

ACCESSION NUMBER RANGES

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STAR (N-10000 Series) N82-20139 - N82-22140

IAA (A-10000 Series) A82-25539 - A82-28538

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NASA SP-7037(150)

AERONAUTICAL ENGINEERING

**A CONTINUING BIBLIOGRAPHY
WITH INDEXES**

(Supplement 150)

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced in June 1982 in

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

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INTRODUCTION

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

This supplement to *Aeronautical Engineering -- A Continuing Bibliography* (NASA SP-7037) lists 382 reports, journal articles, and other documents originally announced in June 1982 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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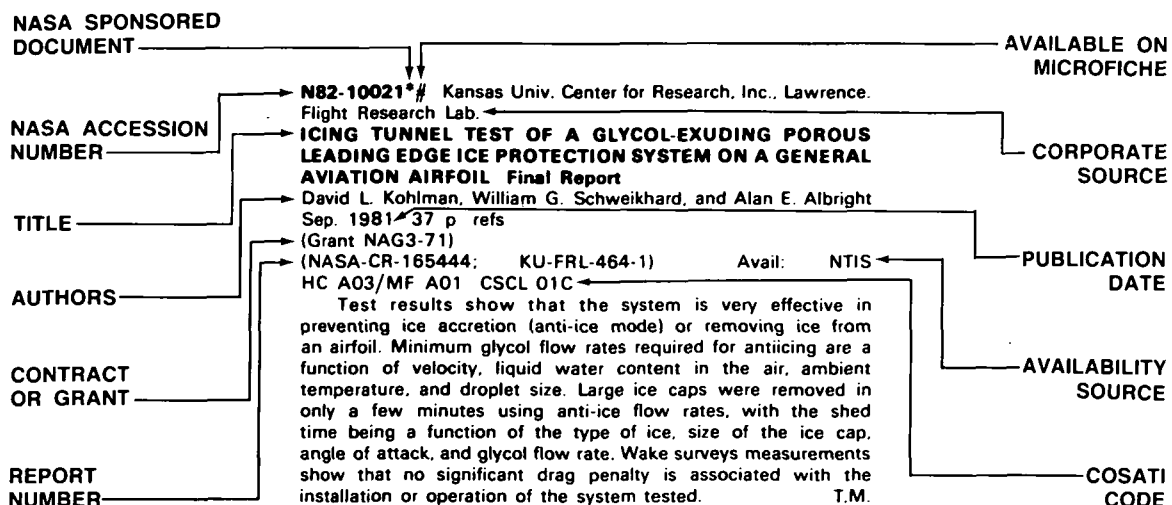
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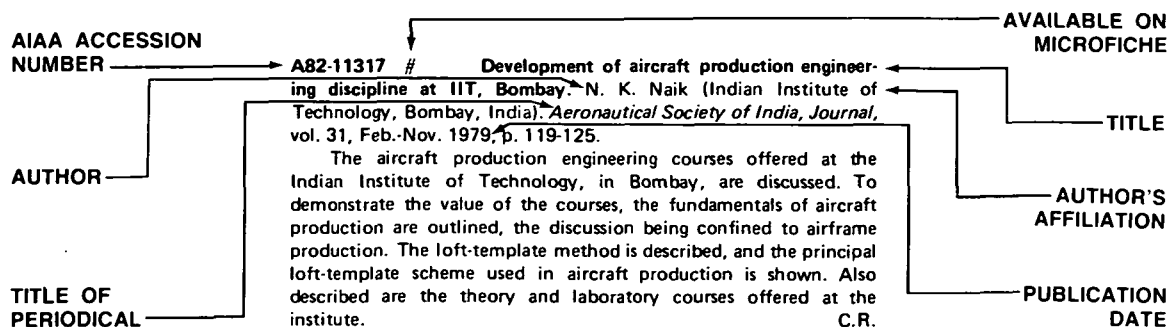
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TYPICAL CITATION AND ABSTRACT FROM IAA



AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 150)

JULY 1982

IAA ENTRIES

A82-25550 Introduction to the principles of fracture mechanics (Einführung in die Grundlagen der Bruchmechanik). W. Dander (Wiederaufarbeitungsanlage Karlsruhe Betriebsgesellschaft mbH, Eggenstein-Leopoldshafen, West Germany). *Zeitschrift für Werkstofftechnik*, vol. 13, Feb. 1982, p. 69-76. In German.

The employment of fracture mechanics makes it possible to obtain vital information concerning the operational life of components of rotor and aircraft structures even in cases in which such information cannot be provided in connection with conventional design technology. Basic questions regarding the origin of cracks in material are discussed, taking into account the strength of solid bodies with ideal elastic characteristics, elementary processes leading to crack formation, and aspects of fracture description. Linear-elastic fracture mechanics is considered along with an energy criterion with respect to crack growth, the crack opening displacement, and the J integral method. Attention is given to basic fracture modes, the fracture mechanical equation and specimen configuration used to determine fracture, and the application of fracture mechanics methodology. G.R.

A82-25577 Integration of multi-sensor navigation data using optimal estimation techniques. D. B. Reid, W. S. Gesing, B. N. McWilliam (Philip A. Lapp, Ltd., Toronto, Canada), and J. E. Smyth (Canada Center For Remote Sensing, Ottawa, Canada). In: Conference on Decision and Control, 19th, and Symposium on Adaptive Processes, Albuquerque, NM, December 10-12, 1980, Proceedings. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 584, 585. 6 refs.

Optimal filtering and smoothing algorithms are used to obtain precise aircraft position, velocity and attitude information for remote sensing applications by postflight processing of navigation data collected by several sensors. The data from an Inertial Navigation System (INS) is differenced with data obtained from other sensors which may include photogrammetric resections, a microwave ranging system, a barometric altimeter, a radar altimeter, a laser radar, a VLF/OMEGA navigation system and doppler radar to construct error measurements. The measurements are prefiltered to compress the data and are then processed through a Kalman filter to produce estimates of the time-correlated sensor errors. The filtered error estimates are smoothed by processing backwards in time and used to correct the INS data. The track recovery program uses the UDU/T/ covariance factorized form of the filter algorithm and is capable of processing data from any subset of sensors. The residual errors observed in processing real data collected in a number of field tests are less than 1 meter in position and less than 0.03 degrees in attitude. (Author)

A82-25673 Von Karman and VKI - The first 25 years. J. J. Ginoux (Institut Von Karman de Dynamique des Fluides, Rhode-Saint-Genève; Bruxelles, Université Libre, Brussels, Belgium). *Zeitschrift für Flugwissenschaften und Weltraumforschung*, vol. 6, Jan.-Feb. 1982, p. 27-34.

The Von Karman Institute (VKI) was established in October 1956 in the buildings of the aeronautical laboratory of the Belgian Civil Aviation Authority. The history of the laboratory goes back to 1922. The early history of the laboratory is considered, taking into account pioneering work on helicopters carried out between 1930 and 1940, the modernization of aerodynamic testing facilities after

World War II, and von Karman's idea to use the laboratory for training students and research workers of the NATO countries in experimental techniques. A description is given of the approaches used to implement von Karman's idea, giving attention to the development of the VKI into the first truly international aerodynamics school. G.R.

A82-25771 Some thoughts on design optimization of transport helicopters. W. Z. Stepniowski and L. H. Sloan. *Vertica*, vol. 6, no. 1, 1982, p. 1-17. 12 refs.

A decrease in the total helicopter operating cost per revenue seat-nautical mile C sub rsm can be achieved by reducing total yearly expenditure for helicopter operation and by increasing annual work time, work speed, and number of revenue seats. Design improvements can lessen maintenance ground time. The most important aspect of design optimization with respect to the fuel-cost share in C sub rsm is the assurance of high gross weight to equivalent drag ratio values at the highest possible flying speeds, with lowest possible effect on aircraft purchase and maintenance costs. Among the factors influencing purchase cost are sharing of production costs, technical and organizational level of production facilities, and labor costs. In designing the power plant, maximization efforts should center around hovering and/or vertical climb aspects. Here disk loading appears to be the strongest design parameter. Finally, gains linked to structural weight increases are modest, although gains are higher when fuel costs decrease. C.D.

A82-25772 * Model helicopter rotor low frequency broadband noise. N. G. Humbad and W. L. Harris (MIT, Cambridge, MA). *Vertica*, vol. 6, no. 1, 1982, p. 19-35. 19 refs. Grant No. NsG-1583.

The results of an experimental investigation of low frequency broadband noise (LFBN) radiated from model helicopter rotors are presented. The results up to tip Mach number of 0.50 suggest that the peak sound pressure level (SPL) of LFBN appears to follow tip Mach number to a fourth power law and rms velocity of turbulence to a second power law. The experimental results on the effect of tip speed and advance ratio on the peak SPL of LFBN can be explained on the basis of a simple scaling law. However, the experimental results on the effect of blade loading on the peak SPL of LFBN is still not clearly understood. A simple peak SPL scaling law for noise from a helicopter in forward flight encountering a sinusoidal gust is also developed. The trends predicted by the scaling law with the experimental results are found satisfactory for the cases of variation of the peak SPL of LFBN with tip speed and advance ratio. C.D.

A82-25773 Sensitivity of helicopter aeromechanical stability to dynamic inflow. G. H. Gaonkar, A. K. Mitra, T. S. R. Reddy (Indian Institute of Science, Bangalore, India), and D. A. Peters (Washington University, St. Louis, MO). *Vertica*, vol. 6, no. 1, 1982, p. 59-75. 14 refs. NSF Grant No. CME-79-06304.

Since aeromechanical instability or 'resonance' of nonarticulated helicopters generally involves low-frequency flap and lead-lag regressing modes as well as a coupled rotor-body pitch or roll mode, it is expected to be appreciably influenced by dynamic inflow. Therefore, a resonance analysis in hover is presented with four objectives concerning (1) the effect of dynamic inflow on air and ground resonance, (2) the adequacy of the equivalent Lock number and drag coefficient to account for the effect, (3) the possible improvement in correlation with recent experimental data, with the inclusion of inflow and (4) a better understanding of the effect of rotor parameters on the resonance phenomena with dynamic inflow.

Dynamic inflow is found to appreciably decrease the damping of body modes, although it increases the damping of the lag regressing mode. The effect can be approximately treated in most cases by the much simpler method of equivalent Lock number and drag coefficient. C.D.

A82-25794 † Suppression of self-oscillations in open wind tunnels (Podavlenie avtokolebanii v aerodinamicheskikh trubakh s otkrytoi rabochei chast'iu). M. Iu. Boiarchikova, E. V. Vlasov, A. S. Ginevskii, and A. V. Zosimov. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza*, Jan.-Feb. 1982, p. 126-132. In Russian.

A method of self-oscillation suppression for open wind tunnels is described which is based on the reduction of turbulence in subsonic jets by high-frequency acoustic irradiation. It is shown that regular low-frequency oscillations with characteristic Strouhal numbers $Sh = fd/V = 0.2-0.7$ (where d is the nozzle diameter, V is the flow velocity on the nozzle section, and f is the characteristic frequency of oscillations in the jet or the frequency of acoustic irradiation) can be significantly reduced by the action on the jet of high-frequency acoustic oscillations, whose characteristic frequency corresponds to Strouhal numbers of 2-5. B.J.

A82-25795 † Conditions of pulsed starting of supersonic wind tunnel diffusers (Ustoviiia impul'snogo zapuska sverkhzvukovykh diffuzorov aerodinamicheskikh trub). V. L. Grigorenko. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza*, Jan.-Feb. 1982, p. 133-141. 14 refs. In Russian.

A quasi-one-dimensional approach in the framework of an ideal gas is used to study the pulsed starting of nonregulated supersonic wind tunnel diffusers. Relations for determining the optimal pulsed-starting conditions are obtained on the basis of (1) the application of the Chisnell hypothesis to a reversed shock wave propagating along a nonuniform flow; (2) allowance for the interaction of this wave with disturbances reflected from the diffuser; and (3) the assumption of quasi-steady flow at the concluding stage. The starting limit determined in this manner agrees well with numerical calculations. B.J.

A82-25798 † Allowance for flow nonuniformity in the minimum section in the optimal contouring of the expanding part of a nozzle (Ob uchete neravnomernosti potoka v minimal'nom sechenii pri optimal'nom profilirovanii rasshiriaushcheisia chasti sopla). A. N. Kraiko and N. I. Tilliaeva. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza*, Jan.-Feb. 1982, p. 184-186. 8 refs. In Russian.

The paper examines the problem of taking into account the actual nonuniform distributions of flow parameters in the minimum section of a Laval nozzle in the maximum-thrust design of its supersonic part for fixed counterpressure and maximum dimensions. Direct calculations show that the replacement of nonuniform distributions by uniform ones, i.e., the use of the plane transition surface assumption (the straight sonic line), produces contours which realize a thrust that is only hundredths of a percent less than the thrust of nozzles contoured for a curved sonic line. B.J.

A82-25874 The bomber that radar cannot see. B. Sweetman. *New Scientist*, vol. 93, Mar. 4, 1982, p. 565-568.

The evolution, design features, materials, and missions of the Stealth bomber under development are outlined. The idea of planes invisible to radar originated in the late 1940's with observations that certain aircraft configurations have less discernable radar images than others. High speed Soviet aircraft have tended to negate the use of low-flying, subsonic attack bombers, and the advent of carbon composite materials which absorb radio waves encouraged the creation of aircraft smaller than previous bombers, which can fly at any altitude and require minimum power for ECM because of a low radar profile. Advanced testing is currently under way at the skunk works, with concurrent Stealth technology runs at the perimeters of Soviet radar defenses to ascertain the EW configurations facing the Stealth. M.S.K.

A82-25923 # A generalized Hill's method for the stability analysis of parametrically excited dynamic systems. S. T. Noah and G. R. Hopkins (Texas A & M University, College Station, TX). *ASME, Transactions, Journal of Applied Mechanics*, vol. 49, Mar.

1982, p. 217-223. 40 refs.

In the analysis of various dynamical systems, representation of the motion involved frequently leads to a system of second-order linear differential equations with periodic coefficients. Examples include rotors subjected to pulsating torque, the aeroelastic stability of helicopter blades, missiles subjected to pulsating thrusts, and the attitude stability of spinning satellites. The methods available in cases in which the assumption of small variations in the amplitude of the periodic coefficients cannot be justified are essentially based on Floquet's work (1883). Hill utilized Floquet's solution to show that the stability of a second-order differential equation with periodic coefficients could be determined from a single transcendental equation. In the present study, the stability of the null solution for a general coupled system of linear ordinary equations with periodic coefficients is considered. G.R.

A82-25971 † Inverse heat-transfer problems - Domains of application in the design and testing of technical systems (Obratnye zadachi teploobmena - Oblasti primeneniia pri proektirovanii i ispytaniakh tekhnicheskikh ob'ektov). V. P. Mishin and O. M. Alifanov. *Inzhenerno-Fizicheskii Zhurnal*, vol. 42, Feb. 1982, p. 181-192. 39 refs. In Russian.

The application of inverse heat-transfer methods to the design and testing of spacecraft systems is considered. Attention is given to the use of these methods for the development of mathematical thermal models, the design of thermally stressed structures, and the carrying out of model, bench, and flight tests. The planning of thermophysical experiments, with the aim of improving the efficiency of the testing of spacecraft systems, is discussed. B.J.

A82-25995 Transonic flow past thin wings. P. Niyogi (Indian Institute of Technology, Kharagpur, India). *Indian Academy of Sciences, Proceedings (Engineering Sciences)*, vol. 4, Sept. 1981, p. 347-361. 23 refs.

This paper is devoted to a discussion of steady inviscid transonic flow past thin wings, with subsonic free-stream Mach number of less than 1, by the integral equation method. The integral equation formulation is developed for a thin unsymmetric wing at small incidence. A simple approximate analytical solution is presented for shock-free supercritical flow past a thin symmetric wing at zero incidence. The direct iteration scheme of Niyogi and Chakraborty is then extended to the three-dimensional zero incidence case, which may be used to obtain more accurate solutions for shock-free flows as well as for flows with shocks. The question of the existence and the uniqueness of a solution is studied by means of the Banach contraction mapping principle which establishes the condition of convergence of the direct iteration scheme. (Author)

A82-26025 Materials and aeronautics. J. Charnley (Ministry of Defence, London, England). *Aerospace (UK)*, vol. 9, Feb. 1982, p. 16-23. 13 refs.

For airframe structural materials there are four essential requirements: low density, high strength, high stiffness, and good corrosion resistance. Aluminum alloys are generally used since they provide high fatigue resistance and tensile strength, are cheap and less susceptible to corrosion than steel. Plastic reinforced with glass or carbon fiber finds use in helicopter blades and airframes. Engines and turbine materials require high-temperature materials and techniques such as single-crystal fabrication. Titanium and nickel alloys are standard in compressor turbine disks. Silicon is used for integrated circuits; piezoelectric materials like quartz or lithium niobate are used in surface acoustic wave devices. Cadmium mercury telluride is a sensitive infrared detector, while yttrium aluminum garnet is useful in laser range finders and target markers. Electroluminescent and liquid crystal displays use polycrystalline powders or thin films of zinc sulfide or organic materials. C.D.

A82-26039 Optimum three-dimensional flight of a supersonic aircraft. C.-F. Lin (Applied Dynamics International, Ann Arbor, MI). *Applied Mathematical Modelling*, vol. 6, Apr. 1982, p. 124-129.

Optimum three-dimensional flight of supersonic aircraft is considered, particularly the minimization of flight time, which is important in the climbing and turning performance of a supersonic

fighter. General properties of optimum three-dimensional flight are presented, and the maximum principle is used. Optimal control is obtained by a geometrical method using the domain of manoeuvrability. (Author)

A82-26044 AV-8B/Harrier GR.5 - Range, payload and VSTOL. M. Lambert. *Interavia*, Mar. 1982, p. 224-227.

Harrier II is a compact, relatively lightweight day-and-night fair weather attack aircraft with sufficient maneuverability to escape from existing and expected Soviet interceptors. It is basically subsonic and not fitted with radar, but can push past Mach 1 in a shallow dive even with a large load of external stores. The sustained turn performance is stated to be better than 5 G at 5,000 ft. In a short take-off it can get airborne in 1000 ft. at 28,750 lb carrying more than 5000 lb of internal fuel and 16 Mk 82 bombs, giving a combat radius of 158 nmi. New digital avionics as well as available equipment give Harrier a precise and powerful attack capability. These include the standard US Navy AYK-14 mission computer, the ASN-130 one-box inertial navigator, the Smiths single-color head-up display, a digital air data computer and a radar altimeter. All are interconnected through the standard 1553A multiple digital data bus. Weapons systems include an angle-rate bombing system. C.D.

A82-26045 Yak-36 Forger - The brand X VTOL fighter. G. Lafon. *Interavia*, Mar. 1982, p. 228-230.

The design of the Forger, the Soviet Union's first VTOL fighter, presents an enigma. Its wing, with 42 deg sweep on the leading edge and a thickness/chord ratio of five or six percent, is inherently capable of transonic flight, yet all three aerodynamic control surfaces incorporate set-back hinges and trailing edge tabs, clear evidence that the controls are manually operated rather than powered. Manual controls are unsuitable for transonic flight. Forger's poor standard of combat performance is evident in its estimated sustained thrust-limited turn rate of 10 deg/sec at sea level and its maximum specific excess power of 500 ft/sec. A serious limitation on Forger's operational capability is that for any takeoff, the carrier has to steam, albeit slowly, in a direction which generates a light relative wind along the axis of the angled deck. It is concluded that, in spite of Forger's advanced technology for jet-borne flight and thrust management system, it must be employed to guard the Soviet fleets primarily against enemy maritime reconnaissance aircraft. C.D.

A82-26046 On-board computers save fuel and help ATC. C. Bulloch. *Interavia*, Mar. 1982, p. 251, 252.

Since 1975, NASA's Langley Research Center, in cooperation with the FAA, has pursued the Terminal Configured Vehicle program, which is concerned with the control and compartment of aircraft in the destination terminal area, from top-of-descent point or later to the conclusion of the landing roll. The program could, through improved airspace utilization, effect a 20 percent reduction in typical short/medium haul block time, which would translate into a 13 percent reduction in direct operating costs. The program concentrates on the cockpit, running experiments in a specially adapted Boeing 737 and Lockheed TriStar L-1011. TCX program experiments at Denver and Dallas-Fort Worth have shown that flight crews backed by automated on-board systems can perform more efficiently in the descent phase from cruise to the pre-approach metering fix point than they could under ATC guidance. Other on-board automation systems concepts are 'distributed control' and 'flow control'. C.D.

A82-26098 Aerodynamics - Retrospect and prospect /The 21st Lanchester Memorial Lecture/. E. W. E. Rogers (Royal Aircraft Establishment, Farnborough, Hants., England). *Aeronautical Journal*, vol. 86, Feb. 1982, p. 43-67. 103 refs.

The history of aerodynamics theory is reviewed, beginning from Newton's formulation for the force of a stream on an inclined plane to the present, and future directions for aerodynamics are indicated. The development of the Bernoulli theorem and the Navier-Stokes equation are considered, along with the inclusion of viscous and inviscid flows and Reynolds and Prandtl numbers for flow calculations. Drag and vortices were discovered, together with flow separation, and aerodynamics test facilities were constructed in the 19th century. The work of Lanchester is prominently featured, particularly for the criteria of stable flight. Work in the U.K. in the

interval 1910-1945 is outlined. The advent of computers permitted transonic flows to be modeled and aided designers, and future activities are foreseen to concentrate on airframe efficiency, control, maneuvering, and comprise studies in aerodynamics, unsteady aerodynamics, flight dynamics, and rotorcraft aerodynamics. M.S.K.

A82-26121 Advanced display-control concepts for power plant operation. D. L. Parks (Boeing Co., Seattle, WA). (*Electric Power Research Institute, U.S. Department of Energy, and IEEE, Symposium on Nuclear Power Systems, 13th, San Francisco, CA, Oct. 21-23, 1981.*) *IEEE Transactions on Nuclear Science*, vol. NS-29, Feb. 1982, p. 945-951.

This paper illustrates some of the concepts being developed for aerospace systems that are being applied in commercial airplanes and could transfer to nuclear control room applications. The same hardware and software capabilities could be tailored to develop display-control features for nuclear operations. Electronic systems permit integrated formatting to avoid mental syntheses of data from several instruments; they allow the use of multifunction, time-shared displays rather than dedicated ones. Displays can be high or low resolution as conditions require, and messages should be short and readily interpretable regardless of software coding convenience. Multifunction display and switching provide a considerable increase in flexibility. Switch matrices can themselves be mini-displays and appropriate software can make the display 'smart'. Color coding and directional arrows can be used when an emergency requires instant action. Research is ongoing to make use of the voice as a switching method. It is possible to design a simplified monitoring-control display that incorporates multiple systems and parameters. C.D.

A82-26130 Supercritical flow past symmetrical airfoils. K.-M. Li and M. Holt (California, University, Berkeley, CA). *Journal of Fluid Mechanics*, vol. 114, Jan. 1982, p. 399-418. 27 refs. Grant No. AF-AFOSR-80-0230.

A numerical method is developed for computing steady supercritical flow about an ellipse at zero angle of 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 co-ordinate 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. (Author)

A82-26176 Australasian Conference on Hydraulics and Fluid Mechanics, 7th, Brisbane, Australia, August 18-22, 1980, Preprints of Papers. Barton, Australia, Institution of Engineers (National Conference Publication, No. 80/4), 1981. 590 p.

A review is provided of research and developments in hydraulics in Australasia during the past decade, and aspects of prospecting for wind energy are explored. Power generation from the East Australian current by use of arrays of submerged Darrieus vertical axis turbines is considered along with normal stress measurements for viscoelastic liquids using real time holographic interferometry of the Weissenberg effect, admissibility requirements and the least squares finite element solution for potential flow, two-dimensional solid blockage in a slotted wall wind tunnel, and the dynamic behavior of propeller anemometers. Attention is given to the potential flow signature of a turbulent spot, topographic forcing in nonlinear and linear barotropic models, flow control by secondary injection, friction factors of aqueous electrolyte solutions in pipe flow, the vortex shedding process behind a circular cylinder, and the use of the method of lines for choking flow in a nozzle. G.R.

A82-26181 # Self streamlining wind tunnels without computers. N. Pollock (Department of Defence, Aeronautical Research

Laboratories, Victoria, Australia). In: Australasian Conference on Hydraulics and Fluid Mechanics, 7th, Brisbane, Australia, August 18-22, 1980, Preprints of Papers. Barton, Australia, Institution of Engineers, 1981, p. 123-126. 6 refs.

A brief review of wind tunnel wall interference is presented with particular emphasis on 'self correcting' and 'correctable interference' tunnels. Two simple methods of modifying tunnel walls to approximate unconstrained flow streamlines are presented. One method, which requires only very limited computation, involves the use of an analytic expression for the far field flow, and the other, which requires no computation, uses a purely mechanical wall arrangement which deflects appropriately under the applied pressure field.

(Author)

A82-26184 # The dynamic behaviour of propeller anemometers. P. S. Jackson (Auckland, University, Auckland, New Zealand). In: Australasian Conference on Hydraulics and Fluid Mechanics, 7th, Brisbane, Australia, August 18-22, 1980, Preprints of Papers. Barton, Australia, Institution of Engineers, 1981, p. 139-142. 11 refs.

A model equation is developed to predict the response of propeller anemometers in turbulent flow. The equation is nonlinear, and is shown to describe anemometer motion correctly for the situations which are easily simulated in a wind tunnel. Implications for the measurement of turbulent flows are discussed.

(Author)

A82-26194 # The effect of induced sound on the flow around a rectangular body in a wind tunnel. M. C. Welsh (Commonwealth Scientific and Industrial Research Organization, Div. of Mechanical Engineering, Melbourne, Australia), R. Parker, and S. A. T. Stoneman (Swansea, University College, Swansea, Wales). In: Australasian Conference on Hydraulics and Fluid Mechanics, 7th, Brisbane, Australia, August 18-22, 1980, Preprints of Papers. Barton, Australia, Institution of Engineers, 1981, p. 275-278. 14 refs.

The changed character of the flow around a thick blunt flat plate in a flow duct containing self induced resonant sound has been examined. It has been established that induced sound can 'feed back' on the vortex shedding process causing a step change in the shedding frequency increasing the Strouhal number for the plate by up to twice its normal value. In this flow state, the leading edge separation bubble reattaches much closer to the plate's leading edge than normal. Vortices are then shed from the position of flow reattachment and are conveyed downstream to form the wake.

(Author)

A82-26208 # Effect of wakes of upstream stator blades on the rotor of an axial flow compressor. A. R. Oliver (Tasmania, University, Hobart, Australia). In: Australasian Conference on Hydraulics and Fluid Mechanics, 7th, Brisbane, Australia, August 18-22, 1980, Preprints of Papers. Barton, Australia, Institution of Engineers, 1981, p. 385-388. 12 refs. Research supported by the Australian Research Grants Committee.

The effect of stator wakes passing over rotor blades in shifting stagnation points, points of separation and transition as well as the length of transition is discussed. The trailing edge problem is presented. A method of calculating stator wake transport in two dimensional incompressible flow is presented but not concluded for want of knowledge of a viscous trailing edge condition.

(Author)

A82-26222 # An experimental study of steady and quasi-steady jet flaps. Y. P. Chai and J. M. Simmons (Queensland, University, Brisbane, Australia). In: Australasian Conference on Hydraulics and Fluid Mechanics, 7th, Brisbane, Australia, August 18-22, 1980, Preprints of Papers. Barton, Australia, Institution of Engineers, 1981, p. 521-524. 11 refs.

Measurements of the spread of a steady jet flap are reported, as are uses of the measurements in refining the quasi-steady theory. Also described is the extension of this theory to cases involving pitching and plunging motions. The measured center-line of a steady jet flap is shown to differ significantly from that predicted by inviscid steady theory. Incorporation of the measured center-line into the quasi-steady theory of Simmons and Platzer (1978) improves the agreement with measurements of the frequency response of lift on a fixed airfoil with an oscillating jet flap. Simple

extensions of the quasi-steady model to cases of pitching and plunging of a jet-flapped airfoil give predictions of frequency response of lift which have trends consistent with measurements.

C.R.

A82-26223 # Results of recent measurements on an oscillating aerofoil. K. H. Ly and V. A. L. Chasteau (Auckland, University, Auckland, New Zealand). In: Australasian Conference on Hydraulics and Fluid Mechanics, 7th, Brisbane, Australia, August 18-22, 1980, Preprints of Papers. Barton, Australia, Institution of Engineers, 1981, p. 525-528. 14 refs.

Forces measured on a two-dimensional NACA 0012 aerofoil oscillating at pitch amplitudes up to 34 deg and heave amplitudes up to 0.2 of chord are presented. Reynolds numbers ranged from 70,000 to 330,000 and reduced frequencies of up to 0.45. In pitch, the greatest differences from the theoretical flat plate prediction occurred at the lowest reduced frequencies and larger amplitudes, and were the result of complicated real flow stall effects; results tended to converge to theoretical values for reduced frequencies greater than 0.4. In pure heave, forward thrust occurred for increasing reduced frequencies. The propulsive efficiency is discussed. Dynamic stall angles in pure pitch are also presented.

(Author)

A82-26227 # The vortex flow field generated by a hovering helicopter. K. R. Reddy (Department of Defence, Aeronautical Research Laboratories, Melbourne, Australia). In: Australasian Conference on Hydraulics and Fluid Mechanics, 7th, Brisbane, Australia, August 18-22, 1980, Preprints of Papers. Barton, Australia, Institution of Engineers, 1981, p. 553-556. 11 refs.

Important vortex elements in the wake of a hovering helicopter are identified on the basis of well established fixed wing theory. The vortex positions are specified using experimental results. To make the problem mathematically simple, Willmer's rectangularisation principle is introduced. Using this wake model, the calculated velocity field and blade loading are compared with available helicopter flight data. The comparison shows that the present simple method yields satisfactory results.

(Author)

A82-26298 # Helicopter rotor performance improvement by utilization of swept back parabolic blade tip. J. J. Philippe and P. Lafon (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *La Recherche Aéronautique* (English Edition), no. 5, 1981, p. 55, 56. Research supported by the Direction des Recherches, Etudes et Techniques.

Swept back parabolic tips designed to improve the working conditions of an advancing blade by reducing the intensity of the shock waves and the drag associated with such shocks are tested in the S2 wind tunnel at Chalais-Meudon on a three-bladed rotor. The influence of the sole planform of the blade tips on the total aerodynamic performance of the rotor, twist angle and the profiles of the tips remaining identical is investigated, and the performance of the reference rotor with rectangular blades is compared with that of the rotor fitted with swept back parabolic tips. Results show that the blade tip optimized for advancing blade conditions gives an overall improvement in performance.

D.L.G.

A82-26299 # Real time digital filtering test in the S1 continuous wind tunnel at Modane. J. Appel (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *La Recherche Aéronautique* (English Edition), no. 5, 1981, p. 57-61.

A real time digital filtering test was performed in October 1980 in the S1 wind tunnel at Modane to compare the performances of digital filters programmed at various cut-off frequencies with those of analog filters already in use. Results confirm the interest of low-pass filtering at a very low cut-off frequency for restoring static parameters while the model is performing an angle of attack sweep in continuous mode. At the cut-off frequency of 0.5 Hz, the Keimo analog filters are of good quality since the results they give coincide with those of the digital filters to within 0.0001.

D.L.G.

A82-26313 Torsional vibrations of non-uniform rotating blades with attachment flexibility. V. T. Nagaraj and N. Sahu (Hindustan Aeronautics, Ltd., Helicopter Design Bureau, Bangalore,

India). *Journal of Sound and Vibration*, vol. 80, Feb. 8, 1982, p. 401-411. 8 refs.

The torsional vibrations of non-uniform pretwisted rotating blades are studied by using finite element methods based on both the Rayleigh-Ritz and Galerkin formulations. The apparent differences between the matrices obtained from these formulations are explained and, as obtained by using three different orders of elements, results are presented for blades with flexibly attached roots and for a non-uniform blade representative of a bearingless rotor. A parametric study is carried out to resolve a controversy regarding the relative importance of certain terms in the equations of motion of pretwisted rotating blades. In Appendix I, an exact solution is presented for the torsional vibrations of flexibly attached rotating blades with piecewise constant inertia and elastic properties, which serves as a benchmark solution for the finite element results. (Author)

A82-26318 * High frequency sound emission from moving point multipole sources embedded in arbitrary transversely sheared mean flows. M. E. Goldstein (NASA, Lewis Research Center, Cleveland, OH). *Journal of Sound and Vibration*, vol. 80, Feb. 22, 1982, p. 499-522. 25 refs.

Formulas are derived for the high frequency sound emission from moving point multipole sources embedded in an arbitrary unidirectional transversely sheared mean flow. The results are used to study the sound generated by non-axisymmetric turbulent jets. The effect of the asymmetry in both the mean flow and the source distribution is accounted for by a 'circumferential directivity factor', which is easily calculated from the solution of a second order ordinary differential equation in the general case and from an explicit formula when the mean flow is symmetric but the source location is not. This factor is used to assess the potential of employing asymmetric velocity profiles that redirect the sound upward to reduce the noise radiation below the flight path of a jet aircraft. (Author)

A82-26319 * On the generation of side-edge flap noise. M. S. Howe (Bolt Beranek and Newman, Inc., Cambridge, MA). *Journal of Sound and Vibration*, vol. 80, Feb. 22, 1982, p. 555-573. 21 refs. NASA-supported research.

A theory is proposed for estimating the noise generated at the side edges of part span trailing edge flaps in terms of pressure fluctuations measured just in-board of the side edge on the upper surface of the flap. Asymptotic formulas are developed in the opposite extremes of Lorentz contracted acoustic wavelength large/small compared with the chord of the flap. Interpolation between these limiting results enables the field shape and its dependence on subsonic forward flight speed to be predicted over the whole frequency range. It is shown that the mean width of the side edge gap between the flap and the undeflected portion of the airfoil has a significant influence on the intensity of the radiated sound. The results indicate that the noise generated at a single side of a full scale part span flap can exceed that produced along the whole of the trailing edge of the flap by 3 dB or more. (Author)

A82-26320 Comments on 'Nature of inlet turbulence and strut flow disturbances and their effect on turbomachinery rotor noise'. G. F. Homicz (Calspan Advanced Technology Center, Buffalo, NY). *Journal of Sound and Vibration*, vol. 80, Feb. 22, 1982, p. 575, 576; Authors' Reply, p. 576, 577. 8 refs.

A82-26340 # Unsteady response of rectangular wings in spanwise uniform shear flow. M. Kobayakawa (Kyoto University, Kyoto, Japan). *AIAA Journal*, vol. 20, Apr. 1982, p. 471-476. 8 refs.

An unsteady lifting surface theory based on inviscid and incompressible spanwise shear flow is presented. The stream approaching a thin, rectangular wing is assumed to have a linear shear distribution, and a Poisson type equation is defined for the velocity in unsteady cases, and a Laplace equation for steady cases. The lift distribution is calculated and solved by a method of solution by mode functions. The lifting surface technique in potential flow is shown to be applicable for numerical solutions if the Mach number is set at zero. Calculations are also performed for the response functions to sinusoidal heaving oscillations and sinusoidal gust, corresponding to the Theodorsen function and the Sears function, respectively. M.S.K.

A82-26366 * # Computational fluid dynamics - The coming revolution. R. A. Graves, Jr. (NASA, Washington, DC). *Astronautics and Aeronautics*, vol. 20, Mar. 1982, p. 20-28, 62. 28 refs.

The development of aerodynamic theory is traced from the days of Aristotle to the present, with the next stage in computational fluid dynamics dependent on superspeed computers for flow calculations. Additional attention is given to the history of numerical methods inherent in writing computer codes applicable to viscous and inviscid analyses for complex configurations. The advent of the superconducting Josephson junction is noted to place configurational demands on computer design to avoid limitations imposed by the speed of light, and a Japanese projection of a computer capable of several hundred billion operations/sec is mentioned. The NASA Numerical Aerodynamic Simulator is described, showing capabilities of a billion operations/sec with a memory of 240 million words using existing technology. Near-term advances in fluid dynamics are discussed. M.S.K.

A82-26367 * # Lightning detection and ranging. C. L. Lennon (NASA, Kennedy Space Center, Cocoa Beach, FL) and H. A. Poehler (RCA Service Co., Cocoa Beach, FL). *Astronautics and Aeronautics*, vol. 20, Mar. 1982, p. 29-31. 6 refs.

A lightning detector and ranging (LDAR) system developed at the Kennedy Space Center and recently transferred to Wallops Island is described. The system detects pulsed VHF signals due to electrical discharges occurring in a thunderstorm by means of 56-75 MHz receivers located at the hub and at the tips of 8 km radial lines. Incoming signals are transmitted by wideband links to a central computing facility which processes the times of arrival, using two independent calculations to determine position in order to guard against false data. The results are plotted on a CRT display, and an example of a thunderstorm lightning strike detection near Kennedy Space Center is outlined. The LDAR correctly identified potential ground strike zones and additionally provided a high correlation between updrafts and ground strikes. M.S.K.

A82-26376 The Model 412 multi-bladed rotor system. A. W. Meyers, N. B. Phillips, and D. E. Snyder (Bell Helicopter Textron, Fort Worth, TX). *American Helicopter Society, National Specialists Meeting on Rotor System Design, Philadelphia, PA, Oct. 22-24, 1980, Paper, 9 p. 7 refs.*

A multibladed soft-inplane main rotor system is being certified for the Bell Model 412 utility helicopter. This rotor system is a third-generation design and is the result of technology developed in earlier multibladed soft-inplane rotor programs. The new rotor was designed to easily retrofit existing helicopters in the field. The design of a fiberglass blade was also included in the program. Torsional loads encountered during the development program were higher than anticipated because of the influence of live twist on rotor response and control loads. Increased trailing edge reflex was used to significantly affect both rotor response and control loads. Bell's technical predictions for the rotor have been confirmed in the development and FAA certification phases of the program. (Author)

A82-26377 Dynamic stability of low effective flap hinge BMR concepts. F. J. McHugh, J. A. Staley, and M. W. Sheffler (Boeing Vertol Co., Philadelphia, PA). *American Helicopter Society, National Specialists Meeting on Rotor System Design, Philadelphia, PA, Oct. 22-24, 1980, Paper, 11 p. 6 refs.*

The considered Bearingless Main Rotor (BMR) test shows that a five percent effective flap hinge BMR which has acceptable aeroelastic stability characteristics is feasible. Significant advancements regarding the development of the BMR concept will potentially provide a reduction in hub weight, piece parts, and fabrication costs while reducing gust sensitivity and vibratory hub moments. Dual beam and single flex strap designs studied have an equivalent flap hinge offset of approximately five percent of blade radius. The baseline dual beam was found to have a higher level of stability than the single flex strap. G.R.

A82-26378 Design for the operating environment - Ring-fin tail rotor program. H. E. Lemont (Bell Helicopter Textron, Fort Worth, TX). *American Helicopter Society, National Specialists Meeting on Rotor System Design, Philadelphia, PA, Oct. 22-24, 1980, Paper, 16 p. 6 refs.*

A82-26379

Many aircraft accidents involve tail rotor strikes. Replacing the helicopter fin with an airfoil-shaped cross-section ring provides greater safety, increases thrust and lowers noise. Full-scale ground, wind-tunnel, and feasibility flight testing shows that the rotor blade tip vortices educt air around the guard ring by external mixing to produce increased thrust for the same power input and a larger maximum available value. Acoustic data under static thrust conditions show reduced noise levels up to eight dBA by the use of the thrust ring and lowered operating tip speeds. Improved aircraft handling qualities are also indicated by feasibility flight test data. Applying the thrust ring to the main rotor requires a light ring and a relatively small rotor. Lighter transmissions, smaller antitorque devices and a compact construction would be pluses. Negatively, there would be problems with the weight of the ring and unknown factors in aerodynamics, controllability, and stability. C.D.

A82-26379 **The general purpose research rotor - Design features and considerations.** A. Z. Lemnios and R. Jones (Kaman Aerospace Corp., Bloomfield, CT). *American Helicopter Society, National Specialists Meeting on Rotor System Design, Philadelphia, PA, Oct. 22-24, 1980, Paper.* 16 p. 6 refs.

The General Purpose Research Rotor (GPRR) involves an in-depth preliminary design of a configuration which has multifunctional capabilities that can be used to investigate several different optional configurations with minor modifications to the basic structure. It is pointed out that, even with a number of advancements made with respect to airfoil design and tip shapes, significant problems still exist in the development of helicopter rotors. In particular, a better understanding is required of the rotor parameters which affect performance, vibration, noise, and stability. The GPRR provides a configuration which is ideally suited to study the sensitivity of these characteristics to configurational changes. The GPRR is a four-bladed configuration with each blade fabricated from composite materials. Attention is given to a conceptual study, a parametric study, a feasibility study, the evaluation of a selected configuration, and aspects of technological payoffs. G.R.

A82-26380 **Design of higher harmonic control for the ABC.** J. O'Leary and W. Miao (United Technologies Corp., Sikorsky Aircraft Div., Stratford, CT). *American Helicopter Society, National Specialists Meeting on Rotor System Design, Philadelphia, PA, Oct. 22-24, 1980, Paper.* 11 p. 9 refs.

Attention is given to the vibration characteristics of the ABC helicopter, ABC vibration with higher harmonic control (HHC), an active vibration controller, and the implementation of HHC on the ABC XH-59A helicopter. It is found that HHC is ideal for the ABC helicopter because of its large operational range of rotor speeds and natural interrotor load cancellation. It is feasible to achieve a 90% reduction of vibration through HHC. HHC requirements are in the range of 0.5 to 2 deg depending upon the harmonic frequency of the input. HHC does not alter the interrotor cancellation characteristic of the ABC rotors. The existing interrotor cancellation on the ABC helicopter makes the HHC application easier. G.R.

A82-26381 **CH-46 and CH-47 composite rotor blade lightning protection testing.** G. Heiderscheidt and J. Sarro (Boeing Vertol Co., Philadelphia, PA). *American Helicopter Society, National Specialists Meeting on Rotor System Design, Philadelphia, PA, Oct. 22-24, 1980, Paper.* 8 p.

A helicopter composite rotor blade suited to the lightning environment must be able to withstand a single strike of 200,000 amps and multiple strikes of 50,000 amps or less with only minor damage. The main element in the CH-46 and CH-47 lightning protection system is the titanium nose cap. All metal parts of the blade are either shielded by it or conduct to it. A conductive path leads from the cap to the metal rotor hub and then to the other metal sections of the aircraft. High-voltage long-arc tests involved 17 strikes averaging between 10,000 and 12,000 amps peak. Only minor damage occurred, including pitting and loosening of the top bonding strap. Swept-stroke tests involved 100 amp continuing current with 50,000 amp restrike swept from one blade to the next. No significant damage was seen. High current tests, including three 200,000 amp artificial lightning strikes, resulted in bond strips being blown away but no serious damage. C.D.

A82-26382 **A preliminary investigation of Individual Blade-control Independent of a Swashplate.** K. F. Guinn (Bell Helicopter Textron, Fort Worth, TX). *American Helicopter Society, National Specialists Meeting on Rotor System Design, Philadelphia, PA, Oct. 22-24, 1980, Paper.* 9 p. 11 refs.

A description is presented of the Individual Blade-control Independent of a Swashplate (IBIS) system, taking into account system components and their function. The IBIS fly-by-light control system is a unique concept for controlling the rotor blades of a helicopter of V/STOL aircraft. The concept stresses simplicity and utilization of integrated subsystems which inherently increase reliability while reducing weight and cost. Secondary flight control actuators are not needed with the fly-by-light system since secondary functions such as autopilot and SAS may be implemented simultaneously through the primary control actuators. By proper use of signal limiting, secondary control authority and rate limits may be provided by electronic circuitry instead of by secondary actuators with velocity and stroke limitations. G.R.

A82-26383 * # **Selection of some rotor parameters to reduce pitch-roll coupling of helicopter flight dynamics.** R. T. N. Chen (NASA, Ames Research Center, Moffett Field, CA). *American Helicopter Society, National Specialists Meeting on Rotor System Design, Philadelphia, PA, Oct. 22-24, 1980, Paper.* 19 p. 21 refs.

The results of a study conducted to investigate further a means of choosing primary rotor parameters to reduce the coupling of longitudinal and lateral flapping in hover and in forward flight are presented. The rotor parameters included - flapping hinge offset, flapping hinge restraint, pitch-flap coupling, and blade Lock number - are known to influence the agility, stability, and operational safety of helicopters. Effects of the nonuniform downwash model of White and Blake on the blade flapping motion are examined, and the theoretical calculation is then correlated with experimental test data. The condition for achieving perfect decoupling of the flapping response due to aircraft pitch and roll rates, which was previously obtained for a hovering rotor, is evaluated in forward flight. The results show that negligible coupling is achieved in forward flight; moreover, there is the additional benefit of a slight reduction in the coupling of the roll rate to coning. It is also indicated that the values of the rotor parameters chosen according to the decoupling condition are moderate and that the flapping motion is stable with the parameters chosen. (Author)

A82-26384 **CH-46 fiberglass rotor blade repair program.** N. Caravasos (Boeing Vertol Co., Philadelphia, PA). *American Helicopter Society, National Specialists Meeting on Rotor System Design, Philadelphia, PA, Oct. 22-24, 1980, Paper.* 8 p.

This paper discusses the importance of field repair capability of fiberglass rotor blades at the lowest maintenance level. An overview of validated repairs in a controlled environment is presented, including fatigue testing as well as actual repairs - out of the laboratory and in the field by Navy and Marine Corps mechanics. Substantial cost improvement between fiberglass and metal blades was realized because of improved reliability of fiberglass blades requiring less maintenance actions. (Author)

A82-26385 **A survey of U.S. Army helicopter main and tail rotor blade obstacle strikes.** L. T. Burrows (U.S. Army, Applied Technology Laboratory, Fort Eustis, VA). *American Helicopter Society, National Specialists Meeting on Rotor System Design, Philadelphia, PA, Oct. 22-24, 1980, Paper.* 8 p.

