30 Sep. 1980 118 p refs
(Contract DAAH01-80-C-0258)
(AD-A093483; AD-E950071) Avail: NTIS HC A06/MF A01 CSCL 17/5

In order to fully utilize the potential of the 'fire and forget' class of helicopter-borne missiles, it is necessary to solve the technical problems associated with acquiring and handing off multiple targets from a precision pointing and tracking system (PTS) to several missile seekers simultaneously or almost so in a short period of time. The multiple target problem is that of locating targets and missile seeker aim points within the PTS field of view, deciding which target is to be assigned to each missile, generating error signals to the torquers in order to slew the missile LOS such that its assigned target is in the center of its FOV, and initiating automatic seeker tracking. The task of locating a given smaller image within a larger image is known as 'image registration'. A detailed comparison of the important multiple image registration methods based on the number of arithmetic operations for software implementation and the complexity of hardware for real time implementation is presented. New methods of accomplishing multiple image registration which are computationally more efficient than the most commonly used template matching techniques (correlation and sequential similarity detection algorithm) are described. Conclusions and recommendations are given. GRA

N81-17102# Engins Matra, Velizy (France).
AUTO-ADAPTIVE PILOTING [PILOTAGE AUTO-ADAPTATIF]
Yves Wesse, ed. and Alain Pechon, ed. Jul. 1978 124 p refs In FRENCH; ENGLISH summary
(GA-380) Avail: NTIS HC A06/MF A01

An auto-adpative numerical pilot for tactical missiles, primarily ground-to-air and air-to-air, is defined to assure the functions of stabilization and guidance over a wide range of dynamic pressure values. A simplified mathematical model of a finned missile and its pilot is given and was programmed on an IBM 370-158 computer. Simulation results are used to tune a system of differential equations evolving in hyperspace (dynamic parameters) which describes the servo control loops. Analysis of response to changes in dynamic pressure in fact shows the importance of this parameter and simulation results are given for extreme (high and low pressure) flight conditions.
Author (ESA)

N81-17103# Shaker Research Corp., Ballston Lake, N. Y.
COMPRESSOR BLADE MONITORING SYSTEM FOR A VA1310 (ALLIS CHALMERS) WIND TUNNEL COMPRESSOR Final Report, Jul. 1979 - May 1980
Donald S. Wilson and John F. Frarey Jul. 1980 58 p refs
(Contract F33615-79-C-3019; AF Proj. 2414)
(AD-A092920; AFWAL-TR-80-3072) Avail: NTIS HC A04/MF A01 CSCL 21/5

The purpose of the work summarized in this report is to identify and develop a cost effective, reliable procedure for identifying potential blade failures in time to prevent the actual occurrence. The procedure is developed for application to an Allis-Chalmers ten-stage, axial flow compressor, Model VA 1310. The approach followed in conducting this study included a review of the current techniques used to insure blade integrity, a review of other approaches as described in literature for verifying the condition of compressor blades and, finally, development of a technique suitable for use with the VA 1310 compressor. GRA

N81-17104# Princeton Univ., N. J. Dept. of Mechanical and Aerospace Engineering.
WIND TUNNEL WALL INTERFERENCE Interim Report, 1 Apr. 1979 - 31 May 1980
D. B. Bliss Nov. 1980 25 p refs
(Grant AF-AFOSR-3337-77; AF Proj. 2307)
(AD-A093301; AFOSR-80-1359TR) Avail: NTIS HC A02/MF A01 CSCL 20/4

The previous analysis of the aerodynamics of an isolated slender slot in a wall has been extended to include the effect of a streamwise pressure gradient. For certain slot planforms, an analytical solution is available for the case of a linear pressure gradient. The effect of aerodynamic interference for a single infinite row of slots was also studied. Solutions were obtained numerically for various Mach numbers, slot spacings, and aspect ratios. The effect of interaction between slots was to increase the slot flow rate for a given pressure differential. A wavy wall problem was posed to study the proper method of obtaining an average wall boundary condition given the behavior of individual holes or perforations. This problem contains all the important physics and allows the basic parameters to be controlled in such a way that the important efforts can be clearly identified. Due to computational difficulties, the solution is being reformulated in a more efficient and useful form. However, preliminary calculations with the original approach did show that the boundary condition should be constructed differently for subsonic and supersonic flows, and that there are effects of pressure gradient and hole location become apparent as the pressure field wavelength is decreased. Some work was also done on isolated slot aerodynamics with large free surface displacement and on the compliant wall wind tunnel concept. GRA

N81-17105# ARO, Inc., Arnold Air Force Station, Tenn.
LASER SCATTERING APPLICATIONS DEVELOPMENT TEST IN AEDC TUNNEL B AT MACH NUMBER 8 Final Report, 16 Jan. 1980 - 12 Feb. 1980
W. T. Strike and L. L. Price AEDC Mar. 1980 51 p refs Sponsored by AF
(AD-A093929; AEDC-TSR-80-V16) Avail: NTIS HC A04/MF A01 CSCL 14/2

