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A Continuing Bibliography with Indexes

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Aeronautical Engineering

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NASA SP-7037(138)

AERONAUTICAL ENGINEERING

A Continuing Bibliography

Supplement 138

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced in July 1981 in

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INTRODUCTION

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

This supplement to *Aeronautical Engineering -- A Continuing Bibliography* (NASA SP-7037) lists 366 reports, journal articles, and other documents originally announced in July 1981 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*.

The coverage includes documents on the engineering and theoretical aspects of design, construction, evaluation, testing, operation, and performance of aircraft (including aircraft engines) and associated components, equipment, and systems. It also includes research and development in aerodynamics, aeronautics, and ground support equipment for aeronautical vehicles.

Each entry in the bibliography consists of a standard bibliographic citation accompanied in most cases by an abstract. The listing of the entries is arranged in two major sections, *IAA Entries* and *STAR Entries*, in that order. The citations, and abstracts when available, are reproduced exactly as they appeared originally in *IAA* and *STAR*, including the original accession numbers from the respective announcement journals. This procedure, which saves time and money, accounts for the slight variation in citation appearances.

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N81-10636*# FWG Associates, Inc., Tullahoma, Tenn.
PILOT-AIRCRAFT SYSTEM REPONSE TO WIND SHEAR
Interim Report
Barry S. Turkel and Walter Frost Washington NASA Nov. 1980 98 p refs
(Contract NAS8-33458)
(NASA-CR-3342) Avail: NTIS HC A05/MF A01 CSCL 04B

The nonlinear aircraft motion and automatic control model is expanded to incorporate the human pilot into simulations of aircraft response to wind to wind shear. The human pilot is described by a constant gains lag filter. Two runs are carried out using pilot transfer functions. Fixed-stick, autopilot, and manned computer simulations are made with an aircraft having characteristics of a small commuter type aircraft flown through longitudinal winds measured by a Doppler radar beamed along the glide slope. Simulations are also made flying an aircraft through sinusoidal head wind and tail wind shears at the phugoid frequency to evaluate the response of manned aircraft in thunderstorm wind environments. S.F.

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A81-10474 # **The design of blowing-cooled aircraft electrical machines (Voprosy konstruktsii produvaemykh aviatsionnykh elektricheskikh mashin).** V. I. Naumenko, O. G. Klochkov, and V. V. Bandurin (Akademiia Nauk Ukrainskoi SSR, Institut Elektrodinamiki, Kiev, Ukrainian SSR). *Tekhnicheskaia Elektrodinamika*, July-Aug. 1980, p. 81-87. In Russian.

The current status of air-cooled aircraft electrical machines is reviewed. The possibility of reducing the weight and size of air-cooled machines is discussed, with particular emphasis on the design of cooling systems for synchronous ac-generators. B.J.

AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 138)

AUGUST 1981

IAA ENTRIES

A81-30653 # **A theoretical treatment of lifting surface theory of an elliptic wing.** T. Kida (Osaka Prefecture, University, Sakai, Japan). *Zeitschrift für angewandte Mathematik und Mechanik,* vol. 60, Dec. 1980, p. 645-651. 13 refs.

An exact theoretical treatment of the three-dimensional lifting surface theory as treated in Krienes (1940) is presented. A new technique for the numerical approach is given in order to improve the accuracy of Krienes' results. An elliptic wing is analyzed and the singularity of the lift distribution near the wing tips is examined in detail, using the trigonometric series expressions of Lamé polynomial functions. The asymptotic behavior of circulation near the wing tips is also calculated. D.K.

A81-30689 **The USAF Armament Division Structural Dynamics Lab.** W. O. Dreadin (USAF, Structural Dynamics Laboratory, Eglin AFB, Fla.). *Journal of Environmental Sciences,* vol. 24, Mar.-Apr. 1981, p. 45-48.

The aircraft/weapon certification programs of the Structural Dynamics Laboratory are discussed. A variety of static structural and dynamic tests are conducted on weapons, suspension equipment, and aircraft to assure safe carriage limits for numerous tactical configurations. Loads testing conducted in the facility include load path verification studies and nondestructive load limit testing. Modal tests and analyses are performed in support of analytical flutter studies which are used to determine aircraft/weapon flight envelopes free of dynamic instabilities. Random input ground vibration testing has also shown itself to be a viable and useful technique. D.K.

A81-30705 **On the design of modern airfoil sections by numerical methods.** D. J. Jones (National Aeronautical Establishment, Ottawa, Canada) and B. Eggleston (de Havilland Aircraft of Canada, Ltd., Downsview, Ontario, Canada). In: Innovative numerical analysis for the engineering sciences; Proceedings of the Second International Symposium, Montreal, Canada, June 16-20, 1980. Charlottesville, Va., University Press of Virginia, 1980, p. 169-178. 10 refs.

Numerical procedures are described for the design of advanced supercritical and multielement airfoils, including a direct, simplex approach to performance optimization subject to certain constraints. The method has as its unique advantage the fact that real airfoil profiles are always considered, by contrast to the inverse design approach in which, for a given pressure distribution, upper and lower airfoil surfaces may cross upstream of the trailing edge. It is shown that a combination of various techniques is often needed to arrive at an optimum airfoil design. O.C.

A81-30710 **A computer code for the calculation of aircraft trailing vortices.** G. J. Saint-Cyr (Poseidon Research, Los Angeles, Calif.). In: Innovative numerical analysis for the engineering sciences; Proceedings of the Second International Symposium, Montreal, Canada, June 16-20, 1980. Charlottesville, Va., University Press of Virginia, 1980, p. 239-249. 6 refs.

The governing equations, numerical methods and examples of code output are presented for a computer program developed for calculating the trajectory and duration of aircraft trailing vortices. The program consists of the synergistic combination of a flux-corrected transport algorithm, a block-cyclic reduction method, and a two-equation turbulence model. Having specified the initial conditions, the stream function is computed by using Biot-Savart integration over vorticity at the borders of the computational grid and by using a block-cyclic reduction algorithm for Poisson's equation at the interior of the grid. Differentiation of the stream function yields the velocity field. Computational results are compared to measurements obtained in laboratory experiments. O.C.

A81-30717 **A time marching finite volume method for blade-to-blade flows using a body-fitted curvilinear mesh.** M. E. Younis (Pratt and Whitney Aircraft of Canada, Ltd., Longueil, Canada) and R. Camarero (Ecole Polytechnique, Montreal, Canada). In: Innovative numerical analysis for the engineering sciences; Proceedings of the Second International Symposium, Montreal, Canada, June 16-20, 1980. Charlottesville, Va., University Press of Virginia, 1980, p. 321-328. 10 refs.

An efficient and accurate approach to the time-dependent finite volume method, applied to blade-to-blade flows in two dimensions, is presented. The approach consists of the solution of the Euler equations in conservation law form, on a curvilinear, body-fitted mesh. In addition to the advantage of an automatic and very efficient generation of the curvilinear mesh, the solutions are more accurate than existing alternatives and stationary solutions can be obtained with briefer computations. O.C.

A81-30730 **Approximations and short cuts based on generalized functions.** R. P. Kanwal (Pennsylvania State University, University Park, Pa.). In: Innovative numerical analysis for the engineering sciences; Proceedings of the Second International Symposium, Montreal, Canada, June 16-20, 1980. Charlottesville, Va., University Press of Virginia, 1980, p. 531-542. 11 refs.

Various applications of the Dirac delta function and its distributional derivatives are demonstrated by including the viscous terms in the equations of motion. The aerofoil theory is discussed in these terms. The concept of an impulse or a concentrated force at a point is extended, and the generalized functions are distributed over a segment of a coordinate axis. This method is then extended to include a segment on any straight line in the plane, not necessarily a coordinate axis. The applicability of generalized functions to two branches of mathematical analysis is demonstrated. Here, a simple example illustrates the use of the functions in the solution of the singular integral equations. The functions are then shown to be applicable to the study of orthogonal polynomials. C.R.