A description is presented of the results of a survey of main and tail rotor blade obstacle strikes which resulted in damage-causing mishaps. The occurrence of the considered mishaps are partly the consequence of an increased employment of terrain flying tactics. Such tactics are necessary to improve the chances for the survival of helicopters in the mid to high intensity combat environment. In the majority of the mishaps analyzed, the objects most often struck were trees, branches, bushes, or other vegetation. The aircraft considered include the OH-58 Kiowa, the AH-1 Cobra, and the UH-1 Iroquois. Approaches to obstacle strike tolerance are also discussed. G.R.

A82-26386 **The YAH-64A composite flexbeam tail rotor.** D. Banerjee, R. E. Head, R. Marthe (Hughes Helicopters, Inc., Culver

City, CA), and M. Ploudre (U.S. Army, Manufacturing Technology Branch, St. Louis, MO). *American Helicopter Society, National Specialists Meeting on Rotor System Design, Philadelphia, PA, Oct. 22-24, 1980, Paper. 12 p. 9 refs.*

A new composite flexbeam tail rotor is being fabricated for the YAH-64 Advanced Attack Helicopter. This rotor builds on the aerodynamic/dynamic and composites manufacturing technology which has been developed over the past several years for hingeless tail rotors. The design of a structurally and dynamically bearingless tail rotor design requires the solution of a number of problems. The problems are discussed along with the approaches developed for their solution. Attention is given to the prototype rotor, tail rotor design refinements, and manufacturing techniques. The flexbeam is considered along with the hub, the pitch case, the blade, the rotor dynamics, and certain key parameters. G.R.

A82-26387 * # Performance improvements with the free-tip rotor. R. H. Stroub (NASA, Ames Research Center, Moffett Field, CA). *American Helicopter Society, National Specialists Meeting on Rotor System Design, Philadelphia, PA, Oct. 22-24, 1980, Paper. 9 p.*

A new rotor configuration called the free-tip rotor was investigated for its potential to improve helicopter forward-flight performance characteristics. This rotor differs from a conventional rotor only in the blade tip region. Free tip is self-adjusting in pitch with respect to the rest of the blade. With this capability, the resulting pitch motion generated a more uniform airload distribution around the azimuth. Computer math models were used to compare performance characteristics of the free-tip rotor with those of a conventional rotor operating at flight speeds from 130 to 160 knots. The free-tip rotor is shown to improve cruise L/DE by at least 22%. (Author)

A82-26388 # Operational experience with the fiberglass rotor blade. R. E. Yeend (U.S. Naval Air Systems Command, Arlington, VA). *American Helicopter Society, National Specialists Meeting on Rotor System Design, Philadelphia, PA, Oct. 22-24, 1980, Paper. 15 p.*

A recently introduced fiberglass rotor blade (FRB) for the Navy/Marine Corps H-46 helicopters resulted in greatly increased mean blade flight hours between maintenance actions, removal to depot, and failure as compared to metal rotor blades. Aircraft flying qualities and performance characteristics were essentially unchanged from those obtained with metal rotor blades. No return to depot was required during reliability demonstration tests. Operational experience showed that in 82,000 total blade flight hours, involving over 500 FRB's, none had to be returned to depot for repair, compared to 464 metal blades in that time span. Of the 18 FRB's that were damaged, 15 were returned to service at the field activity level. Inherent failure that occurred in three blades is not expected to occur in production blades. Problems currently under investigation are titanium sparking during night flight, blade retention pin wear due to ingestion of sand, and corrosion of the lightning protection screen. C.D.

A82-26389 Design of a composite main rotor blade spar for fabrication by tubular braiding. M. L. White (Kaman Aerospace Corp., Bloomfield, CT). *American Helicopter Society, National Specialists Meeting on Rotor System Design, Philadelphia, PA, Oct. 22-24, 1980, Paper. 7 p. 8 refs.* Army-sponsored research.

Mechanical tubular braiding has been shown to be a viable spar manufacturing process in a program which included preliminary design of an improved main rotor blade for the OH-58 helicopter. The blade incorporates an advanced aerodynamic shape and has as its primary structural member a Kevlar 49/epoxy spar fabricated by braiding. Achievement of an analytically acceptable blade and spar design meeting critical structural and dynamic requirements was not hindered by braiding process constraints. Mechanical property tests of flat panels and spar sections exhibited excellent correlation with analytical predictions, substantiating the applicability of normal composite laminate analysis methods and the validity of the specific design. Ballistic testing of spar sections demonstrated superior containment of structural damage compared to composite spars produced by more conventional methods. Manufacturing cost estimates predict a price reduction of 1/3 for the braided spar over a similar S-glass/epoxy spar fabricated by orthodox, low-cost technology for an OH-58 blade of identical external shape. (Author)

A82-26390 Sikorsky tail rotor - 1980: Advanced manufacturing and quality control techniques. G. Wehnert (United Technologies Corp., Sikorsky Aircraft Div., Stratford, CT). *American Helicopter Society, National Specialists Meeting on Rotor System Design, Philadelphia, PA, Oct. 22-24, 1980, Paper. 8 p.*

A new lay-up design for the unidirectional graphite/epoxy spar of the tail rotor blade assembly in the Sikorsky BLACK HAWK aircraft simplifies manufacturing while changing none of the spar's physical and structural characteristics. The currently used 321 torpedo plies are replaced by 213 unidirectional one-piece plies laid up alternately at plus or minus 5 degrees to the horizontal. Spar yield is also improved by using press grade graphite with lower epoxy resin content, resulting in more uniform flow characteristics during molding. Consequently, less debulking in the thicker areas is required, porosity is reduced and the cure cycle is simplified because of more repeatable gel characteristics. The quality control employs a fully automated ultrasonic inspection and back-up inspections that distinguish between voids and inclusions on the one hand and porosity on the other with the resultant improved yield. C.D.

A82-26391 SH-60B Seahawk automatic blade fold system. C. V. Toner (United Technologies Corp., Sikorsky Aircraft Div., Stratford, CT). *American Helicopter Society, National Specialists Meeting on Rotor System Design, Philadelphia, PA, Oct. 22-24, 1980, Paper. 11 p.*

An automatic electromechanical blade fold system has been successfully tested as part of the U.S. Navy SH-60B Seahawk antisubmarine helicopter development program. Originally the blade fold systems had been hydraulically powered. However, for the SH-60B program a decision was made to change to an electrically powered system, because it promised inherently higher reliability and potentially lighter weight in a simpler system. Attention is given to system requirements, air vehicle reliability, a system definition, the blade fold, the lag dampers, aspects of pitch lock design, the blade retention bearing, the initial blade fold design, questions of blade unlocking, the fold actuator, the fold hinge detent, lock pin extraction, lock pin sequencing, and questions of fold actuator isolation. G.R.

A82-26392 The impact of missions on the preliminary design of an ABC rotor. G. de Simone, R. S. Blauch, and R. A. Fisher (United Technologies Corp., Sikorsky Aircraft Div., Stratford, CT). *American Helicopter Society, National Specialists Meeting on Rotor System Design, Philadelphia, PA, Oct. 22-24, 1980, Paper. 19 p. 8 refs.*

A number of studies have shown the suitability of the ABC rotor in a wide range of applications which require combinations of high speed flight and low speed agility and efficiency. Studies related to two of the envisaged applications are discussed. An advanced rotor has been derived for a cruise design point and a hover design point. Attempts have been made to chart the impact of airfoils, taper, and twist on the performance of an advanced rotor and a baseline XH-59A geometry rotor. Design trends using the two rotor data bases have been generated for a troop assault mission (high cruise speed requirement) and for an observation mission (high hover time required). G.R.

A82-26393 Main rotor hub electromagnetic signature reduction. J. Shostak (U.S. Army, Applied Technology Laboratory, Fort Eustis, VA) and J. Carver (Rockwell International Corp., Tulsa, OK). *American Helicopter Society, National Specialists Meeting on Rotor System Design, Philadelphia, PA, Oct. 22-24, 1980, Paper. 10 p.*

A main rotor hub cover was developed to reduce the electromagnetic (EM) signatures of the Army AH-1G/S helicopters' main rotor hub. The signatures addressed in the rotor hub cover design were the radar cross section (RCS), infrared radiation (IR) and visual, with emphasis being placed on RCS reduction. A detailed discussion of the main rotor hub cover development program and its subsequent RCS testing are presented in this paper. The stated program goals established the criteria from which the hub cover evolved. Careful consideration was given to the selection of materials and the cover design for optimization of the electromagnetic signature reduction. Static RCS signature measurements were performed on the rotor hub cover as were subsequent in-flight RCS measurements on the entire helicopter equipped with and without the hub cover. The in-flight

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measurements were made on an Army AH-1S (production) helicopter whose main rotor system was the same as that of the AH-1G helicopter. (Author)

A82-26394 * Evaluation of the effect of elastomeric damping material on the stability of a bearingless main rotor system. M. Sheffler, J. Staley (Boeing Vertol Co., Philadelphia, PA), and W. Warmbrodt (NASA, Ames Research Center, Moffett Field, CA). *American Helicopter Society, National Specialists Meeting on Rotor System Design, Philadelphia, PA, Oct. 22-24, 1980, Paper.* 9 p. 9 refs.

The considered investigation was conducted in connection with a contract to design, fabricate, and test a prototype bearingless main rotor (BMR) system. Part of the design process involved an aeroelastic stability investigation in a wind tunnel. Attention is given to a description of model testing, model test results, the description of the full scale wind tunnel configuration, full scale test results, and aspects of correlation with theory. It was found that the complex geometry of the BMR, with 12.5 degrees of nose-up prepitch at the hub and 2.5 degrees of tip-up pre-droop at the blade attachment clevis, is required to achieve a stable configuration. Subsequent model testing showed that a constrained layer of elastomer material could increase stability at all rotor speeds and collectives tested for a flat strap configuration. G.R.

A82-26395 Rotor preliminary design trade-offs for the Advanced Scout Helicopter. M. P. Scully and R. A. Shinn (U.S. Army, Research and Technology Laboratories, Moffett Field, CA). *American Helicopter Society, National Specialists Meeting on Rotor System Design, Philadelphia, PA, Oct. 22-24, 1980, Paper.* 21 p.

A description is presented of the Advanced Scout Helicopter (ASH) main rotor design trade-offs required for the selection of rotor diameter, tip speed, blade chord, number of blades, and blade inertia. The rotor design process is a constrained optimization in which both the objective function and the constraints are complicated, non-linear, and negotiable. The rotor design portion of ASH studies demonstrates the effect of constraints such as autorotation and survivable chord on the design, and shows the importance of developing more realistic versions of these constraints. Attention is given to design objectives, aspects of methodology, design constraints, baseline configurations, and questions of rotor and engine sizing. G.R.

A82-26396 Performance and aeroelastic tradeoffs on recent rotor blade designs. D. P. Schrage and J. A. O'Malley (U.S. Army, Development and Qualification Directorate, St. Louis, MO). *American Helicopter Society, National Specialists Meeting on Rotor System Design, Philadelphia, PA, Oct. 22-24, 1980, Paper.* 11 p. 15 refs.

A review is conducted of the performance and aeroelastic requirements of a helicopter rotor blade in both hover and forward flight. It is found that aeroelastic simplifications in rotor blade design are no longer practical if optimal performance is to be achieved. It is necessary to consider airfoil geometric variations. The influence of these variations on drag divergence Mach number at lift coefficients from near zero to near maximum lift and on pitching moments must be properly addressed during the design process. Blade torsional frequency, torsional stiffness, and section pitching moment, are exceedingly important parameters in optimizing performance and control loads. These parameters must, therefore, be adequately represented in analytical models. G.R.

A82-26397 CH-47 fiberglass rotor blade design and fabrication. R. W. Sandford and R. P. Belkó (Boeing Vertol Co., Philadelphia, PA). *American Helicopter Society, National Specialists Meeting on Rotor System Design, Philadelphia, PA, Oct. 22-24, 1980, Paper.* 11 p.

A fiberglass rotor blade for the CH-47 Chinook helicopter is now in production. It provides interchangeability, improved performance, failsafe construction, minimum inspection and maintenance requirements, maximum field reparability, and 3600 hours depot level reliability. A composite design optimizes blade geometry and features unidirectional material, titanium nose-cap, and a unit-fabricated fairing of fiberglass surrounding a non-metallic honeycomb core. The stainless-steel lag damper bracket is overwound with

prestressed fibers. Bench tests were conducted to ensure against buckling of the spar wall and trailing edge, and to evaluate fatigue of the root ends with results showing that the fatigue life objective would be met. Whirl and flight tests confirmed that the blade fiberglass components, damper bracket and windings have essentially unlimited fatigue life. The titanium nose-cap fatigue life substantially exceeded the design objective. C.D.

A82-26398 Black Hawk rotor de-icing. J. R. Reilly (United Technologies Corp., Sikorsky Aircraft Div., Stratford, CT). *American Helicopter Society, National Specialists Meeting on Rotor System Design, Philadelphia, PA, Oct. 22-24, 1980, Paper.* 10 p.

The U.S. Army Black Hawk helicopter is designed to operate in moderate icing conditions. Heating is provided at the engine inlets by engine bleed air and by electrothermal anti-icing elements in the windshield and pitot head. The rotor de-icing system melts the bonding layer of accreted ice, allowing the rest to be shed. A blade heating mat that carries current is integrally built within the leading edge and shielded by dielectric layers. The blades are connected to a distributor which connects to the rotor, which in turn connects to the de-ice controller and detectors. In operation, an off-time heater element responds to a predetermined accumulation of ice by commanding the on-time heater element, which operates until a predetermined ambient temperature is attained. Feedback systems monitor heat distribution and guard against excess current and blade overheating. To conserve power, the two sets of opposing blades are alternately de-iced. In tests, the system consistently produced clean ice shedding over thirty hours of testing. C.D.

A82-26399 Design optimization of rotor systems for tilt-rotor aircraft that fold for shipboard compatibility. R. R. Pruyn and R. B. Shannon (Boeing Vertol Co., Philadelphia, PA). *American Helicopter Society, National Specialists Meeting on Rotor System Design, Philadelphia, PA, Oct. 22-24, 1980, Paper.* 20 p.

Preliminary design studies have identified the best design concepts for four-bladed prop-rotors that must fold for shipboard compatibility. All practical combinations of folding method and hub configuration were evaluated for operational suitability, maintainability, reliability, cost, and developmental risk. Results show that the scissors-folding hingeless rotor is best if the aircraft configuration can accept a prop-rotor folding length of the prop-rotor diameter. For an aircraft configuration that requires the prop-rotor to fold to a length of approximately the rotor radius, a flexure and elastomeric articulated hub is the best choice. (Author)

A82-26400 The Circulation Control Rotor (CCR) control system. D. R. Barnes (Kaman Aerospace Corp., Bloomfield, CT). *American Helicopter Society, National Specialists Meeting on Rotor System Design, Philadelphia, PA, Oct. 22-24, 1980, Paper.* 10 p. 8 refs.

This paper presents an overview of the XH-2/CCR, Circulation Control Rotor Flight Demonstrator, control system design. The circulation control rotor is a major departure from conventional rotor systems and presents the control system designer with both a new set of options and a new set of challenges. The paper emphasizes the CCR unique components and aspects of the control system. Component selection, sizing, integration and operation are addressed. Specific details of the XH-2/CCR control system are presented. Multicyclic control capability is included. (Author)

A82-26461 # Mach 2.0 rotating arm rain erosion test apparatus. K. W. Foulke (U.S. Naval Material Command, Naval Air Development Center, Warminster, PA). In: Symposium on Electromagnetic Windows, 15th, Atlanta, GA, June 18-20, 1980, Proceedings. Atlanta, GA, Georgia Institute of Technology, 1980, p. 61-70.

In studies of radome erosion damage involving aircraft operating in Southeast Asia, it was found that the materials, coatings and designs in use could not withstand such an environment. In connection with a search for improved designs and materials, a survey of possible test methods was conducted. It was concluded that a rotating arm would provide the best laboratory simulation of the environment for investigating rain erosion at subsonic and supersonic speeds. The rotating arm offered the advantages of multiple drop impact, sustained exposure time, test samples of

acceptable size, low development cost, and reasonable cost per data point for test velocities to Mach 2.0. The rain erosion test apparatus consists of a four-foot radius arm rotating in a steel chamber 10 feet in diameter. G.R.

A82-26462 # Effects of filler materials upon radome rain erosion performance at subsonic conditions. E. Greene (IBM Corp., Owego, NY). In: Symposium on Electromagnetic Windows, 15th, Atlanta, GA, June 18-20, 1980, Proceedings. Atlanta, GA, Georgia Institute of Technology, 1980, p. 71-75.

The considered investigation was initiated after premature blistering of the rain erosion coating and radome soft spots were found to occur on some near sonic speed aircraft after relatively low flight time through rain. A rotating arm rain impact test facility was used as the vehicle simulator in the investigation. Attention is given to the results from three series of rain impact tests. It was found that filler materials used between rain erosion coating and radome substrate may conceal surface blemishes or irregularities and provide an attractive surface appearance. However, the tests show that radome performance can be severely degraded in a rain impact environment. G.R.

A82-26464 # Radome rain damage - An environmental analysis technique. B. J. Crowe (Flight Systems, Inc., Newport Beach, CA). In: Symposium on Electromagnetic Windows, 15th, Atlanta, GA, June 18-20, 1980, Proceedings. Atlanta, GA, Georgia Institute of Technology, 1980, p. 86-92. 6 refs. Contracts No. F33615-79-C-5036; No. N60530-79-C-0068; No. N00123-79-C-1042.

An environmental analysis technique has been developed for the rapid evaluation of path-cumulative rainfall statistics. Although the analysis assumes intense rainfall concentrations, the results it produces appear to be similar to those for more uniformly distributed rainfall. The accuracy of the technique is somewhat dependent on the character of the storm distribution models assumed, but parametric analyses have enhanced confidence in the general validity of the results to date. With further refinement, and improvements in the data base, it is believed that the considered approach could provide a much needed means for quantitatively evaluating the rain environment limitations of tactical missile radomes. G.R.

A82-26465 # Radome aerodynamic heating effects on boresight error. L. B. Weckesser (Johns Hopkins University, Laurel, MD). In: Symposium on Electromagnetic Windows, 15th, Atlanta, GA, June 18-20, 1980, Proceedings. Atlanta, GA, Georgia Institute of Technology, 1980, p. 97-101.

Previous studies have shown that aeroheating of a Pyroceram 9606 radome to temperatures as low as 600 F could cause a large enough change in the RF performance of the radome to affect missile performance. The decision was, therefore, made to carry out an experiment in which direct boresight error (BSE) measurements of a heated radome would be obtained. A description is presented of the special radome/antenna support fixture designed and built specifically for this test program. Attention is also given to aspects of general test arrangement, the radome, the test temperatures, and BSE results. G.R.

A82-26467 # Full scale test facilities for radomes and antenna windows. A. Ossin and H. J. Readey, Jr. (Martin Marietta Aerospace, Orlando, FL). In: Symposium on Electromagnetic Windows, 15th, Atlanta, GA, June 18-20, 1980, Proceedings. Atlanta, GA, Georgia Institute of Technology, 1980, p. 107-111.

The CONFLOW and Ramburner test facilities, with newly added capability, will provide a variety of environments and capabilities for the aerothermal and electrical evaluation of full-up radome structures, antenna windows, and material screening. The CONFLOW facility is a computer-controlled, continuous flow, hot air generator. A description is given of an investigation which shows that measurements of radome boresight error can be made at the CONFLOW facility with sufficient accuracy for most known applications of interest, provided the seeker under test can be sufficiently isolated from CONFLOW-induced movement. G.R.

A82-26468 # Duplication of radome aerodynamic heating using the Central Receiver Test Facility solar furnace. R. K. Frazer (Johns Hopkins University, Laurel, MD). In: Symposium on Electromagnetic Windows, 15th, Atlanta, GA, June 18-20, 1980, Proceedings. Atlanta, GA, Georgia Institute of Technology, 1980, p. 112-116. 5 refs.

An experiment has been conducted that used the solar furnace at the Central Receiver Test Facility (CRTF) in Albuquerque, NM, to create flight-like temperatures in three supersonic missile radomes. The radomes tested have a von Karman profile, are made of Pyroceram 9606 about 0.25 in. thick, and have a fineness ratio of 2.1 with a base diameter of 13.5 in. The purpose of this effort was to measure the changes in radome boresight error (BSE) caused by aerodynamic heating. This paper describes the thermal aspects of the experiment, including the facility selection, heat flux survey measurements, temperature measurements made on a calibration radome, and calibration of optical pyrometers. (Author)

A82-26470 # F-5 Shark Nose Radome - A development overview. G. W. Scott. In: Symposium on Electromagnetic Windows, 15th, Atlanta, GA, June 18-20, 1980, Proceedings. Atlanta, GA, Georgia Institute of Technology, 1980, p. 128-133.

It is pointed out that the Shark Nose Radome, with its pronounced ellipticity and sharp discontinuity edges on the forward region, gave rise to complex interrelationships between materials, structure, mechanical design, manufacturing process, environmental evaluation, and electromagnetic performance. Because of this, the development and test phases required many iterations, trade-offs, and compromises. Extensive ground and flight tests were carried out. The production model was found to satisfy all specifications and is now being installed on production F-5 aircraft. C.R.

A82-26471 # Automated radome performance evaluation in the Radio Frequency Simulation System /RFSS/ facility at MICOM. J. M. Schuchardt, D. J. Kozakoff, D. O. Gallentine, T. N. Long (Georgia Institute of Technology, Atlanta, GA), M. M. Hallum, and B. F. Wilson (U.S. Army, System Simulation and Development Directorate, Redstone Arsenal, AL). In: Symposium on Electromagnetic Windows, 15th, Atlanta, GA, June 18-20, 1980, Proceedings. Atlanta, GA, Georgia Institute of Technology, 1980, p. 134-141. 8 refs.

The need for rapid collection of missile radome/seeker interaction data in the U.S. Army RFSS facility has led to the development of an instrumentation system by the Georgia Institute of Technology. The system consists of a microcomputer-controlled radome positioner and radome measurements receiver. The positioner can handle radomes with diameters up to 18.0 inches and weights up to approximately 50 pounds. The receiver system operates over an RF frequency range of 0.11-18.0 GHz. A microcomputer system featuring dual floppy disk data storage furnishes a method of intermediate test data storage/buffering. Tests carried out with an actual radome/seeker antenna combination demonstrate the signal processing feature of the receiver's microcomputer. C.R.

A82-26479 † The relative motion of a particle in the case of exponential changes of the velocity of the medium (Ob otноситel'nom dvizhenii chastitsy pri eksponentsial'nom izmenenii skorosti sredy). S. V. Ananikov and B. M. Azizov. *Aviatsionnaia Tekhnika*, no. 3, 1981, p. 3-6. 13 refs. In Russian.

An analytic solution, expressed by elementary and special functions, is obtained for the relative motion of a particle in a gas flow whose velocity changes exponentially. The case of a single spherical particle in an isothermal gas flow is examined. The analysis is pertinent to the study of combustion processes in jet engines. B.J.

A82-26483 † The effect of the shape of a body on the efficiency of its utilization as a flame stabilizer (Vliianie formy tela na effektivnost' ego ispol'zovaniia v kachestve stabilizatora plameni). V. N. Gruzdev, M. M. Nuriev, and A. V. Talantov. *Aviatsionnaia Tekhnika*, no. 3, 1981, p. 43-47. In Russian.

Experimental results are presented on flame stabilizers of various shapes with regard to combustion efficiency, flameout limits, and hydraulic resistance. It is found that the replacement of the

conventional V-shaped stabilizer by a hydraulically equivalent flat-plate stabilizer makes it possible to reduce the mass of the stabilizer array without reducing the combustion efficiency. B.J.

A82-26486 † Requirements on modern mathematical models of gas turbine engines. I (Trebvaniia k sovremennym matematicheskim modeliam gazoturbinnnykh dvigatelei. I). E. B. Mats and A. P. Tunakov. *Aviatsionnaia Tekhnika*, no. 3, 1981, p. 63-65. 6 refs. In Russian.

Requirements assuring the sufficient accuracy of mathematical models of gas turbine engines are discussed. Consideration is given to the possibility of taking into account the following characteristics: moisture, gas dissociation, changes in the composition and properties of the working fluid, the turbine characteristics, the Reynolds number, changes in the loss coefficient and the combustion efficiency, radial flow nonuniformity, and static-pressure difference. B.J.

A82-26487 † Method for engine-airframe integration using a high-level computer-assisted engine design system of the Apparatus series (Metodika soglasovaniia dvigatelei i samoleta v SAPR-D verkhnego urovnia tsikla 'Apparat'). S. V. Rumiantsev and V. A. Sgilevskii. *Aviatsionnaia Tekhnika*, no. 3, 1981, p. 66-70. In Russian.

The theoretical principles underlying engine-airframe integration using a high-level computer-assisted engine design system are presented. The integration approach is described in detail, and a block diagram of the integration system is presented. B.J.

A82-26491 † Application of combined balancing methods to flexible rotors of aviation gas-turbine engines (Primenenie kombinirovannykh metodov uravnoveshivaniia gibkikh rotorov aviatsionnykh gazoturbinnnykh dvigatelei). A. I. Gleizer. *Aviatsionnaia Tekhnika*, no. 3, 1981, p. 81-85. 5 refs. In Russian.

A82-26492 † Determination of losses in a channel with a sudden expansion behind a diffuser (K voprosu opredeleniia poter' v kanale s vnezapnym rasshireniem, raspolozhennym za diffuzorom). A. Ia. Dantsyg, N. M. Petrov, and N. N. Ponomarev. *Aviatsionnaia Tekhnika*, no. 3, 1981, p. 86-89. In Russian.

An exact and relatively simple method is proposed for determining total-pressure losses in a step diffuser, i.e., a system consisting of a diffuser and a channel with a sudden expansion. This method makes it possible to develop a procedure for analyzing losses in a step diffuser with allowance for gas compressibility in the case of variations of the degree of sudden expansion. B.J.

A82-26494 † The formation of benzpyrene during the combustion of aviation fuels (K voprosu ob obrazovanii benz/a/pirena pri gorenii aviatsionnykh topliv). V. P. Lukachev, Iu. A. Knysh, A. A. Gorbatko, and A. V. Ivliev. *Aviatsionnaia Tekhnika*, no. 3, 1981, p. 94-96. 5 refs. In Russian.

It has been suggested that the emission of benzpyrene during the combustion of jet-engine fuels should be accompanied by the emission of smoke and carbon monoxide. Experimental results are presented on the emission of benzpyrene during the combustion of kerosene in two aircraft engines. A discrepancy between the benzpyrene emission characteristics is found for the two engines, which is as yet unexplained; in one case, the benzpyrene emission characteristics are proportional to those of smoke and CO, in the other case, they are not. B.J.

A82-26495 † Methodology for determining fuel-combustion efficiency and the toxicity of exhaust gases (K metodike opredeleniia polnoty sgoraniia topliva i toksichnosti vykhlopnykh gazov). V. P. Lukachev and A. V. Ivliev. *Aviatsionnaia Tekhnika*, no. 3, 1981, p. 96-99. In Russian.

Methodological questions relating to the experimental determination of the combustion efficiency of jet-engine fuels and the toxicity of the exhaust gases are discussed. Particular consideration is given to the sampling of combustion products and to the elimination of low-frequency fluctuations of combustion-product composition. B.J.

A82-26496 † Analysis of the characteristics of a bypass engine, with allowance for variable pressure losses in the channels (Raschet kharakteristik TRDD s uchedom peremennykh poter'davleniia v kanalakh). B. D. Fishbein. *Aviatsionnaia Tekhnika*, no. 3, 1981, p. 99-102. In Russian.

A82-26500 † Radio-navigation equipment of aircraft - Devices and operation (Radionavigatsionnoe oborudovanie samoletov - Ustroistvo i ekspluatatsiia). A. N. Goliak, S. I. Plotkin, and I. F. Koval'chuk. Moscow, Izdatel'stvo Transport, 1981. 248 p. 7 refs. In Russian.

An automatic direction finder is described, taking into account general information, the goniometric system, aspects of control, the automatic tuning system, and operational details. A radio altimeter is also considered, giving attention to the high-frequency measuring device, the amplifier of the difference frequency, the transceiver unit, the altitude indicator, and details regarding the operation of the instrument. Another instrument discussed has been designed to provide air navigation on the basis of a utilization of the international VOR system and the Instrument Landing Systems. Aspects of approach control for the aircraft during landing operations are examined along with questions of instrument control, operational principles, and instrument design. A description is also provided of aircraft radio-navigation equipment employed for an automatic, continuous measurement and indication of the polar coordinates of the aircraft. G.R.

A82-26511 Automating air-traffic control. H.-M. D. Toong (MIT, Cambridge, MA) and A. Gupta. *Technology Review*, vol. 85, Apr. 1982, p. 40-49, 54. 5 refs.

The present air-traffic control system based on 1960s technology that uses redundancy to deal with random interruptions of service is being modernized for the 1990s. The system has become increasingly unreliable with obsolete hardware lacking sufficient memory space, and degrading computer response time. The FAA has proposed replacing selected pieces of existing hardware with functionally similar hardware ('rehosting'), but which would increase capacity with minimal software modification. Only basic computer instructions would be required. Communications facilities would be modernized by transmitting computer-generated instructions directly to the aircraft, reducing the involvement of air traffic controllers in this task. By 1996, the entire task of routing air traffic will be done with little human intervention, saving fuel and flying time. The cost of upgrading will be in the vicinity of \$300 million, with a factor-of-ten increase over the current computer speed. C.D.

A82-26526 * # The role of modern control theory in the design of controls for aircraft turbine engines. J. Zeller, B. Lehtinen, and W. Merrill (NASA, Lewis Research Center, Cleveland, OH). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0320*. 32 p. 117 refs.

The development, applications, and current research in modern control theory (MCT) are reviewed, noting the importance for fuel-efficient operation of turbines with variable inlet guide vanes, compressor stators, and exhaust nozzle area. The evolution of multivariable propulsion control design is examined, noting a basis in a matrix formulation of the differential equations defining the process, leading to state space formulations. Reports and papers which appeared from 1970-1982 which dealt with problems in MCT applications to turbine engine control design are outlined, including works on linear quadratic regulator methods, frequency domain methods, identification, estimation, and model reduction, detection, isolation, and accommodation, and state space control, adaptive control, and optimization approaches. Finally, NASA programs in frequency domain design, sensor failure detection, computer-aided control design, and plant modeling are explored. M.S.K.

A82-26536 A310 - Europe builds on Airbus success. D. Velupillai. *Flight International*, vol. 121, Feb. 27, 1982, p. 477-484.

Some of the overall problems of the Airbus A310 as well as design details of its new wing are discussed. The wing has the same sweep as the A300 wing and similar slats and flaps. Greater supercriticality was achieved, with consequent reduced airfoil size and thicker section without drag penalty. A 3-D airflow analysis

showed that large spanwise changes in airfoil-section were necessary, which in turn demanded extensive double curvature in the lower skin of the inner wing, produced by a new shot-peening technique. 3-D analysis was also used to optimize wing twist along the span and to minimize downward lift generated by the tail-plane during cruise. Detail improvements were made in the leading-edge slats and flaps, the outboard ailerons were eliminated, and other drag clean-ups were made. The spanwise skin-joint is now outboard and will later be eliminated. In the rest of the airframe there is minimum change. The A310 is designed for crack-free life of 20,000 flights, or about 10 years of service. Some comparisons are made with the Boeing 767 and 757 and fuel consumption, production line and cockpit details are also given. C.D.

A82-26537 **Advanced helicopter concepts compete.** G. Warwick. *Flight International*, vol. 121, Mar. 13, 1982, p. 615, 616, 625, 626.

The U.S. Army is defining a tri-Service medium-lift V/STOL aircraft for the early 1990s, with advancing-blade, tilt-rotor, and X-wing concepts among the contenders. One way to increase helicopter speed is to install a pair of coaxial counter-rotating rotors so that all lift is generated on opposing advancing blades. This enables retreating blades to operate at low or zero pitch. Helicopter speed can be increased by avoiding edgewise flow; this is done by tilting the rotors forward into the airflow to become large-diameter propellers and transferring lift to a fixed wing. Speeds of 300 kt at sea level and 350 kt at 20,000 ft are achieved. The key to X-wing is circulation control. The blades have an elliptical section with rounded leading and trailing edges. Air pumped into the hollow blades exits through narrow slots running the length of the upper surface at 5% and 95% chord. Blowing reduces drag and produces lift essentially independent of blade pitch and airflow velocity. Speeds of 500 kt have been attained. C.D.

A82-26538 **From claws to jaws - Tiger into Tigershark.** R. Braybrook. *Air International*, vol. 22, Mar. 1982, p. 111-116, 136-138.

Northrop began considering lightweight low-cost fighters in the early 1950s, building a series leading to the F-5s. These aircraft combined twin-engine safety with straightforward handling characteristics and the infrared guidance missiles gave these aircraft an effective air combat role. The F-5A was a basic fighter that gave poorer nations an introduction to supersonics at low prices, while the F-5E was a more powerful short-range air superiority fighter with ground attack capability. The F-5G Tigershark features the F404 engine with 16,390 lb of afterburning thrust, a flattened nose shape to maintain excellent handling qualities at high angle of attack, enlarged leading edge extension and improved longitudinal control. Much of the operational equipment will be that of the F-5E, but add-on or alternative equipment will soon be available. The first flight is scheduled for September 1982. C.D.

A82-26541 # **Structural design and construction of the New Technology Wing.** M. Flemming. *Dornier-Post* (English Edition), no. 4, 1981, p. 14-18.

The New Technology Wing (NTW) for general aviation aircraft uses milling for the rib flanges as well as the skin/stringer panels, providing a very smooth outside contour which improves the aerodynamic quality of the wing. The need for about 12,000 rivets is eliminated as well as the possibility of leaks that rivets entail. Only about ten percent more milling time is required by the NTW. To compress the rib flange, the usual shot peening method is inadequate. Instead, the flange is formed by two or three applications of a hand compression tool at opposite nodes of the flange all along its length. This technique causes permanent tensile stresses that could cause tension crack corrosion during extended operation. Qualifying tests are therefore envisioned in sensitive materials. No negative effects are expected with respect to fatigue, and tests confirm this. The entire wing is simply assembled and includes a lighter trailing edge box made of fiberglass reinforced plastic sandwich structures with plastic honeycombs. C.D.

A82-26542 # **Experimental program for general aviation.** W. Haberland. *Dornier-Post* (English Edition), no. 4, 1981, p. 19-22.

The New Technology Wing Program involved the design,

construction, and testing of a representative wing having a novel aerodynamic profile and slotted flaps to improve maximum lift and L/D ratios, suitable wing edges to reduce induced drag, and wing design allowing cost-efficient production. More than 250 successful test flights have demonstrated 25%-40% improvement in range and 30% reduction in fuel consumption when cruising at 400 km/h, compared to conventional aircraft having the same engines and payload. The tests, which apply to both single-engine and twin-engine planes, showed that the aircraft could climb from high airfields at full payload even when one engine fails. Production cost for the wing box was reduced about 30%. C.D.

A82-26543 # **One year flight testing of the Transonic Wing.** B. Moeken. *Dornier-Post* (English Edition), no. 4, 1981, p. 39-43.

Flight testing of the Dornier Transonic Wing (TW) on the Alpha Jet A1 test bed is described. The experimental version of the TW is characterized by its transonic profile with a large leading-edge radius, a relatively flat surface curvature of the front profile, and a more pronounced camber in the rear profile. The geometrical features of the wing provide higher cruise speed, more lift or payload, and - at higher profile thickness - a correspondingly reduced structural weight and more fuel volume, depending on the design requirement. Industrial and military flight tests were made and showed that the TW provides lower fuel consumption, particularly at high Mach numbers. The TW's radius of action is improved compared to conventional wing designs. Lower corner speed is considerably reduced and upper corner speed is heightened. Stall behavior is excellent. C.D.

A82-26567 * # **Sonic fatigue testing of an advanced composite aileron.** J. Soovere (Lockheed-California Co., Burbank, CA). (*American Institute of Aeronautics and Astronautics, Dynamics Specialists Conference, Atlanta, GA, Apr. 9, 10, 1981, Paper 81-0634.*) *Journal of Aircraft*, vol. 19, Apr. 1982, p. 304-310. Contract No. NAS1-15069.

The sonic fatigue test program to verify the design of the composite inboard aileron for the L-1011 airplane is described. The composite aileron is fabricated from graphite/epoxy minisandwich covers which are attached to graphite/epoxy front spar and ribs, and to an aluminum rear spar with fasteners. The program covers the development of random fatigue data by means of coupon testing and modal studies on a representative section of the composite aileron, culminating in the accelerated sonic fatigue proof test. The composite aileron sustained nonlinear panel vibration during the proof test without failure. Viscous damping coefficients as low as 0.4% were measured on the panels. The effects of moisture conditioning and elevated temperature on the random fatigue life of both undamaged and impact damaged coupons were investigated. The combination of impact damage, moisture, and a 180 F temperature could reduce the random fatigue life by 50%. (Author)

A82-26568 # **Fuel optimal trajectory computation.** J. W. Burrows (Boeing Computer Services Co., Energy Technology Applications Div., Seattle, WA). *Journal of Aircraft*, vol. 19, Apr. 1982, p. 324-329, 8 refs.

Roughly a quarter of the total fuel savings of the new generation of large jet transports will come from the capability of computing fuel optimal flight trajectories between departure point and destination. The shape of the trajectory in the vertical plane is treated here. A simplified mathematical model is described including spline fits to the drag and fuel flow functions. A suboptimal trajectory is found using the maximum principle of optimal control and singular perturbation theory. The inner or boundary-layer solutions are identified as the climb or descent segments of the flight, while the outer solution corresponds to cruise. The inner solutions are expanded to second order in the vicinity of the outer solution to develop cruise control laws for cost-effective response to altered in-flight conditions. (Author)

A82-26569 # **Wing/control surface flutter analysis using experimentally corrected aerodynamics.** C. D. Turner (North Carolina State University, Raleigh, NC). *Journal of Aircraft*, vol. 19, Apr. 1982, p. 342-344. 11 refs. Research supported by the Beech Aircraft Corp.

In previous studies related to the flutter problem concerning aircraft, it appeared that results based on the use of theoretical

unsteady aerodynamics might not always represent the actually existing conditions. In an investigation of the reported difficulties, an analytical flutter model of the experimental model used by For-sching et al (1971) was developed. In order to correct the wing/control surface aerodynamics a matrix method recommended by Rodden was applied to the analytic aerodynamic data. This approach made it possible to use the experimental pressure with the analytical flutter model. Results obtained with the analysis involving the corrected aerodynamics are compared with the data provided by the uncorrected model. G.R.

A82-26620 * Helicopter vibration suppression using simple pendulum absorbers on the rotor blade. M.-N. H. Hamouda and G. A. Pierce (Georgia Institute of Technology, Atlanta, GA). *American Helicopter Society, National Specialists Meeting on Helicopter Vibration, Hartford, CT, Nov. 2-4, 1981, Paper.* 15 p. 10 refs. Grant No. NsG-1592.

A design procedure is presented for the installation of simple pendulums on the blades of a helicopter rotor to suppress the root reactions. The procedure consists of a frequency response analysis for a hingeless rotor blade excited by a harmonic variation of spanwise airload distributions during forward flight, as well as a concentrated load at the tip. The structural modeling of the blade provides for elastic degrees of freedom in flap and lead-lag bending plus torsion. Simple flap and lead-lag pendulums are considered individually. Using a rational order scheme, the general nonlinear equations of motion are linearized. A quasi-steady aerodynamic representation is used in the formation of the airloads. The solution of the system equations derives from their representation as a transfer matrix. The results include the effect of pendulum tuning on the minimization of the hub reactions. C.R.

A82-26630 A simple crack closure model for prediction of fatigue crack growth rates under variable-amplitude loading. A. U. de Koning (Nationaal Lucht- en Ruimtevaartlaboratorium, Amsterdam, Netherlands). In: *Fracture mechanics; Proceedings of the Thirteenth National Symposium, Philadelphia, PA, June 16-18, 1980.*

Philadelphia, PA, American Society for Testing and Materials, 1981, p. 63-85. 17 refs. Research supported by the Nederlands Instituut voor Vliegtuigontwikkeling en Ruimtevaart.

A relatively simple model accounting for load interaction effects as well as for the plane strain to plane stress transition has been developed for the analysis of fatigue crack growth in aluminum alloys. The model is based on an approximate description of the crack closure behavior and can be used to predict effects of crack growth acceleration and retardation observed experimentally under variable-amplitude loading. The model has been used successfully to analyze the effect of parameter variations in a flight simulation load spectrum on the crack growth rate in centrally cracked specimens cut from 7075-T6 sheet material. V.L.

A82-26637 Fracture mechanics technology applied to individual aircraft tracking. A. G. Denyer (Rockwell International Corp., El Segundo, CA). In: *Fracture mechanics; Proceedings of the Thirteenth National Symposium, Philadelphia, PA, June 16-18, 1980.* Philadelphia, PA, American Society for Testing and Materials, 1981, p. 288-302.

A tracking program being prepared for the USAF T-39 Utility Trainer which uses crack growth principles for both durability and damage tolerance life estimates is discussed. The tracking program consists of defining the structural life of aircraft and the corresponding crack growth limits, selecting the critical structural locations to be tracked, collecting flight records from the aircraft fleet, and performing crack growth analysis using the flight records to obtain the accumulated damage and an estimate of the remaining life. A cost-effective crack growth integration technique which makes tracking for durability feasible even if the life is as much as 100,000 hr is presented. V.L.

A82-26639 Fracture control in ballistic-damaged graphite/epoxy wing structure. J. G. Avery, S. J. Bradley, and K. M. King (Boeing Military Airplane Co., Seattle, WA). In: *Fracture mechanics; Proceedings of the Thirteenth National Symposium, Philadelphia, PA, June 16-18, 1980.* Philadelphia, PA, American Society for Testing and Materials, 1981, p. 338-359. 6 refs. DOD-sponsored research.

A graphite/epoxy wing skin configuration has been developed which is capable of sustaining limit load after being hit by a 23-mm high-explosive-incendiary projectile under worst-case damage conditions. The skin configuration consists of a 45-deg cross-ply graphite/epoxy laminate with integral spanwise and chordwise crack-arresting pads formed by adding 0-deg glass/epoxy between the graphite/epoxy plies. The 45-deg orientation provides enhanced battle damage tolerance because of its higher residual strain-to-fracture capability relative to quasi-isotropic 0/+ or - 45/90 laminates. The fracture control approach has been successfully demonstrated for a full-scale component. V.L.

A82-26652 Evaluation of crack growth gages for service life tracking. C. R. Saff (McDonnell Aircraft Co., St. Louis, MO) and D. R. Holloway (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, OH). In: *Fracture mechanics; Proceedings of the Thirteenth National Symposium, Philadelphia, PA, June 16-18, 1980.* Philadelphia, PA, American Society for Testing and Materials, 1981, p. 623-639. 13 refs. Contract No. F42600-78-D-0014.

A82-26820 Future helicopter technology. R. B. Lewis, II (U.S. Army, Aviation Research and Development Command, St. Louis, MO). *Vertiflite*, vol. 28, Mar.-Apr. 1982, p. 12-15.

Technological opportunities concerning helicopter developments are related to fuel efficient engines, composite airframes, digital avionics, optical flight controls, and advanced rotor concepts. The Army is currently formulating a comprehensive program for the 1980s and 1990s which will apply these technologies to a new Light Helicopter Family, a new Special Electronic Mission Aircraft, the Advanced Attack Helicopter, and the Modernized Chinook. Particular attention is given to aspects of digital systems integration, developments regarding an employment of composite materials, advances related to engine development, and details of rotor system design. G.R.

A82-26821 The future of helicopter flight control technology. R. Zincon (United Technologies Corp., Sikorsky Aircraft Div., Stratford, CT). *Vertiflite*, vol. 28, Mar.-Apr. 1982, p. 16-19.

Major opportunities for significant technological gains by the helicopter industry in the next decade are related to the rapid advances being made in digital microprocessor technology, optical transmission, and advanced control concepts. An investigation is conducted concerning the effects of the new developments on the civil helicopters of the 1990s. The impact of new control system technology is considered, taking into account aspects of improved performance, empennage size, fly-by-wire techniques, and cost effectiveness payoffs related to maintenance. Questions concerning increased pilot productivity and safety through reduced workload are discussed, giving attention to improved handling qualities, advanced cockpit technology, cockpit systems, cockpit controls, improved ride quality, and vibration suppression. Effects of the technologies on operator requirements are also examined. G.R.

A82-26822 NOTAR. A. H. Logan (Hughes Helicopters, Inc., Culver City, CA). *Vertiflite*, vol. 28, Mar.-Apr. 1982, p. 20-23.

The single-rotor helicopter owes much of its longevity to the successful use of the tail rotor concept as a means of counteracting the torque induced by the main rotor rotation. However, the tail rotor does have several drawbacks, and recent Army studies have shown that the tail rotor is responsible for 15 percent of all helicopter accidents, placing it second only to engine problems. In connection with efforts to develop an antitorque concept which eliminates the tail rotor, the No-Tail-Rotor (NOTAR) design was created. The new design employs a low pressure air system in place of a tail rotor. NOTAR promises to be a viable alternative to the tail rotor in operation while affording the helicopter pilot identical maneuvering capabilities. Attention is given to details of NOTAR system design, aspects of NOTAR development, and flight tests. G.R.