Free stream and local flow field measurements on a blunt (0.375 in. radius) nose 5 deg cone were made in Tunnel B at Mach number 8. The nonintrusive flow field measurements were made using various laser scattering optical systems to determine the free stream and local flow field particulate concentration and size distribution, the nitrogen molecule number density, and the local stream velocity using a Fabry-Perot interferometer system. The 5 deg cone pressure distributions were used to confirm the test section Mach number and to produce a known local flow field which could be used to demonstrate potentially useful laser scattering measuring techniques. GRA

N81-17106# ARO, Inc., Arnold Air Force Station, Tenn.
EVALUATION OF THE ACOUSTIC AND AERODYNAMIC CHARACTERISTICS OF SEVERAL SLOT-BAFFLE CONFIGURATIONS FOR TRANSONIC WIND TUNNEL WALLS Final Report, 20 Oct. - 15 Nov. 1978
J. L. Jacocks, D. W. Sinclair, and R. L. Parker AEDC Jan. 1981 51 p refs Sponsored by AF
(AD-A093957; AEDC-TR-79-59) Avail: NTIS HC A04/MF A01 CSCL 14/2

An experimental investigation was conducted to record the acoustic and aerodynamic performance of several slotted walls with transverse baffles in the slots for transonic test sections. Primary configuration variables were the baffle angle inclination relative to the airstream and a wire mesh screen on the airside wall surface. At all baffle angles, the addition of the screen overlay decreased the acoustic noise level and improved the flow generation and supersonic wave cancellation properties of the wall but increased the subsonic wall interference effects.
GRA

N81-17107# Naval Postgraduate School, Monterey, Calif. Dept. of Aeronautics.
EVALUATION OF A SUBSONIC CASCADE WIND TUNNEL FOR COMPRESSOR BLADE TESTING M.S. Thesis
David A. DuVal Sep. 1980 87 p refs
(AD-A093591) Avail: NTIS HC A05/MF A01 CSCL 20/4

Development of the subsonic cascade wind tunnel facility required determination of the two dimensionality and periodicity of the airflow in the test section with test cascade installed. Data acquisition procedures were developed and data were recorded for two facility configurations. The flow was shown to be unsatisfactory at a diffusion factor of approximately 0.58 and aspect ratio 1.25, and to be acceptably two dimensional and periodic at a diffusion factor of approximately 0.39 and aspect ratio 1.95. GRA

N81-17108# Lille Univ. (France). Inst. de Mecanique des Fluides.
A ROTATING WIND TUNNEL BALANCE AND ASSOCIATED EXPERIMENTAL TECHNIQUES [BALANCE ROTATIVE DE L'INSTITUT DE MECANIQUE DES FLUIDES DE LILLE ET TECHNIQUES EXPERIMENTALES ASSOCIEES]
R. Verbrugge Paris Association Aeronautique et Astronautique de France 1980 52 p In FRENCH Presented at 16th Colloq. d'Aerodyn. Appl., Lille, 13-15 Nov. 1979
(AAAF-NT-80-13; ISBN-2-7170-0609-5) Avail: NTIS HC A04/MF A01; CEDOCAR, Paris FF 40 (France and EEC) FF 45 (others)

Aerodynamic phenomena at steep angles of incidence associated with large amplitude movements incorporating continuous rotation are discussed in terms of coupling effects, generally nonlinear, necessary to formulating equations of motion. A rotating wind tunnel balance adapted to the similation of these flight conditions is described. Steep attack angle flight leading to loss of control and stalling regimes relative to aircraft spin were studied. Results obtained with a Mirage type aircraft model are shown. Author (ESA)

N81-17109# Avions Marcel Dassault-Breguet Aviation, Saint-Cloud (France).
FIRST RESULTS OBTAINED WITH A ROTATING CONSTRUCTION [PREMIERS RESULTATS OBTENUS PAR LA SOCIETE AVIONS MARCEL DASSAULT-BREGUET AVIATION SUR LE MONTAGE TOURNANT DE L'INSTITUT DE MECANIQUE DES FLUIDES, LILLE]
C. Couedor Paris Association Aeronautique et Astronautique de France 1980 22 p In FRENCH Presented at 16th Colloq. d'Aerondyn. Appl., Lille, 13-15 Nov. 1979
(AAAF-NT-80-14; ISBN-2-7170-0610-9) Avail: NTIS HC A02/MF A01; CEDOCAR, Paris FF 25 (France and EEC) FF 30 (others)

A rotating wind tunnel balance used to study the behavior of aircraft flying at steep angles of attack is described. A particular study carried out on a model of a Mirage type fighter plane, characterized by its delta wing design, is reported on. Measurement signal acquisition and processing are covered. Flight characteristics for both the model stationary and in motion were defined and the significance of these data is discussed.
Author (ESA)