A81-30776 **A 7.5-GHz microstrip phased array for aircraft-to-satellite communication.** F. W. Cipolla (Ball Corp., Ball Aerospace Systems Div., Boulder, Colo.). *IEEE Transactions on Antennas and Propagation,* vol. AP-29, Jan. 1981, p. 166-171. Contract No. F30602-78-C-0329.

The design features of a 7.5 GHz microstrip phased array fabricated for the super high frequency SATCOM communications system are given. The receive-only array is left-hand circularly polarized and has 3-bit digital p-i-n diode phase shifters for steering the beam. A microprocessor-based beam steering controller is included for calculating the phase shifter settings for each beam position. The entire array, including the radiating elements, quadrature hybrid, phase shifters, corporate feed, RF chokes, and dc bias, is in a microstrip medium. The array achieves a gain of 19.6 dBic for the broadside beam. L.S.

A81-30779 **An extremely lightweight fuselage-integrated phased array for airborne applications.** J. S. Yee and W. J. Furlong (Boeing Military Airplane Co., Advanced Airplane Branch, Seattle, Wash.). *IEEE Transactions on Antennas and Propagation,* vol. AP-29, Jan. 1981, p. 178-182.

A design of a lightweight low volume electronically scanned antenna is described. This antenna, besides being the radiating aperture, serves as a load-sharing fuselage panel in a small weight-sensitive remotely piloted vehicle (RPV). A demonstration array incorporating the microstrip radiating elements, stripline feed circuit, and microstrip-line p-i-n diode phase shifters was assembled to evaluate the electrical characteristics and scanning capabilities of the array. The demonstration array was tested on the antenna range and operated successfully as part of a radar/communication subsystem demonstration. An eight-element lightweight section of the demonstration array was subsequently designed and fabricated in a modern production facility utilizing numerically controlled machines and state-of-the-art printed circuit board etching and plating equipment. Successful operation of this lightweight section sufficiently demonstrated that a lightweight and low volume electronically steerable phase-array antenna can be fabricated and integrated into a structural panel in production quantities. (Author)

A81-30785 **The displacement-thickness theory of trailing edge noise.** M. S. Howe (Bolt Beranek and Newman, Inc., Cambridge, Mass.). *Journal of Sound and Vibration,* vol. 75, Mar. 22, 1981, p. 239-250. 19 refs.

A theory of edge noise is developed which is valid at low Strouhal numbers and which accounts for changes occurring at the edge in the boundary layer inhomogeneities. Two-dimensional problem of boundary layer flow over the edge of a semi-infinite rigid plate with the boundary layer disturbances taken as uniform in the spanwise direction is considered. Expressions are given for the far field sound and for the surface pressure fluctuations close to the edge of the plate. It is shown that the use of Liepmann's (1954) method leads to the prediction of an additional acoustic dipole source at the trailing edge, the axis of which is orientated in the direction of the mean flow. At very low Mach numbers, comparison with evanescent wave theory indicates that this dipole makes a negligible contribution to the radiated sound, although it can lead to a significant modification of the hydrodynamic pressure on the surface of the plate near the trailing edge. At higher Mach numbers, the dipole also modifies the acoustic field shape in the region downstream of the edge within which evanescent wave theory predicts a relatively weak radiation intensity. L.S.

A81-30786 **Non-linear oscillator models in bluff body aeroelasticity.** E. H. Dowell (Princeton University, Princeton, N.J.). *Journal of Sound and Vibration,* vol. 75, Mar. 22, 1981, p. 251-264. 17 refs. NSF Grant No. CME-79-16933.

A critique of nonlinear oscillator models is offered and a systematic and self-consistent procedure for constructing such a model is proposed based upon theoretical and experimental fluid mechanical information. Numerical studies are conducted for the proposed model as well as for the earlier one of Skop and Griffin. A comparison with Jones' experimental results is also made. (Author)

A81-30802 **Computation of wall temperature and heat flux distributions of the film cooled walls.** S.-Y. Ko (Academia Sinica, Mechanics Institute, Beijing, Communist China). In: Heat and mass transfer in metallurgical systems; Proceedings of the Seminar, Dubrovnik, Yugoslavia, September 3-7, 1979. Seminar sponsored by the International Centre for Heat and Mass Transfer. Washington, D.C., Hemisphere Publishing Corp., 1981, p. 635-649. 8 refs.

A computational algorithm and a computer program have been developed for determining the wall temperature distribution of film-cooled gas turbine flame tube. In the computer program, the Newton-Raphson iteration method is used for the solution of heat balance equation; a graphic method has been also proposed for the same purpose. Results indicate that a 1% reduction in the turbulent mixing coefficient of the combustion chamber would reduce the wall temperature by about 20 C, which would substantially increase the service life of turbine components. V.L.

A81-30914 **Coriolis effect on the vibration of flat rotating low aspect ratio cantilever plates.** S. Sreenivasamurthy and V. Ramamurti (Indian Institute of Technology, Madras, India). *Journal of Strain Analysis for Engineering Design,* vol. 16, Apr. 1981, p. 97-106. 17 refs.

The Coriolis effect on the first bending and first torsional frequencies of flat rotating low aspect ratio cantilever plates has been investigated using finite element method. The cantilever plate has been modelled using plane triangular shell elements with three nodes and eighteen degrees of freedom. Three typical skew angles (0, 45, and 90 degrees) and two aspect ratios (1 and 2) are considered in the analysis. In addition to the Coriolis effect other effects, namely the geometric stiffness and the supplementary stiffness, have been considered. The mass and stiffness matrices have been derived using area coordinates. It has been found that the effect of including Coriolis effect is to lower the first two frequencies. This effect is negligible when the skew angle is 90 degrees. In the other two cases, skew of 0 and 45 degrees, there is a noticeable effect on the first torsional mode frequency when the aspect ratio is unity and on the first bending mode frequency when the aspect ratio is 2. An increase in the Coriolis effect is observed when the aspect ratio is increased from 1 to 2, with the skew angles of 0 and 45 degrees and a decrease when the skew angle is 90 degrees. The difference between the two frequencies (with and without Coriolis effect) becomes more and more noticeable as the rotational speed increases. (Author)

A81-30915 **Tensile stress/strain characterization of non-linear materials.** J. Margetson (Propellents, Explosives and Rocket Motor Establishment, Aylesbury, Bucks., England). *Journal of Strain Analysis for Engineering Design,* vol. 16, Apr. 1981, p. 107-110.

A modified Ramberg-Osgood equation is used to empirically represent a uniaxial stress/strain curve, with values improved iteratively by a least-squares fit using all the experimental points on the curve. The procedure is used to generate stress/strain relationships for a variety of materials, and good agreement is found with experimental values. The method is also applied to an aerodynamic heating simulation experiment. O.C.

A81-30956 # **Influence of hinge line gap on aerodynamic forces acting on a harmonically oscillating thin profile in an incompressible flow. I, II.** S. Filipkowski and M. Nowak (Polska Akademia Nauk, Instytut Podstawowych Problemow Techniki, Warsaw, Poland). *Archiwum Mechaniki Stosowanej,* vol. 32, no. 4, 1980, p. 517-548. 28 refs.

The method of strongly singular integral equations is used to derive the solution of the Birnbaum-Possio equations for a system of two profiles lying on one straight line parallel to the direction of flow at infinity. The full linearization of the model of the phenomenon is retained, and the solution of the problem of the effect of a gap on the pressure distribution acting on the harmonically oscillating profile with the control surface, and on the aerodynamic coefficients of the profile is presented. Both the pressure distribution over the profile and the aerodynamic coefficients are expressed in terms of elementary functions and canonical forms of elliptic integrals. Only a few integrals which depend on the geometry of the system and on the frequency coefficient require numerical procedures. The method of calculating the aerodynamic coefficients can be applied in the analysis of the flutter of the profile. Some examples of numerical calculations illustrating the influence of the size of the gap on the pressure distributions and the aerodynamic coefficient are given. D.K.

A81-30975 # **GPS Navstar, the universal positioning system of the future.** B. Owen and J. O'Toole (Amalgamated Wireless /Australasia/, Ltd., Sydney, Australia). *Navigation* (Australia), vol. 6, Dec. 1980, p. 859-866.