A82-26966 * Large scale model measurements of airframe noise using cross-correlation techniques. W. R. Miller, W. C. Meecham

(California, University, Los Angeles, CA), and W. F. Ahtye (NASA, Ames Research Center, Moffett Field, CA). *Acoustical Society of America, Journal*, vol. 71, Mar. 1982, p. 591-599. 22 refs. NASA-supported research.

Cross-correlation techniques are used to measure the sound radiated by wing/flap airfoil configurations in the NASA-Ames 40 x 80 ft wind tunnel using a 6.7-m semispan model with three deployed flaps. The dominant source of flap noise is identified as the flap side edges, which exceeds that radiated by the midspan region by more than 10 dB. The turbulent surface eddies at the flap side edge have scales on the order of one-half the flap chord. The installation of flap actuator fairings at the flap side edge reduces the noise radiated from that location by 10 to 15 dB. The cross-correlation technique extracts airframe noise radiated by specific surface locations from the tunnel background noise, even when the noise is 25 dB higher than the measured airframe noise level. D.L.G.

A82-26993 # Aeroelasticity of compressor blades - Subsonic stall flutter. H. Loiseau and E. Szechenyi (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *La Recherche Aérospatiale* (English Edition), Nov.-Dec. 1981, p. 47-59. 6 refs.

Studies carried out at ONERA concerning the aeroelasticity of turbomachine blades are described. Results relating to subsonic and transonic stall flutter are presented, and prediction calculations using experimental data from the wind tunnel are compared with damping and unsteady pressure measurements made in the corresponding compressor. The techniques for measuring the aeroelastic coefficients based on excitation by hydraulic actuators and measurement using transducers are found to be operational and efficient. Unsteady flow simulated in the wind tunnel is found to be well simulated from a quantitative point of view. It is concluded that the unsteady phenomena revealed by the wind tunnel tests are representative of real phenomena in compressors, and the steady flow conditions necessary for stall flutter have been established. D.L.G.

A82-27048 Modernizing air traffic control in France. J. de Galard. *Airport Forum*, vol. 11, Feb. 1982, p. 29-34.

A description is given of the Coordonnateur Automatique du Trafic Aérien (CAUTRA) IV ATC system, which has been operating at Brest, France since 1980. CAUTRA IV uses a distributed system architecture, based on Mitra minicomputers, and incorporates as interconnected systems a centralized Initial Flight Plan Data Processing System, a Flight Plan Data Processor, and a Radar Data Processor for each enroute ATC center. There are five redundant data processing sets per center, which may be reconfigured through reconnection by means of a mixing and switching device to all synchronous interfaces supporting operational peripherals and external links. Attention is given to a computerized safety net system integrated into CAUTRA IV that is capable of automatically detecting a large percentage of threatened collisions and informing controllers. O.C.

A82-27049 IATA's Unit Terminal Concept. E. B. Tutty (International Air Transport Association, Technical Dept., Montreal, Canada). *Airport Forum*, vol. 11, Feb. 1982, p. 47-50.

An account is given of the airport design and development criteria formulated by the Airport Terminals Advisory Committee (ATAC) of the International Air Transport Association (IATA), which has undertaken studies of terminal units of exceptional design simplicity, smoothness of function and cost-effectiveness. These criteria are to be integrated in the forthcoming IATA Airport Terminals Reference Manual. Attention is given the Unit Terminal Concept, which has been supported by Lufthansa since the 1960s and used in the design of such airports as Cologne/Bonn, Hannover, and Berlin-Tegel with great success due to its ease of adjustment to meet novel requirements through the addition of terminal units as the need arises. O.C.

A82-27050 The effects of weather on runway operations. G. N. Steuart (Toronto, University, Toronto, Canada) and A. R. Gray (Urban Transport Development Co., Toronto, Canada). *Airport Forum*, vol. 11, Feb. 1982, p. 60-70. 10 refs. Research supported by the Natural Sciences and Engineering Research Council of Canada.

It is established that all phases of runway operating conditions are more variable in poor than in good weather, and that, although

average runway occupancy times may remain unchanged in some deteriorating weather conditions, effective performance is reduced because operations which depend on runway friction are significantly degraded. It is further determined that all aircraft touch down on a given runway at a location that bears a fixed relationship to a specific point, and that the position of this aiming point depends on the relative approach slope and primary exit taxiway location rather than on weather conditions. While pilots often adjust deceleration to compensate for inconvenient exit locations and thereby reduce runway occupancy times in good weather, this practice is not followed in poor weather. O.C.

A82-27068 # Correlation of wear with oxidation of carbon-carbon composites. H. W. Chang (Bendix Advanced Technology Center, Columbia, MD). In: *Wear of materials 1981; Proceedings of the International Conference, San Francisco, CA, March 30-April 1, 1981.* New York, American Society of Mechanical Engineers, 1981, p. 544-547. 6 refs.

The wear characteristics of carbon-carbon composites for aircraft brake materials are investigated using an inertial dynamometer. The wear rates are measured in terms of weight loss and thickness reduction. The wear rates in terms of weight loss are in all cases greater than those in terms of thickness reduction over a wide range of braking conditions. This difference is consistent with previous work done under a normal braking condition and, as before, is attributed to the oxidation of carbon on nonfriction surfaces. Good agreement is obtained between the activation energies for oxidation of carbon (29 kcal/mole) and for material loss on nonfriction surfaces (27 kcal/mole). C.R.

A82-27071 * # Effect of mechanical surface and heat treatments on erosion resistance. J. Salik and D. H. Buckley (NASA, Lewis Research Center, Cleveland, OH). In: *Wear of materials 1981; Proceedings of the International Conference, San Francisco, CA, March 30-April 1, 1981.* New York, American Society of Mechanical Engineers, 1981, p. 592-596. 8 refs.

The effect of erosion by glass beads and crushed glass and by heat treatments on the erosional resistance of 6061 aluminum alloy and 1045 steel were studied. The aluminum alloy's erosion resistance was found to be insensitive to mechanical surface treatment applied before testing, and was determined to depend on the properties of the work-hardened surface layer; this was also demonstrated for aluminum alloy single crystals. The aluminum alloy heat treatments included annealing, solution, and precipitation. Solution was found to increase erosion resistance but precipitation had the opposite effect. Hardness showed no correlation with erosion resistance for either aluminum alloy steel. The steel tests showed that crushed glass provides an order of magnitude more erosion than glass beads. C.D.

A82-27078 * # Rub energetics of compressor blade tip seals. W. F. Lavery (United Technologies Corp., Pratt and Whitney Aircraft Group, East Hartford, CT). In: *Wear of materials 1981; Proceedings of the International Conference, San Francisco, CA, March 30-April 1, 1981.* New York, American Society of Mechanical Engineers, 1981, p. 714-721. 9 refs. NASA-sponsored research.

The rub mechanics of aircraft gas turbine engine compressor abradable blade tip seals was studied at simulated engine conditions. In 12 statistically planned, instrumented rub tests using single titanium blades and fiber-metal rubstrips the rub velocity, incursion rate, incursion depth, blade thickness, and abradable strength were varied to determine the effects on rub energy, heat split between the blade, rubstrip surface and rub debris, and blade and seal wear. The rub energies were found to be most significantly affected by the incursion rate while rub velocity and blade thickness were of secondary importance. In five additional rub tests using single nickel alloy blades and multiple titanium alloy blades, rub energy and wear effects were found to be similar for titanium and nickel alloy blades while rub energies increased for multiple blades relative to single blade test results. C.D.

A82-27082 # Communicating critical weather information to pilots. R. C. Goff (FAA, Technical Center, Atlantic City, NJ). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0016.* 12 p.

Present hazardous weather forecasts are reviewed, along with product generation and information dissemination methods, and system improvements for the 0-2 hr forecast (nowcast) are investigated. The problem of actually detecting or projecting hazardous weather conditions from sensor readings or computer-based cause and effect inferences is regarded as secondary to ensuring that the actual information reaches pilots, air traffic controllers, and aviation meteorologists. Current data gathering systems include rawinsondes, surface networks, weather satellites, and dedicated weather radar. Although subjective assessments of the combined data picture are possible, it is noted that en route weather information is lacking, although partially supplanted by pilot reports of threatening conditions. A high speed national network of nowcasts is being constructed which will provide real time combined weather information available to pilots and covering temporally short hazardous weather.

M.S.K.

A82-27083 * # Numerical solution of Space Shuttle Orbiter flow field. E. Venkatapathy, J. C. Tannehill (Iowa State University of Science and Technology, Ames, IA), and J. V. Rakich (NASA, Ames Research Center, Moffett Field, CA). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0028.* 17 p. 35 refs. Research supported by the Iowa State University of Science and Technology; Grant No. NGR-16-002-038.

The supersonic, viscous laminar flow around the Space Shuttle Orbiter forebody has been computed with a parabolized Navier-Stokes code using a generalized coordinate transformation. The initial solution for the nose part of the Orbiter geometry was obtained with a three-dimensional time-dependent Navier-Stokes solver. It was necessary to employ a wind axis oriented coordinate system to obtain the initial solution with the time-dependent code. The generalized PNS technique used in this study allows the solution to be marched from the given initial data surface to any desired surface downstream. A grid point clustering scheme was employed to accurately describe the body shape by clustering points at the wing tip and at the wing body juncture. The computed heat transfer coefficients, pressure coefficients, and shock shapes are compared with the available experimental data for 0 degrees and 30 degrees angle of attack.

(Author)

A82-27086 # Experimental study of the flowfield of an airfoil with deflected spoiler. B. G. McLachlan, K. Karamcheti (Stanford University, Stanford, CA), and F. van Leynseele (Boeing Commercial Airplane Co., Seattle, WA). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0126.* 9 p. 14 refs. Research supported by the Boeing Commercial Airplane Co.

An experimental study of the flow field generated by a typical two-dimensional airfoil-spoiler configuration is presented, in which subsonic tests ascertained the effects of varying such parameters as spoiler deflection and angle of attack, at Reynolds numbers of 280,000 and 520,000. Data gathered on static surface pressures, wake and boundary layer mean velocities and vortex shedding characteristics show that the spoiler wake is dominated by vortex shedding over a wide range of conditions, in agreement with other bluff body investigations of Strouhal number and base pressure coefficient.

O.C.

A82-27087 # An experimental and analytical study of mixing flow of turbofan engine exhaust through circular and 2-dimensional mixer/nozzle. F. P. Saheli, R. L. Hanson, and B. F. Kerkham (Boeing Aerospace Co., Seattle, WA). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0130.* 9 p.

The results of a test program conducted to obtain plume temperature, nozzle wall temperature and nozzle flow coefficient data for two-dimensional nozzles, with and without forced mixing, indicate that an 18-lobe mixer achieved nearly complete mixing. Analytical predictions of exit temperature profiles and wall temperatures generated by a three-dimensional viscous flow computer program agreed well with test data for cases with and without the mixer. Although such specific features as the exact location of the peak temperature, in the case of mixer/nozzle simulation, were not predicted, major trends of total temperature distribution were

simulated. It is shown by a comparison of measurements of two-dimensional nozzle thrust and flow coefficients with those of a circular nozzle, that the mixing efficiency gain due to the addition of an 18-lobe mixer is greater for the axisymmetric nozzle. (Author)

A82-27093 # Heavy rain penalties for a flight simulator. P. Haines and J. K. Luers (Dayton, University, Dayton, OH). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0213.* 19 p. 7 refs.

A set of curves, representing lift and drag performance degradation of aircraft due to airfoil surface roughness effects under heavy rain, is established for application to flight simulators. Experimental data was analyzed to quantify the lift and drag increments of single- and multi-element airfoils, both for cases where distributed roughness elements uniformly cover the entire wing and where roughness elements begin at various locations aft of the leading edge. Simulated airfoil roughness is then related to rainfall rates and frost parameters, so that the performance penalty induced by a given environmental condition can be estimated. Flight simulator test results which include roughness effects may lead to revised procedures for aircraft takeoff, landing, and maneuvers under severe environmental conditions.

O.C.

A82-27098 * # Mathematical modeling of ice accretion on airfoils. C. D. MacArthur, J. L. Keller, and J. K. Luers (Dayton, University, Dayton, OH). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0284.* 18 p. 8 refs. Grant No. NAG3-65.

The progress toward development of a computer model suitable for predicting icing behavior on airfoils over a wide range of environmental conditions and airfoils shapes is reported. The LEWICE program was formulated to solve a set of equations which describe the physical processes which occur during accretion of ice on an airfoil, including heat transfer in a time dependent mode, with the restriction that the flow must be describable by a two-dimensional flow code. Input data comprises the cloud liquid water content, mean droplet diameter, ambient air temperature, air velocity, and relative humidity. A potential flowfield around the airfoil is calculated, along with the droplet trajectories within the flowfield, followed by local values of water droplet collection efficiency at the impact points. Both glaze and rime ice conditions are reproduced, and comparisons with test results on icing of circular cylinders showed good agreement with the physical situation.

A82-27109 Quantitative interpretation of recirculated flow visualization by the analysis of video pictures. P. Calvet, A. Giovannini, P. Hebrard, and G. Toulouse (ONERA, Département de Mécanique et Energétique des Systèmes, Toulouse, France). In: *Flow visualization II; Proceedings of the Second International Symposium, Bochum, West Germany, September 9-12, 1980.* Washington, DC, Hemisphere Publishing Corp., 1982, p. 63-68.

The development of a television monitoring system for use in flow visualization studies in a hydrodynamic tunnel constructed at ONERA-CERT is detailed. In order to obtain quantitative results without recourse to large computer storage requirements, electronic coupling was devised between a video camera, microcomputer, and plotter for use in colorimetric and trajectographic experiments. Real-time information of local and time-averaged data was made available of dye tracers brightness or residence time. The wiring possesses four circuits: a reference window, a video experimental window for spatial analysis, scan line analysis for changes of dark-to-light, and a trajectographic circuit connected to a camera and a microcomputer in order to fix a particle position in Cartesian coordinates. Successive images are coded into computer memory for retrieval and analysis.

M.S.K.

A82-27114 More than meets the eye - The oil dot technique. E. Atraghji (National Aeronautical Establishment, Ottawa, Canada). In: *Flow visualization II; Proceedings of the Second International Symposium, Bochum, West Germany, September 9-12, 1980.* Washington, DC, Hemisphere Publishing Corp., 1982, p. 619-628. 7 refs.

A numerical model is developed to gain quantitative data on the surface shear stress distribution on an object studied by means of the

oil dot technique. Consideration is given to an idealized dot set in motion by a constant shear stress and leaving a streak which in time is described by equations of motion. Viscosity is accounted for by means of a pi theorem. Examples are provided for the flow over an ellipsoid of revolution using lamp black suspended in Blazers oil L, with simultaneous pressure measurements by Preston and pitot tubes. A second trial was performed using lamp black and glycerine on a flat glass plate in a flow of varying Mach number. A nonlinear behavior of the shear stress in relation to the streak length was observed in the first trial, and a proportionality between the length and the shear stress in the second. It is concluded that glycerine is a more suitable streak fluid than the lamp black, and that small magnetic disks can be tried with suitably magnetic bodies. M.S.K.

A82-27126 **Fibrous composites in structural design.** Edited by E. M. Lenoe, D. W. Oplinger, and J. J. Burke (U.S. Army, Army Materials and Mechanics Research Center, Watertown, MA). New York, Plenum Press, 1980. 883 p. \$85.

Developments related to aircraft structures are discussed, taking into account composite aircraft structures, composite wing substructure technology on the AV-8B advanced aircraft, a preliminary design development AV-8B forward fuselage composite structure, a wing fuselage critical component development program, and the development of a preloaded hybrid advanced composite wing pivot fairing. Other topics considered are related to missile and space applications, crashworthiness, impact damage, postbuckling, dynamics response, and special design considerations. Attention is also given to laminate plate theories, edge effects, flaw growth, helicopter applications, composite joints, a reliability/durability analysis, environmental effects, the development of an advanced composite hydrofoil control flap, and advancements in composite material flywheels. G.R.

A82-27127 * **Composite aircraft structures.** L. F. Vosteen (NASA, Langley Research Center, Hampton, VA). In: Fibrous composites in structural design. New York, Plenum Press, 1980, p. 7-24. 6 refs.

In late 1975, the Aircraft Energy Efficiency (ACEE) program was initiated by NASA in order to accelerate the development of selected technologies which showed promise for substantial improvements in the fuel efficiency of commercial transport aircraft. A description is presented of the status of the composite structure development programs which form one of the six sections of the ACEE program. Six aircraft components are currently being developed under NASA contract by three major transport manufacturers. The components include the upper aft rudder of the Douglas DC-10, the inboard ailerons of the Lockheed L-1011, the elevators of the Boeing 727, the vertical stabilizers for the Lockheed L-1011 and Douglas DC-10, and the horizontal stabilizers of the Boeing 737. It is found that the composite components show a high potential for achieving cost comparability with the metal parts they are designed to replace. G.R.

A82-27128 **Composite wing substructure technology on the AV-8B advanced aircraft.** M. L. Huttrop (McDonnell Aircraft Co., St. Louis, MO). In: Fibrous composites in structural design. New York, Plenum Press, 1980, p. 25-40.

Design improvements to the AV-8B V/STOL aircraft to increase the payload-radius capability include a new wing design. New wing design features are related to an increased aspect ratio for better cruise performance, an increased thickness ratio for lighter structure and increased fuel volume, additional store stations, maneuvering flaps with positive circulation, increased aileron and flap travel, and composite structure for reduced weight and unconstrained optimization of the aerodynamic shape of the advanced supercritical airfoil. The wing has one-piece graphite/epoxy skins and a multi-spar substructure with graphite/epoxy sinewave webs. Attention is given to a wing description, aspects of substructure design, sinewave configuration, tooling, design details, corrosion prevention, and nondestructive testing. G.R.

A82-27129 **Preliminary design development AV-8B forward fuselage composite structure.** J. C. Watson (McDonnell Aircraft Co., St. Louis, MO). In: Fibrous composites in structural design. New York, Plenum Press, 1980, p.41-61.

The AV-8B is a second generation V/STOL aircraft which derives its superior performance from selective improvements to the AV-8A. It has twice the payload radius capability of the AV-8A, improved weapon delivery accuracy, and increased operational readiness. These improvements are being validated by flight demonstrations with two YAV-8B prototype aircraft. The AV-8B combines U.S. V/STOL technology with the proven vectored thrust concept. A new, larger wing has a higher aspect ratio and a supercritical airfoil. The major structural elements of the wing and forward fuselage are of composite materials. The forward fuselage is a conventional single-seat structure with the multiframe and stringer construction. Attention is given to details concerning the composite structure, the reparability of the composite design, the influence of trade studies on the design, a comparison of weights and costs, and fuselage fabrication techniques. G.R.

A82-27130 **Wing/fuselage critical component development program.** R. W. Walter, R. R. June, J. E. Mooney, and R. A. Hamm (Boeing Co., Seattle, WA). In: Fibrous composites in structural design. New York, Plenum Press, 1980, p. 63-83. Contract No. F33615-77-C-5228.

The employment of advanced composites in modern high performance aircraft has been generally limited to relatively uncomplicated structure and based on substitution design or replacement approaches. The logical and orderly expansion of the use of advanced composites in more complex primary structure will result in additional cost and weight saving. Potential lower acquisition costs can be achieved due to improved low cost manufacturing approaches. The relative insensitivity of advanced composites to fatigue damage can result in longer service life and significantly lower life cycle costs. A summary is presented of the results obtained by an American aircraft manufacturer in an Air-Force sponsored Phase I study program. Attention is given to a structural configuration definition, preliminary structural design and trade studies, and aspects of structural design development. G.R.

A82-27131 **Development of a preloaded hybrid advanced composite wing pivot fairing.** D. O. Losee, J. F. Willis, and W. L. Zirbes (Rockwell International Corp., Los Angeles, CA). In: Fibrous composites in structural design. New York, Plenum Press, 1980, p. 85-102.

A description is presented of the results of the advanced composite developmental work performed in support of the B-1 Bomber Wing Fairing Design Improvement Program under Air Force contract. This study was performed by an American aerospace company during the 12-month period from August 1976 to August 1977. The wing fairing system for the B-1 bomber consists of a fixed fairing for fuselage/fairing moldline transition, an aft movable fairing for nacelle-to-underwing aerodynamics, aft overwing transition panels, and the forward preloaded wing pivot fairing. Attention is given to the redesign of the preloaded pivot fairings. An advanced composite hybrid glass/epoxy design was developed which indicated a potential weight savings of 47 percent of approximately 800 pounds over the solid fiberglass baseline design used on B-1 RDT and E aircraft 1 through 4. G.R.

A82-27132 **Design concepts for composite fuselage structure.** C. R. Foreman (Vought Corp., Dallas, TX). In: Fibrous composites in structural design. New York, Plenum Press, 1980, p. 103-123.

Investigations have been conducted concerning the development of vertical lift concepts in support of the Navy's future generation of V/STOL aircraft. These aircraft will operate from ships considerably smaller and less expensive than current supercarriers. Studies to date have been directed toward two basic types of aircraft, including the subsonic ASW/AEW 'Type A' aircraft, and the Mach 2 fighter 'Type B' aircraft. Composite fuselage development work conducted during the past two years has provided valuable design information. It was found that significant weight savings for use of composite materials versus conventional metal construction in fuselage shell structure can be obtained at low loading intensities, in the minimum gage range. Low fabrication cost design concepts for large, stiffened-panel type fuselage shell structure have been generated, and preliminary testing has been conducted. G.R.

A82-27133 **Advanced composites integral structures meet the challenge of future aircraft systems.** L. M. Lackman, W. L. O'Brien, and M. S. Loyd (Rockwell International Corp., Los Angeles, CA). In: *Fibrous composites in structural design*. New York, Plenum Press, 1980, p. 125-144.

In connection with economic considerations, current planning is based, both in the military and in commercial operations, on much longer spans of usage between major new system acquisitions. The continuing development of advanced structural airframe technology is required in order to implement new structural concepts which are superior in cost/weight performance to more conventional structure. These efforts have led logically to the use of advanced composite structural/material concepts. Attention is given to future fighter technology, concepts of advanced integral primary composite structure, aspects of composite material selection, a wing configuration selection study, a substructure-to-cover study, questions of tooling and manufacturing process development, and a test program. G.R.

A82-27138 **Continuous filament advanced composite isogrid - A promising structural concept.** L. W. Rehfield, R. B. Deo (Georgia Institute of Technology, Atlanta, GA), and G. D. Renieri (McDonnell Douglas Astronautics Co., St. Louis, MO). In: *Fibrous composites in structural design*. New York, Plenum Press, 1980, p. 215-239. 9 refs. Contract No. F49620-77-C-0077.

It is pointed out that major airframe components are normally plate or shell type structures. Efficiency considerations dictate that the components be stiffened or semimonocoque in construction. The usual approach used to stiffen the components involves the employment of longitudinal stringers and frames or ribs which are orthogonal to the stringers. An alternative approach to stiffening is based on isogrid, which is a concept that employs a repetitive equilateral triangular pattern of stiffening ribs. The name 'isogrid' refers to the fact that the triangular grid behaves in a gross sense as an isotropic material. Unlike orthogonal stiffener grids, isogrid is a stable configuration and may be used with or without attached skin. Attention is given to continuous filament advanced composite isogrid, aspects of material selection, design constraints, and design analysis methodology. G.R.

A82-27139 **A crashworthiness test for composite fuselage structure.** R. L. Foye (U.S. Army, Research and Technology Laboratories, Moffett Field, CA), C. W. Swindlehurst (Martin Marietta Aerospace, Baltimore, MD), and W. T. Hodges (U.S. Army, Structures Laboratory, Hampton, VA). In: *Fibrous composites in structural design*. New York, Plenum Press, 1980, p. 241-257.

Crashworthiness or crash survival has many aspects, including fuel containment, seat design, landing gear design, flammability, smoke toxicity, flotation equipment, design criteria, and crew escape systems. The present investigation is concerned with the capacity of the fuselage structure to crush near the point of impact, thereby dissipating kinetic energy of the vehicle. Attention is given to the test specimens, the test procedure, and the results of a number of crushing tests of various composite and aluminum structural concepts. Skin/stringer tests for lightly loaded construction show conclusively that, unless energy absorption requirements are a design consideration, conventional sheet/stringer aluminum construction will be superior to composite sheet/stringer construction with regard to compressive energy absorption capacity. G.R.

A82-27141 **Impact resistance of graphite and hybrid configurations.** J. D. Labor and N. M. Bhatia (Northrop Corp., Aircraft Div., Hawthorne, CA). In: *Fibrous composites in structural design*. New York, Plenum Press, 1980, p. 293-312. 5 refs. Contracts No. F33615-76-C-3142; No. N62269-77-C-0401.

Impact damage in the case of composite materials does not currently involve safety-of-flight concerns for most applications. However, to prevent excessive inspection and repair actions, it is important to consider the effects of impact damage. The present investigation is concerned with low velocity impact studies which were conducted with the aid of instrumented impactors to obtain the force and energy values resulting from the impact. Several geometric configuration variables have been studied, including panel size, impact location, size and shape of the impactor, panel thickness,

type of edge supports, and variations in the mass and velocity of the impactor. A separate series of tests was conducted on 1/2-inch thick monolithic panels which are typical of wing structures. Alternate materials were investigated including added plies of more ductile materials and replacement of basic graphite/epoxy tape prepreg with various woven material materials. G.R.

A82-27144 **Effects of lightning and nuclear electromagnetic pulse on an advanced composites aircraft.** V. Volpe and R. Carri (Grumman Aerospace Corp., Bethpage, NY). In: *Fibrous composites in structural design*. New York, Plenum Press, 1980, p. 341-357. 11 refs. Contract No. F33615-77-C-5169.

Tests with a 1/2 scale model of the Advanced Design Composite Aircraft (ADCA) made of graphite/epoxy for the effects of lightning strikes and the development of a mathematical model to define the internal and external coupling for nuclear and EM pulses are reported. The lightning strike portion of the trails determined the attachment points, their distribution, and the frequency of occurrence. Features of the test model are outlined, along with trial procedures which included directions of the emitting electrodes to simulate yaw, pitch, and roll. Each extremity drew an equal number of strikes, and some degradation of the composite structure was observed at locations of multiple strikes. Nuclear EM pulses were examined and it was found that external coupling is concerned only with composite conductivities parallel to the surface, the aircraft is an infinite conductor, and charge and current densities were quantified and are provided. M.S.K.

A82-27145 **Problems and options in advanced composite repair.** S. H. Myhre and R. W. Kiger (Northrop Corp., Aircraft Div., Hawthorne, CA). In: *Fibrous composites in structural design*. New York, Plenum Press, 1980, p. 359-380. 9 refs. Contract No. F33615-76-C-3017.

The development of composite repair criteria and procedures for aircraft component are reported. The repairs are required to last twice the design life of the aircraft, match the ultimate strength capability, maintain the aerodynamic performance levels, and be enacted at a reasonable cost. The use of portable heating equipment has proven feasible, and repair tests on honeycomb panels accessible on both sides, on one side, a 50-ply laminate damaged 21 plies deep, and a 50-ply laminate accessible on both sides are reviewed. The failure loads, strains, and failure modes of the repaired panels are provided to demonstrate the possibility of returning a damaged composite to full strength. Specific recommendations are offered for patch material and joining, patch configurations, scarf lengths, hole edge peeling, incipient compression failure, wet laminate repair, thick laminate repair, sandwich panel repair, and blind side repair. M.S.K.

A82-27146 **A CAD approach to cost estimating composite aircraft.** R. A. Camin (General Dynamics Corp., Fort Worth, TX). In: *Fibrous composites in structural design*. New York, Plenum Press, 1980, p. 381-398. 8 refs.

The current state-of-the-art in aircraft cost estimating centers around vast collections of historical cost data. Probably the greatest deficiency of the current procedure is related to the absence of historical data for new technologies. An American aerospace company has developed a new approach with regard to cost estimation in the case of composite structures. The approach makes extensive use of a data base management system tailored to aircraft design and manufacturing, and interactive graphics techniques. Best described as a deterministic computer-aided design tool, STEP (Structural Technology Evaluation Program) is designed to capitalize on currently available data. Yet it remains sufficiently flexible to accept new data as it becomes available. A detailed description is presented of the methodology STEP uses during each phase of its operation. G.R.

A82-27151 **Prediction of cyclic growth of cracks and debonds in aluminum sheets reinforced with boron/epoxy.** G. L. Roderick (U.S. Army, Structures Laboratory, Hampton, VA). In: *Fibrous composites in structural design*. New York, Plenum Press, 1980, p. 467-481. 7 refs.

An analysis was developed to predict the cyclic growth of cracks and debonds in cracked metal sheets reinforced with uncracked composite sheets. Inplane and interlaminar stresses, the stress intensity at the crack tip, and the strain-energy-release rate at the

debond front were calculated with complex-variable Green's functions. An incremental analysis was developed that used the stress intensity to predict crack growth and the strain-energy-release rate to predict debond growth. To evaluate this analysis, fatigue tests were conducted on two panels having different thicknesses; each panel consisted of a cracked aluminum sheet bonded to an uncracked boron/epoxy sheet. For both panels, the predicted crack growths agreed with experimental values. In one panel, a significant debond occurred and was predicted by the analysis. In the other panel, the debond was very localized and somewhat smaller than predicted.

C.D.

A82-27152 **Application of advanced composite materials to helicopter airframe structures.** M. J. Rich (United Technologies Corp., Sikorsky Aircraft Div., Stratford, CT). In: *Fibrous composites in structural design*. New York, Plenum Press, 1980, p. 483-496. 8 refs.

Under a NASA contract an analytical assessment was made as to the effectiveness of a general application of advanced composites for helicopter airframes. The result of the study concluded that a light gage diagonal tension skin integrated with foam stabilized stringers/frames could result in appreciable weight savings and reduce life cycle costs. The study also indicated that reduced weight/cost might be achieved if a single co-cure could be used and if all Kevlar skins were substituted for graphite/Kevlar in the original design concept. A program initiated under another NASA contract is concerned with the design, the fabrication, and testing of helicopter advanced composite structures. A review is conducted of the progress made in connection with both NASA contracts.

G.R.

A82-27153 **Design and production of fiberglass helicopter rotor blades.** C. E. Covington and P. S. Baumgardner (Bell Helicopter Textron, Fort Worth, TX). In: *Fibrous composites in structural design*. New York, Plenum Press, 1980, p. 497-513.

A prototype blade program to explore the potential of composite materials for rotor blades and to establish the necessary design and manufacturing technology for their economical production was conducted. The blade featured spar caps of spanwise oriented unidirectional glass. The fabrication and flight tests are described; results were excellent, the only drawbacks being the low amount of machine-laid structure and the low ballistic damage tolerance. The actual production program is then described, including the tooling, equipment (production orbital pin winding machine, production tube winding machine, compactor, integrally heated blade bonding press), winding techniques, material form, assembly techniques, quality control, qualification, flight, and fatigue tests, fail safety demonstration, environmental, ballistic survivability, and lightning tests. After completion of one-half of qualification testing, an FAA type certificate has been awarded. The blade will have at least a 10,000 hour life.

C.D.

A82-27154 **Preliminary design of an advanced composite rotor hub for the UH-60A Black Hawk.** E. F. Olster (United Technologies Corp., Sikorsky Aircraft Div., Stratford, CT) and H. K. Reddick, Jr. (U.S. Army, Applied Technology Laboratory, Fort Eustis, VA). In: *Fibrous composites in structural design*.

New York, Plenum Press, 1980, p. 515-526. 9 refs. Army-supported research.

A program has been conducted to develop a preliminary design of a composite main rotor hub for the UH-60A Black Hawk helicopter. Graphite/epoxy was the chosen material because of its damage tolerance characteristics, and bolted joints for ballistic safety. A trade-off analysis was made consisting of three candidate hub concepts. The third concept, a configuration consisting of two horizontal flat plates connected by four filament-wound tubes housing elastomeric bearings, was selected for more in-depth design and analysis. Tests done were structural analysis, ballistic vulnerability analysis, damage tolerance assessment, reliability and maintainability assessment, cost assessment, lightning protection assessment, and radar cross section assessment. The damage tolerance of the composite hub was equal to metal for low energy impact damage but not quite as good for high impact, although it met the objectives. Reliability for the composite hub was superior to that of the metal hub.

C.D.

A82-27155 **Evaluation of graphite/epoxy shims in a high capacity laminate helicopter bearing.** R. H. Finney (Lord Kinematics, Erie, PA) and S. C. Aker (Bell Helicopter Textron, Fort Worth, TX). In: *Fibrous composites in structural design*. New York, Plenum Press, 1980, p. 527-541.

A program undertaken to incorporate graphite/epoxy shims in a high-capacity elastomeric radial-journal bearing is discussed. The prime objective is to develop a method of reducing the weight in the helicopter dynamic system. Two different winding patterns are evaluated for the concentric tubular shims: + or - 45 deg, + or - 45 deg, + or - 45 deg, + or - 90 deg. The testing consists of ultimate torsion, ultimate axial and fatigue testing at accelerated loads and motions. The potential hysteresis heating of the elastomer is monitored with thermocouples on the shims and is found not to be a problem. The results of the fatigue tests are compared with previous test results on steel shim and aluminum shim specimens. The life of the bearing is found to be less dependent on the shim material than on the elastomer design and fabrication techniques.

C.R.

A82-27156 **Mechanically-fastened joints for advanced composites - Phenomenological considerations and simple analyses.** L. J. Hart-Smith (Douglas Aircraft Co., Long Beach, CA). In: *Fibrous composites in structural design*. New York, Plenum Press, 1980, p. 543-574. 18 refs.

Various factors affecting the strength of bolted or riveted joints in advanced composites are discussed qualitatively. The mechanisms associated with each type of failure - tension, bearing, shearout, cleavage, and pull-through - are explained. The work is based mainly on experimental observations from which conclusions are drawn to integrate the study. A simple theory to explain the elastic stress concentrations at loaded bolt holes (in terms of the various geometric parameters) is deduced from experimental and analytical evidence for isotropic materials. Further tests on composite materials are used in deducing correlation factors which relate this theory to the limited, but significant, stress concentration relief observed before failure.

C.R.

A82-27158 **Sensitivity of bonded and bolted joints in composites to load/environmental spectrum variations.** G. C. Grimes, L. L. Jeans, and E. Demuts. In: *Fibrous composites in structural design*. New York, Plenum Press, 1980, p. 619-644. 12 refs. Contract No. F33615-75-C-5236.

Results obtained after three years of a five-year research program are summarized. Most of the standard-design bolted joint testing is complete, but this is true of only 50% of the bonded joint testing. The load and environmental spectrum definitions are discussed here, along with the sensitivities observed to date. Areas where problems remain and where significant strides have been made are named, among them test machine development, materials and processes, quality assurance, experimental procedures, and environmental conditioning. Quality level variation is found to have a substantial effect on the test data variations, in some cases overshadowing the load and environmental sensitivity effects. It is reported that the testing of 20 replicate bonded joint specimens, simultaneously, proved to be a problem that was solved by changing the test fixture design. Sensitivity of the bolted joints to load and environmental spectral variations is found to be less than that of the bonded joints.

C.R.

A82-27159 **Composite fasteners - A compatible joining technique for fibrous composites in structural design.** C. Tanis (USAF, Materials Laboratory, Wright-Patterson AFB, OH) and M. Poulos, Jr. (Vought Corp., Dallas, TX). In: *Fibrous composites in structural design*. New York, Plenum Press, 1980, p. 645-657. Contract No. F33615-77-C-5050.

A composite fastener program at the Air Force Materials Laboratory to establish and demonstrate a production method for fabricating non-corrosive composite fasteners is presented. The fasteners are suitable for fastening composite-to-composite structures, as well as metal-to-metal structures, and should be cost competitive and reduce overall aircraft weight as compared to metal fasteners. Fastener forming equipment is presented, and applications for helicopter composite structure are reviewed. Metal fastener-composite structure potential problem areas are discussed, including galvanic compatibility to graphite, interference fit, hole edge crushing and vibration damage.

D.L.G.

A82-27162 Statistical analysis methods for characterizing composite materials. G. H. Lemon, J. M. Norton, and M. E. Waddoups (General Dynamics Corp., Fort Worth, TX). In: Fibrous composites in structural design. New York, Plenum Press, 1980, p.733-759. 19 refs. Research supported by the General Dynamics Independent Research and Development Program and U.S. Air Force.

A strength-bounded wearout model and a method for calculating fleet material allowables are developed. Residual strength evaluation and wearout are noted as necessary for reliable assessment of composite components, and the determination of design allowables is reviewed, especially for the dependence on the Weibull shape factor. Assumptions postulated by fracture kinetics for characterizing wearout include the existence of preexisting flaws, growth in a deterministic manner depending on material, stress, and flaw features, and the critical load being a function of instantaneous flaw state. Lifetime predictions are analyzed, along with ramp loading and static failure, creep loading, and closure. M.S.K.

A82-27163 Durability evaluation of highly stressed wing box structure. R. V. Wolff and D. J. Wilkins (General Dynamics Corp., Fort Worth, TX). In: Fibrous composites in structural design. New York, Plenum Press, 1980, p. 761-769. 11 refs. Contract No. F33615-73-C-5104.

Box beams representing a single cell of a multispar conceptual composite wing for a fighter aircraft were tested for durability and damage tolerance. The beams were fabricated from graphite-epoxy tape with aluminum honeycomb core and steel bolts. The selected load conditions were: (1) a cold subsonic temperature that produced more torsion and (2) a supersonic, hot, wet temperature with more relative bending. Static tests were conducted at room temperature, dry conditions, showing the composite to be competitive with metal. Under cold, subsonic conditions five of twelve beams delaminated, partly because of stacking sequence. Five of these beams failed in compression. Under hot (250 deg F), wet, supersonic conditions, five beams were blistered badly enough to be useless after thirteen weeks, due to the exceeding of the local glass transition temperature because of thermal spiking. One-lifetime fatigue testing under these conditions resulted in failure in compression. It is concluded that the use of current epoxy laminating resins in hot, wet conditions is questionable. C.D.

A82-27167 Growth of four flaw types in graphite/epoxy composites due to fully reversed fatigue. K. E. Hofer, Jr. and J. Jollay, Jr. (IIT Research Institute, Chicago, IL). In: Fibrous composites in structural design. New York, Plenum Press, 1980, p. 831-845. 13 refs. Research supported by the IIT Research Institute, Rockwell International Corp., and U.S. Air Force.

An experimental program is presented, which investigates the serviceability of graphite/epoxy composites in terms of the propagation of flaws due to fully reversed fatigue. Flaws most likely to affect tensile residual strength of the composites are studied, which consist of a hole in a composite panel, an embedded sheet of foreign matter, a ply dropped from the composite, and surface scratches. Ultrasonic tracking of the flaw growth appears to be feasible, with the effect of flaw growth on the tensile residual strengths of both the tested laminate types appearing to be minimal or nonexistent. D.L.G.

A82-27168 Effects of defects on tension coupons undergoing an accelerated environmental spectrum. D. Y. Konishi (Rockwell International Corp., Los Angeles, CA). In: Fibrous composites in structural design. New York, Plenum Press, 1980, p. 847-860. 7 refs.

A screening program was done to assess the criticality, or ability to sustain a required tensile load, of the effect of defects, including holes, delaminations, ply separations, and scratches in an advanced composite coupon. A coupon test program is described and the results reported. A test spectrum was used which realistically represented the temperature/moisture environment for the aircraft component. A room temperature/dry spectrum was also used for baseline purposes. The AS3501-5A graphite/epoxy failed at the average stress 88.5 ksi. Room temperature residual strength after two lifetimes of ambient spectrum loading was 83 ksi or 94 percent of static strength. A 0.25 inch hole flaw had 43.5 ksi average static

strength: Wet, hot specimens had 49.6 ksi static strength. Other flaw and laminate types had similar results. C.D.

A82-27187 Advanced medium scale real-time system. T. N. Tucker (U.S. Army, Washington, DC) and A. L. Kelley (Sangamo Weston, Inc., Sarasota, FL). In: ITC/USA/80; Proceedings of the International Telemetering Conference, San Diego, CA, October 14-16, 1980. Research Triangle Park, NC, Instrument Society of America, 1980, p. 157-168.

The Real-time Data Acquisition and Processing System (RDAPS), which is being delivered to the U.S. Army for rapid processing of test data at remote sites, is described as a computer-controlled telemetry system that is portable, while having enough capacity to convert data at an up to 50 K word rate to engineering units, and then display selected parameters pertinent to inflight testing decisions. The RDAPS system will be used at Edwards Air Force Base, California, in the airworthiness qualifications of such flight vehicles as advanced helicopters. The system will compile, process and display quantitative test data on stability and control, overall performance, vibration, and stress analysis. O.C.

A82-27188 * Telemetry Computer System at Wallops Flight Center. H. Bell (NASA, Wallops Flight Center, Wallops Island, VA) and J. Strock (Sangamo Weston, Inc., Sarasota, FL). In: ITC/USA/80; Proceedings of the International Telemetering Conference, San Diego, CA, October 14-16, 1980. Research Triangle Park, NC, Instrument Society of America, 1980, p. 169-183.

This paper describes the Telemetry Computer System in operation at NASA's Wallops Flight Center for real-time or off-line processing, storage, and display of telemetry data from rockets and aircraft. The system accepts one or two PCM data streams and one FM multiplex, converting each type of data into computer format and merging time-of-day information. A data compressor merges the active streams, and removes redundant data if desired. Dual minicomputers process data for display, while storing information on computer tape for further processing. Real-time displays are located at the station, at the rocket launch control center, and in the aircraft control tower. The system is set up and run by standard telemetry software under control of engineers and technicians. Expansion capability is built into the system to take care of possible future requirements. (Author)

A82-27209 Small EHF/SHF airborne SATCOM terminal. A. L. Johnson (USAF, Avionics Laboratory, Wright-Patterson AFB, OH). In: ITC/USA/80; Proceedings of the International Telemetering Conference, San Diego, CA, October 14-16, 1980. Research Triangle Park, NC, Instrument Society of America, 1980, p. 419-422.

A fifth-generation airborne microwave satellite communication system currently under development is discussed. The terminal, operating in the EHF and SHF bands, is designed to provide secure, anti-jam communication for the airborne command post fleet of EC-135 aircraft. Among the terminal's characteristics are the following: an air-cooled transmitter, a parabolic dish antenna, intermediate frequencies of 70 and 700 MHz, an uncoded parametric amplifier, a rubidium frequency standard, a weight of 1,200 pounds, and a volume of 18 cu ft. The packaging will allow the terminal to be distributed in available rack space rather than requiring a large integrated rack installation as required in previous microwave systems. The processor-controlled terminal is being designed to minimize the complexity involved in turning on and locking up the SATCOM system. A prestored set of frequency, power level, antenna pointing and Doppler mode will permit the terminal to be brought up automatically in a preprogrammed mode without operator interventions. C.R.

A82-27228 Selection of optimum antennas for tracking telemetry instrumented airborne vehicles. A. Sullivan (Electro Magnetic Processes, Inc., Chatsworth, CA). In: ITC/USA/80; Proceedings of the International Telemetering Conference, San Diego, CA, October 14-16, 1980. Research Triangle Park, NC, Instrument Society of America, 1980, p. 597-607.

A simplified method of developing the link budget to determine the required antenna gain is presented. A heuristic analysis is

presented to determine whether a low cost fixed antenna can be used or if a tracking system is required. If a tracking system is required, an analysis is presented to determine whether a single axis tracking system will suffice or a two axis tracking system is required. The pros and cons of single channel monopulse versus conical scan are also presented. Additionally, tracking system acquisition aid techniques are discussed. (Author)

A82-27231 Terrain reflection effects on data reception from airborne vehicles. C. W. Chandler. In: ITC/USA/'80; Proceedings of the International Telemetry Conference, San Diego, CA, October 14-16, 1980. Research Triangle Park, NC, Instrument Society of America, 1980, p. 625-630.

It is noted that propagation phenomena, particularly the interference between the direct and terrain reflected waves, strongly affect the path loss between the transmitting and receiving antennas. A method of analysis and computer-drawn patterns are presented to show the multi-lobed character and deep nulls that result in range-altitude coverage. The effects created by the antenna pattern, the type of terrain, and polarization are shown. Attention is also given to applying the results to system design. C.R.

A82-27398 Studies in the history and theory of development of aviation and rocketry and space science and technology (Issledovaniia po istorii i teorii razvitiia aviatsionnoi i raketno-kosmicheskoi nauki i tekhniki). Edited by B. V. Raushenbakh. Moscow, Izdatel'stvo Nauka, 1981. 264 p. In Russian.

A series of papers is presented on the history and development of aviation and space science and technology. Attention is given to the work of Tsiolkovskii, Kondratuk, Tsander, and Korolev, and to Soviet efforts in rocket engine design, automatic control of spacecraft, and manned space flight. The development of jet engines and aircraft control systems in the Soviet Union is also considered. B.J.

A82-27401 Technology transfer; Proceedings of the Thirteenth National Technical Conference, Mount Pocono, PA, October 13-15, 1981. Conference sponsored by the Society for the Advancement of Material and Process Engineering. Azusa, CA, Society for the Advancement of Material and Process Engineering (National SAMPE Technical Conference Series. Volume 13), 1981. 709 p. \$60.

Advanced composites materials, applications, processing, and combinations were discussed. Fillers and reinforcements for improved plastics were examined, along with core materials for use with polymer and graphite face sheets, curing process effects on adhesive properties, moisture degradation in composites, and the effects of environmental exposure. Applications and tests of composites and foams for aircraft structures, spacecraft antenna reflectors, solar mirrors, a helicopter fuselage, electronic systems encapsulants, and wings were described. Different mixtures for structural adhesives, metal-to-metal bonding, and polymers based on botanical oils were detailed. Preparation techniques for fiber reinforcements, with radiation curing, for low temperature field repairs, and for thickness control to enhance peel strength were reviewed. M.S.K.