N81-17110# Forschungsinstitut fuer Funk und Mathematik, Werthoven (West Germany).
FORMATION TRACKING. PART 2: TRACKING AND CONTROL PROCEDURES
G. Binias Apr. 1979 75 p refs In GERMAN; ENGLISH summary
(FFM-279-Pt-2) Avail: NTIS HC A04/MF A01

Tracking procedures based on a formation track initiation procedure are described and compared to single target tracking. Formation tracking is shown to be a collectivizing method of target data processing aimed at the control of the mean cinematic behavior of the formation targets and the control of a distinguished group of marginal targets which support the formation track in computer controlled target tracking. The control procedures enable the system to detect configuration variations in the formation and initiate branchings of formation tracks or junctions of formation tracks with other tracks in response. In order to comprehend the influence of maneuvers by the entire formation, control variables are determined in a central track oriented coordinate system. Simulation results are presented which demonstrate the effectiveness of these tracking and control procedures.
Author (ESA)

N81-17171*# Boeing Commercial Airplane Co., Seattle, Wash.
ASSESSMENT OF RISK TO BOEING COMMERICAL TRANSPORT AIRCRAFT FROM CARBON FIBERS Final Report, Sep. 1978 - Jan. 1980
C. A. Clarke and E. L. Brown Jun. 1980 94 p refs
(Contract NAS1-15510).
(NASA-CR-159211; D6-48855) Avail: NTIS HC A05/MF A01 CSCL 11D

The possible effects of free carbon fibers on aircraft avionic equipment operation, removal costs, and safety were investigated. Possible carbon fiber flow paths, flow rates, and transfer functions into the Boeing 707, 727, 737, 747 aircraft and potentially vulnerable equipment were identified. Probabilities of equipment removal and probabilities of aircraft exposure to carbon fiber were derived. J.M.S.

N81-17175*# HITCO, Gardena, Calif. Defense Products Div.
FABRICATION AND PHYSICAL TESTING OF GRAPHITE COMPOSITE PANELS UTILIZING WOVEN GRAPHITE FABRIC WITH CURRENT AND ADVANCED STATE-OF-THE-ART RESIN SYSTEMS Final Report
Samuel C. S. Lee Jun. 1979 26 p refs
(Contract NAS2-9977)
(NASA-CR-152292) Avail: NTIS HC A03/MF A01 CSCL 11D

Three weaves were evaluated; a balanced plain weave, a balanced 8-harness satin weave, and a semiunidirectional crowfoot satin weave. The current state-of-the-art resin system selected was Fiberite's 934 Epoxy; the advanced resin systems evaluated were Phenolic, Phenolic/Novolac, Benzyl and Bismaleimide. The panels were fabricated for testing on NASA/Ames Research Center's Composites Modification Program. Room temperature mechanical tests only were performed by Hitco; the results are presented. T.M.

N81-17235# General Electric Co., Cincinnati, Ohio. Materials and Process Technology Labs.
CRACK GROWTH MODELING IN AN ADVANCED POWDER METALLURGY ALLOY Final Technical Report, 1 Sep. 1977 - 1 Feb. 1980
David A. Utah Jul. 1980 146 p refs
(Contract F33615-77-C-5082; AF Proj. 2420)
(AD-A093992; AFWAL-TR-80-4098) Avail: NTIS HC A07/MF A01 CSCL 11/6

An interpolative model has been developed to calculate the cyclic crack growth rate of an advanced aircraft engine disk alloy (AF115). The test variables included within the model consists of stress ratio, temperature, frequency, and hold time. The model was based on experimental results conducted within a statistically designed test program. A nonsymmetric Sigmoidal equation consisting of six independant coefficients was used to equate stress intensity range to cyclic growth rate. Two verification tests were conducted at two conditions other than those used during the development of the model to evaluate the model.
GRA

N81-17242# McDonnell Aircraft Co., St. Louis, Mo.
ENVIRONMENT-LOAD INTERACTION EFFECTS ON CRACK GROWTH IN LANDING GEAR STEELS Final Report, Aug. 1979 - Aug. 1980
C. R. Saff Oct. 1980 155 p refs
(Contract N62269-79-C-0275; WF41400000)
(AD-A093803; NADC-79095-60) Avail: NTIS HC A08/MF A01 CSCL 11/6

The objective of this program was to investigate chemical environment-load interaction effects on crack propagation. Dry air (+10 percent relative humidity) was used as a reference

environment. Alternate immersion in synthetic sea water was used to simulate the aggressive chemical environment to which Navy carrier based aircraft are subjected. Tests were performed to determine the behavior of 300 M and HP-9-4-.30 steel in both environments under a variety of stress ratios and load wave shapes. A crack growth prediction capability developed through analysis and test accounts for environment and load interaction effects. A flight-by-flight test stress history was developed for a landing gear of a carrier based Navy aircraft. Crack growth predictions were prepared and tests performed to verify the chemical environment-spectrum loading analysis capability. A comparison of landing gear spectra under Air Force and Navy design conditions is presented. GRA