A brief description of the Navstar Global Position System (GPS) is presented. The GPS, a DOD program, designed to provide instant three-dimensional navigation information, will employ 18 satellites and is expected to be fully operational for military as well as civilian use by 1987. The 18 satellites (which will circle the earth twice daily at 11,000 n mi above earth) will be in three orbital planes, six per orbit, and they will give global coverage under all weather conditions by 1985. The GPS set, a combination radio receiver and computer, will lock onto Navstar signals from the four satellites most favorably located and compute the signals' time, range, and co-ordinates into navigational data. A highly accurate atomic clock is a key component of the system. A master control station, an upload station, and four monitor stations will daily monitor, update, and maintain positioning and clock accuracy of the satellites. An unlimited number of GPS sets can receive the satellite signals. Attention is given to potential problems of a commercial users, i.e., position fixing, velocity, order of accuracy, and signal matching. The concept validation program has been completed, whereas full-scale development and the system test program are not under way. K.S.

A81-31034 # **Subsonic gas flow past a wing profile (Obtekanie krylovogo profilia dozvukovym potokom gaza).** N. A. Meller. *Zhurnal Vychislitel'noi Matematiki i Matematicheskoi Fiziki,* vol. 21, Jan.-Feb. 1981, p. 139-149. In Russian.

Doronitsyn's (1978) small-parameter integration method is used to analyze subsonic gas flow past a symmetric profile at angle of attack. Solutions are obtained for flow past a cylinder and a Zhukovskii profile at angle of attack. Velocity fields are obtained for various Mach numbers. B.J.

A81-31039 # **Mathematical model of the linear unsteady aerodynamics of the entire aircraft (Matematicky model linearni nestacionarni aerodynamiky celeho letadla).** Z. Skoda. *Zpravodaj VZLU,* no. 5, 1980, p. 195-199. 6 refs. In Czech.

A mathematical model of the linear unsteady aerodynamics of an aircraft as a whole is developed on the basis of the response of the aircraft to stepwise changes of the parameters of motion. The aerodynamic force acting on the aircraft is replaced by a system of discrete forces acting on elementary parts of the aircraft. The system of discrete forces is obtained by solving the system of algebraic equations that describe stepwise changes of the parameters of aircraft motion. B.J.

A81-31041 # **Calculation of the flow pattern behind an aircraft wing (Vypocet obrazu proudeni za kridlem letounu).** M. Zadnik. *Zpravodaj VZLU,* no. 5, 1980, p. 207-215. 6 refs. In Czech.

A numerical method for calculating the flow pattern behind a wing is presented. Results of calculation are compared with those of a wind tunnel test for the case of an isolated rectangular wing. The numerical method is applied to symmetrical flow past a jet aircraft with an all-moving tail and deflected flaps. B.J.

A81-31042 # **Measurement of the aerodynamic forces acting on a harmonically oscillating wing at high subsonic speeds (Mereni aerodynamickych sil pusobicich na harmonicky kmitajici kridlo pri vysokych podzvukovych rychlostech).** J. Lebduska. *Zpravodaj VZLU,* no. 5, 1980, p. 217-220. 8 refs. In Czech.

The damped oscillation method was used to obtain the unsteady aerodynamic derivatives of a half-wing undergoing harmonic pitching oscillations in a wind tunnel in the Mach number range of 0.4-1.0. Such factors as the effect of walls, the effect of the gap between the model and the wall, and the dynamic characteristics of the oscillating body, are examined. B.J.

A81-31044 # **New interpretations in the theory of viscous incompressible fluid flow past airfoil profiles (Novejsi interpretace v teorii vazkeho nestalacitelneho obtekani leteckych profilu).** P. Berak. *Zpravodaj VZLU,* no. 6, 1980, p. 255-259. 8 refs. In Czech.

Methods of the theoretical prediction of the aerodynamic characteristics of airfoils are discussed. An extended formula for the friction drag on a plate is given; and the application of a generalized function to the flows of viscous and ideal fluids is considered. The use of a double expansion for the analytical solution of the Navier-Stokes equations by the perturbation method is examined. A practical iterative procedure for determining the aerodynamic characteristics of airfoils is described; it is shown that the parallel solution of the Navier-Stokes equations by the perturbation method and the iterative procedure assures a correct iterative solution. B.J.

A81-31045 # **Concerning Khristianovich's transformation of a subsonic flow past an airfoil into a low-speed flow (Poznamka k Christianovicove transformaci mezisubsonickym a nizkorychlostnim obtekanim profilu).** V. Broz. *Zpravodaj VZLU,* no. 6, 1980, p. 261-265. 6 refs. In Czech.

Khristianovich's (1940) method that can be used to transform a subsonic flow past an airfoil into a low-speed flow is described. It is shown that a ratio between the pressure coefficients of the subsonic flow and the low-speed flow can be deduced from the transformation. B.J.

A81-31109 **Operator training systems/simulators.** G. Wergeni (Datasaab AB, Jarfalla, Sweden). In: Military Electronics Defence Expo '80; Proceedings of the Conference, Wiesbaden, West Germany, October 7-9, 1980. Cointrin, Geneva, Switzerland, Interavia, S.A., 1980, p. 117-139.

The design criteria and operational capabilities of a family of training simulators for Air Defence and Air Traffic Control operators are described, with stress on the tactical flexibility and the maintainability of the systems. All training exercises are preprogrammed and define the position of trainee controllers and pilots, radar characteristics, direction-finding stations, etc. It is also possible to run several simultaneous exercises independently, with full freedom of assignment to each trainee. O.C.

A81-31110 **A simulator to test compressor research facility control system software.** R. H. Byers, M. Snider, and B. Brownstein (Battelle Columbus Laboratories, Columbus, Ohio). In: Military Electronics Defence Expo '80; Proceedings of the Conference, Wiesbaden, West Germany, October 7-9, 1980. Cointrin, Geneva, Switzerland, Interavia, S.A., 1980, p. 140-153.

A simulator employed in control software integrity testing and operator training for a compressor research facility is described, which is of critical importance in software integrity verification when a new compressor is to be tested or changes made to the facility's control network software. Detailed descriptions of the simulator system architecture, function, task timing and priorities, and simulated test facilities are given. O.C.

A81-31113 **Rapport tactical self protection systems design.** J. D. Sparno (Loral Corp., Yonkers, N.Y.). In: Military Electronics Defence Expo '80; Proceedings of the Conference, Wiesbaden, West Germany, October 7-9, 1980. Cointrin, Geneva, Switzerland, Interavia, S.A., 1980, p. 207-212.

The performance requirements and capabilities of the Rapport tactical combat aircraft self-protection electronics are considered, with stress on the system's adaptation to the F-16 fighter. As installed in the F-16, the Rapport 3 system occupies only 2.8 cu ft, weighs 366 lb, and has minimum impacts on aircraft cooling and power requirements. Rapport eliminates hardware duplication and improves response time through integration of warning and ECM functions, permits programmable power management, distributes transmitter location to allow full power jamming both forward and aft, and is entirely stored internally in the aircraft. O.C.

A81-31114 **Helicopter rotor blade effects on mast-mounted sensor images.** H. E. Matuszewski (Bell Helicopter Textron, Fort Worth, Tex.). In: Military Electronics Defence Expo '80; Proceedings of the Conference, Wiesbaden, West Germany, October 7-9, 1980. Cointrin, Geneva, Switzerland, Interavia, S.A., 1980, p. 249-262.

This paper reviews the background and general requirements for helicopter mast-mounted infrared, TV, and laser sensors. Tests and analyses conducted are summarized. The objective of the tests was to obtain conclusive empirical data on the change in quality of sensor images while looking through the helicopter rotor blade plane. Test data was recorded on video tape. Analytical extrapolations of the video are presented. There was no apparent degradation of target images for any test condition. Further analyses showed no major degradation for most helicopters, rotors, sensor types, and sensor modes of operation. (Author)

A81-31115 **A high performance TV camera for use in target acquisition and laser designator systems.** L. Arlan (RCA, Government Systems Div., Burlington, Mass.). In: Military Electronics Defence Expo '80; Proceedings of the Conference, Wiesbaden, West Germany, October 7-9, 1980. Cointrin, Geneva, Switzerland, Interavia, S.A., 1980, p. 287-304. Research supported by Northrop Corp.