A82-27402 Flight service evaluation of advanced structures. C. W. Schneider (Lockheed-Georgia Co., Advanced Structures Dept., Marietta, GA). In: Technology transfer; Proceedings of the Thirteenth National Technical Conference, Mount Pocono, PA, October 13-15, 1981. Azusa, CA, Society for the Advancement of Material and Process Engineering, 1981, p. 1-12. 9 refs.

Extended service tests of composite structures on operational aircraft are reported, specifically for the use of boron and graphite-epoxy materials at Lockheed. Reviews are given of a boron wing tip on a C-141, along with a boron oleo door, boron slats on the C-5A, and a boron-reinforced center wing on a C-130. Graphite structures have been used as C-5 wing-to-body fairing panels, fixed trailing edge panels, and a fairing covering the joint between the center and outer wing. Another program currently involves composite leading edges for the C-141. The composites have all replaced metal materials at a lower cost and have displayed greater durability, to the extent that the metal substructures sometimes corroded beneath the composite components, which showed no signs of wear. The flight program

reported had run for 13 yr, with further tests continuing on the C-141 leading edges. M.S.K.

A82-27403 Damage tolerance and durability design of composite structures for commercial aircraft. E. Chow and C. Y. Kam (Douglas Aircraft Co., Long Beach, CA). In: Technology transfer; Proceedings of the Thirteenth National Technical Conference, Mount Pocono, PA, October 13-15, 1981.

Azusa, CA, Society for the Advancement of Material and Process Engineering, 1981, p. 13-25. 8 refs.

The development of composite structures to the point of acceptability by the FAA for use in commercial aircraft, and to the consideration of composite structures for safety-critical aircraft components is reviewed, based on the experiences at McDonnell Douglas. Secondary structures such as the DC-10 upper aft rudder, vertical stabilizer trailing edge panel, and floor beams, a Kevlar tail cone and fan cowl doors and a Kevlar/polyimide nacelle stang fairing for the DC-9 are described. Current testing includes a nose gear aft door, aileron access panel, and the vertical stabilizer box for the DC-10. Initial tests established the mechanical characteristics of the composites, the structural reliability of the design concepts, and confirmed the structural integrity of the integrated parts. Fibrous composites are noted to differ from metal parts in anisotropy and nonhomogeneity and comprehensive trials to solve problems of potential complex failure modes are recommended. M.S.K.

A82-27404 Light weight adhesive joining of composite structures. K. D. Cressy (M & T Chemicals, Inc., Los Angeles, CA). In: Technology transfer; Proceedings of the Thirteenth National Technical Conference, Mount Pocono, PA, October 13-15, 1981.

Azusa, CA, Society for the Advancement of Material and Process Engineering, 1981, p. 26-31.

The procedures, characteristics, and performance of adhesively joined composite structures for aircraft parts are outlined. Adhesives are noted to form effective moisture barriers, provide good stress distribution, avoid bimetallic corrosion, and offer fatigue resistance and low cost use. Methods of field repairs are reviewed, and adhesive bonding of aluminum and NOMEX honeycomb aircraft parts have been demonstrated to have an overlap shear strength ranging from 1000-2500 psi. Heat cure epoxy adhesives have shown high compressive strength at 350 F, although maintaining a sufficient rigidity modulus with desirable resilience and toughness above 250 F has caused difficulties. Urethane compounds have been developed which retain strength below -65 F and a peel strength of 150 ppi is projected in applications on aluminum substrates. The thixotropy displayed after initial curing allows gap filling to occur. M.S.K.

A82-27407 Service sensitivity of polysulfide sealants. R. J. Stout (General Dynamics Corp., Fort Worth, TX). In: Technology transfer; Proceedings of the Thirteenth National Technical Conference, Mount Pocono, PA, October 13-15, 1981.

Azusa, CA, Society for the Advancement of Material and Process Engineering, 1981, p. 64-76.

Investigations into incidents of sealant chalking and sponging of MIL-S-83430 sealants in Air Force aircraft are reported. The polysulfide sealants began chalking a short time after entering service. Subsequent X-ray spectrographic analyses of chalked and unchalked surfaces revealed the chalk to be a concentration of sealant fillers, mainly calcium carbonate. The chalking was precipitated by fuel extraction of the elastomeric component of the sealant and accelerated by the presence of mercaptans and metallic ions in the fuel. The chalking penetration into the sealant was determined to be of negligible rate. Sealant sponging in fuel test tanks was examined in terms of a thermal history and service use of a fuel-saturated sealant at high temperatures were concluded to cause the sponging. Qualifications tests did not include rapidly increasing temperatures when transition to supersonic speeds occurs with a nearly empty fuel tank. M.S.K.

A82-27412 A new resin for field repair. C. B. Delano, A. H. McLeod (Acurex Corp., Aerotherm Div., Mountain View, CA), F. J. Riel (Rohr Industries, Inc., Chula Vista, CA), and R. H. Greer (Rohr Industries, Inc., Riverside, CA). In: Technology transfer; Proceedings of the Thirteenth National Technical Conference, Mount Pocono, PA, October 13-15, 1981. Azusa, CA,

Society for the Advancement of Material and Process Engineering, 1981, p. 134-149. Contract No. F33615-79-C-5038.

Progress towards the realization of resins for field repairs of composite materials using temperatures in the ranges 180-200 F and 300 F are reported. A low moisture absorption, two-part epoxy system with commercially available components and good environmental durability was indicated in a screening process, and the epoxy novolac, DEN 438 cured with isophorone diamine was selected for development. Although slow cure at room temperature was possible, heat curing at 160 F was investigated for rapid turnaround possibilities. High and lower temperature cure cycles with aluminum-composite double strap bonds were employed in a series of bond and strength tests. Sustained stress induced negligible reductions in bond strengths, whereas moisture absorption did cause failures at the strap surfaces. Bond strengths remained steady after 500 hr aging at 300 F. A necessity of fabricating a room temperature primer is mentioned.

M.S.K.

A82-27414 **Compatibility of 350 deg curing honeycomb adhesives with phosphoric acid anodizing.** E. E. Peterson, D. B. Arnold, and M. C. Locke (Boeing Commercial Airplane Co., Seattle, WA). In: Technology transfer; Proceedings of the Thirteenth National Technical Conference, Mount Pocono, PA, October 13-15, 1981. Azusa, CA, Society for the Advancement of Material and Process Engineering, 1981, p. 177-188. 8 refs. USAF-supported research.

Results of an investigation of the relative mechanical properties and environmental durability of square edge metal/metal honeycomb bonded panels with skins processed with phosphoric acid anodize (PAA) and Forest Products Laboratory (FPL) are reported. The PAA process conditions were varied on metal-to-metal shear strength tests and environmental durability was examined, using cyclic room temperature to -67 F conditions. Peel strengths increased at low temperatures and failure analysis revealed no specimen failure interfacially between oxide and primer, while moderate to good filleting to the core enhanced peel strength. Test specimens were all aluminum alloys, and environmental failures occurred between the adhesive and the aluminum core. Finally, variation in the PAA process had negligible effect on the lap-shear strength or the fracture toughness of metal-to-metal bonded joints.

M.S.K.

A82-27415 **Characterization of composition variations in a structural adhesive.** K. G. Kibler (General Dynamics Materials Research Laboratory, Fort Worth, TX). In: Technology transfer; Proceedings of the Thirteenth National Technical Conference, Mount Pocono, PA, October 13-15, 1981. Azusa, CA, Society for the Advancement of Material and Process Engineering, 1981, p. 189-202. 7 refs. Contracts No. F33615-80-G-0007; No. F33615-80-G-0002; No. F33615-80-G-0003.

Attempts to establish correlations between compositional changes, processability, and structural-environmental performance of the 350 F cure structural adhesive RB398 are reported. The program was intended to define material acceptance specifications in terms of composition, formulation, and cure limits as part of the F-16 Technology Modernization Program. RB398 was tested in multiple variations of constituents in physicochemical, performance, and processability trials. High performance liquid chromatography was found to be a suitable method for detecting variations in organic constituents at levels which affect processing or performance. M.S.K.

A82-27423 **Composite control tubes.** S. C. Aker and W. G. O. Sonneborn (Bell Helicopter Textron, Fort Worth, TX). In: Technology transfer; Proceedings of the Thirteenth National Technical Conference, Mount Pocono, PA, October 13-15, 1981.

Azusa, CA, Society for the Advancement of Material and Process Engineering, 1981, p. 280-286.

The design and development of composite material push-pull control tubes to replace aluminum tubes in helicopter flight control systems are described. A three-year development and FAA certification program is discussed, which resulted in a weight savings for tubes of approximately 50% relative to current aluminum designs. Reliable and potentially lower cost hardware that will be fielded in the Bell Helicopter Textron Model 214ST transport helicopter has also been developed by the program. Mechanized manufacturing methods for the production of the tubes are described, and it is

shown that inventory simplifications for spares can be achieved by two-piece construction of the tubes. D.L.G.

A82-27424 **The design, construction, and performance of composite fuselage components for the Boeing 234 helicopter.** L. J. Marchinski and R. L. Pinckney (Boeing Vertol Co., Philadelphia, PA). In: Technology transfer; Proceedings of the Thirteenth National Technical Conference, Mount Pocono, PA, October 13-15, 1981. Azusa, CA, Society for the Advancement of Material and Process Engineering, 1981, p. 287-297.

The design, construction and structural evaluation of the composite fuel pods for the commercial Boeing 234 helicopter are presented. The all-composite pods are attached to the airframe structure through vibration isolation devices, and are of sandwich shell design employing Kevlar and graphite fibers. The all-composite cargo floors used in the commercial 234 are also discussed, which, along with the fuel pods, have proved to be less costly, of lower weight, and easily tailored to requirements. D.L.G.

A82-27429 **Engine industry cost considerations for emerging technologies.** M. A. Siegel (United Technologies Corp., Government Products Div., West Palm Beach, FL). In: Technology transfer; Proceedings of the Thirteenth National Technical Conference, Mount Pocono, PA, October 13-15, 1981. Azusa, CA, Society for the Advancement of Material and Process Engineering, 1981, p. 358-363.

Aspects related to the successful implementation of new technologies in aircraft engines are examined. The present investigation assumes that the benefits other than cost have been established. The cost factors in product selection cover a wide range of influence encompassing the basic cost of the product or part, the development cost, capitalization to produce the part, and operating costs. The ability to accurately calculate these costs frequently determines acceptance of a new concept and its success in service. Attention is given to materials and processes which have paced the growth of the aircraft and aerospace industry. G.R.

A82-27430 **Manufacturing cost trade-studies in avionics.** B. R. Noton (Battelle Columbus Laboratories, Columbus, OH), J. G. Vecellio (Rockwell International Corp., Avionics and Missiles Group, Cedar Rapids, IA), and R. Remski (Honeywell, Inc., Avionics Div., Minneapolis, MN). In: Technology transfer; Proceedings of the Thirteenth National Technical Conference, Mount Pocono, PA, October 13-15, 1981. Azusa, CA, Society for the Advancement of Material and Process Engineering, 1981, p. 364-379.

It is becoming increasingly important to arrest and reduce costs at all levels of the aircraft system life-cycle. The 'Manufacturing Cost/Design Guide' (MC/DG) Data Development Program for airframes and avionics provides an opportunity for the designer to study a larger number of alternative design configurations for airframes and avionics to achieve the lowest manufacturing cost. The MC/DG man-hour information is presented in basically three forms. These are lowest-cost processes for the designer, manufacturing methods for multiple discrete parts, and multiple manufacturing methods for single discrete parts. Attention is given to major system design parameters, MC/DG section development for electronics fabrication and assembly, electronic cost-drivers, an integrated example utilizing MC/DG formats for electronics, and fabrication and assembly cost-drivers. G.R.

A82-27432 **An evaluation of several polymers for high density humidity PC coatings.** H. E. Frankel, C. Ray, and F. P. Casto (Fairchild Space and Electronics Co., Germantown, MD). In: Technology transfer; Proceedings of the Thirteenth National Technical Conference, Mount Pocono, PA, October 13-15, 1981.

Azusa, CA, Society for the Advancement of Material and Process Engineering, 1981, p. 399-406.

In the evaluation, one of the most severe environments to which military aircraft is subjected is considered. Attention is given to rapidly changing temperatures at seacoast locations, taking into account situations in which the atmosphere may be laden with industrial or fossil fuel by-products. A urethane coating used for printed wiring boards afforded generally excellent protection. However, in connection with more stringent requirements, particularly with regard to rapidity of high-altitude, high-humidity cycling, it

became clear that only either a new type of coating or a much thicker urethane coating could provide the required protection. An experiment was, therefore devised to evaluate the single parameters of imperviousness to moisture, taking into consideration six types of coating. The qualifications of the various coatings are discussed. G.R.

A82-27435 Transition of aerospace adhesive bonding technology from R&D to operational use. H. S. Schwartz (USAF, Materials Laboratory, Wright-Patterson AFB, OH). In: *Technology transfer; Proceedings of the Thirteenth National Technical Conference*, Mount Pocono, PA, October 13-15, 1981. Azusa, CA, Society for the Advancement of Material and Process Engineering, 1981, p. 425-436. 18 refs.

A chronological review is presented of developments in the materials processes and quality assurance aspects of aerospace bonding, and the degree of success in transitioning these developments. Early applications of adhesive bonding technology in aircraft structure exploited intrinsic structural advantages, such as long fatigue life and high stiffness-to-weight ratio. High temperature polymers were later developed for use up to 700 F. Service experience in the 1960s revealed deficiencies in moisture resistance of the epoxy-based adhesive bonding technology for aluminum structures, which led to the development of high durability bonding technology for the aluminum structures in the mid-1970s. Current emphasis is on reliable performance and economical production.

D.L.G.

A82-27437 Correlation of surface characterization of phosphoric acid anodize oxide with physical properties of bonded specimens. K. K. Knock and M. C. Locke (Boeing Co., Seattle, WA). In: *Technology transfer; Proceedings of the Thirteenth National Technical Conference*, Mount Pocono, PA, October 13-15, 1981. Azusa, CA, Society for the Advancement of Material and Process Engineering, 1981, p. 445-458. 6 refs.

A82-27446 Recent developments in materials and processes for aircraft corrosion control. S. J. Ketcham and J. J. De Luccia (U.S. Naval Material Command, Naval Air Development Center, Warminster, PA). In: *Technology transfer; Proceedings of the Thirteenth National Technical Conference*, Mount Pocono, PA, October 13-15, 1981. Azusa, CA, Society for the Advancement of Material and Process Engineering, 1981, p. 571-582. 10 refs.

The subjects investigated are primarily useful in considerations related to airframes, although the results may also be applicable to electronic equipment. A number of corrosion preventive, water displacing compounds are considered, taking into account their areas of application. It is pointed out that elastomeric sealants are widely used on naval aircraft to seal out the environment. It is anticipated that the use of these sealants will increase in the future due to their ability to accommodate the dynamic loads imposed on aerospace equipment without cracking. Attention is also given to surface treatments for aluminum alloys, and aspects of alloy selection and treatment. Materials under development are related to a water displacing paint, a flexible primer, the development of an aluminum plating process, phase transfer inhibitors, crack arrestment compounds, and powder metallurgy aluminum alloys. G.R.

A82-27509 † Problems in the automation of the thermal-stress analysis of flight vehicles (Problemy avtomatizatsii teploprochnostnykh issledovaniy letatel'nykh apparatov). I. F. Obratsov, O. M. Alifanov, V. S. Kuznetsov, V. I. Lopatin, B. M. Pankratov, and I. M. Ukolov. In: *Scientific lectures on aviation and astronautics 1980*. Moscow, Izdatel'stvo Nauka, 1981, p. 100-110. In Russian.

The paper examines the development of automated data processing systems for the thermal-stress analysis of flight vehicles. A hybrid system for the automated processing of thermal-test data is described, and a block diagram of the system is presented. B.J.

A82-27526 † Strength of the turbine components of a gas-turbine engine under complex loading and associated problems (Prochnost' detalei turbiny GTD v usloviakh slozhnogo nagruzeniia i svyaznyye s nei problemy). N. D. Kuznetsov. *Problemy Prochnosti*, Mar. 1982, p. 10-14. In Russian.

The corrosion resistance and cyclic strength of the blading and disks of aircraft gas-turbine engines are discussed with emphasis on the effects of the fabrication and assembly process variables. The currently used methods of blading design analysis are examined and their faults are demonstrated by comparing the calculated and experimentally determined resonances of a disk. It is shown that more accurate techniques of vibration analysis can be developed on the basis of dynamic elasticity equations. V.L.

A82-27641 # Analysis of side-looking airborne radar (SLAR) performance in the detection of search and rescue targets. S. R. Osmer, N. C. Edwards, Jr. (U.S. Coast Guard, Research and Development Center, Groton, CT), and G. L. Hover (Analysis and Technology, Inc., North Stonington, CT). In: *International Symposium on Remote Sensing of Environment*, 15th, Ann Arbor, MI, May 11-15, 1981, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1981, p. 803-810.

Performance detection tests were conducted on two side-looking airborne radar (SLAR) systems to determine the influence certain environment-related and controllable parameters have on SLAR detection of typical search target types. Analysis techniques consisted of binning and plotting the empirical data to compare SLAR detection performance under sets of conditions for demonstrating the influence of the parameters. Environment-related parameters found to influence performance included wind speed and precipitation, and controllable parameters included target size and composition, altitude, antenna polarization and lateral range. D.L.G.

A82-27709 Optimal target designation techniques. L. M. Novak (MIT, Lexington, MA). In: *Asilomar Conference on Circuits, Systems and Computers*, 14th, Pacific Grove, CA, November 17-19, 1980, Conference Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1981, p. 105-112. 6 refs. USAF-DARPA-Army-sponsored research.

This paper presents studies of signal processing techniques for achieving optimal autonomous acquisition of stationary targets located in a moderately intense non-homogeneous radar ground clutter background. The process of target acquisition is comprised of three basic functions: (1) target detection, (2) target selection or designation, and (3) re-acquiring the target for tracking. It is the second of these functions, i.e., autonomous designation of a target, that is the subject of this paper. Theoretical analyses and predictions of the probability of correct target designation for two acquisition search methods are presented and compared with results achieved using real radar imagery. (Author)

A82-27714 * RAMP - A fault tolerant distributed micro-computer structure for aircraft navigation and control. W. R. Dunn (Southern Colorado University, Pueblo, CO), J. Johnston, and G. Meyer (NASA, Ames Research Center, Moffett Field, CA). In: *Asilomar Conference on Circuits, Systems and Computers*, 14th, Pacific Grove, CA, November 17-19, 1980, Conference Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1981, p. 280-286. 9 refs. Grant No. NAG2-2.

Design methodologies for realizing future high authority auto-flight control systems are being investigated, taking into account also the study of distributed microcomputer architectures. Attention is given to the redundant asynchronous microprocessor (RAMP) structure. RAMP comprises a connected network of microcomputers which has as input command and sensor information, and which generates servo information to drive actuators, and thrust linkages. Tolerance to hardware failures is achieved by static redundancy. Results of a failed microcomputer are simply rejected. This is done in lieu of dynamic redundancy wherein the distributed computer system performs real time fault detection and reconfiguration of the system. Attention is given to the RAMP network structure and operation, flight control with parallel asynchronous computers, and intermittent fault tolerance. G.R.

A82-27869 Applications of adaptive control systems. P. C. Parks (Royal Military College of Science, Shrivenham, Wilts., England), W. Schaufelberger (Zürich, Eidgenössische Technische Hochschule, Zurich, Switzerland), C. Schmid, and H. Unbehauen (Bochum, Ruhr-Universität, Bochum, West Germany). In: *Methods and applications in adaptive control; Proceedings of the International*

Symposium, Bochum, West Germany, March 20, 21, 1980.

Berlin, Springer-Verlag, 1980, p. 161-198. 112 refs.

It is shown through a study of adaptive control applications in the fields of aircraft control systems, industrial process control and electrical drives that, despite the advantages of their sophisticated algorithms, adaptive controls will not be adopted until they are demonstrated to be far superior to classical control techniques. The most successful field of application for adaptive controls has been that of electrical drives, since their system equations and dynamics are well understood and have parasitical vibration modes of high frequency, which can be more easily eliminated in the design process than those encountered in aircraft control. Attention is given to the causes for process industry resistance to adaptive control development, including the complicated dynamic behavior of processes under internal and external disturbances, drifts and parameter changes. O.C.

A82-27876 AUTOTESTCON '80; International Automatic Testing Conference, Washington, DC, November 2-5, 1980, Proceedings. Conference sponsored by the Institute of Electrical and Electronics Engineers. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, 343 p. Members, \$22.50; nonmembers, \$30.

Topics considered include TPS management, ATE hardware systems, testing of the next generation commercial airline avionics, testability and built-in test, digital ATG, management information systems for ATE, and propulsion ATE. Attention is also given to system architecture, modular ATE, analog ATE, supporting shipboard electronics, and new and unusual ATE applications. B.J.

A82-27883 Airline maintenance strategy. W. Brouwer (KLM Royal Dutch Airlines, Engineering and Maintenance Div., Schiphol Airport, Netherlands). In: AUTOTESTCON '80; International Automatic Testing Conference, Washington, DC, November 2-5, 1980, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 38-42.

Problems associated with the maintenance of avionics are discussed, with attention given to the consequences of increases in complexity and reliability, maintenance shop organization, and the role of the technician. The efficiency of LRU removals, the use of automatic test equipment, and the role of software are examined. B.J.

A82-27884 Airline ATE requirements. H. E. Harmon (American Airlines, Inc., Dallas, TX). In: AUTOTESTCON '80; International Automatic Testing Conference, Washington, DC, November 2-5, 1980, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 43-46.

The general requirements of airline ATE (automatic test equipment) are reviewed, and attention is given to dedicated, modular, general-purpose, and circuit-card ATE. It is noted that maintenance of all-digital avionics will require the full utilization of standardized instrument techniques and the ATLAS test language to accomplish cost effective testing and repair. And it is recommended that airlines effectively communicate these test equipment requirements to the suppliers of future avionics equipment. B.J.

A82-27885 The role of software in commercial ATE. G. M. Jenkins (Boeing Computer Services Co., Seattle, WA). In: AUTOTESTCON '80; International Automatic Testing Conference, Washington, DC, November 2-5, 1980, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 47-50.

The paper examines the role of software in some specific applications of commercial ATE (automatic test equipment) to the testing of avionics in commercial aircraft. The systems and software used in the Boeing Electronics Test Shop to test units for use in the 707, 727, and 737 aircraft are described. In addition, a new Air Data Computer test station is discussed along with the future use of ATLAS. The role of the software in these systems is considered. B.J.

A82-27886 The modular ATE. E. I. Levy (Eastern Air Lines, Inc., Miami, FL). In: AUTOTESTCON '80; International

Automatic Testing Conference, Washington, DC, November 2-5, 1980, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 51-53.

The Eastern Air Lines concept of modular ATE is presented, with attention given to both hardware and software aspects. Existing maintenance philosophies and the classical ATE are reviewed to show why present concepts are no longer cost effective. Potential problems of the modular ATE concept are examined, and the need for further standardization and close industry cooperation is discussed. B.J.

A82-27887 # AEWTS - Realistic not futuristic. D. D. Banks (U.S. Navy, Pacific Missile Test Center, Point Mugu, CA) and D. O. Jacoby (U.S. Naval Air Systems Command, Washington, DC). In: AUTOTESTCON '80; International Automatic Testing Conference, Washington, DC, November 2-5, 1980, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 54-59.

The Advanced Electronic Warfare Test Set (AEWTS) program is described, with attention given to AEWTS design considerations, the dual port testing concept, and the operator interface. Phase I studies indicate that AEWTS technical requirements are achievable; in particular it is found that the dual port testing concept is not only realistic and feasible but also cost effective in terms of throughput efficiency. B.J.

A82-27890 # ATE logistics in the United States Air Force. R. H. Freeman (USAF, Aeronautical Systems Div., Wright-Patterson AFB, OH). In: AUTOTESTCON '80; International Automatic Testing Conference, Washington, DC, November 2-5, 1980, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 79-83.

It is noted that the problems and complexities of ATE (automatic test equipment) have a dollar and mission impact that now demands visibility from all levels of USAF management. Several solutions have been proposed to minimize these difficulties. One of the more promising solutions is MATE (Modular Automatic Test Equipment), a cradle-to-grave acquisition methodology approach to ATE. A second solution is to reduce the requirement for ATE by changing USAF maintenance concepts. Both solutions are being actively considered within the USAF for implementation. B.J.

A82-27891 ATLAS/test data provision for the Tornado ATS - A challenging task. H. Scheibenzuber (Elektronik-System-Gesellschaft mbH, Munich, West Germany). In: AUTOTESTCON '80; International Automatic Testing Conference, Washington, DC, November 2-5, 1980, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 84-89.

The provisions of the ATLAS test specifications/test data for the Line Replaceable Units (LRUs) allocated to the Tornado aircraft Automatic Test System (ATS) are an important part in the development of the maintenance support system of the aircraft. The basic ATLAS/test data requirements include a standard serviceability test and a diagnostic test. LRU test data sheets form the baseline for ATS design and development and consist of four parts: an introduction, LRU test specifications, LRU specific requirements, and LRU interface requirements. The validation of the data is done by checking applicability, structure, syntax and lexicon, compatibility, logic, and diagnostic capability. Engineering support provided includes provision of test sheets, flow charts, and specifications. C.D.

A82-27892 # Naval Air Systems Command/NAVAIR/ATE program - Standardized ATE for the carrier environment. A. W. Rossiter (U.S. Naval Air Systems Command, Washington, DC). In: AUTOTESTCON '80; International Automatic Testing Conference, Washington, DC, November 2-5, 1980, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 90-95.

It is pointed out that the principal avionics support equipment goal of the Naval Air Systems Command has been, and remains, to provide timely and effective organic support capability to optimize U.S. aircraft weapon system readiness. A definition is provided of an Automatic Test Equipment (ATE) program that will optimize the avionic repair capability of the shipboard Aircraft Intermediate Maintenance Department. Attention is given to four factors which

illustrate the unique nature of carrier support, and the ATE program plan is discussed. The Family of Common ATE is considered, taking into account aspects of general avionics support, inertial navigation system support, electro-optical support, and electronic warfare system support. A Consolidated Support System to meet the advanced support needs of the 1990's is also examined. G.R.

A82-27893 Configuration management techniques for automatic testing. R. W. Tobias, G. D. Scherer, and W. H. Kraper (AAI Corp., Baltimore, MD). In: AUTOTESTCON '80; International Automatic Testing Conference, Washington, DC, November 2-5, 1980, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 99-104.

The configuration management process as it relates to automatic testing is discussed with reference to a process developed for an automatic test system supporting the P3 ORION long-range patrol aircraft. Attention is given to problems involved in the control of the hardware and software of the three key items: the automatic test system, the unit under test, and the test program test. It is emphasized that the configuration management process relating to each of these three items is critical to the overall success of the maintenance and support process. V.L.

A82-27903 Pacer Comet II jet engine test system. A. M. Bishop (Control Data Corp., Professional Services Div., San Antonio, TX). In: AUTOTESTCON '80; International Automatic Testing Conference, Washington, DC, November 2-5, 1980, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 199-202.

The ten year evolution of the Pacer Comet system has produced a versatile, 'full-authority', minicomputer based test system which simultaneously controls engine testing in four test cells. This fully automated test system is operational at Kelly, Tinker and Edwards Air Force Bases. The hardware and software evolution are described with particular emphasis on the lessons learned. It will also describe the present software structure, engine test supervisor, interface between executive and UUT software, and the operator interface. Concluding remarks address the human engineering aspect of automation. (Author)

A82-27904 The United States Air Force Automated Vibration Diagnostics System (AVID) for improved jet engine maintenance. R. A. Rio (Mechanical Technology, Inc., Latham, NY). In: AUTOTESTCON '80; International Automatic Testing Conference, Washington, DC, November 2-5, 1980, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 203-208.

This paper describes the successful application of an Automated Vibration Diagnostic System (AVID) in the U.S. Air Force's high-volume engine overhaul center at Tinker Air Force Base, OK. The AVID concept to automate troubleshooting procedures for fully-assembled rebuilt engines is addressed. This system extracts high-frequency vibration data from existing standard instrumentation, thereby providing meaningful mechanical information. A growing appreciation on the part of engine overhaul personnel of the power of automated test equipment has enabled these key features to be combined to reduce operating expenses at engine rebuild facilities. (Author)

A82-27920 # Aerial combat simulation in the U.S. Air Force. P. A. Cook (USAF, Human Resources Laboratory, Williams AFB, AZ). In: Computer Graphics Symposium, Phoenix, AZ, April 24, 1982, Proceedings. New York, American Institute of Aeronautics and Astronautics, 1982, p. 16-19.

The history, current applications, research programs, and features of future air combat simulators for pilot training are reviewed. The Link system, invented in 1929, provided good cockpit orientation and instrumentation instruction. Current Air Force simulators, specifically those located in Phoenix, AZ, are mounted on six-degrees-of-freedom motion simulators. Seven visual display screens provide a 300 x 140 deg horizontal by vertical field of view, and are configured for A-10 and F-16 fighters. Experiments with pilots trained in simulators and in classrooms for strafing and air-to-ground bombing missions have demonstrated that simulator trained pilots

are more proficient in real flights past the seventh mission. Improvements in full combat simulation are reviewed, noting that human eyes are still keener than raster scans, and techniques for improving resolution and developing multiple interactive cockpits are outlined. M.S.K.

A82-27946 Corona and antenna effects on the RH-53D minesweeping helicopter and Raydist navigation set. J. F. Shaeffer, L. N. Medgyesi-Mitschang (McDonnell Douglas Research Laboratories, St. Louis, MO), J. W. Weber, S. R. Jacobs (McDonnell Aircraft Co., St. Louis, MO), and P. Eisenhauer (U.S. Navy, Naval Coastal Systems Center, Panama City, FL). In: International Symposium on Electromagnetic Compatibility, Baltimore, MD, October 7-9, 1980, Symposium Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 254-264. 11 refs. Contract No. N61339-77-C-0094.

A series of flight and bench tests have been carried out in order to determine the origin of interference effects on the Raydist navigation system of the Navy RH-53D minesweeping helicopter during the streaming, towing, and recovery of the minesweeping gear. Two distinct mechanisms have been identified by which the tow cable can cause unwanted effects on the navigation system: (1) a negative corona discharge (Trichel pulses) from the tow cable caused by electrification of the helicopter in the streaming and recovery modes; and (2) interaction of the monopole antenna with the tow cable in the towing mode. V.L.

A82-28015 † Analysis of the temperature field of a baffle-cooled gas-turbine-engine blade under conjugated boundary conditions (Raschet temperaturnogo polia okhlazhdaemoi deflektornoi lopatki GTU pri sopriazhennykh granichnykh usloviyakh). Iu. I. Shvets, A. Sh. Dorfman, O. I. Didenko, and O. D. Lipovetskaia (Akademiia Nauk Ukrainskoi SSR, Institut Tekhnicheskoi Teplofiziki, Kiev, Ukrainian SSR). *Promyshlennaia Teplotekhnika*, vol. 4, Mar.-Apr. 1982, p. 9-14. In Russian.

A high-accuracy method is developed for calculating gas-blade heat transfer coefficients and temperature fields of baffle-cooled gas-turbine-engine blades under conjugated boundary conditions. An example of such calculation is discussed, and it is shown that at some points of the blade the heat transfer coefficients obtained with this method can differ by 40% from coefficients obtained by conventional calculation methods. B.J.

A82-28018 † Investigation of heat transfer in the vicinity of the leading and trailing edges of a cooled nozzle blade of a low-consuming gas turbine (Issledovanie teploobmena v zone vkhodnoi i vykhodnoi kromok okhlazhdaemoi soplovoi lopatki maloraskhodnoi gazovoi turbiny). Iu. S. Osheroev (Nauchno-Proizvodstvennoe Ob'edinenie, Proletarskii Zavod, Leningrad, USSR). *Promyshlennaia Teplotekhnika*, vol. 4, Mar.-Apr. 1982, p. 34-37. 5 refs. In Russian.

Electrocalorimetry was used to study heat transfer near the leading and trailing edges of a cooled nozzle blade of a low-consuming gas turbine. Relationships are obtained for determining the mean and local values of heat transfer coefficients. The results are pertinent to the development of a cooling method for regions near the leading and trailing edges of nozzle blades. B.J.

A82-28019 † The effect of temperature-time factors on the metal damage and endurance characteristics of gas-turbine-engine rotor blades (Vliianie temperaturno-vremennykh faktorov na povrezhdenie metalla i kharakteristiki vynoslivosti rabochikh lopatok GTD). V. T. Troshchenko, B. A. Griaznov, I. A. Makovetskaia, O. I. Marusii, and Iu. S. Nalimov (Akademiia Nauk Ukrainskoi SSR, Institut Problem Prochnosti, Kiev, Ukrainian SSR). *Promyshlennaia Teplotekhnika*, vol. 4, Mar.-Apr. 1982, p. 65-68. In Russian.

The endurance of turbine rotor blades was tested after prolonged operation. A significant reduction in blade endurance is revealed after 20,000 hours of operation. The main cause of observed defects was found to be the formation of a sulfur-saturated surface layer. In addition, some of the blades exhibited a reduction in cyclic strength and a displacement of the fatigue-crack-initiation zone from the base of the blade to its center. B.J.

A82-28149

A82-28149 The status of airport noise prediction, with special reference to the United Kingdom and Europe. J. B. Large and M. E. House (Southampton, University, Southampton, England). *Noise Control Engineering*, vol. 17, July-Aug. 1981, p. 38-44. 12 refs.

The current status of airport noise prediction is reviewed with reference to both air-to-ground noise and near-ground noise such as noise generated by road traffic, auxiliary power units, engine ground running, approaching aircraft, and aircraft on taxiways and aprons. Methodologies for contour calculation and assessment are outlined, and areas for further study and refinement of procedures are indicated. In particular, the need for greater accuracy is emphasized in assessments made for legislative and statutory purposes. V.L.

A82-28150 The impact and future direction of aircraft noise certification. M. J. T. Smith (Rolls-Royce, Ltd., Derby, England). *Noise Control Engineering*, vol. 18, Mar.-Apr. 1982, p. 52-61. 17 refs.

After an historical account of the takeoff and landing noise problems created by the introduction of jet aircraft, and the aircraft noise footprint control requirements formulated by such regulatory bodies as the International Civil Aviation Organization in response to airport community demands, attention is given to the performance parameters determining the contours of aircraft noise footprints and the procedures for their quantification. It is suggested that computed noise contour dimensions be adjusted at the lateral, flyover and approach closure points to more accurately reflect aircraft noise emission characteristics, where presently such effects as shielding, forward speed and lateral attenuation cannot be defined from first principles to the degree of accuracy often assumed. It is emphasized that regulations must recognize aircraft manufacturer's exceeding even the lowest stipulated noise limits, and suitably reward them. O.C.

A82-28275 To the root of the problem - Some helicopter research topics. R. L. Maltby (Royal Aircraft Establishment, Farnborough, Hants., England). *Aerospace (UK)*, vol. 9, Mar. 1982, p. 12-18. 10 refs.

A historical review is presented of the development of aircraft which can hover in flight and land vertically, beginning with the autogyro and proceeding through the aerodynamics of helicopter flight. Initial stability problems with the autogyro were overcome by separating the lift and propulsive functions, with a concomitant loss of vertical take-off ability. Glauert's method formulated an account of the edgewise flow of the blades in forward flight and defined the vortices for induced flow theory. Wake calculations were devised to describe the spiral disturbances each blade had to pass through from the preceding blade's passage. Computers have allowed examination of surface pressures, blade motions, and surface strains in-flight, and wake studies with 17 pressure transducers on a blade of the Puma helicopter are described. Further discussion is given of blade dynamics, flight mechanics, particularly the man-machine interface, and air and ground resonance. M.S.K.

A82-28276 * # Why twin-fuselage aircraft. J. C. Houbolt (NASA, Langley Research Center, Hampton, VA). *Astronautics and Aeronautics*, vol. 20, Apr. 1982, p. 26-35. 8 refs.

Operational and design features of twin-fuselage aircraft are outlined, noting capabilities of transporting 100-400 passengers at subsonic speeds at an efficiency of around 190 passenger mi/gal. Wings for two body aircraft are lighter and are designed more from an aerodynamics point of view due to reductions in the bending moment. A 280 passenger configuration would need a 172 ft wingspan, compared to a 155 ft wingspan for a conventional aircraft, but the conventional wings would have a larger area. The higher aspect ratio contributed to the increased efficiency of the twin body operation. A lower wetted fuselage area is calculated for the two body aircraft with passenger capacities over 190, and twin fuselages are shown to have a higher passenger packaging density than double-deck widebodies. Finally, simple compounding of existing aircraft such as the DC-9 into a two-body shape is projected to offer a 1.9 factor increase in passenger mi/gal. M.S.K.

A82-28277 # Toward VLA air-cargo service. H. Liese (Dornier GmbH, Friedrichshafen, West Germany). *Astronautics and*

Aeronautics, vol. 20, Apr. 1982, p. 36-41.

Trends and design possibilities for very large aircraft (VLA) for transporting containerized cargo are examined. Time losses in current air cargo transport are attributed to repacking necessities, uncoordinated manpower, insufficient personnel and facilities, and too little notification of shipments. Air transport costs more than sea transport, and also cuts the average delivery time by over 80%. It is noted that higher value goods, especially those requiring fast delivery, are shipped by air, for a fee averaging 1.8 that of sea routes. Comparison of conventional air transport to VLA transport of containerized cargo shows that use of VLA would increase air cargo share of containerized cargo to 43% of the total cargo shipped, compared with a present-day 5.9%. Necessities for a successful VLA-based air cargo system are reviewed, including a 1000 ton takeoff weight, sea- and land-basing options, and container interface with ground transport. M.S.K.

A82-28278 # Very large vehicles - Technology looking for a need. W. H. Arata, Jr. *Astronautics and Aeronautics*, vol. 20, Apr. 1982, p. 42, 43, 77. 26 refs.

Strategic and commercial incentives for the construction of very large vehicles (VLV) to be used for transporting massive air freight are considered. The acquisition and delivery of raw materials such as Al, beryllium, Ti, and Mn, for which the U.S. and Europe are completely dependent on imports, are cited as driving commercial reasons for the development of VLVs. Military employment of a rapid deployment force is noted to depend on transferring troops and supplies to remote spots of the world in short time periods, a situation which would be strongly aided by the presence of Mach 0.8 vehicles in a twin-fuselage configuration capable of carrying 1000 tons. Finally, only the combination of military and commercial demand would be sufficient to ensure the economic viability of the development of VLVs. M.S.K.

A82-28280 * # Flying qualities - A costly lapse in flight-control design. D. T. Berry (NASA, Flight Research Center, Edwards, CA). *Astronautics and Aeronautics*, vol. 20, Apr. 1982, p. 54-57, 35.

Generic problems in advanced aircraft with advanced control systems which suffer from control sensitivity, sluggish response, and pilot-induced oscillation tendencies are examined, with a view to improving techniques for eliminating the problems in the design phase. Results of two NASA and NASA/AIAA workshops reached a consensus that flying qualities criteria do not match control system development, control system designers are not relying on past experience in their field, ground-based simulation is relied on too heavily, and communications between flying qualities and control systems engineers need improvement. A summation is offered in that hardware and software have outstripped the pilot's capacity to use the capabilities which new aircraft offer. The flying qualities data base is stressed to be dynamic, and continually redefining the man/machine relationships. M.S.K.

A82-28281 # VSTOLs - We can build them, but can we sell them. J. W. Flaig (U.S. Naval Air Systems Command, Washington, DC). *Astronautics and Aeronautics*, vol. 20, Apr. 1982, p. 58-61.

Conclusions regarding the development of a VSTOL wing for the Navy reached at the 2nd AIAA/NASA VSTOL Conference are reviewed. It was noted that a specific mission could not be designated for VSTOL aircraft and, subsequently, funds could not be dedicated to the program on a full-scale development level. Decreasing the margin of greater cost of the VSTOL aircraft to 16% rather than the current 25-30% more than conventional aircraft was recommended, along with finding specific scenarios which favor VSTOL employment. A solution was indicated in that VSTOL aircraft are capable of operating out of degraded field conditions, and also that faster deck cycling is possible. Further arguments favoring the use of VSTOL aircraft such as the AV-8B were that the response time for ground support is less than half that with conventional aircraft, and that VSTOL engines are hard to extinguish. M.S.K.

A82-28311 US Navy begins slow shuffle towards V/STOL. *Flight International*, vol. 121, Feb. 20, 1982, p. 419-421.

The US Navy is defining its next fighter/attack aircraft, and it is likely to be a V/STOL type. The design requirements include a sustained speed of Mach 1.6 or better, good STOL performance, high maneuverability, and take-off weight varying from 20,000 lb for VTO to some 40,000 lb for sea-based STO strike. McDonnell-Douglas submitted a vectored-thrust design featuring a turbofan engine producing 34,000 lb with plenum chamber burning, up to Mach 2 speed, VTO weight of 29,840 lb for 103 nm combat radius. Rockwell and General Dynamics based their designs on thrust augmentors. The former uses ejector flaps; the design augmentation ratio is 1:5:1 for 20,730 lb dry installed thrust, VTO weight is 24,000 lb, STO is 29,400 lb and combat radius is 300 nm. General Dynamics' design is 37,770 lb, 21,800 lb VTO, Mach 1.6 maximum. The Vought is 25,330 lb VTO with a tandem-fan engine combining low-bypass cruise properties with medium-bypass air flow for V/STOL. C.D.

A82-28312 Advancing blade flight data gathered. D. E. Fink. *Aviation Week and Space Technology*, vol. 116, Mar. 29, 1982, p. 42-44, 47.

Stability and maneuverability characteristics gathered during 200 hours of flight tests are given for the XH-59A advancing blade concept (ABC) technology demonstration aircraft, which combines twin counterrotating helicopter rotors for vertical lift with turbojets for high forward speeds. The development of the aircraft is pertinent to both the U.S. Army's 1990s requirement for advanced attack helicopters and the market for intercity commuter aircraft of sufficiently low noise emission characteristics. The control response of the XH-59A in rolling into and out of steep turns is found to be comparable to that of fixed-wing aircraft. The forward thrust available from the auxiliary engines and differential collective of the rotors eliminates the need to pitch the main rotor tilt vector forward for high-speed, level flight. O.C.

A82-28313 Precision casting for gas turbine engines. C. W. Foster (Rolls-Royce, Ltd., London, England). *Aircraft Engineering*, vol. 54, Feb. 1982, p. 11-14.

The paper describes the gas turbine casting process in detail. High-temperature creep resistance is the property whose desirability most advances casting and materials technology. Vacuum melting and casting, directionally solidified (DS) casting, equi-axed and single-crystal casting are major developments in the progress of this technology. The vacuum process was used in the RB211-524 engine, while the DS process was employed in more advanced engines of the RB series. Rolls-Royce has built a new demonstration furnace whose melting unit, furnace chamber, withdrawal chamber, vacuum system, casting cycle, and control system are described. The future will bring increasing use of automation, production of more cast-to-size features, single-crystal castings application and process developments that will produce complex internal cooling configurations that are impossible today. C.D.

A82-28318 An investigation of the swirl in an S-duct. R. W. Guo and J. Seddon. *Aeronautical Quarterly*, vol. 33, Feb. 1982, p. 25-58. 7 refs.

Measurements are presented of the static pressure, total pressure, swirl and three-dimensional turbulence in the flow through an S-curved rectangular duct mounted in a wind tunnel at different incidences, yaw angles and mass flow ratios. The results show that at high incidence there is a large vortex around an area of flow separation after the first bend and a pair of contra-rotating vortices in the flow after the second bend. The distortion of total pressure at the exit of the S-duct is significantly high, and the corresponding three-dimensional turbulence is up to 16.7%. Appreciation of the existence of this type of flow is important in the field of air intake design for jet aircraft. (Author)

A82-28322 * # Performance degradation of propeller/rotor systems due to rime ice accretion. K. D. Korkan (Texas A & M University, College Station, TX), L. Dadone (Boeing Vertol Co., Philadelphia, PA), and R. J. Shaw (NASA, Lewis Research Center, Cleveland, OH). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0286*. 14 p. Grants No. NAG3-109; No. NAG3-242.

A theoretical model has been established which is applicable to both propeller and helicopter systems that determines the effect of rime ice accretion on the thrust coefficient, power coefficient, and efficiency as a function of time in a natural icing condition. Theoretical comparisons have been made with experimentally determined decrease in propeller thrust coefficient and efficiency for five natural icing conditions with good agreement. The present analytical model is also applicable to the helicopter case, where the method predicts radial and azimuthal rotor blade ice shapes in addition to torque rise as a function of time in a natural icing condition.

(Author)

A82-28349 The characteristics and detection of low level wind shear in the critical phases of flight. P. D. Simmons. *The Controller*, vol. 21, Mar. 1982, p. 16-18.

Wind shear, defined as a change in wind speed and/or direction per unit distance between two points in the atmosphere, can precipitate a change in aircraft airspeed or other flight characteristic which, in extreme cases, may be uncorrectable by even maximum use of pilot maneuver and power controls. While micro scale shears cause only rapid turbulence and synoptic scale shears change flight conditions more slowly than would be hazardous, meso scale shears at low levels and in either vertical or horizontal directions pose considerable danger to aircraft during their landing glide path. Horizontal wind shear, which is often more powerful than the vertical and effectively reverses wind direction, has been identified as the greater threat. The relationship of wind shear to thunderstorm activity on a global scale is considered. O.C.