N81-17281# Exxon Research and Engineering Co., Linden, N.J. Products Research Div.
EFFECT OF REFINING VARIABLES ON THE PROPERTIES AND COMPOSITION OF JP-5 Final Report, Sep. 1978 - Feb. 1980
Martin Lieberman and William F. Taylor Nov. 1980 161 p refs
(Contract N00140-78-C-1491)
(AD-A093842; EXXON/RL.2PE.80) Avail: NTIS HC A08/MF A01 CSCL 21/4

The primary objective of this program was to identify potential future problem areas that could arise from changes in the composition, properties and potential availability of JP-5 produced in the near future. The study employed a systems type approach, looking at the various processing trains used to make JP-5 in the U.S. and abroad, the types of crudes used with the different processing trains and the crude-processing interactions that might impact on the quality and potential availability of JP-5 produced in the near future. Analyses were made separately for the two major geographical regions (PADs) currently producing JP-5 for the U.S. Navy. Potential fuel problems concerning thermal stability, lubricity, low temperature flow, combustion, and the effect of the use of specific additives on fuel properties and performance were identified and discussed. GRA

N81-17299# Naval Civil Engineering Lab., Port Hueneme, Calif.
SHRINKAGE-COMPENSATING CEMENT FOR AIRPORT PAVEMENT. PHASE 3: FIBROUS CONCRETES. ADDENDUM Final Report, Jan. 1979 - May 1980
John R. Keeton Sep. 1980 27 p refs
(AD-A092945; CEL-TN-1561-ADD; FAA-RD-79-11-ADD) Avail: NTIS HC A03/MF A01 CSCL 11/2

Details of a research study on shrinkage-compensating fibrous concrete for airport pavements are presented. A total of 77 slab-type prisms 1 sq ft and 4, 6, and 8 in. thick were subjected to shrinkage in 50% RH. Concrete mixes containing 5.5, 6.5, and 7.5 bags of shrinkage-compensating cement were used in the study. Fly ash was also used for better workability and later added strength. Fiber contents used were 1.0, 1.5, and 2.0% by volume of the concrete. Residual concrete compressive stresses are used as a basis for recommendation of transverse joint spacing of 150 ft for expansive fibrous concrete overlays. GRA

N81-17327# Network Analysis Corp., Vienna, Va.
COMMUNICATIONS SUPPORT FOR NATIONAL FLIGHT DATA CENTER INFORMATION SYSTEM Final Report, 1979 - 1980
Washington DOT Nov. 1980 160 p refs
(Contract DOT-FA79WA-4355)
(AD-A093095; NAC/FR-3030/01; FAA-RD-80-116) Avail: NTIS HC A08/MF A01 CSCL 17/2

The National Flight Data Center/Information System (NFDC/IS) data communications requirements were analyzed to determine the technical feasibility and the most cost beneficial approach of NADIN support. The following conclusions were made: The most cost/beneficial approach to NADIN support of the NFDC/IS data communications requirements provides for the use of NADIN for interactive and message traffic and dedicated facilities for the point-to-point, source-to-sink batch traffic. The most significant aspect of NADIN support for the NFDC/IS data communications requirements is in providing the communications link between the NFDC host system and the external systems with which it must interface. GRA

N81-17333# Mission Research Corp., Albuquerque, N. Mex.
AIRCRAFT EMP ISOLATION STUDY Final Report
A. Finci, H. Price, P. Chao, S. Mercer, and T. Naff Kirtland AFB, N. Mex. AFWL Jul. 1980 97 p refs
(Contract F29601-78-C-0082; AF Proj. 1209)
(AD-A093772; AD-E200630; AFWL-TR-79-156) Avail: NTIS HC A05/MF A01 CSCL 20/14

This report presents the results of a preliminary study into methods for electrically isolating the E-4B, the EC-135, and the EC-130 aircraft during EMP tests where the aircraft under test is directly driven by a high-voltage pulser. GRA

N81-17342# IIT Research Inst., Annapolis, Md.
A SUPPLEMENTARY EMC ANALYSIS OF THE PROPOSED AIRPORT SURFACE DETECTION EQUIPMENT (ASDE-3) RADAR
G. Larry Brown Aug. 1980 30 p refs
(Contracts F19628-78-C-0006; DOT-FA77WAI-778)
(AD-A092965; ECAC-CR-80-044; FAA-RD-80-123) Avail: NTIS HC A03/MF A01 CSCL 17/9

This report supplements information in an earlier report which identified electromagnetic compatibility (EMC) problems associated with the deployment of Airport Surface Detection Equipment (ASDE-3) Radars at a number of proposed sites in the United States. Subsequent to the earlier study, several operational parameters of the ASDE-3 radar have been modified in a direction to lessen the probability of causing or receiving interference, thereby necessitating a reanalysis of portions of the earlier study. As before, interferring signal levels are compared against established receiver thresholds to determine operational compatibility and frequency management techniques are identified as a solution to potential interference cases, where applicable. GRA