A family of low-power, high-performance miniaturized TV sensors are described, which are ideally suited for such military applications as mast-mounted sights, remotely piloted vehicles, and other systems in which small optical sensors must operate in extreme electromagnetic interference environments. The results of electrical and mechanical performance tests for these devices are discussed in detail. O.C.

A81-31122 **An X-band power GaAs FET amplifier for military avionics radar applications.** K. R. Broome and D. S. James (Ferranti Electronics, Ltd., Microwave Div., Poynton, Ches., England). In: Military Electronics Defence Expo '80; Proceedings of the Conference, Wiesbaden, West Germany, October 7-9, 1980. Cointrin, Geneva, Switzerland, Interavia, S.A., 1980, p. 453-460. Research supported by the Ministry of Defence (Procurement Executive).

An all-FET power amplifier, incorporating hermetically sealed GaAs devices of flip-chip configuration, is discussed. It is noted that the RF design includes a PIN attenuator for on-aircraft gain preset and gain/temperature compensation. RF power sensors are employed at input and output to provide overall BITE indication of satisfactory power gain. The construction is modular, and care has been taken to satisfy the stringent thermal and vibration requirements. The modules making up the RF portion include three circuit boards of metal-backed low dielectric constant material and a stripline double isolator unit. Details are also given on the screening and burn-in procedures, and reliability estimates are discussed. C.R.

A81-31125 **Passive location finding with a multiwavelength two element interferometer.** R. B. Scher (Litton Industries, Amecom Div., College Park, Md.). In: Military Electronics Defence Expo '80; Proceedings of the Conference, Wiesbaden, West Germany, October 7-9, 1980. Cointrin, Geneva, Switzerland, Interavia, S.A., 1980, p. 517-528. Contract No. F33615-78-C-1496.

A81-31126 **Applications of new technology in the infrared.** D. B. Duke, G. S. Walton, and P. J. Griffiths (British Aerospace, Dynamics Group, Hatfield, Herts., England). In: Military Electronics Defence Expo '80; Proceedings of the Conference, Wiesbaden, West Germany, October 7-9, 1980. Cointrin, Geneva, Switzerland, Interavia, S.A., 1980, p. 529-533.

Current infrared reconnaissance system technologies are reviewed, and areas where new technology is being applied to improve the design and capability of such systems are pointed out. It is noted that the areas of particular interest to the system designer are the recent developments and future expectations in infrared detector technology and the new techniques available for signal processing and data handling; these will greatly improve the exploitation of reconnaissance information. C.R.

A81-31131 **AN/TPX-54 interrogator.** J. M. Dano and R. W. Fischer (Hazeltine Corp., Greenlawn, N.Y.). In: Military Electronics Defence Expo '80; Proceedings of the Conference, Wiesbaden, West Germany, October 7-9, 1980. Cointrin, Geneva, Switzerland, Interavia, S.A., 1980, p. 859-865.

The AN/TPX-54 IFF interrogator/receiver processor is discussed. The flexibility imparted to the system by the modular building block approach is noted. Among the features of the system are military-qualified solid-state transmitters, an extensive built-in test (for detecting and isolating faults), and a surface acoustic wave oscillator (ensuring high stability). Predicted mean time between failure of the basic interrogator is more than 2,800 hr in a ground environment. A block diagram of the interrogator system is included. Optional features include a destagger circuit, an automatic and programmable countdown circuit, and a suppression gate circuit. C.R.

A81-31132 **A new generation IFF - The AN/APX-100/V/ transponder.** J. L. Shagena, Jr. and J. T. Shaul (Bendix Corp., Communications Div., Baltimore, Md.). In: Military Electronics Defence Expo '80; Proceedings of the Conference, Wiesbaden, West Germany, October 7-9, 1980. Cointrin, Geneva, Switzerland, Interavia, S.A., 1980, p. 866-877. 6 refs.

An integrated panel-mounted transponder developed by the Bendix Communications Division through the use of microminiaturization in both digital and RF circuitry is discussed. It is noted that the transponder eliminates the need for much of the interconnecting cables, connectors, and associated components of older system configurations. The advantages accruing from system integration are enumerated, and the design of the system is discussed (with a listing of the principal performance features of the main modules). Other aspects of the system discussed include the diversity feature, automatic overload control, antijamming features, the built-in-test, and the solid state transmitter. C.R.

A81-31133 **New technology applied to an IFF diversity transponder.** D. Panisset (Le Matériel Téléphonique, Boulogne-Billancourt, Hauts-de-Seine, France). In: Military Electronics Defence Expo '80; Proceedings of the Conference, Wiesbaden, West Germany, October 7-9, 1980. Cointrin, Geneva, Switzerland, Interavia, S.A., 1980, p. 878-896.

The NRAI 7, a fully solid state diversity transponder developed for the French Air Force, is discussed. The major characteristics of the transponder are given, namely diversity operation (in SIF and mode 4 separately), cross channel automatic overload control, cross desensitization with respect to the strongest antenna signal, and high reliability due to the solid state technology. The electrical and physical characteristics are also set forth, and attention is given to the transponder's subassemblies, among them the receiver, transmitter, switching/duplexing circuit, analog processor, test signals generator, and power supply. C.R.

A81-31134 **Discrete Address Beacon System.** N. Solat (FAA, Communications and Surveillance Div., Washington, D.C.). In: Military Electronics Defence Expo '80; Proceedings of the Conference, Wiesbaden, West Germany, October 7-9, 1980. Cointrin, Geneva, Switzerland, Interavia, S.A., 1980, p. 897-909.

The Discrete Address Beacon System (DABS), developed as the next generation secondary surveillance radar (SSR) for air traffic control in the United States, is discussed. It is noted that while DABS occupies the same frequency channels as the present SSR system (1030 and 1090 MHz), the signal wave forms are totally compatible, allowing full use of the present civil/military beacon system while proceeding with the implementation of the DABS. The basic concept of radar beacon surveillance is explored in order to show how both compatibility and improved performance for aircraft surveillance are achieved through the DABS. Attention is also given to the Automatic Traffic Advisory and Resolution Service (ATARS), which uses data from the DABS. It is noted that the focus of the DABS program through the remainder of the decade will be on the use of the high capacity data link to increase safety and efficiency. C.R.

A81-31249 # **Subsonic and transonic flow on a wing at different sweep angles. I (Oplyw poddzwiekowy i przydzwiekowy na skrzydle przy roznych katach skosu. I).** J. Staszek. *Technika Lotnicza i Astronautyczna*, vol. 36, Feb. 1981, p. 5-8. In Polish.

Experimental and theoretical studies of the properties of variable-sweep wings examined flow separation and vortices at subsonic and transonic velocities as well as the formation and shape of shock waves in the transonic range. Results measured with variable-sweep wing models were compared to calculations by several different methods. Tables and graphs illustrate flow characteristics as functions of wing parameters for different speed ranges. T.M.

A81-31250 # **Subsonic and transonic flow on a wing at different sweep angles. II (Oplyw poddzwiekowy i przydzwiekowy na skrzydle przy roznych katach skosu. II).** J. Staszek. *Technika Lotnicza i Astronautyczna*, vol. 36, Mar. 1981, p. 5-8. In Polish.

Results of experimental and theoretical studies on models of swept rectangular wings are given as fundamental data for characterizing three-dimensional flows at sweep angles from zero to 60 degrees. These data can be used for analysis of flow evolution as a function of sweep angle, angle of attack, and Mach number. They are also useful in evaluating the accuracy and applicability of numerical methods for flow determination. T.M.

A81-31258 # **Numerical methods for studying the stress-strain state and service life of aircraft gas-turbine engine disks (Chislennye metody issledovaniia napriazhenno-deformirovannogo sostoianiia i dolgovechnosti diskov aviatsionnykh GTD).** I. V. Dem'ianushko and Iu. M. Temis. *Problemy Prochnosti*, Apr. 1981, p. 49-55. 33 refs. In Russian.