A82-28395 # Effect of contrast on space perception in TV displays of the external scene observed by the pilot (Einfluss des Kontrastes auf die Raumwahrnehmung bei TV-Flugaussensichtdarstellungen). H. Heising, Wachtberg-Werthhoven, West Germany, *Forschungsinstitut für Anthropotechnik (Forschungsinstitut für Anthropotechnik, Bericht, No. 50)*, 1981. 80 p. 16 refs. In German.

Procedures involving the simulation of the external visual scene perceived by the conductor of a vehicle are, in particular, employed in connection with flight simulation applications for training, research, and development programs. Heising (1977) has reported the development of a simulating device based on a raster formation approach. Every individual image obtained previously in connection with the TV recording of a flight maneuver is modified in such a way that it appears to the person in the simulator in the correct perspective with respect to his position. There are, however, variations in contrast in connection with the image processing operations. An investigation is, therefore, conducted concerning the effects of the contrast changes on space perception. It is found that aspects of positional perception are not affected by the considered contrast variations. It appears, therefore, that the contrast variations do not cause changes with respect to details of space perception. G.R.

A82-28397 Simple vs. sophisticated TacAir avionics. II - Soviet TacAir avionics technology. J. Bussert. *Military Electronics/Countermeasures*, vol. 8, Mar. 1982, p. 56-62.

An historical study is presented of Soviet tactical aircraft avionics developments, encompassing radars, ECM ordnance, communications and cockpit instrumentation. It is noted that (1) there has been a marked shift since 1970 from interceptor to ground support aircraft development and production, (2) that ostensibly obsolete electronics such as the MiG-25 vacuum tube-based Foxfire radar may exploit low vulnerability and exceptionally high power levels, and (3) that the simplicity of Soviet avionics design imposes a lower acquisition and maintenance cost burden while increasing reliability and the trainability of crews. It is suggested that the Soviet study of F-14 Phoenix missile systems since the Iranian revolution has been instrumental in the development of a MiG-25 two-seat variant with anti-cruise missile look down/shoot down capability. O.C.

A82-28403 Real-time failure detection of aircraft engine output sensors. C. W. de Silva. *Arabian Journal for Science and Engineering*, vol. 7, Jan. 1982, p. 45-53. 9 refs.

The Bayesian approach to hypothesis testing in failure detection

is incorporated in a computer algorithm for real-time failure state detection in aircraft engine output sensors, along with a set of hypothesis-conditioned Kalman filters for failed sensor output estimation and associated error covariance matrix determination. Real-time processing incorporating current sensor readings is employed by the algorithm. A decision logic which overcomes analytical difficulties due to inherent aircraft engine nonlinearities is proposed, and an application of the method to a realistic turbojet engine model undergoing simulated output sensor failures furnishes a numerical example. O.C.

A82-28475 † The use of dynamometer readings for damping of the natural vibrations of twin-rotor gyrocompasses (Pro vikoristannia pokazan' N'utonometriv dlia dempfirovannia vlasnikh kohivan' dvorotornikh girokompassiv). V. M. Kalinovich (Akademiiia Nauk Ukrainkoi SSR, Institut Matematiki, Kiev, Ukrainian SSR). *Akademiia Nauk Ukrainkoi SSR, Dopovidi, Seriiia A - Fiziko-Matematichni ta Tekhnichni Nauki*, Jan. 1982, p. 43-46. 5 refs. In Ukrainian.

It is demonstrated that a circuit is feasible in which the damping of the natural vibrations of a twin-rotor gyrocompass is realized on the basis of dynamometer measurements. Two versions of the proposed circuit using one or two dynamometers and information on the divergence angle of the gyroscopes are discussed. V.L.

A82-28476 Improving the crashworthiness of general aviation aircraft by crash injury investigations. W. R. Kirkham (FAA, Civil Aeromedical Institute, Oklahoma City, OK). *Aviation, Space, and Environmental Medicine*, vol. 53, Apr. 1982, p. 319-325.

An aircraft accident investigation program correlates injuries to occupants with the severity of impacts and structural changes in the crash. Findings brought to the attention of aircraft manufacturers have led to specific aircraft being made more crashworthy. The finding of a failure in a shoulder harness attachment led to the strengthening of the attachment brace. The way a shoulder harness was joined to a lapbelt was modified following a noted failure. The finding of fractures of lapbelt and shoulder harness cable tie-downs led to the use of stronger cables and modification of the installation. Other findings resulted in a shoulder strap guide being placed on an inertia reel and a sidemounted seat being modified. Described also are three seat-related features which, although meeting FAA standards, during the dynamics of a crash may lack desirable energy attenuation. These findings illustrate the value of aircraft crash injury correlations. (Author)

A82-28513 # Active flutter suppression on an F-4F aircraft. O. Sensburg, H. Hönliger (Messerschmitt-Bölkow-Blohm GmbH, Munich, West Germany), T. E. Noll, and L. J. Huttzell (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH). (*AIAA, ASME, ASCE, and AHS, Structures, Structural Dynamics and Materials Conference, 21st, Seattle, WA, May 12-14, 1980, AIAA Paper 80-0770.*) *Journal of Aircraft*, vol. 19, May 1982, p. 354-359. 18 refs.

Extensive research programs have been conducted at Messerschmitt-Bölkow-Blohm (MBB) to investigate the application of active flutter and mode control to achieve increased flutter margins. Such techniques are of special interest for airplanes that already have a full command and stability augmentation system together with fast responding control surface actuators and that carry heavy wing mounted stores. A flutter suppression system (FSS) was installed on the F-4F, and this system was flight tested. The control law was found by applying optimal control theory, thus minimizing the control surface motion due to disturbances and providing the required stability margins. During the test it was found that the dynamic properties of the wing-pylon-store system change considerably with vibration amplitude because of play and preload. (Author)

A82-28514 # Experimental study of oscillating-wing propulsion. J. D. DeLaurier (Toronto, University, Toronto, Canada) and J. M. Harris (Battelle Memorial Institute, Columbus, OH). *Journal of Aircraft*, vol. 19, May 1982, p. 368-373. 10 refs. Research supported by the University of Toronto.

In this experimental study of flapping-wing thrust, a wing of 8 in. span and 2 in. chord was oscillated in a low-speed wind tunnel.

The driving apparatus produced nearly sinusoidal heaving with superimposed pitching of variable amplitude and phase angle. The flapping frequency range of 0-8 Hz produced reduced frequencies for which flow separation was unlikely to occur, based on the measured static characteristics of the test airfoil (NACA 0012) over the Reynolds number range of interest (25,000-40,000). The average thrusting effort of the wing was measured and plotted in coefficient form against reduced frequency, with pitching amplitude and phase angle as parameters. Comparisons of the results with theoretical predictions and previous experimental work were made. In general, the results show approximately linear dependence of thrust on reduced frequency and best performance at phase angles of 90-120 deg of pitching lagging heaving. Although thrusting effort was produced for all pitching amplitudes, including zero, the highest readings were obtained for the maximum pitching amplitude of 12.1 deg. (Author)

A82-28515 # Advanced engine technology and its influence on aircraft performance. U. Olsson (Volvo Flugmotor AB, Trollhattan, Sweden). *Journal of Aircraft*, vol. 19, May 1982, p. 380-384. Research supported by the Swedish Air Material Board.

In order to identify problem areas and to investigate the importance of advanced engine technologies, design studies were made on a hypothetical engine for the mid-1980s. The resulting engine has a turbine inlet temperature of 1800 K, overall pressure ratio of 22.9, and thrust-to-weight ratio of 11.5. Technologies involved include boron-aluminum fan blades, a two-stage flash-vaporizing combustor, tungsten-reinforced turbine blades, and full authority electronic control. In fighter mission simulation studies the engine has been shown to result in aircraft superior to those existing today. (Author)

A82-28518 # Effect of downwash on the induced drag of canard-wing combinations. G. F. Butler (Royal Aircraft Establishment, Farnborough, Hants., England). *Journal of Aircraft*, vol. 19, May 1982, p. 410, 411. 7 refs.

The induced drag of canard-wing and wing-tail combinations is calculated for the limiting case in which the downstream surface is located in the Trefftz plane (infinite stagger), but based on the assumption that the loading on each surface is elliptical in isolation. It is shown that additional terms associated with induced circulation effects act to reduce the drag over that calculated using the classical theory. This induced thrust component is shown to be very small for the wing-tail configuration, but significant for the canard-wing layout. In addition, given elliptic loading on the upstream surface, an expression is derived for the loading distribution on the downstream surface which is optimum in the sense that the induced thrust component is maximized. G.R.

A82-28519 # Aircraft pitch attitude as a performance parameter. M. E. Eshelby (Cranfield Institute of Technology, Cranfield, Beds., England). *Journal of Aircraft*, vol. 19, May 1982, p. 412-414.

It is pointed out that in transport operations the pitch attitude of the cabin may have an effect on the safety and the comfort of the passengers and the crew. If the angle of the cabin floor to the horizontal is steep, it will present a hazard to passengers and cabin staff moving about the aircraft. It is preferable to maintain as much as possible a near-level cabin pitch attitude throughout the flight. Once the enroute climb is initiated it should be possible to restrict the aircraft body axis system to very small limits. This can be achieved by using the changes in zero-lift incidence with flap setting, and associated changes in zero-lift drag, to determine the relationship between aircraft body attitude and wing incidence and equating the difference to flight path gradient. An analysis of attitude-directed performance is conducted. G.R.

A82-28534 Automated ultrasonic inspection of adhesive bonded structure. D. J. Hagemeyer (Douglas Aircraft Co., Long Beach, CA). *Materials Evaluation*, vol. 40, Apr. 1982, p. 572-578. 14 refs.

The development of an automated ultrasonic bond inspection device for inspecting adhesively bonded metal-to-metal panels containing voids and porosity is described. Defects are noted to be present in the interface between the adhesive and the sheet metal, in the cured adhesive material, and other types caused during fabrica-

tion. A multiprobe adhesive bond inspection technique employing an ultrasonic resonance impedance method was chosen for operation in the immersion mode. The samples were C-scanned at 5 MHz, then again with a modified tester at 300 kHz at varying water paths from 0.025-2.54 mm. Finally, a 166 kHz scan was proven capable of detecting porosity, voids, and unbonds. The results indicate acceptable performance for applications in automated high production rate bonded fuselage inspections.

M.S.K.

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STAR ENTRIES

N82-20139# Air Force Academy, Colo. Dept. of Aeronautics.
**AIR FORCE ACADEMY AERONAUTICS DIGEST FALL/
SUMMER 1980 Final Report**

A. M. Higgins, ed., E. J. Jumper, ed., J. M. Kempf, ed., and B. J. Gregory, ed. May 1981 149 p refs
(AD-A108338; USAFA-TR-81-4) Avail: NTIS
HC A07/MF A01 CSCL 20/4

The digest includes technical papers in the specific areas of aerodynamics, propulsion, experimental instrumentation, biomechanics, engineering education, and aeronautical history. Canard wake measurements, the relation between camber and zero-lift angle of attack, and the early history of the jet engine were examined. T.M.

N82-20140# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

JOURNAL OF AERONAUTICS AND ASTRONOMY
11 Dec. 1981 183 p refs Transl. into ENGLISH from Acta Aeron. et Astronautica Sinica (China), v. 1, no. 1, 1980 104 p
(AD-A109681; FTD-ID(RS)T-0722-81) Avail: NTIS
HC A09/MF A01 CSCL 20/4

Articles dealing with aerodynamics and astronomy are presented. Slender wings, axisymmetric bodies, attitude control systems and digital filters are discussed. R.J.F.

N82-20142 Ohio State Univ., Columbus.
**AEROELASTIC CHARACTERISTICS OF A MISTUNED
BLADED-DISC ASSEMBLY Ph.D. Thesis**

Robert Evans Kielb 1981 206 p
Avail: Univ. Microfilms Order No. 8129037

The aeroelastic characteristics of mistuned bladed disc assemblies are studied by analytically modeling the bladed disc and its environment and using these models to conduct parametric studies. These studies have concentrated on the effect of mistuning on the system stability and, to a lesser extent, on the aeroelastic response. Aerodynamic coupling between the blades is investigated. Each blade is modeled as a two degree of freedom oscillator in which the airfoil is permitted to have bending (plunging) and torsional (pitching) motions which are inertially coupled. The disc is focused on and a technique is presented for calculating the free vibration frequencies and mode shapes of a rotating disc with variable thickness and temperature. The resulting model is used to study the dependency of disc modal frequency on the nodal diameter of the mode. Dissert. Abstr.

N82-20143*# McDonnell Aircraft Co., St. Louis, Mo.
**TESTS AND ANALYSIS OF A VENTED D THRUST DEFLECTING
NOZZLE ON A TURBOFAN ENGINE Final Report, Mar.
1980 - Mar. 1982**

E. W. Roseberg Mar. 1982 78 p refs
(Contract NAS2-10564)
(NASA-CR-166279; NAS 1.26:166279; MDC-IR0280) Avail:
NTIS HC A05/MF A01 CSCL 21E

The objectives were to: obtain nozzle performance characteristics in and out of ground effects; demonstrate the compatibility of the nozzle with a turbofan engine; obtain pressure and temperature distributions on the surface of the D vented nozzle; and establish a correlation of the nozzle performance between small scale and large scale models. The test nozzle was a boilerplate model of the MCAIR D vented nozzle configured for operation with a General Electric YTF-34-F5 turbofan engine. The nozzle was configured to provide: a thrust vectoring range of 0 to 115 deg; a yaw vectoring range of 0 to 10 deg; variable nozzle area control; and variable spacing between the core exit and nozzle entrance station. Compatibility between the YTF-34-F5 turbofan engine and the D vented nozzle was demonstrated. Velocity coefficients of 0.96 and greater were obtained for 90

deg of thrust vectoring. The nozzle walls remained cool during all test conditions. T.M.

N82-20145*# National Aeronautics and Space Administration.
Langley Research Center, Hampton, Va.
**PRELIMINARY INVESTIGATION OF EFFECTS OF HEAVY
RAIN ON THE PERFORMANCE OF AIRCRAFT**

Otto W. K. Lee Feb. 1982 16 p refs
(NASA-TM-83272; NAS 1.15:83272) Avail: NTIS
HC A02/MF A01 CSCL 01C

A guideline was defined for the analysis of flight data to determine the effects of rain on the aerodynamic performance of an aircraft. It distinguishes and separates the effects of horizontal wind shears, downdrafts, gusts at the phugoid frequency, and rain based on various aerodynamic parameters. Flight data from NASA LaRC's TCV B-737 were inconclusive because precipitation rates encountered probably were not high enough. However, the guideline seemed to be valid and can be used on further flight data evaluations. Difficulties in this type of data analysis are discussed. Other indirect influences of rain on the degradation of airplane performance are also considered. Author

N82-20149*# National Aeronautics and Space Administration.
Langley Research Center, Hampton, Va.
**LAMINAR FLOW CONTROL. THE RESEARCH AND
TECHNOLOGY STUDIES 1981**

Dal V. Maddalon, ed. Mar. 1982 135 p refs Proceedings of Conf. held at Dryden Flight Research Center, Edwards, Calif., 17-18 Sep. 1981
(NASA-CP-2218; NAS 1.55:2218; L-15084) Avail: NTIS
HC A07/MF A01 CSCL 01A

Laminar flow airfoil design and construction, boundary layer control characteristics, and construction materials and methods are discussed. For individual titles, see N82-20150 through N82-20155.

N82-20150*# National Aeronautics and Space Administration.
Langley Research Center, Hampton, Va.**NASA LANGLEY LAMINAR FLOW CONTROL AIRFOIL
EXPERIMENT**

W. D. Harvey and J. D. Pride *In its* Laminar Flow Control
Mar. 1982 p 1-42 refs

Avail: NTIS HC A07/MF A01 CSCL 01A

The design and construction of an advanced swept supercritical airfoil for commercial aircraft to be tested in a transonic wind tunnel is described. The swept LFC airfoil was designed for a given thickness ratio and lift coefficient, with emphasis placed on high critical Mach number with shock-free flow. It is compatible with satisfactory low speed and buffeting characteristics and minimizing the suction laminarization. Further emphasis was placed on achieving shock-free flow over a wide range of off-design conditions including trailing edge flap control. The requirements and design of the suction system and modifications to the Langley 8 foot transonic pressure tunnel is briefly described. Contouring of nonporous test section walls for free air simulation and flow quality improvements is included. J.D.H.

N82-20151*# National Aeronautics and Space Administration.
Langley Research Center, Hampton, Va.**STATUS OF NASA ADVANCED LFC AIRFOIL HIGH-LIFT
STUDY**

Zachary T. Applin *In its* Laminar Flow Control Mar. 1982
p 43-62 refs
Avail: NTIS HC A07/MF A01 CSCL 01A

The design of a high lift system for the NASA advanced LFC airfoil designed by Pfenninger is described. The high lift system consists of both leading and trailing edge flaps. A 3 meter semispan, 1 meter chord wing model using the above airfoil and high lift system is under construction and will be tested in the NASA Langley 4 by 7 meter tunnel. This model will have two separate full span leading edge flaps (0.10c and 0.12c) and one full span trailing edge flap (0.25c). The performance of this high lift system was predicted by the NASA two dimensional viscous multicomponent airfoil program. This program was also used to predict the characteristics of the LFC airfoils developed by the Douglas Aircraft Company and Lockheed-Georgia Aircraft Company. J.D.H.

N82-20152*# Virginia Polytechnic Inst. and State Univ.,
Blacksburg. Dept. of Engineering Sciences and Mechanics.

N82-20153

STABILITY OF BOUNDARY LAYERS WITH POROUS SUCTION STRIPS: EXPERIMENT AND THEORY

G. A. Reynolds, W. S. Saric, H. L. Reed, and A. H. Nayfeh *In* NASA. Langley Research Center Laminar Flow Control Mar. 1982 p 63-74 ref

(Grants NsG-1608; NsG-1255; Contract N00014-75-C-0381)
Avail: NTIS HC A07/MF A01 CSCL 01A

Low turbulence tunnel experiments on the stability and transition of 2 D boundary layers on flat plates with and without suction are described. A number of general suction cases are discussed. Test results showed that the maximum stabilization occurred when the suction was moved toward the Branch I neutral point. An analytical study of the stability of two dimensional, incompressible boundary layer flows over plates with suction through porous strips was performed. The mean flow was calculated using linearized triple deck, closed form solutions. The stability results of the triple deck theory are shown to be in good agreement with those of the interacting boundary layers. An analytical optimization scheme for the suction configuration was developed. Numerical calculations were performed corresponding to the experimental configurations. In each case, the theory correctly predicts the experimental results. J.D.H.

N82-20153*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

PROBABILITY OF LAMINAR FLOW LOSS BECAUSE OF ICE CRYSTAL ENCOUNTERS

Richard E. Davis *In its* Laminar Flow Control Mar. 1982 p 75-94 refs

Avail: NTIS HC A07/MF A01 CSCL 01A

A method for combining the cloud detector observation results from the Global Atmospheric Sampling Program (GASP) with Knollenberg probe observations of cloud particle concentration from other programs to derive estimates of the ambient concentration of particles larger than a given size was developed. The method was applied to estimate the probability of encountering particle concentrations which would degrade the performance of laminar flow control (LFC) aircraft. It is concluded that LF loss should occur only about one percent of the time in clear air and that flight within clouds should always result in a significant loss of LF, with 90 percent LF loss occurring about one percent of the time. Preliminary estimates of cloud encounter probability are presented for four airline routes, and conclusions are presented as to the best altitudes for cloud avoidance in extratropical and tropical latitudes. Author

N82-20154*# Rockwell International Corp., Los Angeles, Calif. Aircraft Div.

SPF/DB TITANIUM CONCEPTS FOR STRUCTURAL EFFICIENCY FOI HC

V. E. Wilson *In* NASA. Langley Research Center Laminar Flow Control Mar. 1982 p 95-110

Avail: NTIS HC A07/MF A01 CSCL 01A

Illustrations for a presentation on superplastic forming/diffusion bonding titanium design concepts are presented. Sandwich skin panels with hat section, semicircular corrugation, sine wave, and truss cores are shown. The fabrication of wing panels is illustrated, and applications to the design of advanced variable sweep bombers summarized. J.D.H.

N82-20155*# McDonnell-Douglas Corp., Long Beach, Calif.

SPF/DB TITANIUM LFC POROUS PANEL CONCEPT
Neil R. Williams *In* NASA. Langley Research Center Laminar Flow Control Mar. 1982 p 111-138

Avail: NTIS HC A07/MF A01 CSCL 01A

Illustrations for a presentation demonstrating superplastic forming/diffusion bonding titanium porous panels are presented. Fabrication phases, sandwich panels, load bearing qualities, microstructure, and panel surface after finishing are illustrated. J.D.H.

N82-20156*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

STATIC INTERNAL PERFORMANCE OF SINGLE EXPANSION-RAMP NOZZLES WITH THRUST VECTORING AND REVERSING

Richard J. Re and Bobby L. Berrier Mar. 1982 143 p refs (NASA-TP-1962; L-14902; NAS 1.60:1962) Avail: NTIS HC A07/MF A01 CSCL 01A

The effects of geometric design parameters on the internal performance of nonaxisymmetric single expansion-ramp nozzles were investigated at nozzle pressure ratios up to approximately 10. Forward-flight (cruise), vectored-thrust, and reversed-thrust nozzle operating modes were investigated. B.W.

N82-20157# Transportation Systems Center, Cambridge, Mass. Research and Special Programs Administration.

CHICAGO MONOSTATIC ACOUSTIC VORTEX SENSING SYSTEM. VOLUME 2: DECAY OF B-707 AND DC-8 VORTICES Final Report, Oct. 1976 - Dec. 1979

D. C. Burnham and J. N. Hallock Washington FAA Sep. 1981 136 p refs

(AD-A109518; DOT-TSL-FAA-79-18-Vol-2; FAA-RD-79-103-Vol-2) Avail: NTIS HC A07/MF A01 CSCL 01/2

A Monostatic Acoustic Vortex Sensing System (MAVSS) was installed at Chicago's O'Hare International Airport to measure the strength and decay of aircraft wake vortices from landing aircraft. The MAVSS consists of an array of acoustic antennas which measure the vertical profile up to 60-m altitude of the vertical component of the wind. The decay in wake vortex strength is measured as the vortex passes over successive antennas in the array. In this volume, the data are analyzed to examine whether landing B-707 and DC-8 aircraft need to be divided into Heavy and non-Heavy categories on the basis of wake vortex hazard. Volume I (published in October 1979) described the MAVSS principles of operation, the hardware developed, and the data reduction methods employed. GRA

N82-20158# Calspan Field Services, Inc., Arnold Air Force Station, Tenn. AEDC Div.

AERODYNAMIC CHARACTERISTICS AND STORE LOADS OF A 1/24 SCALE F-111 AIRCRAFT MODEL WITH THREE EXTERNAL STORE LOADINGS Final Report

C. F. Anderson AEDC Jul. 1981 41 p refs Sponsored by Air Force

(AD-A109449; AEDC-TR-81-P30) Avail: NTIS HC A03/MF A01 CSCL 02/4

The 1/24 scale F-111 aircraft model was tested in the Aerodynamic Wind Tunnel (4T) to obtain simultaneous measurements of the aircraft and store aerodynamic loads. Static stability and store loads data were obtained at 4 wind sweep angles for Mach numbers from 0.6 to 1.2. The angle of attack was varied from -2 to 24 deg and the angle of sideslip was varied from -10 to 10 deg. Author (GRA)

N82-20159# Committee on Commerce, Science, and Transportation (U. S. Senate).

FUTURE OF GENERAL AND COMMUTER AVIATION TECHNOLOGY AND TRADE

Washington GPO 1981 317 p refs Joint hearing before the Subcomm. on Transportation, Aviation and Materials of the Comm. on Sci. and Technol. and the Subcomm. on Aviation of the Comm. on Commerce, Sci., and Transportation, 97th Congr., 1st Sess., No. 42, 27 Aug. 1981 (GPO-85-832) Avail: Subcomm. on Transportation, Aviation and Materials

Problems affecting the aircraft industry are discussed and include Federal tax laws, interest rates, fuel costs, and government involvement in civil aviation. Aeronautical research programs and the funding that they receive were reviewed. The economic contribution of general aviation is considered and ways in which government can assist the general aviation industries are highlighted. T.M.

N82-20160# Naval Ocean Systems Center, San Diego, Calif. Bioacoustics and Bionics Div.

PROJECT SEA HUNT: A REPORT ON PROTOTYPE DEVELOPMENT AND TESTS Final Report, 1979 - 1980

J. V. Simmons, Jr. Jul. 1981 66 p refs (AD-A109510; NOSC/TR-746) Avail: NTIS HC A04/MF A01 CSCL 06/7

During FY 79-80, a prototype Sea Hunt system was built and tested. Sea Hunt utilizes trained pigeons carried in a container attached to the underside of a helicopter to locate objects colored red, yellow or orange. Development of hardware and pigeon training methods are presented. Conclusions based on test data are: Sea Hunt improves detection and localization of appropriate targets; the system is reliable and easily serviced and

maintained. A recommendation is made to conduct operational field testing of Sea Hunt at a Coast Guard air station. GRA

N82-20161# Naval Air Development Center, Warminster, Pa. Aircraft and Crew Systems Technology Directorate.
DEVELOPMENT OF AN EJECTION SEAT BALLAST BLOCK FOR THE S-3A AIRCRAFT Final Report

Dan Lorch 4 Nov. 1981 18 p
(AD-A109808: NADC-81272-60) Avail: NTIS HC A02/MF A01 CSCL 01/3

The purpose of this Ballast Block is to ballast an unoccupied ejection seat in the S-3A aircraft. The block adjusts the mass of the seat and the center of gravity to fall within acceptable limits to prevent rapid seat acceleration and tumbling both of which might cause interference with an ejected occupied seat.

Author (GRA)

N82-20162# Naval Air Development Center, Warminster, Pa. Aircraft and Crew Systems Technology Directorate.
DEVELOPMENT OF A SUPPORTED AIRBAG EJECTION RESTRAINT (SABER) FOR WINDBLAST PROTECTION

Dan Lorch 4 Nov. 1981 22 p refs
(AD-A109807: NADC-81274-60) Avail: NTIS HC A02/MF A01 CSCL 01/3

This is a preliminary investigation to develop an airbag mounted on an ejection seat. The airbag is designed to deploy during an emergency ejection and may provide both prepositioning of the aircrewman and windblast protection for his upper torso. The airbag is tightly packed on a flexible steel strap which is mounted at the aircrewman's shoulder level. Quick disconnect fittings on either side permit the crewmen to enter the seat; they also disconnect the entire system upon seat/man separation.

Author (GRA)

N82-20163# National Oceanic and Atmospheric Administration, Norman, Okla.

DOPPLER RADAR RESEARCH AND APPLICATION TO AVIATION FLIGHT SAFETY, 1977 - 1979 Final Report

J. T. Lee Jun. 1981 45 p refs
(Contract DOT-FA77WAI-808)
(AD-A109845: FAA-RD-81-79) Avail: NTIS HC A03/MF A01 CSCL 17/9

Thunderstorm turbulence detection and the display of the turbulence location offer a significant advance toward improvement in flight safety and utilization of critical air space. A cooperative program involving the Federal Aviation Administration, U.S. Air Force's Aeronautical Systems Command, and the National Oceanic and Atmospheric Administration's National Severe Storms Laboratory has been conducted under a code name of 'Rough Rider'. An F-4-C aircraft instrumented to record turbulence, temperature and wind during thunderstorm penetrations has been used to obtain in situ measurements of these parameters concurrently with Doppler and conventional weather radar observations. The results of this program indicate that the Doppler measured radial wind component's spectral width holds promise as a turbulence indicator. Turbulence of the severe or greater nature was always accompanied by spectral widths greater than 4 m/s. A second part of the program was to display forenoted Doppler radar data in real time at a Radar Approach Control office and at an Air Route Traffic Control Center. This display provided an insight into requirements for an operational system.

Author (GRA)

N82-20164# Environmental Research and Technology, Inc., Concord, Mass.

DETECTION AND TRACKING ALGORITHM REFINEMENT Final Technical Report

G. B. Gustafson and R. K. Crane Washington DOT Oct. 1981 194 p refs
(Contracts DTFA01-81-Y-10521; NA-81-RAC-00072)
(AD-A109517: ERT-P-B035; FAA-RD-81-80) Avail: NTIS HC A09/MF A01 CSCL 01/2

A previous aircraft hazard detection algorithm shown to have high detectability but with a high false alarm rate has been modified to improve reliability for aircraft warnings. The derived Doppler parameter tangential (or radial) shear is incorporated as a radar cell attribute and used in the determination of significant hazard. Further modifications to the processing structure allow for radar operation in a non-automatic mode, thereby accommodating arbitrary changes in PRF, integrator type or scan geometry. A revised output format provides a sorted hierarchical list of

derived meteorological structures in a form readily adapted to a graphics display. Author (GRA)

N82-20165# Army Test and Evaluation Command, Fort Huachuca, Ariz.

SAFETY (AVIATION MATERIAL) Final Report

18 Jan. 1982 45 p
(AD-A110361) Avail: NTIS HC A03/MF A01 CSCL 01/2

Existing test methodology and techniques necessary to determine the degree to which aviation material meets the safety requirements stated in the requirements documents are discussed. These procedures cover the requirements, aircraft armaments, airframes, ejection seats, and electrical, mechanical, and miscellaneous hazards related to Army aircraft. A guide for laser safety is included. R.J.F.

N82-20166 Ohio Univ., Athens.

UTD TERRAIN REFLECTION MODEL WITH APPLICATION TO ILS GLIDE SLOPE Ph.D. Thesis

Vichate Ungvichian 1981 279 p
Avail: Univ. Microfilms Order No. 8126070

A terrain reflection model based on the uniform theory of diffraction (UTD) is described which can accommodate any piecewise linear terrain profile, requires less computer time than the physical optics models, is capable of including transverse terrain effects, and determines the reflected fields with all important diffraction and blockage effects included. The results when compared to measurements indicate that this UTD model can accurately predict ILS flight path effects due to ground irregularity. Furthermore, the results obtained from this UTD model are compared against the predictions of a previously developed physical optics (PO) model. UTD and PO predictions in most cases agree with one another, but better results are obtained from the UTD model for truncated or severely upsloping terrain. Dissert. Abstr.

N82-20167# Committee on Science and Technology (U. S. House).

AIR TRAFFIC CONTROL EN ROUTE COMPUTER MODERNIZATION

Washington GPO 1981 28 p Report presented by the Subcomm. on Transportation, Aviation, and Materials of the Comm. on Sci. and Technol., 97th Congr., 1st Sess., Aug. 1981 (GPO-82-773) Avail: Subcomm. on Transportation, Aviation, and Materials

The need for full modernization and replacement of the enroute computers is discussed. Interim replacement options are considered. The service life of the current system and the FAA's ability to manage the enroute computer modernization were examined. Anticipated costs and computer outages are presented. It is concluded that proceeding with full modernization is the best way to achieve needed productivity benefits and assure continued safe operation in the enroute airspace. T.M.

N82-20168# Committee on Science and Technology (U. S. House).

FAA AIR TRAFFIC CONTROL COMPUTER MODERNIZATION

Washington GPO 1981 101 p Hearings before the Subcomm. on Transportation, Aviation and Materials of the Comm. on Sci. and Technol., 97th Congr., 1st Sess., No. 13, 16-18 Jun. 1981 (GPO-82-375) Avail: Subcomm. on Transportation, Aviation and Materials

The issues of air traffic safety, the separation of air traffic, and the movement of traffic from one part of the country to another, are discussed. The proposed computer system was examined. Questions concerning whether the current system can be safely operated while a new system is being implemented and whether the overall cost effectiveness of the new system is adequate, are considered. The FAA's plans were reviewed along with its management of the current system. T.M.

N82-20169# Committee on Science and Technology (U. S. House).

AIRCRAFT COLLISION AVOIDANCE AND AIR TRAFFIC SAFETY

Washington GPO 1982 80 p Hearing before the Subcomm. on Transportation Aviation and Materials of the Comm. on Sci. and Technol., 97th Congr., 1st Sess., No. 52, 2 Sep. 1981 (GPO-88-545) Avail: Subcomm. on Transportation, Aviation and Materials

The threat alert and collision avoidance system is examined. The technical and policy aspects of air transportation safety are reviewed. S.L.

N82-20172# Transportation Systems Center, Cambridge, Mass. Research and Special Programs Administration.
STATISTICAL ANALYSIS AND TIME SERIES MODELING OF AIR TRAFFIC OPERATIONS DATA FROM FLIGHT SERVICE STATIONS AND TERMINAL RADAR APPROACH CONTROL FACILITIES: TWO CASE STUDIES Final Report, Oct. 1979 - Sep. 1980
 Norman J. Meyerhoff and George H. Wang Washington FAA Oct. 1981 60 p refs
 (AD-A109873; TSC-FAA-81-18; DTS-522; DOT-FAA-EM-82-13) Avail: NTIS HC A04/MF A01 CSCL 17/7

Two statistical procedures have been developed to estimate hourly or daily aircraft counts. These counts can then be transformed into estimates of instantaneous air counts. The first procedure estimates the stable (deterministic) mean level of hourly or day of the week patterns by statistical models. The second procedure estimates both deterministic and stochastic periodic (hourly or day of the week) patterns by stochastic time series models. Both statistical procedures have been used to analyze traffic at the St. Louis TRACON and Los Angeles Flight Service Station. This report analyzes hourly variations in operations at the St. Louis TRACON, for each day in four representative months in 1979. It also analyzes daily variations for three months in 1979 of flight plan activity at the Los Angeles FSS. The results of these analyses are given preliminary interpretations, and are available for possible application to other facilities. They are also available for other applications, such as estimation of instantaneous air counts in hubs. GRA

N82-20173# Federal Aviation Administration, Washington, D.C. Systems Research and Development Service.
OPERATIONAL DELAY DAY FORECASTS FOR THE 20 AIR ROUTE TRAFFIC CONTROL CENTERS FOR THE YEAR 1982 THROUGH 2011 Final Report
 W. Livingston Jun. 1981 24 p refs
 (AD-A109844; FAA-RD-81-93) Avail: NTIS HC A02/MF A01 CSCL 17/7

The effect of forecasts of increased traffic growth at each of the 20 CONUS Air Route Traffic Control Centers has been examined to determine the impact upon processor utilization of the Central Computer Complex at each center. The study assumes continuation of the current operational capabilities and procedures at each center, and is based upon field data collected between June 1980 and January 1981, and the June 1981 forecast of the IFR aircraft handled at the 20 Air Route Traffic Control Centers. Other factors such as channel utilization are not included in this phase of the study. Author (GRA)

N82-20174*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SIMULATION OF THE XV-15 TILT ROTOR RESEARCH AIRCRAFT
 Gary B. Churchill (Army Aeromechanics Lab., Moffett Field, Calif.) and Daniel C. Dugan Mar. 1982 23 p refs
 (NASA-TM-84222; A-8848; NAS 1.15:84222) Avail: NTIS HC A02/MF A01 CSCL 01C

The effective use of simulation from issuance of the request for proposal through conduct of a flight test program for the XV-15 Tilt Rotor Research Aircraft is discussed. From program inception, simulation complemented all phases of XV-15 development. The initial simulation evaluations during the source evaluation board proceedings contributed significantly to performance and stability and control evaluations. Eight subsequent simulation periods provided major contributions in the areas of control concepts; cockpit configuration; handling qualities; pilot workload; failure effects and recovery procedures; and flight boundary problems and recovery procedures. The fidelity of the simulation also made it a valuable pilot training aid, as well as a suitable tool for military and civil mission evaluations. Simulation also provided valuable design data for refinement of automatic flight control systems. Throughout the program, fidelity was a prime issue and resulted in unique data and methods for fidelity evaluation which are presented and discussed. R.J.F.

N82-20175*# National Aeronautics and Space Administration, Washington, D. C.

FATIGUE ANALYSIS OF COMPOSITE MATERIALS USING THE FAIL-SAFE CONCEPT

G. Stievenard Jan. 1982 11 p Transl. into ENGLISH of AGARD Rept. AGARD-CP-297 (France), Mar. 1981 p 1-15 Translation was announced as N81-26131 Transl. by SCITRAN, Santa Barbara, Calif.
 (Contract NASw-3542)
 (NASA-TM-76671; NAS 1.15:76671) Avail: NTIS HC A02/MF A01 CSCL 11D

If R1 is the probability of having a crack on a flight component and R2 is the probability of seeing this crack propagate between two scheduled inspections, the global failure regulation states that this product must not exceed 0.0000001. R.J.F.

N82-20176# Aeronautical Research Labs., Melbourne (Australia).
SEA KING FLIGHT TESTS PITOT-STATIC PROBE AND DIRECTIONAL VANE INSTRUMENTATION

D. T. Hourigan and M. J. Williams Jul. 1981 26 p refs
 (AD-A109427; ARL/AERO-TM-332; AR-002-298) Avail: NTIS HC A03/MF A01 CSCL 01/3

A short description is given of the pitot-static pressure probe and vanes mounted on a nose boom for Sea King flight tests. Also described is a probe which was trailed below the aircraft to determine the position error of the boom probe. Results of wind tunnel calibrations of these probes are given. Author (GRA)

N82-20177# Aeronautical Research Labs., Melbourne (Australia).
BOOM PROBE POSITION ERROR CORRECTIONS FOR SEA KING Mk 50 FLIGHT TESTS

M. J. Williams Jul. 1981 34 p refs
 (AD-A109428; ARL/AERO-TM-331; AR-002-297) Avail: NTIS HC A03/MF A01 CSCL 01/3

Position error has been determined for a nose-boom mounted pitot static probe installed on a Sea King Mk. 50 helicopter. The error is sensibly constant in the speed range 35 - 110 knots and is unchanged in climb and descent. Corrections to be applied to indicated nose boom values are 7.5 knots in velocity, and up to 80 ft. in altitude. Author (GRA)

N82-20178# Analytical Methods, Inc., Redmond, Wash.
A SURFACE SINGULARITY METHOD FOR ROTORS IN HOVER OR CLIMB Final Report, 29 Mar. 1979 - 30 Sep. 1981

J. Summa and Brian Maskew Dec. 1981 142 p refs
 (Contract DAAJ02-76-C-0069; DA Proj. 1F2-62209-AH-76)
 (AD-A109687; AMI-8103; USAAVRADCOM-TR-81-D-23) Avail: NTIS HC A07/MF A01 CSCL 20/4

A surface singularity potential flow code, ROTAIR, has been assembled for the calculation of detailed surface pressures on rotors in hover or climb. This method is basically a marriage of two codes: the fixed-wing surface singularity doublet code and the rotor lifting-surface code. The program includes a tip vortex separation model. Also, the rotor tip surface is panelled so that pressures are calculated right around the tip-edge surface. Preliminary calculations have verified the capabilities of the program for computing blade surface properties in the presence of a close-vortex passage. Additionally, calculated pressure distributions compare favorably with experimental data for a low aspect ratio two-bladed rotor, and the calculated circulation distribution is consistent with that computed earlier with the lifting-surface code. Finally, the newly developed far-wake doublet model promises to keep computing efforts practical. Author (GRA)

N82-20179# Naval Air Development Center, Warminster, Pa. Aircraft and Crew Systems Technology Directorate.

A SHORT TAKEOFF PERFORMANCE COMPUTER PROGRAM Final Report

David Bruce Kobus 25 Nov. 1981 122 p refs
 (ZRO20302)
 (AD-A109861; NADC-81259-60) Avail: NTIS HC A06/MF A01 CSCL 01/3

A short takeoff performance computer program has been developed by NAVAIRDEVCCEN to be used for performance estimation and conceptual aircraft design. Author (GRA)

N82-20180*# National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.
SIMULATOR STUDY OF A PICTORIAL DISPLAY FOR GENERAL AVIATION INSTRUMENT FLIGHT

James J. Adams Mar. 1982 59 p refs
(NASA-TP-1963; L-14675; NAS 1.60:1963) Avail: NTIS
HC A04/MF A01 CSCL 01D

A simulation study of a computer drawn pictorial display involved a flight task that included an en route segment, terminal area maneuvering, a final approach, a missed approach, and a hold. The pictorial display consists of the drawing of boxes which either move along the desired path or are fixed at designated way points. Two boxes may be shown at all times, one related to the active way point and the other related to the standby way point. Ground tracks and vertical profiles of the flights, time histories of the final approach, and comments were obtained from time pilots. The results demonstrate the accuracy and consistency with which the segments of the flight are executed. The pilots found that the display is easy to learn and to use; that it provides good situation awareness, and that it could improve the safety of flight. The small size of the display, the lack of numerical information on pitch, roll, and heading angles, and the lack of definition of the boundaries of the conventional glide slope and localizer areas were criticized. A.R.H.

N82-20181# Arizona Univ., Tucson. Optical Sciences Center.
**DESIGN OF A CATADIOPTRIC VCASS HELMET-MOUNTED
DISPLAY Final Report, 15 Feb. 1978 - 15 Sep. 1979**

R. A. Buchroeder, G. W. Seeley, and D. Vukobratovich Wright-Patterson AFB, Ohio AFAMRL Nov. 1981 73 p refs
(Contract F33615-78-C-0520; AF Proj. 7184)
(AD-A109431; AFAMRL-TR-81-133) Avail: NTIS
HC A04/MF A01 CSCL 01/3

A new wide-angle, dual-eye, helmet-mounted display has been designed. Two images combine, with a 15 deg. central field overlap, to provide a panoramic display 102 deg. wide by 45 deg. tall, with a resolution to approximately 1000 TV lines per eye. The image-generating device is a miniature 18 mm CRT. The optics, which are symmetrical for both eyes, comprise partially reflective plastic reflectors, five small glass lens elements, and a 2:1 fiber optic magnifier. A 12 mm exit pupil is obtained with enough eye relief to permit the user to wear glasses, with an interpupillary adjustment of 58 to 73 mm. Total weight of the device, not including the Air Force flight helmet type HGU-2A/P upon which it is mounted, is less than 3 pounds.

Author (GRA)

N82-20182*# National Aeronautics and Space Administration,
Washington, D. C.

**CONDITIONS OF GENERATION AND METHODS OF
DAMPING THE INLET VORTEX OF A TURBOJET ENGINE**

Tadeusz Gajewski Mar. 1982 14 p refs Transl. into ENGLISH
from Tech. Lotnicza Astronaut. (Poland), v. 35, no. 11, Nov.
1980 p 5-8 Translation was announced as A81-19442 Transl.
by Kanner (Leo) Associates, Redwood City, Calif.
(Contract NASw-3541)

(NASA-TM-76678; NAS 1.15:76678) Avail: NTIS
HC A02/MF A01 CSCL 21E

An aeromechanical analysis of the generation of an inlet vortex in a turbojet engine is presented. Methods for the prevention of vortex generation and methods of vortex damping are described.

Author

N82-20184# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio. Turbine Engine Div.

**A RETIREMENT-FOR-CAUSE STUDY OF AN ENGINE
TURBINE DISK Final Report, 1975 - 1978**

Richard J. Hill, Walter H. Reimann, and Jon S. Ogg Nov. 1981
35 p refs

(AF Proj. 3066)
(AD-A109724; AFWAL-TR-81-2094) Avail: NTIS
HC A03/MF A01 CSCL 21/5

This report describes a procedure which allows for the retirement of turbine engine disks for actual life exhaustion rather than a statistical minimum limit of a population. The procedure is applied to the third stage turbine disk of the TF33 engine for demonstration purposes. The demonstration included detailed stress and fracture analysis in addition to actual spin pit testing. All spin pit testing was done by the Navy at the Naval Propulsion Center. The effort was a technical success but could not be implemented for the TF33 engine for logistic reasons.

Author (GRA)

N82-20185# Garrett Corp., Phoenix, Ariz. Pneumatic Systems
Div.

**DUALCHANNEL FUEL CONTROL PROGRAM, PHASE 2
Final Report, Apr. 1978 - Aug. 1980**

John Itamoto Adelphi, Md. HDL Aug. 1981 81 p refs
(Contract N00019-78-G-0288)

(AD-A109715; Rept-41-2710A; HDL-CR-81-288-1) Avail:
NTIS HC A05/MF A01 CSCL 21/5

This report presents the results of a program conducted by Garrett to investigate a dual-channel fuel control for gas turbine engines which could be used in military ground vehicles. The program presents a control system with requirements that are deemed necessary to provide a military gas turbine-powered vehicle with battlefield survivability and minimal restriction on the capability of completing the vehicle mission. This study showed that a parallel dissimilar technology backup control was the desirable approach and that fluidics was the ideal technology to perform this function due to its low cost, reliability, immunity to radiation, and ability to perform computation and logic commensurate with the requirements of achieving mission completion with no degradation in the vehicle's battlefield survivability. GRA

N82-20186*# National Aeronautics and Space Administration,
Ames Research Center, Moffett Field, Calif.

**A TRANSLATIONAL VELOCITY COMMAND SYSTEM FOR
VTOL LOW SPEED FLIGHT**

Vernon K. Merrick Mar. 1982 30 p refs
(NASA-TM-84215; A-8825; NAS 1.15:84215) Avail: NTIS
HC A03/MF A01 CSCL 01C

A translational velocity flight controller, suitable for very low speed maneuvering, is described and its application to a large class of VTOL aircraft from jet lift to propeller driven types is analyzed. Estimates for the more critical lateral axis lead to the conclusion that the controller would provide a jet lift (high disk loading) VTOL aircraft with satisfactory 'hands off' station keeping in operational conditions more stringent than any specified in current or projected requirements. It also seems likely that ducted fan or propeller driven (low disk loading) VTOL aircraft would have acceptable hovering handling qualities even in high turbulence, although in these conditions pilot intervention to maintain satisfactory station keeping would probably be required for landing in restricted areas.