N81-17387# Massachusetts Inst. of Tech., Cambridge. Gas Turbine and Plasma Dynamics Lab.
CURRENT PROBLEMS IN TURBOMACHINERY FLUID DYNAMICS Interim Report, 1 Jun. 1979 - 30 Sep. 1980
Edward M. Greitzer, William T. Thompkins, Jr., James E. McCune, Alan H. Epstein, Choon S. Tan, Jack L. Kerrebrock, and William R. Hawthorne 26 Nov. 1980 104 p refs
(Contract F49620-78-C-0084; AF Proj. 2307)
(AD-A093375; AFOSR-80-1355TR) Avail: NTIS HC A06/MF A01 CSCL 20/4

A multi-investigator effort on problems of current interest in turbomachinery fluid dynamics is being carried out in the Gas Turbine and Plasma Dynamics Laboratory of MIT. Within the overall program four different tasks having to do with a wide range of design and off-design flow fields have been identified. These are: (1) investigation of fan and compressor design point fluid dynamics (including formulation of design procedures using current three dimensional transonic codes and development of techniques for instantaneous measurements in transonic fans); (2) studies of compressor stability enhancement (including basic investigations of the fluid dynamics of rotor casing treatment); (3) fluid mechanics of gas turbine engine operation in inlet flow distortion (including inlet vortex distortion); and (4) investigations of three dimensional flows in highly loaded turbomachines (including actuator duct theory and blade-to-blade flow analysis) and linearized analysis of swirling three dimensional flows in turbomachines. This interim report summarizes progress made to date as well as indicates the direction of future efforts on the various tasks. GRA

N81-17466# Detroit Diesel Allison, Indianapolis, Ind.
MODEL 250-C30/C28B COMPRESSOR DEVELOPMENT
Dennis C. Chapman *In* AGARD Centrifugal Compressors, Flow Phenomena and Performance Nov. 1980 6 p

Avail: NTIS HC A15/MF A01

The performance of advanced versions of the Allison Model 250 engine series in production for the Sikorsky S76 and Bell Long Ranger helicopters is discussed. These engines, designated 250-C30 and -C28B respectively, use a single stage centrifugal compressor matched at 8.7:1 pressure ratio at design speed. The initial design met flow, pressure ratio, and efficiency requirements, but encountered both a localized deficiency in the surge line around 85% speed and excessive impeller blade vibratory stress at high speed. Several potential remedies were tried unsuccessfully and the compressor was redesigned. The redesign featured redistributed impeller blade loading, revised impeller blade thickness, and increased number of diffuser vanes. These changes eliminated the vibratory stress problem. A unique inducer shroud bleed system, requiring no control, resolved the surge line problem and improved high speed flow and efficiency as well. M.G.

N81-17467# Noel Penny Turbines Ltd., Toll Bar End (England).
CENTRIFUGAL COMPRESSORS FOR SMALL AERO AND AUTOMOTIVE GAS TURBINE ENGINES
R. W. Chevis and R. J. Varley *In* AGARD Centrifugal Compressors, Flow Phenomena and Performance Nov. 1980 18 p refs

Avail: NTIS HC A15/MF A01

Compressor design requirements for three engine types are briefly discussed. These types are the expendable turbojet, the low cost single shaft turbopropeller engine, and the automotive truck gas turbine engine. Technical and test data are presented for representative types of compressors. M.G.

N81-17476# Battelle Columbus Labs., Ohio.
FEASIBILITY EVALUATION OF ADVANCED MULTIFREQUENCY EDDY CURRENT TECHNOLOGY FOR USE IN NAVAL AIR MAINTENANCE ENVIRONMENT Final Report, 25 Oct. 1978 - 23 Jul. 1979
Donald T. Hayford and Stephen D. Brown 8 Dec. 1980 80 p (Contract N68335-78-C-1121)
(AD-A093314; NAEC-92-143) Avail: NTIS HC A05/MF A01 CSCL 14/2

The optimization of a multifrequency eddy current test was performed for the detection and characterization of second-number corrosion using computer programs. The results of the analytical studies showed that both inner and outer surface corrosion could be detected and quantified. Air gap variations could also be distinguished from corrosion using multifrequency data. These results were confirmed experimentally using phase-sensitive eddy current instrumentation. GRA

N81-17480*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPOSITE CONTAINMENT SYSTEMS FOR JET ENGINE FAN BLADES
G. T. Smith 1981 18 p refs Presented at the 36th Ann. Conf. of the Reinforced Plastics/Composites Inst. of the Soc. of the Plastics Ind., Inc., Washington, D.C., 16-20 Feb. 1981
(NASA-TM-81675; E-700) Avail: NTIS HC A02/MF A01 CSCL 21E

The use of composites in fan blade containment systems is investigated and the associated structural benefits of the composite system design are identified. Two basic types of containment structures were investigated. The short finned concept was evaluated using Kevlar/epoxy laminates for fins which were mounted in a 6061 T-6 aluminum ring. The long fin concept was evaluated with Kevlar/epoxy, 6Al4V titanium, and 2024 T-3 aluminum fins. The unfinned configurations consisted of the base-line steel sheet, a circumferentially oriented aluminum honeycomb, and a Kevlar cloth filled ring. Results obtained show that a substantial reduction in the fan blade containment system weight is possible. Minimization of damage within the engine arising from impact interaction between blade debris and the engine structure is also achieved. M.G.