Numerical methods currently used for the design of aircraft gas turbine engines are briefly reviewed with emphasis on finite element methods and methods based on thin-plate theory. It is shown that the most reliable results are obtained by comparing calculated stresses and deformations in the disk with experimental long-term and low-cycle fatigue curves. Service life can be also estimated using empirical formulas relating the strain amplitude to the number of cycles to failure. V.L.

A81-31264 # **Experimental determination of the stress intensity factor for cracks with a curvilinear front in complex parts /gas turbine blades/ (Eksperimental'noe opredelenie koeffitsienta intensivnosti napriazhenii dlia treshchin s krivolineinym frontom v slozhnykh detaliakh /lopatkakh GTD/).** A. V. Prokopenko (Akademiia Nauk Ukrainskoi SSR, Institut Problem Prochnosti, Kiev, Ukrainian SSR). *Problemy Prochnosti*, Apr. 1981, p. 105-111. 9 refs. In Russian.

An experimental procedure has been developed whereby a relationship between the crack growth rate and stress intensity factor obtained for a known specimen type under cyclic loading is used to derive the stress intensity factor in a gas turbine blade with a crack of any length. The method is demonstrated for turbine blades of steels 20Kh13, Kh17N2, and 1Kh12N2VMF. V.L.

A81-31285 **The behavior of quartz oscillators in the presence of accelerations (Comportement des oscillateurs à quartz en présence d'accélerations).** J. Beaussier (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *L'Aéronautique et l'Astronautique*, no. 86, 1981, p. 65-75. 20 refs. In French. Research supported by the Direction des Recherches, Etudes et Techniques.

The replacement of atomic clocks by high-quality quartz oscillators in missile and aircraft time-frequency navigation systems is discussed. The problems presented by the behavior of such oscillators when subjected to acceleration loads are considered in detail, and methods by which the accelerometric effects encountered may be compensated for are described. Current research is concerned with characterization of the effect of acceleration on frequency in both 5 MHz bulk wave oscillators and 100 MHz acoustic wave oscillators. O.C.

A81-31287 **Hydrodynamic modelling of the starting process in liquid-propellant engines.** V. M. Kalnin and V. A. Sherstiannikov (Akademiia Nauk SSSR, Moscow, USSR). *Acta Astronautica*, vol. 8, Mar. 1981, p. 231-242.

A brief description of the scheme and the method of hydrodynamic modelling of the working process in the systems of the liquid-propellant engines on the starting regime is given. Experimental investigation results of the hydraulic system filling with the modelling liquid are presented. Dynamic characteristics of the screw-centrifugal pump and axial and centrifugal turbines obtained in the modelling conditions are discussed. The joint effects of mechanical and hydrodynamic forces on the pump rotor occurring during transient regime are studied. (Author)

A81-31288 **Application of signal detection theory to decision making in supervisory control - The effect of the operator's experience.** A. Bisseret (Institut National de Recherche en Informatique et en Automatique, Rocquencourt, Yvelines, France). *Ergonomics*, vol. 24, Feb. 1981, p. 81-94. Research supported by the Direction Générale de l'Aviation Civile and Ecole Nationale de l'Aviation Civile.

Signal detection theory (SDT) was used as a model for a supervisory activity: the decisions of the air traffic controller using radar. Of particular interest was the professional experience factor which was studied by comparing the performance of trainee and experienced controllers. Through a distinction allowed by SDT between information processing and the decision process, it was shown that trainees discriminate better than experienced controllers, but that the latter manifest a greater degree of caution. These results are interpreted in terms of different information processing methods (judgement versus calculation) and different evaluations of the costs of possible outcomes. The practical interest of these results is demonstrated both for the evaluation of an operator-aiding computer system and for methods of training operators. (Author)

A81-31295 # **The variable-speed tail-chase aerial combat problem.** B. S. A. Jarmark (Saab-Scania AB, Linkoping, Sweden), A. W. Merz (Analytical Mechanics Associates, Inc., Mountain View, Calif.), and J. V. Breakwell (Stanford University, Stanford, Calif.). *Journal of Guidance and Control*, vol. 4, May-June 1981, p. 323-328. 10 refs.

The differential-game version of the coplanar tail-chase aerial combat problem is analyzed by the numerical differential dynamic programming method. The faster pursuer and the more maneuverable evader have only their turn rates as input controls, but their speeds fall as their turn rates are increased to the specified normal acceleration limit. The turn rate of the pursuer is such as to minimize the final miss-distance, while the evader's control maximizes this quantity. Solutions to the fifth-order problem are given for a range of flight conditions. Optimal control variations and sensitivities are discussed with respect to the conflicting requirements of high turn rates and high speed, which cannot be exploited simultaneously. (Author)

A81-31297 * # **Airborne method to minimize fuel with fixed time-of-arrival constraints.** J. A. Sorensen (Analytical Mechanics Associates, Inc., Mountain View, Calif.) and M. H. Waters. *Journal of Guidance and Control*, vol. 4, May-June 1981, p. 348, 349. 5 refs. Contract No. NAS1-15497.

A method for generating a minimum-fuel, fixed-range, fixed-time-of-arrival flight path in an on-board flight management system computer for commercial aircraft is described. It is shown that up to 6% of the fuel otherwise used can be saved by means of this capability, despite time-of-arrival delays of up to 30 min, by a medium-range, tri-jet transport aircraft. O.C.

A81-31367 * # **Adaptive-wall wind-tunnel development for transonic testing.** B. Satyanarayana (Stanford University, Stanford, Calif.), E. Schairer, and S. Davis (NASA, Ames Research Center, Moffett Field, Calif.). *Journal of Aircraft,* vol. 18, Apr. 1981, p. 273-279. 17 refs.

Experimental techniques for rapid assessment and correction of wall interference in an adaptive-wall wind tunnel are described. The experimental arrangement allows laser velocimetry measurements on two control surfaces and incorporates a dedicated computer for data processing. The apparatus and its instrumentation are described, and typical results from an experiment on a nonlifting NACA 0012 airfoil at M = 0.78 are discussed. It is concluded that the time to acquire laser Doppler velocimeter data should be decreased, and the possibility of using one-step algorithms should be investigated. O.C.

A81-31368 * # **Effectiveness of leading-edge vortex flaps on 60 and 75 degree delta wings.** J. F. Marchman, III (Virginia Polytechnic Institute and State University, Blacksburg, Va.). *Journal of Aircraft,* vol. 18, Apr. 1981, p. 280-286. NASA-supported research.

A series of wind tunnel tests were run on 60 and 75 deg sweep delta wings to examine the effectiveness of leading-edge vortex flaps. Tests results showed that leading-edge vortex flaps are effective in giving large increases in lift-to-drag ratio and decreases in drag over a wide range of angle of attack. Tests on inverted flaps on the 60 deg delta wing showed substantial increases in lift and drag and may indicate a possibility of using inverted flaps on delta wings in the landing portion of flight. The 60 deg data were compared with that for a 75 deg sweep delta wing confirming that leading-edge vortex flap effectiveness is stronger as sweep is increased. Pitching moment effects due to vortex flaps use were also examined. (Author)

A81-31369 # **Installation effects on propeller noise.** H. K. Tanna, R. H. Burrin, and H. E. Plumblee, Jr. (Lockheed-Georgia Co., Marietta, Ga.). *(American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 6th, Hartford, Conn., June 4-6, 1980, Paper 80-0993.) Journal of Aircraft,* vol. 18, Apr. 1981, p. 303-309. 5 refs.