Author

N82-20187*# National Aeronautics and Space Administration,
Ames Research Center, Moffett Field, Calif.

**DESIGN CRITERIA FOR FLIGHTPATH AND AIRSPEED
CONTROL FOR THE APPROACH AND LANDING OF STOL
AIRCRAFT**

James A. Franklin, Robert C. Innis, Gordon H. Hardy, and Jack D. Stephenson Mar. 1982 98 p refs

(NASA-TP-1911; NAS 1.60:1911; A-8645) Avail: NTIS
HC A05/MF A01 CSCL 01C

A flight research program was conducted to assess requirements for flightpath and airspeed control for glide-slope tracking during a precision approach and for flare control, particularly as applied to powered-lift, short takeoff and landing (STOL) aircraft. Ames Research Center's Augmentor Wing Research Aircraft was used to fly approaches on a 7.5 deg glide slope to landings on a 30 X 518 m (100 X 1700 ft) STOL runway. The dominant aircraft response characteristics determined were flightpath overshoot, flightpath-airspeed coupling, and initial flightpath response time. The significant contribution to control of the landing flare using pitch attitude was the short-term flightpath response. The limiting condition for initial flightpath response time for flare control with thrust was also identified. It is possible to define flying-qualities design criteria for glide-slope and flare control based on the aforementioned response characteristics. M.D.K.

N82-20188*# National Aeronautics and Space Administration,
Ames Research Center, Moffett Field, Calif.

**SELF-TUNING REGULATORS FOR MULTICYCLIC CONTROL
OF HELICOPTER VIBRATION**

Wayne Johnson Mar. 1982 50 p refs
(NASA-TP-1996; NAS 1.60:1996; A-8719) Avail: NTIS
HC A03/MF A01 CSCL 01C

A class of algorithms for the multicyclic control of helicopter vibration and loads is derived and discussed. This class is characterized by a linear, quasi-static, frequency-domain model of the helicopter response to control; identification of the helicopter model by least-squared-error or Kalman filter methods; and a minimum variance or quadratic performance function controller. Previous research on such controllers is reviewed. The derivations and discussions cover the helicopter model; the identification

N82-20189

problem, including both off-line and on-line (recursive) algorithms; the control problem, including both open-loop and closed-loop feedback; and the various regulator configurations possible within this class. Conclusions from analysis and numerical simulations of the regulators provide guidance in the design and selection of algorithms for further development, including wind tunnel and flight tests. M.G.

N82-20189# Naval Air Development Center, Warminster, Pa. Aircraft and Crew Systems Technology Directorate.

DEVELOPMENT OF LONGITUDINAL EQUIVALENT SYSTEM MODELS FOR SELECTED US NAVY TACTICAL AIRCRAFT

Final Report, 1 Jan. 1980 - 1 Jul. 1981

David E. Bischoff 1 Aug. 1981 86 p refs

(WF41400000)

(AD-A109488; NADC-81069-60)

Avail: NTIS

HC A05/MF A01 CSCL 01/3

Frequency response matching techniques were applied to the longitudinal dynamics of five Navy tactical aircraft: the A-6, A-7, S-3, F-14 and F-18, to obtain equivalent system models of their short period response. The pitch rate transfer function was matched with a first order numerator over second order denominator equivalent system model. Freeing the numerator root (L Alpha) in the matching process resulted in large unrealistic values of the numerator term. The variation in L Alpha was reduced by simultaneously matching the pitch rate and normal acceleration transfer functions with the denominators constrained to be equal. The mismatch parameter associated with aircraft configurations which were not amenable to the first over second order equivalent models could be improved by identifying additional roots in the equivalent model. Correlation of the data with the requirements of MIL-F-8785C was straightforward for both short period damping ratio and time delay. Correlation of the frequency requirements, however, required that the control anticipation parameter definition be modified to represent the maximum rather than the initial pitch acceleration response.

Author (GRA)

N82-20190# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio. Structures and Dynamics Div.

CATEGORIZATION OF ATMOSPHERIC TURBULENCE IN TERMS OF AIRCRAFT RESPONSE FOR USE IN TURBULENCE REPORTS AND FORECASTS Final Report, Jan. 1979 - Feb. 1980

Elijah W. Turner, Jackie C. Sims, and Andy White Nov. 1981

146 p refs

(AF Proj. 7500)

(AD-A109585; AFWAL-TR-81-3058)

Avail: NTIS

HC A07/MF A01 CSCL 01/2

This report describes a method of calculating the gust sensitivity of conventional aircraft and presents gust sensitivity values for a total of 69 military and civilian aircraft. Gust sensitivity is presented in terms of the vertical load factor response of aircraft per foot per second discrete gust. The information is intended to permit organizations engaged in the forecasting of atmospheric turbulence to properly take into consideration the capability of particular aircraft to operate safely in various turbulence levels. The basis for calculating the gust sensitivity is the so called 'gust loads formula' which is a single degree of freedom mathematical model of the aircraft excited by a one-minus-cosine shaped wave form of 25 chord wave length. An empirical equation is used to calculate the aircraft normal force coefficient over the subsonic, transonic, and supersonic airspeed range.

Author (GRA)

N82-20191# Army Aviation Research and Development Command, St. Louis, Mo.

INTEGRATION OF CONTROLS AND DISPLAYS IN U.S. ARMY HELICOPTER COCKPITS

J. A. Dasaro and C. T. Elliott Nov. 1981 28 p refs

(AD-A109594; USAAVRADCOM-TR-81-E-4)

Avail: NTIS

HC A03/MF A01 CSCL 01/4

The U.S. Army has embarked on a digital avionic program with the immediate goal of developing an integrated avionic system which would eliminate all dedicated communication, navigation, and identification (CNI) control and display units (CDU's) from the cockpit. The CNI equipments were viewed as a well defined set whose control and display functions could be integrated at minimal risk. The integrated CDU developed can be used to in-service or developmental aircraft to alleviate space problems, reduce pilot workload, and increase CNI capability. A four-phase effort consisting of design, hardware fabrication, system

integration, and testing was established. A cockpit was synthesized for the BLACK HAWK helicopter in which all crew functions were accomplished using multifunction interactive controls and displays. The results of this effort are presented, together with the status of the hardware currently in fabrication and the Army's plans for bench and flight testing. This exploratory effort is called the Army Digital Avionic System (ADAS). GRA

N82-20192*# National Aeronautics and Space Administration, Washington, D. C.

SONIC WIND TUNNEL OF THE INSTITUTE OF FLUID MECHANICS OF LILLE

G. Gontier Mar. 1982 17 p refs Transl. into ENGLISH from La Recherche Aeronautique (France), no. 10, 1949 p 3-9 Transl. by Kanner (Leo) Associates, Redwood City, Calif.

(Contract NASw-3541)

(NASA-TM-76687; NAS 1.15:76687)

Avail: NTIS

HC A02/MF A01 CSCL 14E

A 65 hp wind tunnel with a 40 mm by 240 mm airstream is described. This wind tunnel can achieve speeds in the neighborhood of the speed of sound, both subsonic and supersonic. It is useful in studying the transonic bump technique. The test section is 600 mm long. The side walls are made of transparent glass, and both the upper and lower walls are deformable, each through the use of nine jacks with elastic sleeves. So as to avoid condensation, the airstream's turbulence is stabilized by an air exchanger at the temperature of the outside air. The first results for supersonic operation, the distribution of Mach numbers within the airstream between the parallel walls, the value of the use factor, and the diffuser's efficiency are all given. B.W.

N82-20193# Sandia Labs., Albuquerque, N. Mex. Dept. of Engineering Science and Mechanics.

METHODS FOR ANALYSIS OF WIND RIPPLE IN WIND TURBINES

R. E. Akins Apr. 1981 59 p refs

(Contract DE-AC04-76-DP-00789)

(SAND-81-7006) Avail: NTIS HC A04/MF A01

Efficient and economical utilization of wind power requires the ability to measure and ultimately predict the effects fluctuations in the incident wind have on a wind turbine. In order to begin to quantitatively assess these effects, experimental techniques were developed to allow analysis of full-scale performance of wind turbines with particular emphasis on the effects caused by turbulence in the incident wind. R.J.F.

N82-20194# Textron Bell Helicopter, Fort Worth, Tex. ROTORCRAFT FLIGHT SIMULATION COMPUTER PROGRAM C81 WITH DATAMAP INTERFACE. VOLUME 1: USER'S MANUAL Final Report, Jul. - Dec. 1979

James R. VanGaasbeek Ft. Eustis, Va. Army Research and Technology Lab. Oct. 1981 576 p refs

(Contract DAAK51-79-C-0015; DA Proj. 1L1-62209-AH-76)

(AD-A108246; BHT-699-099-111-Vol-1;

USAAVRADCOM-TR-80-D-38A)

Avail: NTIS

HC A25/MF A01 CSCL 01/3

This report documents the current version in the C81 family of rotorcraft flight simulation programs developed by Bell Helicopter Textron. This current version of the digital computer program is referred to as AGAP80. The accompanying program for calculating fully-coupled rotor blade mode shapes is called D NAM05, and an associated rotor wake program is called AR9102. The AGAP80 version of C81 was developed by adding some analytical features to the AGAJ76 version, and including the ability to generate Data Transfer Files for use by the File Creation Program of DATAMAP. The User's Manual, contains the detailed information necessary for setting up an input data deck and interpreting the computed data. GRA

N82-20195# Singer Co., Binghamton, N.Y. Link Div. STUDY AND DESIGN OF HIGH G AUGMENTATION DEVICES FOR FLIGHT SIMULATORS Final Report

Gerald J. Kron, Frank M. Cardullo (MIT), and Laurence R. Young Wright-Patterson AFB, Ohio Air Force Human Resources Lab. Dec. 1981 548 p refs

(Contract F33615-77-C-0055; AF Proj. 6114)

(AD-A109127; AFHRL-TP-80-41)

Avail: NTIS

HC A23/MF A01 CSCL 06/19

The physiological effects of accelerated flight are considered to contain perceptual information important to vehicle control and contribute to defining flight envelopes accessible to the pilot.

As such, these effects, or acceptable surrogates thereof, must be considered for inclusion within ground-based devices designed to train pilots for their flight mission. This study investigates the physiological effects of accelerated flight within the cardiovascular musculoskeletal, visual, auditory, tactile, and respiratory systems. The study advances conceptual designs of research-oriented devices thought capable of inducing, in the unaccelerated state, the perception of accelerated flight physiological effects. The authors conclude that one of the most important effects impacting vehicle control and successful mission execution is loss of visual acuity under accelerated flight conditions and propose a dual effect matrixed liquid crystal variable transparency visor to replicate this effect. A math model to simulate the effect is also presented. The study contains a bibliography of 277 references pertinent to accelerated flight physiological effects and equivalent simulation device design. The study presents an appendix containing an annotated bibliography of 133 references. Author (GRA)

N82-20339* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

IDENTIFICATION OF MULTIVARIABLE HIGH PERFORMANCE TURBOFAN ENGINE DYNAMICS FROM CLOSED LOOP DATA

Walter Merrill 1982 16 p refs Presented at the 6th IFAC Symp. on Identification and System Parameter Estimation, Washington, D.C., 7-11 Jun. 1982 (NASA-TM-82785; E-1120; NAS 1.15:82785) Avail: NTIS HC A02/MF A01 CSCL 21E

The multivariable instrumental variable/approximate maximum likelihood (IV/AML) method or recursive time-series analysis is used to identify the multivariable (four inputs-three outputs) dynamics of the Pratt and Whitney F100 engine. A detailed nonlinear engine simulation is used to determine linear engine model structures and parameters at an operating point using open loop data. Also, the IV/AML method is used in a direct identification mode to identify models from actual closed loop engine test data. Models identified from simulated and test data are compared to determine a final model structure and parameterization that can predict engine response for a wide class of inputs. The ability of the IV/AML algorithm to identify useful dynamic models from engine test data is assessed. Author

N82-20343# Southampton Univ. (England). Inst. of Sound and Vibration Research.

VIBRATION OF STRUCTURES EXCITED ACOUSTICALLY

B. L. Clarkson *In* AGARD Mod. Data Anal. Tech. in Noise and Vibration Probl. Nov. 1981 p 19-37 refs

Avail: NTIS HC A08/MF A01

The analytical methods available to estimate the response of structures to vibration are developed on the assumption that the structure itself does not change the properties of the incident sound field by any feed back or flutter type mechanism. The normal mode method is used for the majority of the work to estimate the response to any sound field. Special cases considered are jet noise excitation, turbulent boundary layer pressure excitation, and a reverberant field excitation. The alternative traveling wave method is also introduced. J.D.H.

N82-20357* National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.

CRYOGENIC TECHNOLOGY, PART 1

Mar. 1980 273 p refs Conf. held at Hampton, Va., 27-29 Nov. 1979

(NASA-CP-2122-Pt-1; L-13547; NAS 1.55:2122-Pt-1) Avail: NTIS HC A12/MF A01 CSCL 20L

Different engineering problems associated with the design of mechanisms and systems to operate in a cryogenic environment are discussed. The focal point for the entire engineering effort was the design of the National Transonic Facility, which is a closed-circuit cryogenic wind tunnel. The papers covered a variety of mechanical, structural, and systems design subjects including thermal structures insulation systems, noise, seals, and materials. R.J.F.

N82-20358* National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.

CRYOGENIC TECHNOLOGY, PART 2

Mar. 1980 159 p refs Conf. held at Hampton, Va., 27-29 Nov. 1979

(NASA-CP-2122-Pt-2; L-13547; NAS 1.55:2122-Pt-2) Avail: NTIS HC A08/MF A01 CSCL 20L

Proceedings of a conference on the cryogenic technology developed in support of a transonic wind tunnel are given. Papers address tunnel instrumentation and mode/sting technology.

R.J.F.

N82-20384# Naval Research Lab., Washington, D. C. Space Science Div.

COMPUTER-PROGRAM MODEL FOR PREDICTING HORIZONTALLY AND VERTICALLY POLARIZED VLF ATMOSPHERIC RADIO NOISE AT ELEVATED RECEIVERS Final Report

Francis J. Kelly, J. P. Hauser, and F. J. Rhoads 28 Dec. 1981 22 p refs (AD-A109448; NRL-8479) Avail: NTIS HC A02/MF A01 CSCL 20/14

A computer program was developed that can predict horizontally and vertically polarized atmospheric radio noise at any altitude or location in the Earth-ionosphere waveguide in the very-low-frequency (VLF) range from 10 to 30 kHz. The new program, HORNS, uses the outputs of two previously written programs, COMPWR and NOISLAN, which predict the vertical electric noise field at the ground. The HORNS program computes all the field components at any altitude using the vertical electric field at the Earth's surface as a basis. Predicted values from several versions of the new model were compared with presently available data. The results are encouraging, but more data are needed to test the model. GRA

N82-20392# Transportation Systems Center, Cambridge, Mass. Research and Special Programs Administration.

TEST PLAN FOR SSR Final Report

Janis Vilcans Washington FAA Oct. 1981 143 p (AD-A109503; FA-180-PM-81-40; DOT-FAA-RD-81-64; TSC-FAA-81-23) Avail: NTIS HC A07/MF A01 CSCL 17/9

A comprehensive test plan is presented to evaluate the impact of wind and ice loading on the rotation rate stability of a Secondary Surveillance Radar (SSR) antenna used for air traffic control surveillance. Antenna rotation rate variations may introduce errors in the estimate of a position of an intruding aircraft in a passive collision avoidance system used in conjunction with the SSR antenna. The test plan provides a method for determining the statistics of the antenna rotation rate variations. Analytical methods are then presented to assess the effects on CAS performance. The measurement system design, mathematical model development of the antenna system, test data reduction, and analysis programs are presented in detail. Sample calculations of preliminary field data are given and compared with the results obtained from computer simulations. The computer simulations are also intended to predict antenna rotation rate variations at the upper limits of the FAA specified range, which were not generally encountered during normal operations. Author (GRA)

N82-20468# Northrop Corp., Hawthorne, Calif. Aircraft Div. **VORTEX FLOW CORRELATION Final Report, May - Oct. 1980**

Gary E. Erickson Wright-Patterson AFB, Ohio AFWAL Jan. 1981 357 p refs (Contract F33615-80-C-3024; AF Proj. 2307) (AD-A108725; NOR-80-152; AFWAL-TR-80-3143) Avail: NTIS HC A16/MF A01 CSCL 14/2

Key parameters have been identified which permit correlation of vortex flow simulations in a water tunnel with wind tunnel and flight data. Vortex generation, vortex sheet and core location, and a vortex strength on thin slender wings are accurately represented in a water tunnel due to the insensitivity of separation point location to changes in Reynolds number. The fact that theoretical methods which ignore viscous effects can reasonably predict vortex flow aerodynamics is one indication of the Reynolds number insensitivity of these flow phenomena. For wings and bodies where separation point varies with Reynolds number, the fundamental vortex structure is similar regardless of Reynolds number value since vortices at a distance from the generating surfaces are embedded in essentially irrotational flow. External pressure gradient is an important parameter affecting vortex stability and, although there is yet no theoretical verification that this parameter is the dominant one, vortex burst at higher angles of attack for a given configuration occurs at comparable positions in water tunnels as in wind tunnels and flight. A water tunnel is a powerful diagnostic tool capable of providing

N82-20472

high-quality flow visualization of complex fluid flows and insight into the phenomenological aspects of vortex generation, interactions between multiple vortices and aerodynamic surfaces and vortex burst. GRA

N82-20472# Massachusetts Inst. of Tech., Cambridge. Dept. of Ocean Engineering.

EXPERIMENTAL METHODS FOR THE PREDICTION OF THE EFFECT OF VISCOSITY ON PROPELLER PERFORMANCE Ph.D. Thesis

Sukeyuki Kobayashi Jun. 1981 155 p refs
(Contract N00014-76-C-0357; SR0090101)
(AD-A109846; OE-81-7) Avail: NTIS HC A08/MF A01 CSCL 13/10

A Laser Doppler Velocimeter (LDV) was used to perform a propeller wake survey for DTNSRDC propellers 4381 and 4383. Three components of the velocity were measured and from this, the velocity field and the vorticity field were constructed. Through a coordinate transformation, the vorticity field was separated into two parts i.e., trailing vorticity and boundary layer type vorticity in the viscous wake. The data was used for the prediction of propeller blade profile drag (viscous sectional drag). The idea of hypothetical flow by Betz was extended to propeller flow and a formula for the profile drag was derived in terms of velocities, which is suitable for LDV application. The radial distribution of profile drag was computed using the velocity data. It was shown that the value of C_d is close to that of 2-dimensional section at mid-radius range, but becomes substantially lower at inner and outer radii and that it goes up again near the tip and the hub. This trend is consistent with the behavior of profile drag of a finite span wing. Author (GRA)

N82-20544*# National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.

VARIABLE RESPONSE LOAD LIMITING DEVICE Patent Application

Dwight D. McSmith, inventor (to NASA) Filed 6 Oct. 1981 18 p
(NASA-Case-LAR-12801-1; US-Patent-Appl-SN-309291) Avail: NTIS HC A02/MF A01 CSCL 131

An energy absorbing device used as a load limiting member in a structure to control its response to applied loads is described. It functions by utilizing a spool assembly having flanged ends and an interior cavity of sufficiently large diameter to cause it to deform plastically at a prescribed load. In application, the spool is utilized as a pivot point for the legs of an aircraft seat. When properly designed and integrated into the seat arrangement the spool will twist about its axis, deforming plastically when the impact load exceeds the spool yield value. Through this deformation, the spool absorbs the kinetic energy of the movement of the seat at a substantially constant rate, thereby controlling the level of loads transmitted to the seat occupant. By proper sizing and selection of materials, it is possible to control load response in a predictable manner. NASA

N82-20545*# National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.

TUBING AND CABLE CUTTING TOOL Patent Application

Dwight D. McSmith and James I. Richardson, inventors (to NASA) Filed 6 Oct. 1981 10 p
(NASA-Case-LAR-12786-1; US-Patent-Appl-SN-309292) Avail: NTIS HC A02/MF A01 CSCL 131

A hand held hydraulic cutting tool was developed which is particularly useful in deactivating ejection seats in military aircraft rescue operations. The tool consists primarily of a hydraulic system composed of a fluid reservoir, a pumping piston, and an actuator piston. Mechanical cutting jaws are attached to the actuator piston rod. The hydraulic system is controlled by a pump handle. As the pump handle is operated the actuator piston rod is forced outward and thus the cutting jaws are forced together. The frame of the device is a flexible metal tubing which permits easy positioning of the tool cutting jaws in remote and normally inaccessible locations. Bifurcated cutting edges ensure removal of a section of the tubing or cable to thereby reduce the possibility of accidental reactivation of the tubing or cable being severed. NASA

N82-20549# Pace Associates, Inc., Milwaukee, Wis.

HEAVY-DUTY ENGINES ANALYSIS, STUDY 4: A PRELIMINARY MARKET ANALYSIS FOR GAS-TURBINE APPLICATIONS IN THE FARM MARKET

Jul. 1981 18 p refs Prepared for Argonne National Lab.

(Contract W-31-109-eng-38)
(DE82-001758; ANL/CNSV-TM-81) Avail: NTIS HC A02/MF A01

The opportunity for the gas turbine in the farm market and if the market's requirements complement the development of the engine for other markets was analyzed. It was determined that the major applications of gas turbines in the farm equipment market are in two wheel drive and four wheel drive diesel powered tractors. However, the market for gas turbines lies at the heavier end of the spectrum. There is an opportunity for larger quantities of lower horsepower engines because turbine engines for automobiles would be in the same size range. It is suggested that the development of a reliable multifuel turbine combined with a reliable power train capable of meeting the load requirements of the farm tractor is a timely undertaking. Fuel efficiency requirements are balanced by the need for multifuel capability and imposed environmental requirements. DOE

N82-20561*# California Univ., Los Angeles.

APPLICATION OF THE FINITE ELEMENT METHOD TO ROTARY WING AEROELASTICITY Final Report

F. K. Straub and P. P. Friedmann Feb. 1982 232 p refs
(Grant NsG-1578)
(NASA-CR-165854; NAS 1.26:165854; UCLA-ENG-80-81) Avail: NTIS HC A11/MF A01 CSCL 20K

A finite element method for the spatial discretization of the dynamic equations of equilibrium governing rotary-wing aeroelastic problems is presented. Formulation of the finite element equations is based on weighted Galerkin residuals. This Galerkin finite element method reduces algebraic manipulative labor significantly, when compared to the application of the global Galerkin method in similar problems. The coupled flap-lag aeroelastic stability boundaries of hingeless helicopter rotor blades in hover are calculated. The linearized dynamic equations are reduced to the standard eigenvalue problem from which the aeroelastic stability boundaries are obtained. The convergence properties of the Galerkin finite element method are studied numerically by refining the discretization process. Results indicate that four or five elements suffice to capture the dynamics of the blade with the same accuracy as the global Galerkin method. A.R.H.

N82-20566*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

ELASTIC-PLASTIC FINITE-ELEMENT ANALYSES OF THERMALLY CYCLED DOUBLE-EDGE WEDGE SPECIMENS

Albert Kaufman and Larry E. Hunt Mar. 1982 31 p refs
(NASA-TP-1973; E-626; NAS 1.60:1973) Avail: NTIS HC A03/MF A01 CSCL 20K

Elastic-plastic stress-strain analyses were performed for double-edge wedge specimens subjected to thermal cycling in fluidized beds at 316 and 1088 C. Four cases involving different nickel-base alloys (IN 100, Mar M-200, NASA TAZ-8A, and Rene 80) were analyzed by using the MARC nonlinear, finite element computer program. Elastic solutions from MARC showed good agreement with previously reported solutions obtained by using the NASTRAN and ISO3DQ computer programs. Equivalent total strain ranges at the critical locations calculated by elastic analyses agreed within 3 percent with those calculated from elastic-plastic analyses. The elastic analyses always resulted in compressive mean stresses at the critical locations. However, elastic-plastic analyses showed tensile mean stresses for two of the four alloys and an increase in the compressive mean stress for the highest plastic strain case. M.G.

N82-20573# Sandia Labs., Albuquerque, N. Mex.

APPROACH TO THE FATIGUE ANALYSIS OF VERTICAL-AXIS WIND-TURBINE BLADES

P. S. Veers Sep. 1981 35 p refs
(Contract DE-AC04-76DP-00789)
(DE82-003193; SAND-81-2130) Avail: NTIS HC A03/MF A01

The stress history of wind turbine blades indicates that a single stress level at each wind speed does not adequately describe the blade stress history and a statistical description is required. Blade stress data from experimental turbines indicate that the Rayleigh probability density function describes the distribution of vibratory stresses at each wind speed. The Rayleigh probability density function allows the distribution of vibratory stresses to be described by the RMS of the stress vs. time signal. With the RMS stress level described for all wind speeds, the complete

stress history of the turbine blades is known. Miner's linear cumulative damage rule is used as a basis for summing the fatigue damage over all operating conditions. An analytical expression is derived to predict blade fatigue life. DOE

N82-20746 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. fuer Optoelektronik.

RANGEFINDER SYSTEM FOR SLANT RANGE VISIBILITY [WEGE ZUR NETZMAESSIGEN ERFASSUNG DER SCHRAEGSICHT]

Christian Werner In Deutscher Wetterdienst Soc. Meteorol. Palatina, 1780-1795 1980 p 60-65 refs In GERMAN; ENGLISH summary

Avail: Issuing Activity

Careful measurement of the slant range visibility is important for safe and regular aircraft landing operations. Measurements are necessary under visibility conditions lower than 1500 m up to an altitude of about 100 m. Many remote sensing methods are known to determine the slant range visibility. A modified laser rangefinder system which uses a simplified slope method is described. The accuracy of this 'Two-Point-Method' is analyzed for several atmospheric conditions. Measurements with a described prototype system are presented. J.M.S.

N82-20811# Systems Control, Inc., West Palm Beach, Fla. **WEATHER DETERIORATION MODELS APPLIED TO ALTERNATE AIRPORT CRITERIA Final Report**

Edwin D. McConkey Sep. 1981 103 p

(Contract DOT-FA79NA-6029)

(AD-A108877; FAA-RD-81-92)

Avail: NTIS

HC A06/MF A01 CSCL 04/2

Flights under Instrument Flight Rules (IFR) require the filing of a flight plan. The flight plan must contain an alternate airport unless certain conditions at the destination are met. These conditions concern the availability of an instrument approach procedure and anticipated meteorological conditions within one hour of the estimated arrival time. Certain other conditions must be met for an airport to qualify as an alternate airport. These conditions also are based on instrument approach procedure availability and forecast meteorological conditions. Relaxation of the current requirements regarding alternate airports could benefit some aircraft operators by improving schedule reliability and reducing the number of weather related departure delays. The investigation quantified the increased risk of ceilings and visibilities being below landing minimums at several cities in the conterminous U.S. if requirements are relaxed. The study methods utilized climatology data and weather deterioration models to calculate the probability of an airport being below precision and non-precision approach minimums. Author (GRA)

N82-20997# Hampton Inst., Va. Dept. of Mathematics and Computer Science.

A DESCRIPTIVE STUDY OF THE APPLICATION OF ANALYSIS OF VARIANCE AND REGRESSION TECHNIQUES IN AN ERROR ANALYSIS PROGRAM FOR TEST DATA OBTAINED IN A 16 FOOT TRANSONIC TUNNEL M.S. Thesis

Daisy Williams Alston Apr. 1981 216 p refs

Avail: NTIS HC A10/MF A01

A mathematical model has been designed that used standard statistical techniques to perform an error analysis of wind tunnel test data. Three separate but dependent computer programs define the procedure necessary for the generation and manipulation of the required data. By applying the methods of least squares, cubic splines, analysis of variance, and regression analysis, the programs calculate and compare experimental data with test control data. The solution of the problem reveals that the nature of the lift and drag coefficient data versus angle of attack vary linearly, therefore the equation of a straight line is sufficient to represent the data. To minimize the residual differences, a third order curve fit, which defines an equation that represents the experimental pressure coefficient data, is used. Calculation of the F-ratios determines the significant components of the 2 x 7 x 5 factorial design and indicates the independent variables that significantly reduce the error factor. M.G.

N82-21031# Avco Lycoming Div., Stratford, Conn. **YF 102 IN-DUCT COMBUSTOR NOISE MEASUREMENTS**

WITH A TURBINE NOZZLE, VOLUME 1 Final Report, Sep. 1979 - Mar. 1981

Craig A. Wilson and James M. OConnell Sep. 1981 63 p refs

(Contract NAS3-21974)

(NASA-CR-165562-Vol-1; NAS 1.26:165562-Vol-1;

LYC-81-32-Vol-1) Avail: NTIS HC A04/MF A01 CSCL 20A

The internal noise generated by an Avco Lycoming YF-102 engine combustor installed in a test rig was recorded. Two configurations were tested one with and one without the first stage turbine nozzle installed. Acoustic probes and accessories were used. Internal dynamic pressure level measurements were made at ten locations within the combustor. The combustor rig, the test procedures, and data acquisition and reduction systems are described. Tables and plots of narrow band and one third octave band pressure level spectra are included. S.L.

N82-21032# Avco Lycoming Div., Stratford, Conn. **YF 102 IN-DUCT COMBUSTOR NOISE MEASUREMENTS WITH A TURBINE NOZZLE, VOLUME 2 Final Report**

Craig A. Wilson and James M. OConnell Sep. 1981 232 p refs

(Contract NAS3-21974)

(NASA-CR-165562-Vol-2; NAS 1.26:165562-Vol-2;

LYC-81-32-Vol-2) Avail: NTIS HC A11/MF A01 CSCL 20A

The internal noise generated by an Avco Lycoming YF-102 engine combustor installed in a test rig was recorded. The one third octave band pressure level spectra is presented. S.L.

N82-21033# Avco Lycoming Div., Stratford, Conn. **YF 102 IN-DUCT COMBUSTOR NOISE MEASUREMENTS WITH A TURBINE NOZZLE, VOLUME 3 Final Report**

Craig A. Wilson and James M. OConnell Sep. 1981 244 p refs

(Contract NAS3-21974)

(NASA-CR-165562-Vol-3; NAS 1.26:165562-Vol-3;

LYC-81-32-Vol-3) Avail: NTIS HC A11/MF A01 CSCL 20A

The internal noise generated by an Avco Lycoming YF-102 engine combustor installed in a test rig was recorded. The narrow band pressure level spectra is presented. S.L.

N82-21037# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

FLUCTUATING PRESSURES ON FAN BLADES OF A TURBOFAN ENGINE: STATIC AND WIND-TUNNEL INVESTIGATIONS

James A. Schoenster Mar. 1982 48 p refs

(NASA-TP-1976; L-14913; NAS 1.60:1976) Avail: NTIS

HC A03/MF A01 CSCL 21E

To investigate the fan noise generated from turbofan engines, miniature pressure transducers were used to measure the fluctuating pressure on the fan blades of a JT15D engine. Tests were conducted with the engine operating on an outdoor test stand and in a wind tunnel. It was found that a potential flow interaction between the fan blades and six, large support struts in the bypass duct is a dominant noise source in the JT15D engine. Effects of varying fan speed and the forward speed on the blade pressure are also presented. Author

N82-21041# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.

ACOUSTIC MEASUREMENTS OF F-4E AIRCRAFT OPERATING IN HUSH HOUSE, NSN 4920-02-070-2721 Final Report, May - Sep. 1981

Vincent R. Miller, G. A. Plzak, and J. M. Chinn Sep. 1981 105 p refs

(AD-A109827; AFWAL-TM-81-84-FIBE/FIB'G) Avail: NTIS HC A06/MF A01 CSCL 20/1

The primary purpose of this test program was to measure the acoustic environment in the hush house facility located at Kelly Air Force Base, Texas, during operation of the F-4E aircraft to ensure that aircraft structural acoustic design limits were not exceeded. The acoustic measurements showed that sonic fatigue problems are anticipated with the F-4E aircraft aft fuselage structure during operation in the hush house. The measured acoustic levels were less than those measured in an F-4E aircraft water cooled hush house at Hill AFB in the lower frequencies, but were increased over that measured during ground run up on some areas of the aircraft. It was recommended that the acoustic loads measured in this program should be specified in

N82-21042

the structural design criteria for aircraft which will be subjected to hush house operation or defining requirements for associated equipment. Recommendations were also made to increase the fatigue life of the aft fuselage. Author (GRA)

N82-21042# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.

ACOUSTIC MEASUREMENTS OF F-15 AIRCRAFT OPERATING IN HUSH HOUSE, NSN 4920-02-070-2721 Final Report, May - Sep. 1981

Vincent R. Miller, G. A. Plzak, and J. M. Chinn Sep. 1981 117 p refs

(AD-A109828; AFWAL-TM-81-82-FIBE/FIBG) Avail: NTIS HC A06/MF A01 CSCL 20/1

The purpose of this test program was to measure the acoustic environment in the hush house facility located at Kelly Air Force Base, Texas, during operation of the F-15 aircraft to ensure that aircraft structural acoustic design limits were not exceeded. The acoustic measurements showed that no potential sonic fatigue problems are anticipated with the F-15 aircraft structure during operation in the hush house. However, since these acoustic levels were increased over those measuring during run up on a concrete pad, it is recommended that F-15 equipment qualification levels be checked. The data indicated that the noise field within the hush house is diffuse and that the acoustical energy in the hangar area is radiated from the region between the engine exhaust and the hush house muffler front edge toward the forward part of the hangar. Author (GRA)

N82-21043# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.

ACOUSTIC MEASUREMENTS OF F-16 AIRCRAFT OPERATING IN HUSH HOUSE, NSN 4920-02-070-2721 Final Report, May - Sep. 1981

Vincent R. Miller, G. A. Plzak, and J. M. Chinn Sep. 1981 110 p refs

(AD-A109829; AFWAL-TM-81-83-FIBE/FIBG) Avail: NTIS HC A06/MF A01 CSCL 20/1

The purpose of this test program was to measure the acoustic environment in the hush house facility located at Kelly Air Force Base, Texas, during operation of the F-16 aircraft to ensure that aircraft structural acoustic design limits were not exceeded. The acoustic measurements showed that no sonic fatigue problems are anticipated with the F-16 aircraft aft fuselage structure during operation in the hush house. The measured acoustic levels were less than those measured in an F-16 aircraft water cooled hush house at Hill AFB, but were increased over that measured during ground run up. It was recommended that the acoustic loads measured in this program should be specified in the structural design criteria for aircraft which will be subjected to hush house operation or defining requirements for associated equipment. Author (GRA)

N82-21054*# Cornell Univ., Ithaca, N. Y. Dept. of Astronomy.

THE SIXTEEN TO FORTY MICRON SPECTROSCOPY FROM THE NASA LEAR JET Final Technical Report, 1 Oct. 1970 - 31 Oct. 1980

J. R. Houck Mar. 1982 63 p refs

(Grant NGR-33-010-182)

(NASA-CR-168684; NAS 1.26:168684) Avail: NTIS HC A04/MF A01 CSCL 20F

Two cryogenically cooled infrared grating spectrometers were designed, fabricated and used on the NASA Lear Jet Observatory. The first spectrometer was used to measure continuum sources such as dust in H II regions, the galactic center and the thermal emission from Mars, Jupiter, Saturn, and Venus over the 16 to 40 micron spectral range. The second spectrometer had higher resolution and was used to measure ionic spectral lines in H II regions (S III at 18.7 microns). It was later used extensively on NASA C-141 Observatory to make observations of numerous objects including H II regions, planetary nebulae, stars with circumstellar shells, the galactic center and extragalactic objects. The spectrometers are described including the major innovations and a list of the scientific contributions. S.L.

N82-21139*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.

PROCEEDINGS: FIFTH ANNUAL WORKSHOP ON METEOROLOGICAL AND ENVIRONMENTAL INPUTS TO AVIATION SYSTEMS

Dennis W. Camp, ed., Walter Frost, ed. (Tennessee Univ. Space

Inst.), and Pamela D. Parsley, ed. Dec. 1981 149 p refs Workshop held at Tullahoma, Tenn., 30 Mar. - 1 Apr. 1981; sponsored by NASA, NOAA and FAA (Contract NAS8-32692)

(NASA-CP-2192; NAS 1.55:2192; FAA-RD-81-67) Avail: NTIS HC A07/MF A01 CSCL 01B

Aviation safety, meteorology, air traffic control, training, flight operations, general aviation, and aviation weather research and services were examined in an effort to expand understanding and knowledge of the interaction of the atmosphere with aviation systems, better define and implement services to operators, and to collect and interpret data for establishing operational criteria relating the total meteorological inputs from the atmospheric sciences to the needs of aviation communities. For individual titles, see N82-21140 through N82-21152.

N82-21140*# Federal Aviation Administration, Washington, D.C. Energy Div.

METEOROLOGICAL IMPACT ON AVIATION FUEL EFFICIENCY

David E. Winer and John E. Wesler /n NASA, Marshall Space Flight Center Proc.: 5th Ann. Workshop on Meteorol. and Environ. Inputs to Aviation Systems Dec. 1981 p 15-19 refs

Avail: NTIS HC A07/MF A01 CSCL 01C

The connection between fuel consumption and weather data is discussed. Fuel efficient flights creating adequate near real time weather information are examined. The lack of highly resolved real time and near real time wind and temperature data at flight altitudes is investigated. The existing systems, which is based on twice a day balloon observations, supplemented by pilot reports or other occasional data, is not adequate for optimum flight planning. The impacts of upper winds and temperatures on fuel efficiency and flight planning are not widely appreciated and developing new weather products are considered. E.A.K.

N82-21141*# McDonnell-Douglas Electronics Co., St. Charles, Mo.

METEOROLOGICAL INPUTS TO ADVANCED SIMULATORS

Gordon O. Handberg /n NASA, Marshall Space Flight Center Proc.: 5th Ann. Workshop on Meteorol. and Environ. Inputs to Aviation Systems Dec. 1981 p 21-25 refs

Avail: NTIS HC A07/MF A01 CSCL 14B

Weather simulation as it is currently implemented and some suggestions and questions considered in future simulator developments are described. Flight simulators represent weather in a considerably broader sense and with an almost limitless capability for future expansion. Realistic weather is important in pilot training simulators. It offers promising opportunity to provide training because it permits an element of environmental control not available in the real world. E.A.K.

N82-21142*# USAir, Pittsburgh, Pa.

OPERATIONAL PROCEDURES RELATIVE TO SEVERE WEATHER

James F. Sullivan /n NASA, Marshall Space Flight Center Proc.: 5th Ann. Workshop on Meteorol. and Environ. Inputs to Aviation Systems Dec. 1981 p 26-28

Avail: NTIS HC A07/MF A01 CSCL 01C

Severe weather impact on both safety and the economics of all types of aviation, and reduction of elimination are discussed. The functions and responsibilities of the dispatcher are outlined. All surface weather reports showing inclement weather, SIGMET REPORTS, forecasting turbulence or icing, convective SIGMETS: (1) tornadoes; (2) hail 3/4 of an inch or greater; (3) imbedded thunderstorms; (4) squall lines or (5) an area of level four or greater thunderstorms. This information along with PIREPs of severe weather are relayed to affected flights. It is concluded that operational procedures must be timely and well conceived to assure the least amount of impact on airline operations. E.A.K.

N82-21143*# National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.

METEOROLOGY IMPACT ON FUTURE AIRCRAFT DESIGN

Joseph W. Stickle /n NASA, Marshall Space Flight Center Proc.: 5th Ann. Workshop on Meteorol. and Environ. Inputs to

Aviation Systems Dec. 1981 p 29-34

Avail: NTIS HC A07/MF A01 CSCL 01C

Meteorology impact on future aircraft design is discussed. Upcoming changes in both design and operations that will be influenced by the meteorological environment are outlined. Future and more nonconventional designs and meteorological impact brought about by operational changes over the next few years are examined. E.A.K.

N82-21144*# Federal Aviation Administration, Washington, D.C. Systems Research and Development Div.

METEOROLOGY IMPACT ON ATC SYSTEM DESIGN

Frank E. VanDemark *In* NASA, Marshall Space Flight Center Proc.: 5th Ann. Workshop on Meteorol. and Environ. Inputs to Aviation Systems Dec. 1981 p 35-39

Avail: NTIS HC A07/MF A01 CSCL 17G

The impact of meteorology on air traffic control (ATC) system design for designs, and for cost benefit evaluations is discussed. The myriad of choices for implementation is a problem of great magnitude, given the economic climate of today. Cost versus benefit requires greater emphasis. Expanding and improving weather data acquisition, increasing the speed of weather data transmission and automating those actions that lend themselves to standardization for automated data processing are outlined. Three programs are mentioned: (1) automated weather observations, (2) weather radar and improvements to the national airspace system as related to the handling of weather data; and (3) products. E.A.K.

N82-21145*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

OZONE AND AIRCRAFT OPERATIONS

Porter J. Perkins *In* NASA, Marshall Space Flight Center Proc.: 5th Ann. Workshop on Meteorol. and Environ. Inputs to Aviation Systems Dec. 1981 p 40-44 refs

Avail: NTIS HC A07/MF A01 CSCL 04A

The cabin ozone problem is discussed. Cabin ozone in terms of health effects, the characteristics of ozone encounters by aircraft, a brief history of studies to define the problem, corrective actions taken, and possible future courses of action are examined. It is suggested that such actions include avoiding high ozone concentrations by applying ozone forecasting in flight planning procedures. E.A.K.

N82-21146*# National Aeronautics and Space Administration, Washington, D. C.

NASA RESEARCH PROGRAMS RESPONDING TO WORKSHOP RECOMMENDATIONS

A. Richard Tobiason *In* NASA, Marshall Space Flight Center Proc.: 5th Ann. Workshop on Meteorol. and Environ. Inputs to Aviation Systems Dec. 1981 p 58

Avail: NTIS HC A07/MF A01 CSCL 01B

The atmospheric electricity and lightning committee forecasts lightning and dissemination of information on the probability of occurrence. A data source with the F-106 flight program was established. The objective is to improve the detectability of lightning and severe storms and help develop operational avoidance procedures and to study the use of satellite and Doppler radar to detect thunderstorms and forecast the probability of lightning. Three recommendations are made: (1) to establish a national flying lightning laboratory; (2) strike models are considered and to gather strike data; (3) to find the best way to apply electrical field data to operations. E.A.K.

N82-21147*# Naval Research Lab., Washington, D. C. **PROGRESS ON LOW ALTITUDE CLOUD ICING RESEARCH**

Richard K. Jeck *In* NASA, Marshall Space Flight Center Proc.: 5th Ann. Workshop on Meteorol. and Environ. Inputs to Aviation Systems Dec. 1981 p 59-63 refs Prepared in cooperation with Naval Academy

Avail: NTIS HC A07/MF A01 CSCL 04B

The icing environment at altitudes below 10,000 feet were studied. The following questions are asked, are: (1) existing aircraft certification criteria applicable; (2) too stringent on icing for helos;

(3) based on accurate data; (4) appropriate for low (10,000 ft) altitudes? The research plan is outlined: review historical icing data, obtain new measurements, collect modern icing data from other groups, and recommend LWC, OAT, and MVD criteria for helicopters. Estimated accuracies and known sources of error are included. It is concluded that the net effect of possible sources of error of both signs is uncertain. E.A.K.

N82-21148*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

NASA/LEWIS RESEARCH CENTER ICING RESEARCH PROGRAM

Peggy L. Evanich *In* NASA, Marshall Space Flight Center Proc.: 5th Ann. Workshop on Meteorol. and Environ. Inputs to Aviation Systems Dec. 1981 p 64-75

Avail: NTIS HC A07/MF A01 CSCL 01C

Icing requirements for commercial aircraft, light transport and general aviation aircraft, and rotorcraft were studied. The objectives was to: establish the state of the art in aircraft icing, determining the aircraft industry's icing research and technology needs, and recommending both short and long term icing programs to NASA. It is shown that all three categories of aircraft need improved and new ice protection system, icing calculational techniques, icing performance sensitivity on current and modern airfoils, and new and improved icing facilities. The need for a general aviation pilot training film concerning flight into icing conditions is also identified. E.A.K.

N82-21149*# Dayton Univ., Ohio.

EFFECT OF HEAVY RAIN ON AIRCRAFT

James K. Luers *In* NASA, Marshall Space Flight Center Proc.: 5th Ann. Workshop on Meteorol. and Environ. Inputs to Aviation Systems Dec. 1981 76-80

Avail: NTIS HC A07/MF A01 CSCL 01C

A summary on heavy rain effects on aircraft aerodynamics validation of research and some wind shear accidents in which heavy rain were an important factor. Frost formation and what frost does to the lift and drag curves for an airfoil was examined. If frost could cause severe aerodynamic problems for both general aviation and transport aircraft due to its roughness, then heavy rain produce a similar result. The influencing parameters of heavy rain on an aircraft are studied. Sources of aerodynamic roughness due to rain and wind shear and heavy rain accidents are outlined. E.A.K.

N82-21150*# Federal Aviation Administration, Washington, D.C. **PROTOTYPE REGIONAL OBSERVATION AND FORECAST SYSTEM (PROFS)**

John W. Hinkelman, Jr. *In* NASA, Marshall Space Flight Center Proc.: 5th Ann. Workshop on Meteorol. and Environ. Inputs to Aviation Systems Dec. 1981 p 81-85

Avail: NTIS HC A07/MF A01 CSCL 04B

The prototype regional observation and forecast system (PROFS) outputs are demonstrated, functional design specifications to be used to procure and implement operational systems are outlined. Advanced candidate technologies are evaluated as an integral part of the process that leads to these outputs. Evaluation insures that future weather service systems will contain the optimum mix of technologies to be most cost effective in reducing the annual losses and deaths that are directly attributed to severe weather. E.A.K.