N81-17483# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensbereich Flugzeuge.
THE INFLUENCE OF THE COMPRESSIBILITY IN SIMULATING THE CONDUCT OF EXTERIOR LOADS OF A CARRIER [DER EINFLUSS DER KOMPRESSIBILITAET ZUR SIMULATION DES ABGANGSVERHALTENS VON AUSSENLASTEN VOM TRAEGER]
K. Thomas 26 Nov. 1979 21 p refs In GERMAN Presented at DGLR Wehrtech. Symp. on der Abgang von Lasten und Waffen vom Traeger, Bad Neuenahr, West Germany, 26-27 Nov. 1979
(MBB-FE-122/S/PUB/17; DGLR-79-094) Avail: NTIS HC A02/MF A01

The panel method was used in the computation of the flow field of an aircraft, the pressure distribution on the upper surface, and the aerodynamic loads. With this method the effect of compressibility on pressure distribution can be relatively well understood when Gothert's Rule is applied. However, this rule is not applicable on the flow field of the aircraft. A flow field model was developed based on Gothert's Rule and the panel method, in order to obtain an appropriate solution for compressibility effects. Results from the computations on the flow field model are presented. Transl. by E.A.K.

N81-17623*# Northwestern Univ., Evanston, Ill.
TRANSPORT JET AIRCRAFT NOISE ABATEMENT IN FOREIGN COUNTRIES: GROWTH, STRUCTURE, IMPACT. VOLUME 1: EUROPE, JULY 1980 Final Report
Frank A. Spencer Jul. 1980 230 p refs
(Grant NsG-2328)
(NASA-CR-152356) Avail: NTIS HC A11/MF A01 CSCL 13B

The development and implementation of aircraft noise control regulations in various European states are described. The countries include the United Kingdom, France, Switzerland, Federal Republic of Germany, Sweden, Denmark, and the Netherlands. Topics discussed include noise monitoring, airport curfews, land use planning, and the government structure for noise regulation. T.M.

N81-17624*# Northwestern Univ., Evanston, Ill.
TRANSPORT JET AIRCRAFT NOISE ABATEMENT IN FOREIGN COUNTRIES: GROWTH, STRUCTURE, IMPACT. VOLUME 2: PACIFIC BASIN, AUGUST 1980 Final Report
Frank A. Spencer Aug. 1980 202 p
(Grant NsG-3238)
(NASA-CR-152357-Vol-2) Avail: NTIS HC A10/MF A01 CSCL 13B

Noise control measures at the international airports of Hawaii, New Zealand, Australia, Hong Kong, Japan, and Singapore were studied. Factors in noise control, such as government structure are examined. The increasing power of environmental agencies vis-a-vis aviation departments is noted. The following methods of dealing with aircraft noise are examined by type of control: noise at the source control; noise emmission controls, zoning, building codes, subsidies for relocation, insulation, loss in property values, and for TV, radio and telephone interference; and noise-related landing charges. T.M.

N81-17846*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Business Group.
AERODYNAMIC/ACOUSTIC PERFORMANCE OF YJ101/DOUBLE BYPASS VCE WITH COANNULAR PLUG NOZZLE Final Report
John W. Vdoviak, Paul R. Knott, and Jon J. Ebacker Jan. 1981 307 p refs
(Contract NAS3-20582)
(NASA-CR-159869; R80AEG369) Avail: NTIS HC A14/MF A01 CSCL 20A

Results of a forward Variable Area Bypass Injector test and a Coannular Nozzle test performed on a YJ101 Double Bypass Variable Cycle Engine are reported. These components are intended for use on a Variable Cycle Engine. The forward Variable Area Bypass Injector test demonstrated the mode shifting capability between single and double bypass operation with less than predicted aerodynamic losses in the bypass duct. The acoustic nozzle test demonstrated that coannular noise suppression was between 4 and 6 PNdB in the aft quadrant. The YJ101 VCE equipped with the forward VABI and the coannular exhaust nozzle performed as predicted with exhaust system aerodynamic losses lower than predicted both in single and double bypass modes. Extensive acoustic data were collected including far field, near

field, sound separation/ internal probe measurements as Laser Velocimeter traverses. Author