The installation effects on propeller noise and propeller wake flow in flight have been examined experimentally by operating a model-scale propeller in the Lockheed anechoic open-jet wind tunnel. In particular, two aspects of propeller operation in a real situation have been quantified. These are: (1) the effects of nonzero angle of attack or propeller inflow angle relative to the flight path, and (2) the propeller inflow distortion due to the upwash generated by the presence of wing and flap behind the propeller. The results show that not only are these installation effects very important, but they are predicted inadequately using existing methods. (Author)

A81-31370 # **Inflight aircraft vibration modes and their effect on aircraft radar cross section.** S. M. Correa, D. L. Sengupta, and W. J. Anderson (Michigan, University, Ann Arbor, Mich.). *Journal of Aircraft,* vol. 18, Apr. 1981, p. 318, 319. 6 refs. Contract No. F19628-77-C-0232.

A short feasibility study concerning the identification of aircraft types through the modulation of radar cross section by elastic in-flight vibration modes is described. The scheme requires unique elastic mode shapes and/or frequencies for each aircraft, with modes (1) remaining distinct as airspeeds and loads are varied, and (2) having vibration amplitudes comparable to the wavelength of the radar, so that unique vibration characteristics cause equally unique dynamic radar cross section modulation. It is concluded on the strength of 3-cm wavelength simulations for three aircraft types that elastic mode shapes and frequencies vary too much with airspeed and loading to permit accurate identification. O.C.

A81-31376 **Implementing Aircraft Structural Life Management to reduce structural cost of ownership.** T. D. Gray and D. J. White (Vought Corp., Dallas, Tex.). *Society of Allied Weight Engineers, Annual Conference, 39th, St. Louis, Mo., May 12-14, 1980, Paper 1331.* 18 p. 8 refs.

The methods of Aircraft Structural Life Management (SLM), which allow maximum economic utilization of structural life without compromising fleet safety, are described. The method incorporates load spectra definition, life prediction, service monitoring, and structural maintenance planning. It is shown that great cost-savings may be derived from inclusion of SLM as a prime consideration early in the design process, and the requirements for such integration of the method into airframe design, development qualification, and monitoring tasks are detailed. Structural elements of the A-7D aircraft are given as examples of SLM application. O.C.

A81-31377 **The 'light-weight' system - A novel concept for on-board weight and balance measurement using fiber optics.** A. C. Macdougall (Dynamic Sciences, Ltd., Montreal, Canada) and R. M. H. Cheng (Dynamic Sciences, Ltd.; Concordia University, Montreal, Canada). *Society of Allied Weight Engineers, Annual Conference, 39th, St. Louis, Mo., May 12-14, 1980, Paper 1336.* 19 p. Research supported by the Transport Canada.

The theoretical and experimental development of an Onboard Weight and Balance System (OBWB) suitable for small transport aircraft is presented. The optical device chosen is the fiber-optic strain gage, which operates on the principle that the time in which light passes through a glass fiber is affected by tension and compression. An interferometer incorporating this effect was built and shown in laboratory tests to be capable of accurately measuring axle deflections in transport aircraft landing gears. The inherently digital device calls for only infrequent calibration, permits automatic error detection, and may have its sensitivity range extended to cover the full dynamic range of landing gear operation without sacrifice of resolution and accuracy. O.C.

A81-31378 **Operational responses to aft empty C.G.** J. R. McCarty (United Airlines, Inc., Chicago, Ill.). *Society of Allied Weight Engineers, Annual Conference, 39th, St. Louis, Mo., May 12-14, 1980, Paper 1338.* 18 p.

A development history is given for the modification and test program by which the adverse influence of the 727-200 airframe's stretching on centers of gravity, and therefore landing gear loadings, was reduced. The particularly severe influence of airframe redesign on the nose landing gear called for the redistribution of fuel tankage in addition to such measures as radome lead ballast. O.C.

A81-31379 **Test procedures used in determining aircraft suitability for STAN integral weight and balance system.** B. J. Hawkins (Fairchild Camera and Instrument Corp., Industrial Products Group, Commack, N.Y.). *Society of Allied Weight Engineers, Annual Conference, 39th, St. Louis, Mo., May 12-14, 1980, Paper 1339.* 21 p.

The methods by which the numerous pertinent characteristics of new aircraft types are assessed, in preparation for the fitting and calibration of a STAN integral weight and balance system, are described. The system, which requires the precise determination of landing gear striction and static friction and damping, uses landing gear oleo strut pressures as the signal source for transducer pickup. The landing gear taxi test procedures and instrumentation are described in detail. O.C.

A81-31380 **Design considerations for future turboprop transports.** D. P. Marsh (Douglas Aircraft Co., Long Beach, Calif.). *Society of Allied Weight Engineers, Annual Conference, 39th, St. Louis, Mo., May 12-14, 1980, Paper 1340.* 7 p. 9 refs. (Douglas Paper-6975)

Preliminary design studies have been completed, and a flight demonstrator program is being planned, for a new-generation, propfan-driven passenger aircraft of DC-9 Super 80 size whose configuration incorporates the two engines either on the wings or on the horizontal stabilizers. Average fuel savings of 20% per nautical mile are anticipated for a near-term, Mach 0.8 cruise aircraft of such design. Extensive details of the structural adjustments performed on the airframe of the DC-9 to accommodate the engine placement alternatives are furnished. O.C.

A81-31381 **Development and testing of a new technology weight and balance indicator.** H. K. Nelson (WEICO Corp., Lynnwood, Wash.). *Society of Allied Weight Engineers, Annual Conference, 39th, St. Louis, Mo., May 12-14, 1980, Paper 1341.* 16 p.

A weight and balance cockpit indicator for commercial aircraft incorporating new microcomputer and transducer technology is described. The system overcomes design, reliability, and maintainability deficiencies of previous systems, and will become operational on most types of transport aircraft early in this decade. Unique features of the indicator are in-flight weight/center of gravity data, auto-calibration, and low tire pressure detection. O.C.

A81-31382 **Flatbed - The universal transport airplane.** W. E. Warnock (Lockheed-Georgia Co., Marietta, Ga.). *Society of Allied Weight Engineers, Annual Conference, 39th, St. Louis, Mo., May 12-14, 1980, Paper 1343.* 27 p.

The configurational possibilities and performance capabilities of the 'Flatbed' multiuse transport aircraft concept are demonstrated. The structurally novel aircraft consists of a flat central spine, integrating cockpit, wings, engines and tail surfaces, on which a variety of containerized payloads or passenger cabins may be carried. At the expense of a degree of aerodynamic efficiency, outsize payloads such as tanks and earth-moving machinery may be flown on the flatbed without additional covering. The flexibility of this concept recommends it as an ideal solution to the proposed Civil Reserve Air Fleet next-generation commercial aircraft requirements. O.C.

A81-31383 **An Interactive Weight Accounting Program /IWAP/.** P. R. Kraus (McDonnell Aircraft Co., St. Louis, Mo.). *Society of Allied Weight Engineers, Annual Conference, 39th, St. Louis, Mo., May 12-14, 1980, Paper 1345.* 17 p.

The Interactive Weight Accounting Program (IWAP), a system for the collection and reporting of mass properties data, is described. The system comprises a series of on-line computer programs selectively activated by the user through an IBM 370 direct access connection and allows the interactive addition, modification, or deletion of data to generate a variety of different weight, balance, and inertia reports. IWAP has shown reduced operating costs and improved engineer control while eliminating the need for special programming skills. O.C.

A81-31384 **Computer aided technology interface with weights engineering.** R. W. Ridenour (McDonnell Aircraft Co., St. Louis, Mo.). *Society of Allied Weight Engineers, Annual Conference, 39th, St. Louis, Mo., May 12-14, 1980, Paper 1346.* 20 p.

The intensive use of Computer Aided Technology with interactive graphics in the design and analysis work of weight engineers is described, and the improvements in calculation speed and accuracy derived are assessed. The range of functions analyzed by the system include (1) weight, center-of-gravity, and inertia profile, (2) mass distributions, (3) individual part and subsystem weights, and (4) material breakdowns. Special attention is given such features of the system as a program for the calculation of mass matrices for flutter and loads analyses and a fuel tank analysis program which calculates fuel volume and mass properties as functions of fuel depth and vehicle attitude. O.C.