N82-21152*# National Center for Atmospheric Research, Boulder, Colo.

THE JOINT AIRPORT WEATHER STUDIES PROJECT

John McCarthy *In* NASA, Marshall Space Flight Center Proc.: 5th Ann. Workshop on Meteorol. and Environ. Inputs to Aviation Systems Dec. 1981 p 91-95

Avail: NTIS HC A07/MF A01 CSCL 04B

A block diagram of the joint airport weather studies program is presented. Background leading to the development of the program is reviewed. Basic studies, aircraft performance, and detection and warning techniques used to develop fine scale structure of thunderstorm dynamics and kinematics in the vicinity of a major airport; effect of thunderstorm low level wind shear on aircraft performance; and development of real time testing of flow level wind shear detection and warning techniques and displays are described. E.A.K.

N82-21153# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ACTA AERONAUTICA ET ASTRONAUTICA SINICA
 29 Dec. 1981 224 p Transl. into ENGLISH of Acta Aeron. et Astron. Sinica (China), v. 2, no. 2, 1981 p 1-102
 (AD-A110282; FTD-ID(RS)T-1129-81) Avail: NTIS HC A02/MF A01 CSCL 01/3

A collection of articles in aeronautical engineering is presented. Some of the topics discussed are: (1) oscillatory subsonic potential flows around three dimensional bodies and its application in calculating dynamic stability derivatives; (2) interpolation mixed differential method for transonic large distributed symmetrical potential flow around airfoil; (3) calculation of lift and drag characteristics of subsonic wings with winglets; (4) model for predicting overload retardation effect in fatigue crack propagation; (5) J-integral experimental calibration of sheet specimens with single edge notch; (6) design of transonic turbine cascade by hodograph method; (7) three dimensional stress analysis for a shrouded air cooled turbine blade; (8) methods for measuring radar ECCM performance; (9) aiming computation for fighter weapon aiming system; (10) optimum design of nonmoment laminated composite plate. E.A.K.

N82-21154# Societe Nationale Industrielle Aerospatiale, Paris (France). Helicopter Div.
INDUSTRIAL EXPERIENCE IN THE ANGLO-FRENCH HELICOPTER COLLABORATION
 J. C. Sieffer 1980 8 p
 (SNIAS-811-210-101) Avail: NTIS HC A02/MF A01

Anglo-French helicopter collaboration are summarized. The development of the SA 330 Puma, the SA 341 Gazelle, and the WG 13 Lynx multipurpose helicopter, with three versions for a variety of uses, is covered, and the launching of derivative aircraft (Westland WG 30 and Aerospatiale Super-Puma) is mentioned. The organization and experience of the collaboration are described, with the French and British shares of the work on each helicopter quantified. Sales are reviewed and compared with forecasts. Author (ESA)

N82-21155# Royal Aircraft Establishment, Farnborough (England).
A SUMMARY OF EXPERIMENTAL DATA ON WING CHARACTERISTICS AT TRANSONIC SPEEDS
 T. Nonweiler Apr. 1948 42 p refs
 (RAE-TN-Aero-1953-S.D.-77) Avail: NTIS HC A03

Dropped and rocket propelled models are tested. American tests give a variation in form drag with thickness at the speed of sound in accordance with the two thirds power law. British tests indicate a constant drag coefficient on frontal area. There is a tendency to reduce drag by introducing taper or reducing aspect ratio on rectangular wings. Results on swept wings are inconsistent but the reduction in drag with sweepback is very pronounced. Tunnel bulge tests indicate that the drag due to lift becomes very large at Mach numbers just below 1. Author (ESA)

N82-21156*# Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.
HELICOPTER ROTOR LOADS USING A MATCHED ASYMPTOTIC EXPANSION TECHNIQUE Final Report
 G. Alvin Pierce and Anand R. Vaidyanathan May 1981 125 p refs
 (Contract NAS1-16222)
 (NASA-CR-165742; NAS 1.26:165742) Avail: NTIS HC A06/MF A01 CSCL 01A

The theoretical basis and computational feasibility of the Van Holten method, and its performance and range of validity by comparison with experiment and other approximate methods was examined. It is found that within the restrictions of incompressible, potential flow and the assumption of small disturbances, the method does lead to a valid description of the flow. However, the method begins to break down under conditions favoring nonlinear effects such as wake distortion and blade/rotor interaction. E.A.K.

N82-21157*# Sikorsky Aircraft, Stratford, Conn.
AEROELASTIC ANALYSIS OF THE ELASTIC GIMBAL ROTOR Report, May 1980 - May 1981
 Raymond G. Carlson and Wen-Liu Miao May 1981 102 p refs Prepared for Army Research and Technology Labs.
 (Contract DAAK51-80-C-0016)

(NASA-CR-166287; NAS 1.26:166287; USAAVRADCOM-TR-82-A-3; SER-510048) Avail: NTIS HC A06/MF A01 CSCL 01A

An aeroelastic and structural loads analysis of the elastic gimbal rotor (EGR) was conducted. The structural loads analysis of the elastic gimbal rotor indicated that the gimbal spring element is the critical component in the rotor system design, but that practical designs for all components should be achievable. The aeroelastic analysis was conducted using a version of the G400 Rotor Aeroelastic Analysis especially modified to evaluate the EGR. Hover stability showed that a stiff inplane blade was more stable than a soft inplane blade. Stability was sensitive to control system coupling (pitch gimbal coupling), gimbal spring stiffness, and blade frequency placement. Ground resonance analysis showed both soft and stiff inplane rotors to be stable. A limited evaluation of the EGR in forward flight was conducted. Due to G400 analysis limitations, the results were not sufficient to define forward flight stability and stress limits. B.W.

N82-21158*# Vought Corp., Dallas, Tex.
V/STOL TANDEM FAN TRANSITION SECTION MODEL TEST

William E. Simpkin Mar. 1982 156 p refs
 (Contract NAS3-22155)
 (NASA-CR-165587; NAS 1.26:165587; TR2-53200/2R-53085) Avail: NTIS HC A08/MF A01 CSCL 01A

An approximately 0.25 scale model of the transition section of a tandem fan variable cycle engine nacelle was tested in the NASA Lewis Research Center 10-by-10 foot wind tunnel. Two 12-inch, tip-turbine driven fans were used to simulate a tandem fan engine. Three testing modes simulated a V/STOL tandem fan airplane. Parallel mode has two separate propulsion streams for maximum low speed performance. A front inlet, fan, and downward vectorable nozzle forms one stream. An auxiliary top inlet provides air to the aft fan - supplying the core engine and aft vectorable nozzle. Front nozzle and top inlet closure, and removal of a blocker door separating the two streams configures the tandem fan for series mode operations as a typical aircraft propulsion system. Transition mode operation is formed by intermediate settings of the front nozzle, blocker door, and top inlet. Emphasis was on the total pressure recovery and flow distortion at the aft fan face. A range of fan flow rates were tested at tunnel airspeeds from 0 to 240 knots, and angles-of-attack from -10 to 40 deg for all three modes. In addition to the model variables for the three modes, model variants of the top inlet were tested in the parallel mode only. These lip variables were: aft lip boundary layer bleed holes, and three position turning vane. Also a bellmouth extension of the top inlet side lips was tested in parallel mode. B.W.

N82-21159*# Flow Simulations, Inc., Sunnyville, Calif.
COMPUTATION OF WING-VORTEX INTERACTION IN TRANSONIC FLOW USING IMPLICIT FINITE DIFFERENCE ALGORITHM Final Report
 G. Srinivasan and J. L. Steger Mar. 1981 63 p refs
 (Contract NAS2-10474)
 (NASA-CR-166251; NAS 1.26:166251) Avail: NTIS HC A04/MF A01 CSCL 01A

An implicit delta form finite difference algorithm for Euler equations in conservation law form was used in preliminary calculations of three dimensional wing vortex interaction. Both steady and unsteady transonic flow wing vortex interactions are computed. The computations themselves are meant to guide upcoming wind tunnel experiments of the same flow field. Various modifications to the numerical method that are intended to improve computational efficiency are also described and tested in both two and three dimensions. Combination of these methods can reduce the overall computational time by a factor of 4. S.L.

N82-21161# Royal Aircraft Establishment, Farnborough (England).
LOW-SPEED MEASUREMENTS OF THE STATIC PRESSURE DISTRIBUTION AND OVERALL FORCES ON A CAMBERED AND A SYMMETRIC MILD GOTHIC WING OF ASPECT RATIO 1.4

P. J. Butterworth and D. G. Dobney London HMSO 22 May 1980 85 p refs
 (RAE-TR-80066; RAE-AERO-3482; BR75504) Avail: NTIS HC A05/MF A01
 A cambered wing of aspect ratio 1.4 was tested in a low

speed wind tunnel to determine its surface static pressure distribution at its designed attached flow incidence for comparison with the theoretical loading. To isolate the effects of camber on the separated flow characteristics of this planform, the corresponding symmetric wing was also included in the test program. The lift, drag and pitching moment characteristics of each wing were measured over a range of Reynolds numbers for comparison with the results of the earlier force tests and those derived by integration of the measured pressure distributions. It is found that at twice the design lift coefficient, the lift-dependent drag of the cambered wing is about 20% lower than that of the symmetric wing due to the favorable shift of the minimum point of the drag caused by the addition of camber. At higher values of the lift coefficient this reduction in lift-dependent drag is less, due to the unfavorably changed shape of the cambered wing's drag polar. Also, flow visualization tests and the form of the measured pressure distribution near the leading edges of the cambered wing at its design incidence confirm that the flow is attached along the leading edges. Author (ESA)

N82-21162# Messerschmitt-Boelkow-Blohm G.m.b.H., Otto-brunn (West Germany). Unternehmensbereich Flugzeuge.
AERODYNAMICS PROJECT. SIGNIFICANCE AND DIFFICULTIES IN THE EXPERIMENTAL AND NUMERICAL SIMULATION OF COMPLEX FLOW PROCESSES WITH HIGH REYNOLDS NUMBER AS PART OF AIRCRAFT PROJECTS [PROJEKTAERODYNAMIK. BEDEUTUNG UND PROBLEMATIK VON EXPERIMENTELLEN UND NUMERISCHEN SIMULATIONEN KOMPLEXER STROEMUNGSVORGAENGE MIT GROSSER REYNOLDS-ZAHL FÜER DIE PROJEKTEN-WICKLUNG VON FLUGZEUGEN]
 W. Heinzerling 29 May 1980 29 p refs In GERMAN (MBB-FE-120/S/PUB/33; DGLR-80-028) Avail: NTIS HC A03/MF A01

The importance of aerodynamic simulation in design processes is considered. Simulation as an aid in aircraft development is discussed, revealing fundamental problems posed by the modeling of flow regimes on aircraft configurations. The geometry and complexity of flow mechanics for specific configurations are elaborated. The observance of Reynolds similarity conditions is discussed. Possibilities and limitations of complex aerodynamic simulation are assessed. Numerical, experimental, and high Reynolds number simulation are then evaluated. Results are used in reviewing plans for a European transonic cryogenic wind tunnel. Given an optimal layout, the impact of this facility on the performance and competitiveness of the European aircraft industry is forecast. Author (ESA)

N82-21163# Royal Aircraft Establishment, Farnborough (England).
PRESSURE MEASUREMENTS ON A WING OSCILLATING IN SUPERCRITICAL FLOW
 N. C. Lambourne and B. L. Welsh London HMSO 25 Jun. 1979 178 p refs (RAE-TR-79074; RAE-Struct-BF/B/0783; BR71046) Avail: NTIS HC A09/MF A01

Perturbation pressures were measured on a model wing oscillating in a wind tunnel to study wing flutter under transonic conditions. The half model, which is based on a high aspect ratio wing of modern design could be given a small-amplitude oscillation consisting of rigid body rotation about a swept axis. The unsteady in-phase and in-quadrature pressure distributions were measured at five chordwise stations. Free stream Mach number was varied in stages from 0.60 to 0.86. The measurements were restricted to one value of oscillation frequency which corresponded to frequency parameters, based on mean chord, in the range 0.39 to 0.54. The oscillatory pressure distributions together with the principal oscillatory wing forces and moments obtained by integration are considered in relation to the steady flow pattern over the wing and particularly in relation to the development of transonic mixed flow at the upper surface. The effects arising from the presence of a shock wave are identified and discussed. Some comparisons are made between the measurements and the results of subsonic thin wing theory. Author (ESA)

N82-21164# Royal Aircraft Establishment, Farnborough (England).
PRESSURE DISTRIBUTIONS ON SOME DELTA WINGS AT $M = 4$
 L. C. Squire (Cambridge Univ., Engl.) and K. C. Moore London

HMSO 22 May 1980 46 p refs (RAE-TR-80068; RAE-Aero-3484; BR76040) Avail: NTIS HC A03/MF A01

Complete pressure distributions are presented for a series of delta wings tested through an incidence range at a Mach number of 4. Aspect ratios of models 1 and 3 were 4/3 and 1 respectively, and models 3 to 7, 2/3. The results were integrated to obtain lift and drag coefficients and the values found are in good agreement with the trend from measurements on similar wings at lower Mach numbers. Some of the models were designed to test a possible method of engine/airframe integration. The results show that it is possible to add volume to the rear of the wing without increasing the drag of the forebody, thus confirming the proposed method of integration. Author (ESA)

N82-21166*# National Aeronautics and Space Administration, Lyndon B. Johnson Space Center, Houston, Tex.
FULL-SCALE FLAMMABILITY TEST DATA FOR VALIDATION OF AIRCRAFT FIRE MATHEMATICAL MODELS
 Jerome F. Kuminecz and Richard W. Bricker Feb. 1982 874 p refs (NASA-TM-58244; NAS 1.15:58244) Avail: NTIS HC A99/MF A01 CSCL 01C

Twenty-five large scale aircraft flammability tests were conducted in a Boeing 737 fuselage at the NASA Johnson Space Center (JSC). The objective of this test program was to provide a data base on the propagation of large scale aircraft fires to support the validation of aircraft fire mathematical models. Variables in the test program included cabin volume, amount of fuel, fuel pan area, fire location, airflow rate, and cabin materials. A number of tests were conducted with jet A-1 fuel only, while others were conducted with various Boeing 747 type cabin materials. These included urethane foam seats, passenger service units, stowage bins, and wall and ceiling panels. Two tests were also included using special urethane foam and polyimide foam seats. Tests were conducted with each cabin material individually, with various combinations of these materials, and finally, with all materials in the cabin. The data include information obtained from approximately 160 locations inside the fuselage. Author

N82-21167# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio. Biomechanical Protection Branch.
EVALUATION OF A PROPOSED MODIFIED F/FB-111 CREW SEAT AND RESTRAINT SYSTEM
 James W. Brinkley, James H. Raddin, Jr., Bernard F. Hearon, Lawrence A. McGowan, and Joseph M. Powers Nov. 1981 418 p refs (AF Proj. 7231) (AD-A110188; AFAMRL-TR-80-52) Avail: NTIS HC A18/MF A01 CSCL 01/3

A total of 187 human impact tests were performed in the cardinal axes, including vertical (up to 10G, 8.1 m/sec), sideward (up to 8G, 9.2 m/sec), and forward facing (up to 10G, 9.8 m/sec). Subjects were exposed to similar impacts using different seat position adjustments to allow parametric analysis. Measured data included seat acceleration and velocity, head and chest translational acceleration components, triaxial forces acting on the seat pan and footrest, forces acting at the restraint harness attachments, and displacements of various body segments. In vertical impact tests, the forward position of the headrest appeared to cause increased forward acceleration of the head. Vertical impact tests demonstrated increased head accelerations with higher shoulder harness angles. Analysis of restraint loads in sideward impacts showed that more of the lateral support is provided by the lap belt with higher shoulder harness angles. This indicates potentially degraded lateral support of the upper torso with the proposed modification. GRA

N82-21171# Mitre Corp., McLean, Va. Metrek Div.
PRELIMINARY FUNCTIONAL DESCRIPTION OF INTEGRATED FLOW MANAGEMENT
 D. L. Adams, Stephen M. Alvania (FAA), Roger Brubaker (FAA), Kerry M. Levin, Richard J. Marek (FAA), M. F. Medeiros (Transportation Systems Center), G. R. Rowland (FAA), and A. N. Sinha Oct. 1981 246 p refs (Contract DTFA01-81-C-10001) (AD-A109909; MTR-81W252; FAA-EM-82-7) Avail: NTIS HC A11/MF A01 CSCL 05/1

A preliminary functional description of Integrated Flow Management (IFM) is documented in this report. The objective is to provide a strawman concept so that further IFM development

activities will proceed from a common reference point based upon agreement among all related program organizations. The distribution of flow management functions among the various ATC facilities and the related interfacility communications requirements are central issues addressed in this report. A road map projection of the IFM near term evolution through the late 1980s and remaining open issues related to the IFM development are also presented. Author (GRA)

N82-21173# Federal Aviation Administration, Atlantic City, N.J. Technical Center.

JOINT US/USSR MODE S COMPATIBILITY TEST PROGRAM, VOLUME 1 Final Report, 5 Oct. - 30 Oct. 1981

Rodney Guishard and Anatoly Bolshev Oct. 1981 36 p refs 2 Vol.

(FAA Proj. 034-241-510)

(PB82-126616; DOT/FAA-CT-82-16-Vol-1) Avail: NTIS HC A03/MF A01 CSCL 17G

The compatibility of a U.S.S.R. designed transponder with the U.S. Mode S system was investigated. A U.S. transponder was included in these tests for convenient comparison of results. Both bench tests and flight tests were conducted to ascertain compatibility to the U.S. Discrete Address Beacon System (DABS) National Standard of 1978. Radial and orbital flight profiles were used to gather statistical data to draw conclusions about the transponder's performance in conjunction with the Mode S system. Both the methods of conducting these tests and the results obtained are described. GRA

N82-21174# Federal Aviation Administration, Atlantic City, N.J. Technical Center.

JOINT US/USSR MODE S COMPATIBILITY TEST PROGRAM, VOLUME 2 Final Report, 5 Oct.- 30 Oct. 1981

Rodney Guishard and Anatoly Bolshev Oct. 1981 143 p 2 Vol.

(FAA Proj. 034-241-510)

(PB82-126624; DOT/FAA-CT-82-16-Vol-2) Avail: NTIS HC A07/MF A01 CSCL 17G

Data collected during the compatibility tests are presented. These tests included a U.S. transponder for convenience of comparison. It is concluded that the U.S.S.R. mode S transponder operated successfully and is compatible with the U.S. mode S system. Performance of both the U.S. and U.S.S.R. transponders were comparable. T.M.

N82-21175*# National Aeronautics and Space Administration, Hugh L. Dryden Flight Research Center, Edwards, Calif.

AIRCRAFT INTERROGATION AND DISPLAY SYSTEM: A GROUND SUPPORT EQUIPMENT FOR DIGITAL FLIGHT SYSTEMS

Richard D. Glover Apr. 1982 46 p refs

(NASA-TM-81370; NAS 1.15:81370) Avail: NTIS HC A03/MF A01 CSCL 01D

A microprocessor-based general purpose ground support equipment for electronic systems was developed. The hardware and software are designed to permit diverse applications in support of aircraft flight systems and simulation facilities. The implementation of the hardware, the structure of the software, describes the application of the system to an ongoing research aircraft project are described. T.M.

N82-21176# Aeronautical Systems Div., Wright-Patterson AFB, Ohio.

GENERIC TEST BED (GTB) AIRCRAFT Final Report, 1 May 1980 - 1 Oct. 1981

Donald R. Chislighi, Dennis W. Jarvi, and Steven R. Markman Dec. 1981 61 p refs

(AD-A110335; ASD-TR-81-5036) Avail: NTIS HC A04/MF A01 CSCL 01/3

The Night Attack Workload Steering Group (NAWSG) was requested by HQ AFSC/SD to investigate the need for a Generic Test Bed aircraft and to identify potential candidate aircraft. The team learned a need existed for an aircraft that could perform near the night attack envelope. The aircraft is needed to test, under realistic conditions, both the avionics and their effect on pilot crew workload. The team also identified several potential candidate aircraft that had sufficient cockpit space, volume, cooling and power to permit it to support this mission. Author (GRA)

N82-21177# Army Aviation Engineering Flight Activity, Edwards AFB, Calif. Directorate for Development and Qualification.

PRELIMINARY AIRWORTHINESS EVALUATION OF THE

UH-1H WITH HOT METAL PLUS PLUME INFRARED SUPPRESSOR AND INFRARED JAMMER Final Report, 16 Jan. - 18 May 1981

Bartholomew D. Picasso, III, John D. Ottomeyer, Loran A. Haworth, and Richard Vincent Jun. 1981 87 p refs (AD-A110213; USAAEFA-80-06) Avail: NTIS HC A05/MF A01 CSCL 01/2

The Preliminary Airworthiness Evaluation (PAE) of the UH-1H, with the Infrared (IR) Suppressor and AN/ALQ-144 IR Jammer installed, was conducted using a JUH-1H. The initial design caused a degradation in directional stability. The installation was redesigned to reduce the airflow disturbance over the tail rotor and vertical stabilizer. This evaluation was conducted in two phases. Phase 1 was a comparative evaluation of handling qualities of the UH-1H in both the standard and IR suppressor configurations. Phase 2 was primarily a pressure and temperature survey of the IR suppressor configuration. The handling qualities of the UH-1H helicopter were essentially unchanged by the IR suppressor and IR jammer installation tested. The tail boom surface temperatures were higher for the initial design. The metal to metal contact between the engine exhaust ejector and the IR suppressor inner core support struts was identified. Three shortcomings were also identified. GRA

N82-21178# Naval Air Test Center, Patuxent River, Md. Systems Engineering Test Directorate.

ALQ-164 POD/AV-8C ENVIRONMENTAL EVALUATION FLIGHT TEST

Lawrence J. Mertaugh 11 Dec. 1981 152 p

(AD-A110198; NATC-TM-81-109-SY) Avail: NTIS HC A08/MF A01 CSCL 01/3

This report provides the test results of a flight test program conducted to evaluate the environmental conditions to which the ALQ-164 pod is exposed when carried on the AV-8C aircraft. Descriptions are provided of the test program, test equipment, instrumentation, and methods of analysis. The test results include cooling-air mass flow and temperature, vibration levels measured on the pod structure and on the isolator mounted equipment support structure, and pod skin temperature. Test conditions include steady-state conditions throughout the available pod/aircraft flight envelope as well as various vertical takeoff and landing, short takeoff and landing and gun fire operations.

Author (GRA)

N82-21179# Systems Technology, Inc., Hawthorne, Calif.

OPTIMAL TERRAIN-FOLLOWING FEEDBACK CONTROL FOR ADVANCED CRUISE MISSILES Final Report

Richard F. Whitbeck and Julian Wolkovitch (Aeronautical Consultant Associates) Jan. 1982 48 p refs (Contract N00014-79-C-0657)

(AD-A110286) Avail: NTIS HC A03/MF A01 CSCL 16/4

A cruise missile is a vehicle that spends the major portion of its flight at essentially constant altitude and speed. Some cruise missiles are flown at very low altitudes in order to avoid detection. The terrain-following capabilities of such a missile and its guidance system are of importance. It is desirable that the missile should follow closely the contour of the terrain, which may be fixed (land) or time-varying (ocean waves). A previous study (Ref. 1) demonstrated that optimal control theory could usefully be applied to calculate the best achievable accuracy of terrain-following. Reference 1 showed that, even with an optimal guidance system, terrain-following accuracy was limited by considerations of the cruise missile's inertias, airspeed, and aerodynamic configuration. Author (GRA)

N82-21180# Lockheed-Georgia Co., Marietta.

NUMERICAL AIRCRAFT DESIGN USING 3-D TRANSONIC ANALYSIS WITH OPTIMIZATION. VOLUME 1: EXECUTIVE SUMMARY Final Report, May 1978 - Sep. 1980

A. J. Srokowski, M. E. Lores, and P. Aidala (Grumman Aerospace Corp., Bethpage, N.Y.) Wright-Patterson AFB, Ohio AFWAL Aug. 1981 59 p refs 2 Vol.

(Contract F33615-78-C-3014; AF Proj. 2404)

(AD-A110035; LG81ER0107-Vol-1; AFWAL-TR-81-3091-Vol-1) Avail: NTIS HC A04/MF A01 CSCL 20/4

A detailed summary of the work performed in the Advanced Transonic Technology (ATT) program to incorporate 3-D transonic computational aerodynamics methods into aircraft design procedures is presented. Existing transonic analysis programs were modified for the design procedure and linked with a numerical

optimization program to design wings that are in some sense optimized for a given set of design conditions. The design procedure was validated by applying it in two design case studies. The application of the design procedure in each of these case studies is described in detail. The configurations resulting from these studies were subjected to design verification wind tunnel testing. Comparisons of test data with computed results are presented. GRA

N82-21181# Lockheed-Georgia Co., Marietta.
NUMERICAL AIRCRAFT DESIGN USING 3-D TRANSONIC ANALYSIS WITH OPTIMIZATION, VOLUME 2. PART 1: TRANSPORT DESIGN Final Report, May 1978 - Sep. 1980

A. J. Srokowski, M. E. Lores, R. A. Weed, and P. R. Smith
 Wright-Patterson AFB, Ohio AFWAL Aug. 1981 187 p refs
 Prepared in cooperation with Grumman Aerospace Corp.,
 Bethpage, N.Y. 2 Vol.

(Contract F33615-78-C-3014; AF Proj. 2404)

(AD-A110231; LG81ERO107-Vol-2-Pt-1;

AFWAL-TR-81-3091-Vol-1) Avail: NTIS HC A09/MF A01
 CSCL 20/4

The purpose was to develop and validate a new transonic wing design procedure using the numerical optimization technique. The new procedure was used to design both a transport and a fighter configuration. Because the missions and design requirements of a fighter and transport are so different, the design procedure was developed along parallel lines. The results of a transport design case study performed to evaluate the transonic aircraft design procedure developed as part of the Advanced Transonic Technology (ATT) program are presented. A derivative of the C141B aircraft was selected as the design configuration. The design procedure was applied to the baseline configuration and the performance of resulting configuration was then compared to the C141 aircraft. Extensive wind tunnel testing of the design configuration was performed to validate the design procedure. The results of the wind tunnel tests are correlated with computational results generated in the design process. In addition, the evolution of the design procedure and its application in the transport design case study is discussed. GRA

N82-21182# Lockheed-Georgia Co., Marietta.
NUMERICAL AIRCRAFT DESIGN USING 3-D TRANSONIC ANALYSIS WITH OPTIMIZATION, VOLUME 2. PART 2: FIGHTER DESIGN Final Report, May 1978 - Sep. 1980

P. Aidala Wright-Patterson AFB, Ohio AFWAL Aug. 1981
 64 p refs Prepared in cooperation with Grumman Aerospace
 Corp., Bethpage, N.Y.

(Contract F33615-78-C-3014; AF Proj. 2404)

(AD-A110036; LG81ERO107-Vol-2-Pt-2;

AFWAL-TR-81-3091-Vol-2) Avail: NTIS
 HC A04/MF A01 CSCL 20/4

The results of a fighter design case study performed to evaluate the transonic aircraft design procedure developed as part of the Advanced Transonic Technology (ATT) program are presented. The fighter design is based on the Configuration Design of Advanced Fighters program dual role configuration. Extensive wind tunnel testing of the design configuration was performed to validate the design procedure. The results of the wind tunnel tests are correlated with computational results generated in the design process. The purpose of the ATT program was to develop and validate a new transonic wing design procedure using numerical optimization. The new procedure was used to design both a transport and a fighter configuration. Because the missions and design requirements of a fighter and transport are so different, the design procedure was developed along parallel lines. This is Part 2 of a two-part volume: Part 1 details the transport development, and Part 2 describes the fighter development. There are two other volumes which make up the final report. Volume 1 is an executive summary. It highlights the information that has been presented in detail here. GRA

N82-21183# Lockheed-Georgia Co., Marietta.
NUMERICAL AIRCRAFT DESIGN USING 3-D TRANSONIC ANALYSIS WITH OPTIMIZATION, VOLUME 3. PART 1: USER'S GUIDE TO TRANSPORT DESIGN COMPUTER PROGRAMS Final Report, May 1978 - Sep. 1980

R. A. Weed and A. J. Srokowski Wright-Patterson AFB, Ohio
 AFWAL Aug. 1981 136 p refs Prepared in cooperation
 with Grumman Aerospace Corp., Bethpage, N.Y.

(Contract F33615-78-C-3014; AF Proj. 2404)

(AD-A110232; LG81ERO107-Vol-3-Pt-1;

AFWAL-TR-81-3091-Vol-3-Pt-1)

Avail: NTIS

HC A07/MF A01 CSCL 20/4

This document is the first part of a two part volume of detailed User's Guide for the computer programs of a new transonic wind design procedure. Part 1 presents the User's Guide for the transport design programs produced by Lockheed-Georgia Company and Part 2 presents the User's Guide for the fighter design programs. The purpose of the contract was to develop and validate a new transonic wing design procedure using the numerical optimization technique. The new procedure was used to design both a transport and a fighter configuration. Because the missions and design requirements of a fighter and transport are so different, the design procedure was developed along parallel lines. Lockheed-Georgia Co. developed the transport design procedure, and Grumman Aerospace Corp. developed the fighter design procedures. Users guides for the computer programs used in the transport design case study for the aircraft design procedure developed as part of the Advanced Transonic Technology (ATT) program are presented. These programs include two 3D transonic wing analysis codes linked to a numerical optimizing routine, a two dimensional strip boundary layer program and a wing pylon nacelle interference program. The input data required by each program is described in detail. Samples of the output from each program are presented. Author (GRA)

N82-21184# Lockheed-Georgia Co., Marietta.
NUMERICAL AIRCRAFT DESIGN USING 3-D TRANSONIC ANALYSIS WITH OPTIMIZATION, VOLUME 3. PART 2: USER'S GUIDE TO FIGHTER DESIGN COMPUTER PROGRAM Final Report, May 1978 - Sep. 1980

P. Aidala Wright-Patterson AFB, Ohio AFWAL Aug. 1981
 88 p refs Prepared in cooperation with Grumman Aerospace
 Corp., Bethpage, N.Y.

(Contract F33615-78-C-3014; AF Proj. 2404)

(AD-A110037; LG81ERO107-Vol-3-Pt-2;

AFWAL-TR-81-3091-Vol-3-Pt-2) Avail: NTIS
 HC A05/MF A01 CSCL 20/4

A User's Guide for the computer code used in the fighter design case study of the Advanced Transonic Technology (ATT) program is presented. The design code includes a 3D transonic wing-body-canard analysis program linked to a numerical optimization routine and a two dimensional strip boundary layer program. The input data required is described in detail and samples of the output are presented. The purpose of the ATT program was to develop and validate a new transonic wing design procedure using the numerical optimization technique. The new procedure was used to design both a transport and a fighter configuration. Because the missions and design requirements of a fighter and transport are so different, the design procedure was developed along parallel lines. Lockheed-Georgia Co. developed the transport design procedure, and Grumman Aerospace Corp. developed the fighter design procedure. This document is the second part of a two-part volume of detailed User's Guides for the computer programs produced by Lockheed-Georgia Company and Grumman Aerospace Corp. of a new transonic wing design procedure. GRA

N82-21185# Messerschmidt-Boelkow G.m.b.H., Munich (West Germany).
Unternehmensbereich Drehfluegler.

HELICOPTER VIBRATION CONTROL: A SURVEY

G. Reichert Ottobrunn, West Germany 1 Sep. 1980 31 p
 refs Presented at 6th European Rotocraft and Powered Lift
 Aircraft Forum, Bristol, England, 16-19 Sep. 1980

(MBB-UD-302/80-0) Avail: NTIS HC A03/MF A01

Methods for reducing helicopter vibrations are reviewed including structural optimization of the rotor and the whole helicopter, blade and rotor pendulum absorbers, rotor isolation concepts following the antiresonance principle (nodal isolation), and active isolation devices. Vibration characteristics at various speeds and during maneuvers are summarized. The integration of vibration considerations during design and development are shown, including finite element modeling in the detail design phase. Developments in automatic harmonic blade pitch control utilizing closed loop systems are mentioned. Author (ESA)

N82-21186# Messerschmidt-Boelkow G.m.b.H., Munich (West Germany).
Unternehmensbereich Drehfluegler.

INVESTIGATIONS OF HELICOPTER WTRUCTURAL DYNAMICS AND A COMPARISON WITH GROUND VIBRATION TESTS

J. Stoppel and M. Degener (DFVLR, Goettingen, West Germany) Ottobrunn, West Germany 8 Sep. 1980 20 p refs Presented at 6th European Rotorcraft and Powered Lift Aircraft Forum, Bristol, England, 16-19 Sep. 1980 Sponsored by Bundesministerium fuer Forschung und Technologie (MBB-UD-303/80-O) Avail: NTIS HC A02/MF A01

A BO-105 helicopter was studied using the NASTRAN program applied to one model with 4400 degrees of freedom and a second with 1300 degrees of freedom. Ground vibration tests were performed on an actual helicopter (CO-105) to determining the modal parameters of the structure within a frequency of 56 Hz for comparison with the models. The suspended aircraft was excited by six electrodynamic exciters. Dynamic response was measured by inductive accelerometers. Comparison of model results with test data shows that most all measured natural modes have a corresponding analytical mode. There were 30 measured natural modes up to 60 Hz. Some 40 modes, including the six rigid body modes, were calculated. Only five modes in the high frequency range from 50 to 70 Hz have no equivalent from measurements. Most of the frequencies show very good agreement between measurement and calculation. Less than perfect correlation is seen for the pitching modes, which are influenced mainly by the tail boom. Central processor times on an IBM 360-370 model 3033 were 100 sec and 500 sec for the simple and complex models, respectively. Author (ESA)

N82-21187# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensbereich Drehfluegler. **A HINGELESS TAIL ROTOR OF FIBER COMPOSITE CONSTRUCTION AND VIBRATION ISOLATOR SYSTEMS (ARIS, AVIS) FOR HELICOPTERS [GELENKLOSER HECKROTOR IN FASERVERBUND-BAUWEISE UND SCHWINGUNGS-ISOLATIONSSYSTEME (ARIS, ASIS) FUER HUBSCHRAUBER]**

G. Reichert 8 Oct. 1980 37 p refs In GERMAN Presented at 2nd Bundesministerium fuer Forsch. und Technol. Statusseminar on Luftfahrtforsch. und Luftfahrttechnol., Garmisch-Partenkirchen, West Germany, 8-9 Oct. 1980 (MBB-UD-311/80-OE) Avail: NTIS HC A03/MF A01

Systems research and development were undertaken in order to reduce cost and improve characteristics of helicopters. An experimental tail rotor development program and methods of reducing airframe vibration are centered on. Definition, construction, and testing of a three-blade and a four-blade tail rotor system are discussed. Two vibration isolator systems (ARIS, AVIS) are next described. Passive and active force isolators were developed and tested in engineering models. It is proposed that all this equipment be subjected to full scale testing in helicopter assemblies. Author (ESA)

N82-21188# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensbereich Drehfluegler. **RATIONAL PRODUCTION METHODS FOR THE MANUFACTURE OF HELICOPTER ROTOR BLADES [RATIONELLE FERTIGUNGSVERFAHREN ZUR HERSTELLUNG VON HUBSCHRAUBER-ROTORBLAETTERN]**

Klaus Brunsch 8 Oct. 1980 27 p refs In GERMAN Presented at 2nd Bundesministerium fuer Forschung und Technologie Statusseminar Luftfahrtforsch. und Luftfahrttechnol., Garmisch-Partenkirchen, West Germany, 8-9 Oct. 1980 (MBB-UD-312/80-OE) Avail: NTIS HC A03/MF A01

The construction of BO-105/BK 117 rotor blade and the partial mechanization of its production are described. Series production of this rotor blade involves severe tolerances, regarding mass, mass distribution, geometry, mechanical properties, aerodynamics, etc. The necessity of these requirements is explained and consequences on the design of mass manufacturing work stations are pointed out. Development underway to fully automate rotor blade manufacture is then reviewed. Author (ESA)

N82-21190# Royal Aircraft Establishment, Farnborough (England). **REDUCTION OF STRUCTURAL VIBRATION BY A DYNAMIC ABSORBER**

J. M. Williams Dec. 1980 29 p refs (RAE-TM-AERO-1881; BR77778) Avail: NTIS HC A03/MF A01

The transmission of vibration in dynamic systems is described. An example consisting of two freely supported elastic plates, connected by a rigid link was studied in connection with helicopter gear boxes and cabins. The addition of a dynamic

absorber to such a system can significantly attenuate the transmitted velocities over a chosen narrow frequency band. The harmonic excitation of thin plates is explained. Author (ESA)

N82-21191# National Mechanical Engineering Research Inst., Pretoria (South Africa).

USE OF COMPOSITE MATERIALS FOR HELICOPTER ROTOR BLADES

M. S. Hunt 1980 33 p refs (PB82-124041; CSIR-ME-1674; ISBN-0-7988-1470-5) Copyright. Avail: NTIS HC A03/MF A01 CSCL 01C

Arguments in favor of the use of fiber reinforced composite materials for helicopter rotor blades are presented. The design and manufacturing techniques developed in an Institute are discussed and some of the results obtained in the structural testing program are given. GRA

N82-21192# British Aerospace Aircraft Group, Preston (England). **SAFRA: CONTROLLED REQUIREMENTS EXPRESSION**

D. Y. Forsyth and A. O. Ward, Jan. 1980 105 p refs (BAe-TNAAS-84) Avail: NTIS HC A06/MF A01

A collection of procedures and tools for improving the way in which avionic system and software requirements are derived and validated are described. In the context of SAFRA, the method of derivation proposed is a technique termed controlled requirements expression (CORE) and the information structure is modelled on an existing standard for requirement specification. The automated aid is the University of Michigan's ISDOS consisting of the problem statement language (PSL) and problem statement analyzer. The diagrammatic notation used in CORE is explained and the representation of the various relationships in the PSL are shown. Examples are depicted for an avionics system. Author (ESA)

N82-21193*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

COLD-AIR PERFORMANCE OF A 15.41-cm-TIP-DIAMETER AXIAL-FLOW POWER TURBINE WITH VARIABLE-AREA STATOR DESIGNED FOR A 75-kW AUTOMOTIVE GAS TURBINE ENGINE Final Report

Kerry L. McLallin, Milton G. Kofskey, and Robert Y. Wong Feb. 1982 33 p refs (Contract DE-AI01-77CS-51040)

(NASA-TM-82644; E-899; NAS 1.15:82644; DOE/NASA/51040-30) Avail: NTIS HC A03/MF A01 CSCL 21E

An experimental evaluation of the aerodynamic performance of the axial flow, variable area stator power turbine stage for the Department of Energy upgraded automotive gas turbine engine was conducted in cold air. The interstage transition duct, the variable area stator, the rotor, and the exit diffuser were included in the evaluation of the turbine stage. The measured total blading efficiency was 0.096 less than the design value of 0.85. Large radial gradients in flow conditions were found at the exit of the interstage duct that adversely affected power turbine performance. Although power turbine efficiency was less than design, the turbine operating line corresponding to the steady state road load power curve was within 0.02 of the maximum available stage efficiency at any given speed. Author

N82-21194*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

PRELIMINARY RESULTS ON PERFORMANCE TESTING OF A TURBOCHARGED ROTARY COMBUSTION ENGINE

P. R. Meng, W. J. Rice, H. J. Schock, and D. P. Pringle 1982 24 p refs Presented at the 1982 Soc. of Automotive Engrs. Intern. Congr. and Exposition, Detroit, 22-26 Feb. 1982 (NASA-TM-82772; E-1097; NAS 1.15:82772) Avail: NTIS HC A02/MF A01 CSCL 21E

The performance of a turbocharged rotary engine at power levels above 75 kW (100 hp) was studied. A twin rotor turbocharged Mazda engine was tested at speeds of 3000 to 6000 rpm and boost pressures to 7 psi. The NASA developed combustion diagnostic instrumentation was used to quantify indicated and pumping mean effect pressures, peak pressure, and face to face variability on a cycle by cycle basis. Results of this testing showed that a 5900 rpm a 36 percent increase in power was obtained by operating the engine in the turbocharged configuration. When operating with lean carburetor jets at 105 hp (78.3 kW) and 4000 rpm, a brake specific fuel consumption of 0.45 lbm/lb-hr was measured. B.W.

N82-21195*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

ANALYTICAL INVESTIGATION OF NONRECOVERABLE STALL

Leon M. Wenzel and William M. Bruton Feb. 1982 23 p refs

(NASA-TM-82792; E-1126; NAS 1.15:82792) Avail: NTIS HC A02/MF A01 CSCL 21E

A lumped parameter model of the TF34 engine is formulated to study nonrecoverable stall. Features of the model include forward and reverse flow, radial flow in the fan, and variable corrected speed. The purpose of the study is to point out those parameters to which recoverability is highly sensitive but are not well known. Experimental research may then be directed toward identification of the parameters in that category. Compressor performance in the positive flow region and radial flow in the fan are shown to be important but unknown parameters determining recoverability. Other parameters such as compressor performance during reverse flow and in-stall efficiency have relatively small impact on recoverability. Author

N82-21196*# Pratt and Whitney Aircraft Group, East Hartford, Conn. Commercial Products Div.

ENERGY EFFICIENT ENGINE SHROUDDLESS, HOLLOW FAN BLADE TECHNOLOGY REPORT

C. J. Michael Dec. 1981 91 p refs

(Contract NAS3-20646)

(NASA-CR-165586; NAS 1.26:165586; PWA-5594-199) Avail: NTIS HC A05/MF A01 CSCL 21E

The Shrouddless, Hollow Fan Blade Technology program was structured to support the design, fabrication, and subsequent evaluation of advanced hollow and shrouddless blades for the Energy Efficient Engine fan component. Rockwell International was initially selected to produce hollow airfoil specimens employing the superplastic forming/diffusion bonding (SPF/DB) fabrication technique. Rockwell demonstrated that a titanium hollow structure could be fabricated utilizing SPF/DB manufacturing methods. However, some problems such as sharp internal cavity radii and unsatisfactory secondary bonding of the edge and root details prevented production of the required quantity of fatigue test specimens. Subsequently, TRW was selected to (1) produce hollow airfoil test specimens utilizing a laminate-core/hot isostatic press/diffusion bond approach, and (2) manufacture full-size hollow prototype fan blades utilizing the technology that evolved from the specimen fabrication effort. TRW established elements of blade design and defined laminate-core/hot isostatic press/diffusion bonding fabrication techniques to produce test specimens. This fabrication technology was utilized to produce full size hollow fan blades in which the HIP'ed parts were cambered/twisted/isothermally forged, finish machined, and delivered to Pratt & Whitney Aircraft and NASA for further evaluation. Author

N82-21197*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.

CF6 JET ENGINE DIAGNOSTICS PROGRAM: HIGH PRESSURE COMPRESSOR CLEARANCE INVESTIGATION

M. A. Radomski Jan. 1982 48 p ref

(Contract NAS3-20631)

(NASA-CR-165580; NAS 1.26:165580; R82AEB189) Avail: NTIS HC A03/MF A01 CSCL 21E

The effects of high pressure compressor clearance changes on engine performance were experimentally determined on a CF6 core engine. The results indicate that a one percent reduction in normalized average clearance, expressed as a fraction of airfoil length, improves compressor efficiency by one percent. Compressor clearances are reduced by the application of rotor bore cooling, insulation of the stator casing, and use of a low coefficient of expansion material in the aft stages. This improvement amounts to a reduction of normalized average clearance of 0.78 percent, relative to CF6-60 compressor, which is equivalent to an improvement in compressor efficiency of 0.78 percent. J.M.S.

N82-21198*# Computing Devices Co., Ottawa (Ontario).

OPTIMIZATION OF THRUST ALGORITHM CALIBRATION FOR COMPUTING SYSTEM (TCS) FOR THRUST THE NASA HIGHLY MANEUVERABLE AIRCRAFT TECHNOLOGY (HiMAT) VEHICLE'S PROPULSION SYSTEM Final Report

M. J. Hamer and R. I. Alexander Dec. 1981 77 p refs

(Contract NAS4-2812)

(NASA-CR-163121; NAS 1.26:16321; A011/FR) Avail: NTIS HC A05/MF A01 CSCL 21E

A simplified gross thrust computing technique for the HiMAT J85-GE-21 engine using altitude facility data was evaluated. The results over the full engine envelope for both the standard engine mode and the open nozzle engine mode are presented. Results using afterburner casing static pressure taps are compared to those using liner static pressure taps. It is found that the technique is very accurate for both the standard and open nozzle engine modes. The difference in the algorithm accuracy for a calibration based on data from one test condition was small compared to a calibration based on data from all of the test conditions. E.A.K.

N82-21199# General Motors Corp., Indianapolis, Ind. Diesel Allison Div.

EXPERIMENTAL INVESTIGATION OF TURBINE ENDWALL HEAT TRANSFER. VOLUME 1: DESCRIPTION OF EXPERIMENTAL HARDWARE AND TEST CONDITIONS

Final Report, 1 Aug. 1977 - 31 Aug. 1981

L. D. Hylton, M. S. Mihelc, E. R. Turner, and R. E. York Wright-Patterson AFB, Ohio AFWAL Aug. 1981 147 p ref 3 Vol.

(Contract F33615-77-C-2030; AF Proj. 3066)

(AD-A110332; DDA-EDR-10363-Vol-1;

AFWAL-TR-81-2077-Vol-1) Avail: NTIS HC A07/MF A01 CSCL 21/5

Two turbine cascades were tested at simulated engine conditions to provide a data base of endwall heat transfer data. This data base is intended to be sufficiently complete to provide verification data for refined computational models developed to predict first-stage stator endwall heat transfer in advanced turbine engines. A linear, two dimensional cascade provided the bulk of the data. This cascade provided data to separate the effects of exit Mach number, exit Reynolds number, inlet boundary layer thickness, gas-to-wall temperature ratio, inlet pressure gradients, and inlet temperature gradients. In addition, adiabatic wall temperature and inlet turbulence intensity data are available for this linear cascade runs. A computerized data base was generated. This data base, with its associated software management system, provides the user with relatively easy access to the vast amount of data generated. A full annular, three dimensional cascade was used to acquire data for identifying the radial pressure gradient effects. Tests in the annular cascade were run over a wide range of exit Mach and Reynolds numbers and gas-to-wall temperature ratios, all at levels typical to advanced engines. The facilities, cascade geometry, instrumentation, and data acquisition techniques are discussed, as well as a summary of test conditions and a sample summary data set for both cascades. R.J.F.