N81-17848# DyTec Engineering, Inc., Long Beach, Calif.
EVALUATION OF ALTERNATIVE PROCEDURES FOR ATMOSPHERIC ABSORPTION ADJUSTMENTS DURING NOISE CERTIFICATION. VOLUME 3: TABLES OF ATMOSPHERIC ABSORPTION LOSSES Final Report
Alan H. Marsh Oct. 1980 65 p
(Contract DOT-FA78WA-4121)
(AD-A093144; DYTEC-7928; FAA-EE-80-46-Vol-3) Avail: NTIS HC A04/MF A01 CSCL 20/1

The work reported here extends that in FAA-RD-77-167, December 1977, to the problem of adjusting actual aircraft noise 1/3 octave-band spectra measured at 0.5 s intervals. Test-day spectra are used to calculate, PNL, PNLT, EPNL, AL, and SEL. The test-day spectrum at the time of PNLTM and at the time of ALM are adjusted to acoustical-reference conditions using the atmospheric-absorption method in American National Standard ANS S1.26-1978 and applied, using measurements of air temperature and relative humidity at various heights above the ground, by integrating over the frequency range of the passband of ideal filters and by calculating the absorption at the exact band center frequencies only. SAE ARP866A is also used with the vertical-profile temperature/humidity data and with data at 10.0 m to determine adjustments from test to reference conditions. The adjustment methods are applied to noise data from 9 aircraft. Volume 1 describes the analyses and results of the study. Volume 2 presents the computer program that was developed and illustrates its use with a test case. Volume 3 presents tables of attenuation due to atmospheric absorption over a 300 m path. Attenuatons were calculated using ANS S1.26-1978 for pure tones at band center frequencies and for 3 noise spectral slopes by a band-integration method, and using SAE ARP866A. For each of the 5 methods, the tables cover 34 air temperatures from 2 to 35C, 10 relative humidities from 10 to 100 percent, and 24 nominal band center frequencies from 50 to 10,000 Hz. GRA

N81-17849# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
NOISECHECK PROCEDURES FOR MEASURING NOISE EXPOSURE FROM AIRCRAFT OPERATIONS Final Report
Dwight E. Bishop, Andrew S. Harris, Joan Mahoney, and Peter E. Rentz Nov. 1980 96 p
(Contract F33615-77-C-0514; AF Proj. 7231)
(AD-A093948; BBN-3869) Avail: NTIS HC A05/MF A01 CSCL 20/1

NOISECHECK is a measurement program used (1) when an engineer is uncertain about a Sound Exposure Level (SEL) resulting from a particular type of operation or (2) to check noise contours determined by NOISEMAP - an Air Force computer program. The file of aircraft noise data used by NOISEMAP is called NOISEFILE. The NOISECHECK measurement program uses portable noise monitors that measure Day-Night Sound Levels (DNLs) over one or more days as well as individual Sound Exposure Levels (SELs). The measured DNLs are then compared with the DNLs calculated by NOISEMAP, or they contribute SEL data for comparison with NOISEFILE. This report delineates the field test data acquisition and analysis procedures used to conduct NOISECHECK type measurement studies. A companion report, AMRL-TR-78-125, Development of NOISECHECK Technology for Measuring Aircraft Noise Exposure, describes the instrumentation development and subsequent field test conducted at Barksdale AFB as part of this research effort. GRA

N81-17851# Federal Aviation Administration, Washington, D.C. Office of Environment and Energy.
HELICOPTER NOISE CONTOUR DEVELOPMENT TECHNIQUES AND DIRECTIVITY ANALYSIS
J. Steven Newman Sep. 1980 43 p refs
(AD-A093426; FAA-EE-80-41) Avail: NTIS HC A03/MF A01 CSCL 20/1

This paper briefly summarizes techniques which have been developed for use in creating helicopter air-to-ground, noise-distance relationships. Discussion is provided concerning FAA efforts to establish an accurate and practical method (which considers source directivity) for modeling the noise impact associated with helicopter operations. Plots of normalized directivity vectors are provided for eight helicopters in various modes of flight. GRA

N81-17852# Federal Aviation Administration, Washington, D.C. Office of Environment and Energy.
CORRELATION OF HELICOPTER NOISE LEVELS WITH PHYSICAL AND PERFORMANCE CHARACTERISTICS
J. Steven Newman Sep. 1980 31 p refs
(AD-A093428; FAA-EE-80-42) Avail: NTIS HC A03/MF A01 CSCL 01/3

This report investigates the correlation between physical and performance characteristics of helicopters and the noise levels which they generate in various operational modes. The analysis is generally empirical although several theoretical functions described in the literature have been examined. The EPNL is the acoustical metric employed in this study. One, two, and three-step multiple regression analyses are conducted for takeoff, approach, and level flyover operations. Plots are provided for the three best single variable regression models for each mode of flight. GRA

N81-17853# DyTec Engineering, Inc., Long Beach, Calif.
EVALUATION OF ALTERNATIVE PROCEDURES FOR ATMOSPHERIC ABSORPTION ADJUSTMENTS DURING NOISE CERTIFICATION. VOLUME 2: COMPUTER PROGRAM Final Report
Alan H. Marsh Oct. 1980 98 p
(AD-A093267; DYTEC-7927-Vol-2; FAA-EE-80-46-Vol-2) Avail: NTIS HC A05/MF A01 CSCL 20/1