A81-31385 **Weights information systems using minicomputers.** B. W. Soodik (Douglas Aircraft Co., Long Beach, Calif.). *Society of Allied Weight Engineers, Annual Conference, 39th, St. Louis, Mo., May 12-14, 1980, Paper 1347.* 11 p.

The Weights Information System, a bookkeeping system with the additional scientific capabilities needed for weight engineering, is described. Implemented on an HP-3000 minicomputer, the system operates in both on-line and batch modes and uses a network data base for information storage. Because the system is modular in design, and completely menu-driven, implementation and maintenance may be easily handled by the user. O.C.

A81-31386 **The Modular Life Cycle Cost Model for advanced aircraft systems - An overview.** N. L. Sternberger (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). *Society of Allied Weight Engineers, Annual Conference, 39th, St. Louis, Mo., May 12-14, 1980, Paper 1351.* 16 p.

The Modular Life Cycle Cost Model (MLCCM), a methodology and mathematical model with which to enhance engineering tradeoff studies and predict life cycle, production, operations and support costs for advanced-technology aircraft, is described. This methodology consists of a complete set of life cycle cost estimating relationships, providing the design engineer the means by which to effectively conduct detailed and credible design/performance/cost studies for both small, fighter-attack and large, cargo-tanker-transport aircraft. O.C.

A81-31387 **The structural weight fraction - Revisited for fighter/attack type aircraft.** K. L. Sanders (Northrop Corp., Aircraft Group, Hawthorne, Calif.). *Society of Allied Weight Engineers, Annual Conference, 39th, St. Louis, Mo., May 12-14, 1980, Paper 1365.* 11 p. 12 refs.

An historical review is presented of the trend in airframe structural weight fraction among fighter and attack aircraft, with attention to such factors as the unique characteristics of V/STOL aircraft and necessary differences in structural detailing between Navy and Air Force aircraft. It is shown that despite continuous improvements in structural and materials technologies, growing performance demands have kept structural weight fractions within a nearly constant range of between 30 and 40%. These findings suggest that the structural design and development methods of such aircraft as the F-101A, which resulted in exceptionally low structural weight, may deserve consideration along with advanced, and expensive, composite materials technologies. O.C.

A81-31388 **RAPIDLOADS - A preliminary design loads prediction technique for aircraft.** A. L. Curry (Vought Corp., Dallas, Tex.). *Society of Allied Weight Engineers, Annual Conference, 39th, St. Louis, Mo., May 12-14, 1980, Paper 1366.* 79 p. 13 refs.

RAPIDLOADS, an outgrowth of the Fighter Aircraft Structural Loads program, consists of a set of computer programs controlled by an executive routine and incorporates both batch and interactive operational modes. The following types of symmetric and anti-symmetric flight maneuvers may be used in the analyses: (1) symmetrical push-over and pull-up, (2) abrupt pitch, (3) rudder kick and reversed rudder, and (4) roll initiation, reversed roll, and roll termination. Loads data for the body and each lifting surface are in the form of shear, bending moment, and torsion distributions, and all calculations are based on the assumption of a rigid structure. O.C.

A81-31389 **PARAM - A new weight sizing routine.** T. R. Smith (McDonnell Aircraft Co., St. Louis, Mo.). *Society of Allied Weight Engineers, Annual Conference, 39th, St. Louis, Mo., May 12-14, 1980, Paper 1367.* 34 p.

A series of comparative aircraft design studies is used to illustrate the advantages of PARAM, a subroutine created for use in the initial stages of aircraft design in order to iterate a baseline aircraft to some scaling required for the performance of a given mission. The subroutine is shown to provide those engaged in the advanced design stage with a simplicity of formats which saves time and effort. A typical PARAM computer run costs $30-35, while costs for more sophisticated sizing programs approach twice this amount. Among the figures of merit given by the program are takeoff weight, fuel weight, mission radii, wing loadings, and thrust-to-weight ratio at takeoff. O.C.

A81-31399 ***Design, fabrication, calibration, application, and testing of advanced aircraft weighing systems.*** C. R. Ursell (Southwest Research Institute, San Antonio, Tex.) and J. D. Godsey (USAF, Kelly AFB, Tex.). *Society of Allied Weight Engineers, Annual Conference, 39th, St. Louis, Mo., May 12-14, 1980, Paper 1383.* 44 p.

Knowledge gained during the development of an individual load cell and read out system was applied to the design, fabrication, assembly, calibration and demonstration of a weighing system consisting of on-top-of-jack load cells for level weighing and under-tire platforms for ground attitude weighing of aircraft such as the F-5. The result of the development program is a weighing system yielding an accuracy of plus or minus one pound per load cell (three pounds in all, in the case of a fighter aircraft tricycle landing gear). Due to the risk associated with the weighing of aircraft on-top-of-jacks, it is recommended that the ground attitude weighing system be considered with development of the appropriate correction curves. O.C.

A81-31400 **CH-53E combat survivability assessment and survivability enhancement program.** J. J. Morrow (U.S. Naval Weapons Center, China Lake, Calif.). *Society of Allied Weight Engineers, Annual Conference, 39th, St. Louis, Mo., May 12-14, 1980, Paper 1384.* 25 p.

Data of two sequential research programs were discussed with reference to a definition of an optimized helicopter configuration. Combat survivability was considered to be a major criterion in the evaluation of the overall effectiveness of the helicopter. The first program was designed to assess the configuration of the helicopter, the subsystem, component characteristics and features related to potential attrition when exposed to hostile weapons. The second program was geared to quantify and rank combat survivability enhancement concepts. Although several lightweight survivability enhancement concepts were considered, the studies showed that survivability enhancement will generally necessitate increased weight of the helicopter and greater complexity in design and maintenance, besides an increase in the overall cost of the system. E.B.

A81-31401 **V/STOL advanced technology rewards and risk.** R. S. Hamm (Lockheed-California Co., Burbank, Calif.). *Society of Allied Weight Engineers, Annual Conference, 39th, St. Louis, Mo., May 12-14, 1980, Paper 1385.* 13 p.

A preliminary design exploration is presented for the Navy 'Type A' V/STOL aircraft, aimed at a characterization of the advances that must be forthcoming in systems, propulsion, materials and fuel management technologies before the weight savings required for adequate performance are achieved. Attention is given to the potential penalties incurred by falling short of requirements in any one of the technologies mentioned without compensating with overachievement in one of the others. It is concluded that substantial work is called for in all fields concerned. O.C.

A81-31402 **A design analysis technique for evaluating size and weight of V/STOL lift fans.** P. F. Piscopo (U.S. Naval Air Propulsion Test Center, Trenton, N.J.) and R. S. Saint John (Vought Corp., Dallas, Tex.). *Society of Allied Weight Engineers, Annual Conference, 39th, St. Louis, Mo., May 12-14, 1980, Paper 1386.* 32 p.

An analytic method for optimizing V/STOL lift fan components is presented. The data base used to develop the methods consists of nine fans representing a range of fan diameters from 34 to 92 inches. Although emphasizing weight, the component-by-component estimation approach also provides considerable design analysis capability. The lift fan is separated into eleven major elements with each major element further separated into sub-components. The methods provide accountability for design factors such as blade containment, variable geometry rotor blades and vanes, dynamic tuning, foreign object damage, and materials technology. The trade study capability of the fan size and weight estimation methodology is discussed. L.S.

A81-31561 **Developments in the analysis and repair of cracked and uncracked structures.** R. Jones and R. J. Callinan (Department of Defence, Aeronautical Research Laboratories, Melbourne, Australia). In: Finite element methods in engineering; Proceedings of the Third International Conference, Sydney, Australia, July 2-6, 1979. Kensington, New South Wales, Australia, Unisearch, Ltd., 1980, p. 231-245. 13 refs.

A finite element method for analyzing the behavior of structures which are patched with a bonded overlay of composite material is described. The analysis includes the separate responses of the structure, composite and adhesive and allows for the variation of the transverse shear stresses through the thickness of the patch, adhesive, and structure. As an illustrative example the repair of a cracked sheet is considered. (Author)

A81-31598 # **Equilibrium spinning of a typical single-engine low-wing light aircraft.** B. W. McCormick (Pennsylvania State University, University Park, Pa.). *Journal of Aircraft,* vol. 18, Mar. 1981, p. 192-199. 16 refs.