N82-21200# Detroit Diesel Allison, Indianapolis, Ind.

EXPERIMENTAL INVESTIGATION OF TURBINE ENDWALL HEAT TRANSFER. VOLUME 2: LINEAR AND ANNULAR CASCADE SUMMARY DATA SETS Final Report, 1 Aug.

1977 - 31 Aug. 1981

L. D. Hylton, M. S. Mihelc, E. R. Turner, and R. E. York Wright-Patterson AFB, Ohio AFWAL Aug. 1981 329 p 3 Vol.

(Contract F33615-77-C-2030; AF Proj. 3066)

(AD-A110333; DDA-EDR-10363-Vol-2;

AFWAL-TR-81-2077-Vol-2) Avail: NTIS HC A15/MF A01 CSCL 21/5

Two turbine cascades were tested at simulated engine conditions to provide a data base of endwall heat transfer data. This data base is intended to be sufficiently complete to provide verification data for refined computational models developed to predict first-stage stator endwall heat transfer in advanced turbine engines. Summary plots of the results of both the linear and the annular cascade test programs are given. The data is sufficient to allow the designer to estimate the endwall cooling levels and to locate areas of high heat transfer rates. R.J.F.

N82-21201# Detroit Diesel Allison, Indianapolis, Ind.

EXPERIMENTAL INVESTIGATION OF TURBINE ENDWALL HEAT TRANSFER. VOLUME 3: DATA BASE SYSTEM

Final Report, 1 Aug. 1977 - 31 Aug. 1981

L. D. Hylton, M. S. Mihelc, E. R. Turner, and R. E. York Wright-Patterson AFB, Ohio AFWAL Sep. 1981 61 p 3 Vol.

(Contract F33615-77-C-2030; AF Proj. 3066)

(AD-A110334; DDA-EDR-10363-Vol-3;

AFWAL-TR-81-2077-Vol-3) Avail: NTIS HC A04/MF A01 CSCL 21/5

Two turbine cascades were tested at simulated engine conditions to provide a data base of endwall heat transfer data. This data base is intended to be sufficiently complete to provide verification data for refined computational models developed to predict first-stage stator endwall heat transfer in advanced turbine engines. A linear, two dimensional cascade provided the bulk of the data. This cascade provided data to separate the effects of exit Mach number, exit Reynolds number, inlet boundary layer thickness, gas-to-wall temperature ratio, inlet pressure gradients, and inlet temperature gradients. In addition, adiabatic wall temperature and inlet turbulence intensity data are available for the linear cascade runs. A computerized data base was generated. This data base, with its associated software management system, provides the user with relatively easy access to the vast amount of data generated. A full annular, three dimensional cascade was used to acquire data for identifying the radial pressure gradient effects. Tests in the annular cascade were run over a wide range of exit Mach and Reynolds number and gas-to-wall temperature ratios, all at levels typical of advanced engines. A user's manual is presented. R.J.F.

N82-21202# Department of Energy, Bartlesville, Okla. Energy Technology Center.

THERMODYNAMICS OF ORGANIC COMPOUNDS Final Technical Summary Report, 1 Oct. 1980 - 30 Sep. 1981

N. K. Smith, B. E. Gammon, and William D. Good 1981 24 p refs

(Grant AF-AFOSR-ISSA-00013-81; AF Proj. 2308) (AD-A110430; AFOSR-82-0023TR) Avail: NTIS HC A02/MF A01 CSCL 21/5

The research effort continues to be focused on high density/high energy hydrocarbons. In cooperation with researchers at Wright-Patterson Air Force Base, heats of combustion are measured for constituents of current ramjet fuels and for finished fuels; meanwhile, pure hydrocarbons are synthesized for heat-of-combustion measurement whose unusual steric or strain energies may contribute to design of high energy/high density fuels of the future. Four pure hydrocarbons studied were selected among the alkylnaphthalenes and indans that may exhibit unusual steric energies. One unusual hydrocarbon, with very high density and a cage-like molecular structure, was also studied. This substance is undergoing preliminary testing as an experimental fuel. Synthesis and purification of hydrocarbons for future study are in progress at Oklahoma State University. New equipment and procedures were developed for application of the differential scanning calorimeter on measurements of heat capacity of fuels and their constituents. Preparation is underway to study the heat of combustion of several special liquid hydrocarbon fuels. GRA

N82-21203# United Technologies Research Center, East Hartford, Conn.

RESEARCH ON TURBINE ROTOR-STATOR AERODYNAMIC INTERACTION AND ROTOR NEGATIVE INCIDENCE STALL Final Report, Mar. 1979 - Nov. 1981

R. P. Dring, H. D. Joslyn, L. W. Hardin, and J. H. Wagner Wright-Patterson AFB, Ohio AFWAL Nov. 1981 107 p refs (Contract F33615-80-C-2008; AF Proj. 3066)

(AD-A110341; UTRC/R81-915048; AFWAL-TR-81-2114) Avail: NTIS HC A06/MF A01 CSCL 20/4

The aerodynamic interaction between the rotors and stators of a large scale axial turbine stage have been studied experimentally. The data included measurements of the time averaged and instantaneous surface pressures and surface thin film gage output on both the rotor and stator at midspan. The data also included measurement of the stator suction and pressure surface time averaged heat transfer at midspan. The data was acquired with rotor-stator axial gaps of 15% and 65% of axial chord. The upstream potential flow influence of the rotor on the stator was seen as well as the downstream potential flow and wake influences of the stator on the rotor. The second phase of the program was an investigation of the nature of the full-span steady flow over the rotor with incidence varying up to negative incidence stall. Full-span pressure distributions and surface flow visualization were acquired over the entire range of incidence. The data indicated separation-free flow and large radial flows on the pressure surface in the vicinity of design incidence. GRA

N82-21204# Rolls-Royce Ltd., Derby (England). Aero Div.

COATINGS IN THE AERO GAS TURBINE

R. H. Wedge and A. V. Eaves 1980 12 p ref

(PNR-90049) Avail: NTIS HC A02/MF A01

The types of sprayed coatings used are defined, and coating requirements for each section of the gas turbine engine are discussed. Main problem areas are defined as hammer wear at compressor blade (snubber) abutment faces, and turbine blade shroud abutment faces; fretting wear particularly of compressor blade and vane roots rubbing and vane roots rubbing and sliding wear in various applications; the requirement to maintain clearances in gas path seals; and the effects of overheating and thermally cycling turbine parts, particularly rotor blades. The need to restore deliberately overmachined and accidentally overmachined parts is also discussed. Factors to be considered in coating selection are described with particular reference to the application requirements, the types of coating that might be used, and coatings that have proved to give the best results. The relationship between coating performance and cost effectiveness is illustrated with examples. Author (ESA)

N82-21205# Rolls-Royce Ltd., Derby (England). **PROCESS DEVELOPMENT AND EVALUATION OF GAS TURBINE ENGINE COMPONENTS IN IMI 829**

R. M. Duncan (IMI Kynoch Ltd.), R. E. Goosey (IMI Kynoch Ltd.), R. H. Jeal, and P. J. Postans 1980 12 p refs (PNR-90050) Avail: NTIS HC A02/MF A01

Measurements of basic physical properties and mechanical property evaluation of a range of typical gas turbine parts were performed on this titanium alloy (Ti-Al-Sn-Zr-Nb-Mo-Si). It is a near-alpha alloy. It has a density of 4.54 g/cu cm and the alpha + beta/beta transformation temperature is nominally 1015 C. Tensile tests of disk and ring forgings show that: at 20 C the 0.2% proof stress is 30 MPa lower than for IMI 685, but both alloys have similar strength at 540 C. Tensile strength is unaffected by forging route and microstructure, but tensile ductility tends to improve as the grain size decreases. The test results show some scatter but at 20 C the average elongation is 13% with the finest grain size and 8% for the coarsest grain size, and at 540 C the elongations are 15% and 11%, respectively. Creep strength is 20 C superior to IMI 685. Fracture toughness is similar to IMI 685 as are crack growth rates. Author (ESA)

N82-21206# Rolls-Royce Ltd., Derby (England). **THE TESTING AND APPROVAL OF AIRCRAFT ENGINE MOUNTED ACCESSORIES**

D. S. Pearson 1980 21 p ref (PNR-90051) Avail: NTIS HC A02/MF A01

Measurement techniques, data assessment criteria, physical interpretation and laboratory simulation methods applicable to accessory vibration testing are reviewed. The inadequacies of endurance approval testing of accessories by applying unidirectional single frequency excitation to simulate engine conditions at a particular shaft speed are shown. A measurement and assessment technique is described which recognizes the effect of multifrequency vibration in three planes. An experimental specification for accessories, based on the technique, is outlined. Case histories of vibration induced accessory failure are cited. Author (ESA)

N82-21207# Rolls-Royce Ltd., Derby (England). **DEVELOPMENTS TO IMPROVE THE NOISE AND COMBUSTION EMISSIONS ON THE FOKKER F28 AIRCRAFT AND ITS ROLLS-ROYCE RB183-555 ENGINES. SECTION 1: DEVELOPMENT OF THE NEW INTERNAL 10-LOBE MIXER**

S. L. Sarin (Royal Netherlands Aircraft Factories Fokker), K. Goddard, and N. J. Wilson 1981 15 p (PNR-90061) Avail: NTIS HC A02/MF A01

Theoretical and practical aspects of exhaust mixer design for turbofan engines are discussed. The effects on fuel consumption and noise reduction of annular and multilobed internal mixers are compared. The production version of a multilobed mixer is described. The lobed mixer reduces total noise by 5.75 dB A and fuel consumption by 4%. The development trends of exhaust mixers, with particular reference to high bypass ratio engines are also discussed. Author (ESA)

N82-21208# Rolls-Royce Ltd., Derby (England). **ENGINES FOR AIR TRANSPORT**

A. G. Newton 1981 52 p (PNR-90066) Avail: NTIS HC A04/MF A01

The status and trends of commercial aircraft transportation systems were reviewed. The characteristics and specific consumption of aviation fuel are emphasized. It is shown that in the next 15 years the fuel consumption of current large fan engines can be reduced by 15%. The quality of fuel will deteriorate relative to today, which will place greater demands on engine

design. Further improvements in fuel economy using engines designed for lower specific thrust appear feasible. The development of a full authority digital control system and its effects on fuel consumption are also discussed. Author (ESA)

N82-21209# Rolls-Royce Ltd., Derby (England).
ALLOWING FOR THE WALL BOUNDARY LAYER IN A STAGE OF AN AXIAL COMPRESSOR

N. S. Berestneva, N. A. Kocal, F. G. Kontsevich, and Y. G. Otsechkin Jan. 1981 9 p refs Transl. into ENGLISH from *Samoletostr. Tekh. Vozdush. Flota (USSR)*, no. 43, 1978 p 51-54 In ENGLISH and RUSSIAN (PNR-90067; Trans-15546; TLT-00815) Avail: NTIS HC A02/MF A01

The geometric characteristics of the tested stage and the grid parameters are given. The coefficient of adiabatic pressure of the stage is taken as 0.26 at a coefficient of consumption of 0.447. The stage is a model of the initial stage of a high pressure compressor. The operation of the stage in the calculated field of input speeds leads to a 3.5 % increase in its maximum efficiency with no influence upon the limit of its operational stability. Author (ESA)

N82-21210# Rolls-Royce Ltd., Derby (England). Noise Technology Div.

THE ROLLS ROYCE ROLE IN AIRCRAFT NOISE REDUCTION

M. J. T. Smith 8 Sep. 1981 17 p refs Submitted for publication (PNR-90069) Avail: NTIS HC A02/MF A01

Jet turbomachinery, pressure, combustion and aerodynamic noise sources are discussed. General features of reasearch organization and current projects (RBZU-524, RB711-535, RJ500) are outlined. Engine development costs often lead to an emphasis on adopting existing products to new and altered airframes. Author (ESA)

N82-21211# Rolls-Royce Ltd., Derby (England). Dept. of Engineering.

THE MECHANICAL TESTING OF COMPRESSORS AND TURBINES FOR AIRCRAFT GAS TURBINE ENGINES

D. Norris 1981 12 p (PNR-90070) Avail: NTIS HC A02/MF A01

Ten different engine types, including the RB211 family of engines, and both civil and military applications, are considered. Overspeed, fatigue, bird ingestion, and blade containment are described. Author (ESA)

N82-21212# British Aerospace Aircraft Group, Weybridge (England).

SIMULATION OF TURBOFAN ENGINE MODELS IN THE WEYBRIDGE LOW SPEED WIND TUNNEL

R. F. R. Storey Jun. 1981 7 p (BAe-Inform-Note-46) Avail: NTIS HC A02/MF A01

A control arrangement for the gas supply to a low speed wind tunnel is suggested. Clean dry nitrogen gas at up to 1500 lb/sq in and 90 C is supplied from a mobile dispenser at 4.2 lb/sec. Gas pressure is reduced to 400 lb/sq in and drives two model turbofan engines. The flow from the dispenser into the models is controlled by servovalves operating hydraulically from pressure transducer signals. Materials and supply sources are listed. Author (ESA)

N82-21213# Aeronautical Research Labs., Melbourne (Australia).
THE STABILITY OF PORTABLE BRIDGES CARRIED ON SLINGS BENEATH HELICOPTERS

N. Matheson Jan. 1980 56 p refs (ARL/Aero-Rept-154; AR-001-787) Avail: NTIS HC A04/MF A01

Information available concerning the operation of helicopters carrying airportable bridges is reviewed. In addition, a series of wind tunnel tests were made with 1/15 scale models to determine the maximum safe speed for a helicopter carrying two different class 16 bridges, a 16 m (52 ft) clear span, and a 22 m (72 ft) raft, separately on a single hook. The tests indicated that the 16 m (52 ft) bridge can be carried safely at speeds up to 65 knot on a 16 m (53 ft) cable, provided it was slung 5 deg nose up in the static condition, and two small flat fins were attached to the aft end. The raft was carried in two loads, A and B, because of weight limitations. Load A, which consisted

mainly of deck boxes and accessories, can be safely carried without fins at speeds up to 60 knot on a 16 m (53 ft) cable provided it was rigged 1 to 2 deg nose up. Load B, which consisted of four ramps and four articulators, can also be carried at 60 knot, but small flat fins were required and it had to be slung 5 deg nose up and carried on a 10 m (33 ft) cable. S.L.

N82-21214# Princeton Univ., N. J. Dept. of Mechanical and Aerospace Engineering.

DIGITAL COMMAND AUGMENTATION FOR LATERAL-DIRECTIONAL AIRCRAFT DYNAMICS Annual Technical Report, 1 Feb. 1979 - 31 Jan. 1980

David Atzhorn Arlington, Va. ONR May 1981 199 p refs (Contract N00014-78-C-0257; NR Proj. 300-003) (AD-A110274; MAE-1511; ONR-CR-300-003-2) Avail: NTIS HC A09/MF A01 CSCL 01/2

Linear-quadratic sampled-data regulator theory is used to design several Type 0 and Type 1 control laws for lateral-directional aircraft dynamics. Control structures are defined for singular command inputs and for control rate outputs; the former allows for precise following of a command whose integral appears in the state vector, while the latter uses both a difference approximation and the Tustin transform to characterize control rate in the discrete-time domain. Type 0 controllers with control rate restraint and equivalent Type 1 controllers are implemented in a microprocessor-based digital flight control system, and flight tests are conducted using Princeton University's Variable-Response Research Aircraft. The control system, entitled CAS-4, offers four combinations of control: direct (unaugmented) control, Type 0 control with both roll rate/sideslip angle and roll rate/lateral acceleration command combinations, and Type 1 control with roll/sideslip angle command. Ground-based hybrid simulation and flight test results show that major closed-loop response features are unaffected by the choice of sampling rate when sampled-data regulator theory is used. Consequently, much lower sampling rates than would normally be expected can be used when control laws are derived in this manner. GRA

N82-21215# Messerschmitt-Boelkow-Blomh G.m.b.H., Otto-brunn (West Germany).

INFLUENCE OF STRAKES ON COEFFICIENTS OF LONGITUDINAL STABILITY Thesis - Tech. Univ., Munich [EINFLUSS VON STRAKES AUF DIE BEIWERTE DER LAENGSBEWEGUNG]

Gerhard Wolfrum 20 Dec. 1979 190 p refs In GERMAN (MBB-FE-122/S/PUB/22) Avail: NTIS HC A09/MF A01

In a subsonic wind tunnel the influence on the longitudinal stability of seven different strakes mounted on five basic wings was measured. Size of the strake and lift are directly related, while the aerodynamic drag is determined by the basic wing. The importance of pitch is influenced by the strake in relation with the lift. The efficacy of right strakes on more or less swept back wings against buffeting is particularly strong in the subsonic area. In general, strakes do not influence substantially the outline of the aerodynamic configuration, but their size remains the most important single parameter to obtain longitudinal stability. Author (ESA)

N82-21216# Royal Aircraft Establishment, Farnborough (England).

SOME REMARKS ON BUFFETING

D. G. Mabey Feb. 1981 35 p refs Presented at Von Karman Inst. for Fluid Dyn. Lecture Ser. on Unsteady Airloads and Aeroelastic Probl. in Separated and Transonic Flows, Brussels, 10 Mar. 1981 (RAE-TM-Struct-980; BR78530) Avail: NTIS HC A03/MF A01

Buffeting is defined as the structural response to the aerodynamic excitation produced by separated flows. The aerodynamic excitation produced by bubbles, vortices and transonic flows is discussed. Different buffeting criteria for the wings of fighter and transport aircraft are developed. Methods of predicting the onset and severity of buffeting are reviewed. Typical examples are discussed, in which improvements in wing buffeting are compared with changes in mean force measurements. Buffeting measurements on ordinary models in a cryogenic wind, wind tunnel are analyzed. The measurements confirm that cryogenic tunnels can separate Reynolds number and aeroelastic effects. The frequency parameter must be correct on the model if the aerodynamic excitation does not have a flat spectrum, as at vortex breakdown on a slender wing. Author (ESA)

N82-21217# Royal Aircraft Establishment, Farnborough (England). Structures Dept.
THE APPLICATION OF SUBSONIC THEORETICAL AERODYNAMICS TO ACTIVE CONTROLS
 H. C. Garner May 1981 84 p refs
 (RAE-TR-81060; RAE-Struct-BF/B/0860; BR80082) Avail: NTIS HC A05/MF A01

Aerodynamic forces for wing and control surface motion with general time dependence in linearized subsonic flow were analyzed. The time domain where quasisteady displacement and rate terms are combined with a residual history term is discussed. An accurate calculation procedure is devised, and results are illustrated for a high respect ratio wing at Mach number 0.8 with trailing edge, leading edge and all moving tip controls. Asymptotic behavior at small and large times and individual control characteristics are compared. The quasisteady approximation is established for hinge moments and is analyzed for lift. The rapid lift response to leading edge control and the sluggish lift response to trailing edge control are explained. The forces in the time domain are confirmed by Fourier transform calculations in the frequency domain, which shows the extent to which the range of frequency can be truncated. The control surface motion to produce a known time dependent force is determined. Author (ESA)

N82-21218# Messerschmitt-Boelkow-Blohm G.m.b.H., Otto-brunn (West Germany). Aircraft Div.
VIBRATION QUALIFICATION OF EXTERNAL AIRCRAFT STORES AND EQUIPMENT
 M. Steininger and G. Haidl 7 Sep. 1981 17 p refs Presented at 53rd AGARD Struct. and Mater. Panel Meeting, Noordwijkerhout, Netherlands, 27 Sep. - 2 Oct. 1981
 (MBB-FE-173/S/PUB/46) Avail: NTIS HC A02/MF A01

Prediction methods for preliminary assessment of aircraft vibration levels and spectra are described. A dynamic environment simulation for external stores configuration tests is discussed. Standard mounting and excitation techniques are reviewed and mounting rig requirements and shaker capabilities are treated. It is shown that trends in aircraft structural design and operational requirements result in increasing vibration problems. Author (ESA)

N82-21219# Messerschmitt-Boelkow-Blohm G.m.b.H., Otto-brunn (West Germany). Betriebsbereich.
DYNAMIC RESPONSE OF A HOT GAS, CONTROL-SURFACE ACTUATOR
 Erwin Goellner 1981 72 p refs Reprint from J. of Flight Sci. and Space Res. (Cologne), v. 5, no. 4, Jul./Aug. 1981 p 209-216 In GERMAN; ENGLISH summary Presented at 4th Aachener Fluidtech. Kolloq., Aachen, Mar. 1980
 (MBB-UA-599/81-OE; ISSN-0342-068X) Avail: NTIS HC A04/MF A01

The operation of a control surface actuator and its steady state valve characteristics are examined. The linearized transfer functions are calculated under simplified assumptions. Suitable parameters are defined and their influence on the stability of the closed loop is discussed. The response of the closed position control loop is demonstrated. Author (ESA)

N82-21220# Messerschmitt-Boelkow-Blohm G.m.b.H., Otto-brunn (West Germany). Unternehmensbereich Flugzeuge-Entwicklung.
THEORETICAL LINEAR APPROACH TO THE COMBINED MAN-MANIPULATION SYSTEM IN MANUAL CONTROL OF AN AIRCRAFT

Klaus Brauser 2 Jun. 1981 17 p refs Presented at 17th Ann. Conf. on Manual Control, Los Angeles, 16-18 Jun. 1981
 (MBB-FE-301/S/PUB/43) Avail: NTIS HC A02/MF A01

The dynamic characteristics of the pilot control system are studied with a model combining the neuromuscular properties of the man with the physical properties of the control system. The man is assumed to be a quasilinear, time invariant control operator adapted to the operating states of the control system. The frequency domain transfer functions of the man control system and the closed loop pilot aircraft control system are posed. The complete precision man control model must be introduced into the closed loop transfer function to understand standard handling criteria and to derive these criteria directly from human operator properties. Author (ESA)

N82-21222# AAI Corp., Cockeysville, Md. Aeronautical Systems Div.

MINUTES OF PHYSICAL CONFIGURATION AUDIT FOR THE F-16 ELECTRONIC WARFARE TRAINING DEVICE

Dec. 1981 54 p
 (Contract F33657-79-C-0820)
 (AD-A110321; AAI-ER-11613) Avail: NTIS
 HC A04/MF A01 CSDL 05/9

A physical configuration audit (PCA) of the F-16 electronic warfare training device was conducted. The purpose was to conduct a formal examination of the built version of the simulator against the technical engineering drawings to establish the simulators product baseline. E.A.K.

N82-21223# Air Force Human Resources Lab., Brooks AFB, Tex.

THE 1981 IMAGE 2 CONFERENCE PROCEEDINGS Final Report

Eric G. Monroe, comp. Nov. 1981 508 p refs Proceedings Held at Brooks AFB, Texas, 10-12 Jun. 1981
 (AF Proj. 9983)
 (AD-A110226; AFHRL-TR-81-48) Avail: NTIS
 HC A22/MF A01 CSDL 14/2

These proceedings are a collection of papers presented at the 1981 Image Generation/Display Conference 2. The Image Conference is devoted to issues relevant to the development and use of imagery generated and displayed for visual flight simulation. The purpose of the conference is to provide a forum for presenting and discussing topics concerned with the imagery generated for out of the cockpit and sensor visual flight simulation. The 31 papers presented were compatible with the theme of the conference, including both engineering research/development and behavioral research. In the engineering area, papers covered such topics as computer simulated forward looking infrared and low light level television imagery, computer image generation (CIG) texturing of curved surfaces, shuttle mission simulation, nap of the Earth flight simulation, light valve projectors, lasers in simulation, area of interest displays, tactical combat simulation, sensor simulation, and helmet-mounted displays. Topics in behavioral research included such items as effects of visual and motion cues, identification of targets in CIG displays, psychophysical aspects of visual processing, visual illusions, visually induced self motion, determination of visual cue requirements, visual data base development for terrain flight simulation, transformation realism, and strategies to optimize CIG image content. GRA

N82-21224# Mitre Corp., McLean, Va. Metrek Div.
OVERVIEW OF THE O'HARE RUNWAY CONFIGURATION MANAGEMENT SYSTEM

Richard L. Fain Sep. 1981 52 p refs
 (Contract DTF A01-81-C-10001)
 (AD-A110137; MTR-81W235; FAA-EM-82-5) Avail: NTIS
 HC A04/MF A01 CSDL 17/7

The O'Hare Runway Configuration Management System (CMS) is an interactive computer algorithm designed to assist the Assistant Chief of the O'Hare facility in selecting runway configurations which minimize delay. The current version of CMS utilizes a full screen input/output structure to enhance near-term implementation within O'Hare's manual ATC environment. This paper presents an overview of the runway selection logic (including the impacts of transitioning between configurations and balancing demand) and describes the system hardware configuration and the functional responsibilities of the participants in the O'Hare application. The historical development of CMS, future potential enhancements in system logic and system implementation, and application of CMS at other airports are also discussed. Author (GRA)

N82-21226# Messerschmitt-Boelkow-Blohm G.m.b.H., Otto-brunn (West Germany). Unternehmensbereich Flugzeuge.
THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF WIND TUNNEL INTERFERENCE DUE TO ANGLE OF ATTACK

Norbert Gruen 29 Aug. 1980 145 p In GERMAN; ENGLISH summary
 (MBB-FE-124/S/PUB/34) Avail: NTIS HC A07/MF A01

Using wall pressure measurements, recorded simultaneously with model tests, corrections for model surface pressures are calculated. The difference between experimental wall pressure coefficients and computed free flight pressure coefficient distributions is used as a criterion for the wall interference on the tunnel flow. An evaluation of the wall pressure curves shows that their general shape is predetermined by the empty tunnel

and the model support, respectively. Increasing the model angle of attack primarily causes a shift and a change in the gradient of these curves. The calculated free flight pressure coefficients are found to be very small compared to measured values. In order to find the pressure coefficient differences along the tunnel axis, a flow model is established which shows the previously computed differences in pressure coefficients on an imaginary wall at the location of the tunnel wall. The propagation of these disturbances to the tunnel axis is calculated using the finite element method. Results are used to correct measured coefficients for lift, drag and pitching moment. Author (ESA)

N82-21229# Messerschmitt-Boelkow-Blohm G.m.b.H., Otto-brunn (West Germany). Unternehmensbereich Apparate.

COMPUTER GENERATED IMAGES FOR AIRCRAFT PILOT TRAINING

P. Gueldenpfennig and W. Metzke 3 Nov. 1980 19 p refs (MBB-UA-551/80-OE) Avail: NTIS HC A02/MF A01

The various training tasks envisaged for full mission simulation with a prototype visual system are described and the performance of the system evaluated. The upgrading of the system resulting from this evaluation, and its implementation in the operational simulators, are discussed. Deficiencies were noted in the following areas: scene content due to the limited real time edge processing capability, for the training of ground attack, and takeoff/landing; scene content due to the limited online data base for the training of en route flying; and resolution due to the number of TV lines and raster elements per TV line for the training of ground attack and air-to-air-combat. Author (ESA)

N82-21247# Rolls-Royce Ltd., Derby (England).

TELEMETRY IN AERO ENGINE DEVELOPMENT

A. E. Hubble 1980 19 p (PNR-90055) Avail: NTIS HC A02/MF A01

The use of an Acurex telemetry system for obtaining in situ strain and temperature measurements of a high pressure compressor rotor disk is described. The transmitter is mounted inside the compressor shaft with an auxiliary supply of cooling air. Calibration techniques of the strain gages, transmitter and receivers are given. Procedures used for selective test bed transmitter frequencies are listed. Laboratory test results for the thermocouple and static strain transmitters show good agreement with manufacturers' data. A comparison with similar battery operated equipment is made. Author (ESA)

N82-21261# Hughes Aircraft Co., Culver City, Calif.

ADVANCED CONCEPTS FOR COMPOSITE STRUCTURE JOINTS AND ATTACHMENT FITTINGS. VOLUME 1: DESIGN AND EVALUATION Final Report, Jul. 1977 - Dec. 1980

J. V. Alexander and R. H. Messinger Nov. 1981 127 p refs 2 Vol.

(Contract DAAJ02-77-C-0076; DA Proj. 1L2-62209-AH-76)

(AD-A110212; HH-80-402-Vol-1;

USAAVRADCOM-TR-81-D-21A)

Avail: NTIS

HC A07/MF A01 CSCL 01/3

The purpose of this program was to develop the technology of applying fiber-reinforced composite materials to helicopter joints and attachment fittings that permit disassembly of major components. A generic design methodology approach was used to make the data developed applicable to ongoing and future helicopter programs. A detail design, analysis, and testing program was carried out on the three joint and fitting concepts selected: wrapped tension fittings, gearbox attachment fittings, and seat attachment fittings. The scope of the study included analytical design tools, including finite element computer analysis; fabrication techniques, with special emphasis on weight and cost effectiveness considerations; structural integrity testing, including static, dynamic, failsafe/safe-life, and ballistic tolerance considerations; and nondestructive inspection (NDI) techniques.

Author (GRA)

N82-21404 California State Univ., Sacramento.

ANALYSIS OF VERY LOW FREQUENCY OSCILLATIONS IN A RAMJET COMBUSTOR BY USE OF A SENSITIVE TIME LAG MODEL

/n APL The 18th JANNAF Combust. Meeting, Vol. 3 Oct. 1981 p 307-316 refs

(Contract F336157-77-C-2004)

Avail: NTIS HC A20 CSCL 21/9

Pressure oscillations in ramjet combustor were investigated. Coaxial dump combustor configurations and on very low frequency oscillations, oscillations in which the acoustic modes of the combustion chamber are not excited was emphasized. The main features of the analysis are: compressible flow in the air inlet system, bulk oscillations in the combustor, and a combustion response characterized by a time lag sensitive to combustor conditions. Two studies were undertaken by using the analytical model: (1) an empirical correlation for the time lag based on steady state performance data was used; (2) consisted of the calculation of stability limits for the time lag and combustor geometry for various sets of operating conditions. Comparison of the analytical stability limits with the experimental results gave time lag values, which are compared with the empirical correlation used in the first study. E.A.K.

N82-21405 McDonnell-Douglas Research Labs., St. Louis, Mo. **FACTORS INFLUENCING VELOCITY DISTRIBUTIONS AT INLET/COMBUSTOR INTERFACES**

M. Sajben, T. J. Bogar, J. C. Krutil, and J. T. Salmon /n APL The 18th JANNAF Combust. Meeting, Vol. 3 Oct. 1981 p 321-331 refs

(Contract F49720-77-C-0082)

Avail: NTIS HC A20 CSCL 21/9

Flows in six nominally two dimensional, supercritical diffusers, to highlight the effects of selected parameters and operating conditions on the velocity distributions at the downstream end are reviewed. The state of the flow at this location has a significant influence on the performance and stability of liquid fuel ramjet burners. The investigated parameters include the diffuser exit area/throat area ratio, the terminal shock strength and the boundary layer thickness before the throat. The terminal shock strength was found to be a major factor. Initial boundary layer thickness had only moderate effects on the efflux conditions. It is suggested that methodology developed for assuring inlet engine compatibility in turbojet propulsion systems could be modified to aid ramjet development. E.A.K.

N82-21406 United Technologies Corp., Sunnyvale, Calif. Chemical Systems Div.

REPORT OF THE JANNAF WORKSHOP ON HIGH FREQUENCY INSTRUMENTATION AND DATA ANALYSIS TECHNIQUES

P. A. Chun (Naval Weapons Center, China Lake, Calif.) and R. S. Brown /n APL The 18th JANNAF Combust. Meeting, Vol. 3 Oct. 1981 p 333-339 refs Conf. held in New Orleans, 28-29 May 1981

Avail: NTIS HC A20 CSCL 21/9

Pressure oscillations in ramjet combustor, instabilities and transients in ramjet engines and facilities were discussed. The development of ramjets and ramrockets and experience with pressure oscillations in other airborne propulsion systems is examined. Current high frequency instrumentation methods and data analysis practices are reviewed. Guidelines for the consistent and proper use of high frequency response instrumentation on ramjet engine and component testing and data acquisition, recording, analysis, and interpretation techniques are considered. Procedures are presented for obtaining consistent, useful, and repeatable pressure oscillation data. E.A.K.

N82-21424# Air Force Engineering and Services Center, Tyndall AFB, Fla. Engineering and Services Lab.

THE EFFECT OF FUEL COMPOSITION ON GROUNDFALL FROM AIRCRAFT FUEL JETTISONING Final Report, Mar. 1980 - Feb. 1981

Harvey J. Clewell, III Mar. 1981 35 p refs

(AF Proj. 1900)

(AD-A110305; AFESC/ESL-TR-81-13)

Avail: NTIS

HC A03/MF A01 CSCL 01/3

A computer model which simulates the evaporation and free-fall of fuel droplets in the atmosphere was used to determine the effect of fuel composition on the nature and extent of ground contamination by fuel discharged from an aircraft in flight. Three fuel compositions were used: (1) JP-4, the standard Air Force jet fuel; (2) Jet A (JP-8), the standard U.S. commercial jet fuel; and (3) Number 2 Diesel Fuel, representing the upper limit for future, broadened-specification fuels from alternative sources. The results of this study indicate that the amount of liquid fuel reaching the ground from the jettisoning of commercial jet fuels is much greater than for JP-4. Moreover, future broadened specification fuels may produce even greater ground contamination when jettisoned. GRA

N82-21483# Naval Air Systems Command, Washington, D. C.
CONFORMAL ANTENNA ARRAY DESIGN HANDBOOK

R. C. Hansen, ed., P. T. Bargeliotos, J. Boersma, Z. W. Chang, K. E. Golden, A. Hessel, W. H. Kummer, R. Mather, H. E. Mueller, and D. C. Pridmore-Brown Sep. 1981 440 p refs
(AD-A110091) Avail: NTIS HC A19/MF A01 CSCL 09/5

A discussion of conformal antenna arrays is divided in the following three categories: low gain antennas for small missiles and artillery rounds; fuselage mounted ECM arrays for aircraft; and electronically scanned arrays covering wide angles. Conforming the array to the surface not only saves space and allows rapid inertialess scan but often is essential for structural reasons. L.F.M.

N82-21532*# Douglas Aircraft Co., Inc., Long Beach, Calif.
LAMINAR FLOW CONTROL SPF/08 FEASIBILITY DEMONSTRATION Final Report

R. C. Ecklund and N. R. Williams Oct. 1981 50 p
(Contract NAS1-16425)
(NASA-CR-165818; NAS 1.26:165818) Avail: NTIS HC A03/MF A01 CSCL 20D

The feasibility of applying superplastic forming/diffusion bonding (SPF/DB) technology to laminar flow control (LFC) system concepts was demonstrated. Procedures were developed to produce smooth, flat titanium panels, using thin -0.016 inch sheets, meeting LFC surface smoothness requirements. Two large panels 28 x 28 inches were fabricated as final demonstration articles. The first was flat on the top and bottom sides demonstrating the capability of the tooling and the forming and diffusion bonding procedures to produce flat, defect free surfaces. The second panel was configured for LFC porous panel treatment by forming channels with dimpled projections on the top side. The projections were machined away leaving holes extending into the panel. A perforated titanium sheet was adhesively bonded over this surface to complete the LFC demonstration panel. The final surface was considered flat enough to meet LFC requirements for a jet transport aircraft in cruising flight. Author

N82-21600# British Aerospace Aircraft Group, Kingston-upon-Thames (England). Ground Test Services Dept.

POSITRON ANNIHILATION

A. Turner Sep. 1980 8 p refs
(BAE-KGT-N-GEN-00996) Avail: NTIS HC A02/MF A01

A nondestructive investigative technique, using positron annihilation, is introduced, and the physics of it are explained. The collision of a positron and an electron under thermal conditions causes the emission of annihilation radiation in the form of two gamma rays. This radiation is detected using lithium drifted germanium or intrinsic germanium detectors. Applications are limited to quality control, where the very small detection area, (0.55 sq mm to a few sq cm) is not impractical, and to monitor areas with a known defect and following the progress of cracks. Whole aircraft or large component, scanning is not possible because of the enormous number of probes required. Author (ESA)

N82-21601# Royal Aircraft Establishment, Farnborough (England).

NON-DESTRUCTIVE INSPECTION AND THE IMPLEMENTATION OF A DAMAGE TOLERANT DESIGN PHILOSOPHY

D. E. W. Stone Feb. 1981 15 p refs
(RAE-TM-Struct-982; BR78531) Avail: NTIS HC A02/MF A01

Increasing demands are being made for more quantitative NDI, but current inspection capabilities are inadequate. It is difficult to compare destructive and NDI data. Corrosion degrades inspection capability; 90% probability of detection of flaws with a 95% confidence bound is necessary, but only a 50% detection probability is attainable, for a 1/2 inch crack size, with a 95% confidence level. The implementation of a damage tolerant design philosophy requires a less subjective judgement to be made than is the case at present. Author (ESA)

N82-21777# National Academy of Sciences - National Research Council, Washington, D. C. Committee on Hearing Biocoustics and Biomechanics.

ASSESSMENT OF COMMUNITY RESPONSE TO HIGH-ENERGY IMPULSIVE SOUNDS

William J. Galloway Jul. 1981 32 p refs
(AD-A110110) Avail: NTIS HC A03/MF A01 CSCL 20/1

A dose-response relationship between day-night average C-weighted sound level and average degree of community annoyance is proposed for high-energy impulsive sounds. This proposal revises the relationship originally recommended in a NRC-CHABA report (1977) to reflect more recent community response data and additional analyses of previous data. The use of sound level-weighted population as a means for assessing noise impact, as originally proposed by CHABA, is retained in this proposal. Author (GRA)

N82-21788# Rolls-Royce Ltd., Derby (England).
THE IMPACT AND FUTURE DIRECTION OF AIRCRAFT NOISE CERTIFICATION

M. J. T. Smith 1980 29 p refs Presented at 1980 Intern. Conf. on Noise Control Eng., Miami, Dec. 1980
(PNR-90053) Avail: NTIS HC A03/MF A01

The impact of soaring fuel costs and environmental quality pressures is discussed. After a decade of noise legislation, little real improvement has been made. The current growing emphasis on noise footprints has scared manufacturers and operators into believing that a second more powerful certification process at the airport could soon be brought into force. Existing legislation will either be replaced by newer legislation in the nineteen eighties or will become more effective. A better adaptation of existing procedures is suggested which would eliminate the need for secondary controls around airports, the operator and the airport managers judging for themselves the real impact of a new aircraft within the designated route structure. Author (ESA)

N82-21798# Helsinki Univ. of Technology, Espoo (Finland). Inst. of Physics.

ON THE GRAVIMETRIC INVERSION PROBLEM

D. O. Riska 1981 30 p refs
(Rept-129) Avail: NTIS HC A03/MF A01

The multipole expansion series for the gravitational potential and acceleration anomalies on the flat surface of the Earth due to a subterranean body of finite extent are inverted. Explicit formulae for the multipole moments are given in terms of the potential and acceleration components on the surface. Finally a model independent method for the determination of the shape of a starlike body of fixed density from the multipole moments is presented. The results lead to a constructive approach to the inversion problem of gravimetry and also indicate an optimal set of measurement points. Author

N82-21799# Council for Scientific and Industrial Research, Pretoria (South Africa).

ON GEOMORPHOLOGICAL CONVERGENCES. THE CASE OF THE NAMIB DESERT RELIEF (SKELETON COAST AND CENTRAL NAMIB DESERT - SOUTH WEST AFRICA/NAMIBIA)

Uwe Rust 1981 21 p Transl. into ENGLISH from Mitt. der Geograph. Ges. (Munich), v. 64, 1979 p 201-216 Presented at the 42nd German Geographic Meeting, Goettingen, West Germany, 5 Jun. 1979
(CSIR-Trans-1583) Avail: NTIS HC A02/MF A01

Convergence of forms and processes are studied in relation to geomorphological evidence found in the Namib desert. The concept of 'convergence' as a current principle is emphasized. The formation of sharp edged debris by gypsum wedging is compared with the formation of debris by frost wedging in a periglacial environment. In the Namib desert the gypsum wedging which results in material disintegration is linked to gypseous crust formation, and therefore rocks with different genetics can be solidly united by this crust. Important differences between the formative requirements in the Namib desert and in the periglacial environment are mentioned. Time as a factor is very important when it comes to obtaining an understanding of geomorphological convergences. S.L.

N82-22005# Rolls-Royce Ltd., Derby (England). Dept. of Noise Systems.

STANDARDS IN AIRCRAFT NOISE CERTIFICATION

L. R. Bentley 1980 7 p Presented at NPL Conf. on Std. in Acoustics, Teddington, Engl., 8 Oct. 1980
(PNR-90052) Avail: NTIS HC A02/MF A01

The development of the International Civil Aviation Organization and Federal Aviation Agency noise standards is reviewed and compared. The assessment of the effectiveness of standards by on-site measurements by different organizations, and by distribution of magnetic tapes of measurements is mentioned.

The development of root mean square detectors employing digital techniques has simplified the standardization of detector performance. Atmospheric attenuation effects on certification measurements are outlined and problems caused by reflected sound waves received by the microphone located at the mandatory 1.2 m height are cited. Author (ESA)

N82-22007# Royal Aircraft Establishment, Farnborough (England).

SOME APPLICATIONS OF HARTMANN-TYPE SOURCES IN AIRCRAFT NOISE RESEARCH

T. A. Holbeche and R. W. Jeffrey Nov. 1980 18 p refs
Presented at Spring Meeting of the Inst. of Acoustics, Nottingham, England, Mar. 1975

(RAE-TM-AERO-1877; BR77146) Avail: NTIS
HC A02/MF A01

Inflight shielding experiments were performed with a slender delta research aircraft fitted with needle stabilized generators having 19mm diameter driving jets operated from the high pressure turbine of the aircraft engine. Acoustic power output is 1 kW and consists of a strong fundamental 2.8 kHz tone and higher harmonics, discernible above engine noise. Comparative wind tunnel experiments employed quarter-scale versions built to match the tunnel model and these operated at 11 kHz, the output level being well above tunnel background noise. Calibration in an anechoic room shows output to be steady and nearly omnidirectional. Author (ESA)

N82-22095# Rolls-Royce Ltd., Derby (England).

THE BENEFITS OF DATA EXCHANGE

J. R. Fawn 1980 14 p

(PNR-90048) Avail: NTIS HC A02/MF A01

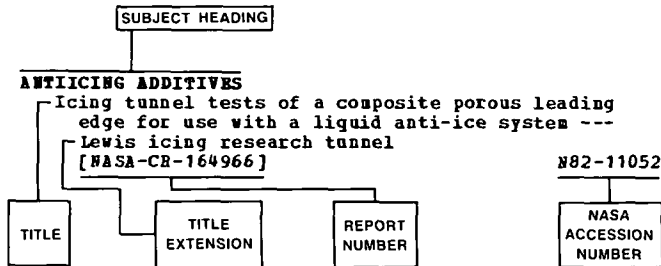
The analysis of operational data and its use in forecasting engine performance is promoted as a cost effective way to identify needed manufacturer engineering action, shop repair policy, and line maintenance policy. Emphasis is placed on the modular large fan engine. The engine manufacturer needs data concerning aircraft utilization, reliability of aircraft, engines, components and systems, as well as safety, engineering and shop data. The need for a standard format is mentioned. A forecasting model for component failure is briefly described for the RB211 engine. Author (ESA)

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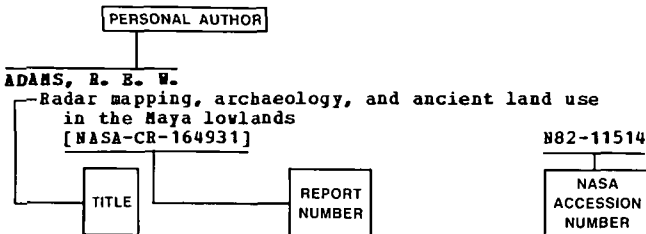
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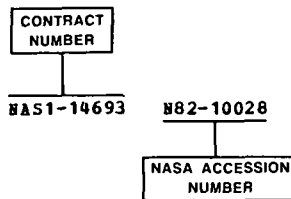
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			N82-21197		
			NAS3-20646		
			N82-21196		

1. Report No. NASA SP-7037(150)	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle Aeronautical Engineering A Continuing Bibliography (Supplement 150)		5. Report Date July 1982	
		6. Performing Organization Code	
7. Author(s)		8. Performing Organization Report No.	
		10. Work Unit No.	
9. Performing Organization Name and Address National Aeronautics and Space Administration Washington, D.C. 20546		11. Contract or Grant No.	
		13. Type of Report and Period Covered	
12. Sponsoring Agency Name and Address		14. Sponsoring Agency Code	
15. Supplementary Notes			
16. Abstract <p style="text-align: center;">This bibliography lists 382 reports, articles and other documents introduced into the NASA scientific and technical information system in June 1982.</p>			
17. Key Words (Suggested by Author(s)) Aerodynamics Aeronautical Engineering Aeronautics Bibliographies		18. Distribution Statement Unclassified - Unlimited	
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages 120	22. Price* \$5.00 HC

* For sale by the National Technical Information Service, Springfield, Virginia 22161

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