The work reported here extends that in FAA-RD-77-167, December 1977, to the problem of adjusting actual aircraft noise 1/3-octave-band spectra measured at 0.5-s intervals. Test-day spectra are used to calculate, PNL, PNLT, EPNL, AL, and SEL. The test-day spectrum at the time of PNLTM and at the time of ALM are adjusted to acoustical-reference conditions using the atmospheric-absorption method in American National Standard ANS S1.26-1978 and applied, using measurements of air temperature and relative humidity at various heights above the ground, by integrating over the frequency range of the passband of ideal filters and by calculating the absorption at the exact band center frequencies only. SAE ARP866A is also used with the vertical-profile temperature/humidity data and with data at 10.0 m to determine adjustments from test to reference conditions. The adjustment methods are applied to noise data from 9 aircraft. Volume 1 describes the analyses and results of the study. Volume 2 presents the computer program that was developed and illustrates its use with a test case. Volume 3 presents tables of attenuation due to atmospheric absorption over a 300 m path. Attenuations were calculated using ANS S1.26-1978 for pure tones at band center frequencies and for 3 noise spectral slopes by a band-integration method, and using SAE ARP866A. For each of the 5 methods, the tables cover 34 air temperatures from 2 to 35C, 10 relative humidities from 10 to 100 percent, and 24 nominal band center frequencies from 50 to 10,000 Hz. GRA

N81-17902# Boeing Aerospace Co., Seattle, Wash.
AIRBORNE-FIBER OPTICS MANUFACTURING TECHNOLOGY, AIRCRAFT INSTALLATION PROCESSES Final Report, May 1978 - Jun. 1980
G. Kosmos and R. A. Greenwell San Diego, Calif. Naval Ocean Systems Center 19 Aug. 1980 348 p refs
(Contract N00123-78-C-0193)
(AD-A093304; NOSC/TR-591) Avail: NTIS HC A15/MF A01 CSCL 20/6

Manufacturing processes were developed for installation of optical fiber harnesses and 'stand alone' links on military aircraft. Fabrication and installation plans and procedures were developed and a routing analysis was performed to provide a basis for installation of fiber optics in military aircraft. A life cycle cost analysis of the optical fiber harness indicates economic advantages. GRA

N81-17936# Department of Energy, Bartlesville, Okla. Energy Technology Center.

THERMODYNAMICS OF ORGANIC COMPOUNDS Final Report, 1 Oct. 1979 - 30 Sep. 1980

W. D. Good, R. H. P. Thomas, B. E. Gammon, S. Lee-Bechtold, J. E. Callanan, and N. K. Smith 1980 29 p refs

(Grant AFOSR ISSA-80-0004; AF Proj. 2308)

(AD-A093087) Avail: NTIS HC A03/MF A01 CSCL 07/3

Basic and applied research have continued on the thermodynamic properties of currently used high density/high energy fuels and of pure chemical compounds that may be constituents of high energy fuels of the future. Enthalpy of combustion was measured for three compounds that are constituents of current ramjet fuels--hexacyclic exo, exo-dihydrodinorbornadiene, hexacyclic endo, endo-dihydrodinorbornadiene and exo-tetrahydrodicyclopentadiene (JP-10). Heat capacities of exo-tetrahydrodicyclopentadiene (JP-10) and RJ-6, a blend of JP-10 and the hydrogenated dimers of norbornadiene, were measured by differential scanning calorimetry. Enthalpy of combustion was measured for two pure hydrocarbons, 1,7-dimethylindan and 1,4-dimethyl-2-isobutylbenzene, that are expected to have high steric interaction energies of alkyl substituents in the ring structure, and measurements are in progress on 1-ethyl-8-methylnaphthalene and 1,6-dimethylidan. GRA

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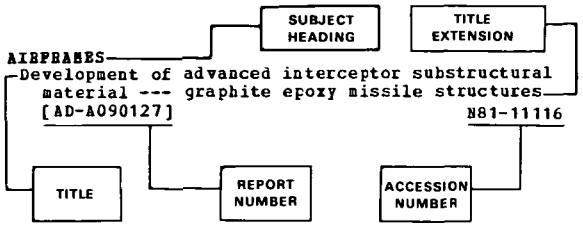

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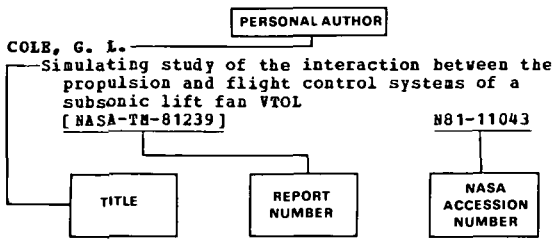

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