A study is performed of rotary balance data, spin tunnel model, radio-controlled (R/C) model, and full-scale flight test results relating to the spinning of light aircraft. A method is presented for predicting steady spin modes using rotary balance data. Differences in spin characteristics of various wing, tail, and fuselage modifications are discussed as well as scale effects. It is concluded that an equilibrium flat spin is governed primarily by the yawing moment coefficient. (Author)

A81-31601 # **Noise characteristics of two parallel jets with unequal flow.** B. N. Shivashankara and W. V. Bhat (Boeing Commercial Airplane Co., Seattle, Wash.). *(American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0168.) AIAA Journal,* vol. 19, Apr. 1981, p. 442-448. 8 refs.

A model experiment was conducted with two parallel jets to investigate the suppression mechanisms of jet noise control devices. It is shown that noise from a high-velocity jet can be reduced by placing a second jet of lower velocity parallel to it, on the same side as the listener. Noise reduction is maximum at the point of complete occultation of the fast jet by the slow, and decreases as one moves azimuthally around the jets from this plane until zero reduction is reached at approximately 75 deg to this plane. It is concluded that for the test configuration, with a separation of about 1.5 diameters, acoustic shielding is the dominant reduction mechanism, rather than mean flow interaction. O.C.

A81-31612 # **Transonic viscous-inviscid interaction over airfoils for separated laminar or turbulent flows.** R. Gordon and J. Rom (Technion - Israel Institute of Technology, Haifa, Israel). *AIAA Journal,* vol. 19, May 1981, p. 545-552. 26 refs.

A new technique is presented for the calculation of the interaction of the inviscid external flow and the separated boundary layer in the case of the transonic flow over airfoils. A finite-difference method is used for the boundary-layer solution. On the forward portion of the airfoil the boundary-layer equations are solved for a given pressure distribution boundary condition, while on the rear portion of the airfoil and beyond, where separated flow occurs, the equations are solved for a given displacement thickness distribution boundary condition. The inviscid transonic flow solution and the boundary-layer solution are matched by a local point relaxation algorithm, incorporating the two methods of boundary-layer equations solution. Results are obtained for separated laminar, transitional, and turbulent flows on circular-arc airfoils at zero angle of attack. These results are in good agreement with available experimental data. The effects of Reynolds and Mach numbers are also examined. (Author)

A81-31613 # **Role of laminar separation bubbles in airfoil leading-edge stalls.** B. van den Berg (Nationaal Lucht- en Ruimtevaartlaboratorium, Amsterdam, Netherlands). *AIAA Journal,* vol. 19, May 1981, p. 553-556. 18 refs.

It is argued that there are two possible mechanisms for leading-edge stalls: (1) burst of the laminar separation bubble near the airfoil leading edge, and (2) turbulent boundary-layer separation in the leading-edge region. To investigate the relative importance of both mechanisms for leading-edge stalls, a theoretical analysis is made of the flow around airfoil noses. The analysis suggests that turbulent boundary-layer separation in the nose region may well be the dominant cause of leading-edge stalls, especially at higher Reynolds numbers. This conclusion is confirmed by an analysis of measured wall shear-stress data in the nose region of two modern airfoil sections. By using a suitable parameter for indicating proximity of separation, the likelihood of turbulent boundary-layer separation in the nose region is demonstrated for these two airfoil sections. (Author)

A81-31622 # **Wing-body carryover at supersonic speeds with finite afterbodies.** S. R. Vukelich and J. E. Williams, Jr. (McDonnell

Douglas Corp., St. Louis, Mo.). *AIAA Journal*, vol. 19, May 1981, p. 661-664.

A method is presented which evaluates the additional lift on a cylindrical body imparted by its interaction with the shock cone of lifting surfaces at supersonic speeds. Specific attention is given the character of this effect on finite afterbodies. Extension of the method to cantilever surfaces is also possible. O.C.

A81-31668 **Mechanical properties of aluminum coatings on heat-resistant steels.** N. V. Abraimov (Voenno-Vozdushnaia Inzhenernaia Akademiia, Moscow, USSR). *(Fiziko-Khimicheskaia Mekhanika Materialov*, vol. 16, May-June 1980, p. 46-50.) *Soviet Materials Science*, vol. 16, no. 3, Nov. 1980, p. 233-236. 6 refs. Translation.

A81-31673 **Fatigue strength of gas turbine engine rotor blades in connection with structural changes in service.** O. I. Marusii, B. A. Griaznov, and I. A. Makovetskaia (Akademiia Nauk Ukrainskoi SSR, Institut Problem Prochnosti, Kiev, Ukrainian SSR). *(Fiziko-Khimicheskaia Mekhanika Materialov*, vol. 16, May-June 1980, p. 97-99.) *Soviet Materials Science*, vol. 16, no. 3, Nov. 1980, p. 282-284. 6 refs. Translation.

The structure, chemical composition, and cyclic strength of the rotor blades (EI826 alloy) of a stationary gas turbine have been investigated after 20,000 hr of service using metallographic methods, X-ray spectrography, and mechanical testing. It is found that the greatest structural changes occur in the surface layers of the blades and are caused by redistribution of the alloying elements due to high temperature and sulfur diffusion from a sulfur contaning environment. The changes in the structure of the surface layer significantly reduce the cyclic strength of the alloy. V.L.

A81-31686 **Steady flow and static stability of airfoils in extreme ground effect.** E. O. Tuck (Adelaide, University, Adelaide, Australia). *Journal of Engineering Mathematics*, vol. 15, Apr. 1981, p. 89-102. 8 refs.

Steady flow over a thin airfoil-like body in close proximity to a plane ground surface is analysed on the basis of a one-dimensional, but non-linear, gap-region flow, matched to the outside via a trailing edge which may possess significant flap-like appendages. The resulting lift and moment predictions are used to estimate quasi-steady stability derivatives in heave and pitch. The results are applied to longitudinal stability of tail-less uncambered airplanes, and to manoeuvring of ships near to a bank, indicating instability in both cases. (Author)

A81-31687 **Leading-edge separation from a thick, conical, slender wing at small angles of incidence.** J. Nutter (East Anglia, University, Norwich, England). *Journal of Engineering Mathematics*, vol. 15, Apr. 1981, p. 103-117. 11 refs.

The inviscid separated flow past slender rhombic cones at incidence is considered. A complex potential is constructed, in a suitable cross-flow plane, which satisfies the conditions on the wing, at infinity, and on the vortex system which models the separated flow. The results obtained both extend earlier results to small incidence, and explain an anomaly within those results. (Author)

A81-31699 **Airships - Transport of the future.** B. J. Russel. *High-Speed Surface Craft*, vol. 20, Apr. 1981, p. 18-21.

The latest airship developments in Britain are reviewed. The airship could find application as a freight and passenger carrier, and it could also be of use to the naval forces due to its ability to patrol and observe a larger area than surface vessels. Among the three new designs expected to be built and tested by 1984 or 1985, is the NR500, which is 50-m long, has a volume of 5,000 cu m, and can carry a payload of 2 tons. It is now under construction, should fly in mid 1981, and is expected to be used for offshore patrol. A larger craft, the NR5000, should find application as a passenger and freight carrier. The largest design is the R150, a 172-m long rigid airship, having a volume of 153,500 cu m, which will be capable of carrying payloads up to 80 tons. Wind tunnel tests on a scale model of the TS100 short-range airships are currently in progress. The airship capital costs are between 1/4 and 1/3 of the costs of a transport aircraft, and the operating costs are about 30% lower. K.S.

A81-31767 # **Study of the secondary flow in the downstream of a moving blade row in an axial flow fan.** T. Adachi, T. Kawai (Tsukuba, University, Sakura, Ibaraki, Japan), and H. Sashikuma (Kawasaki Heavy Industries, Ltd., Aircraft Manufacturing Div., Kakamigahara, Gifu, Japan). *JSME, Bulletin*, vol. 24, Feb. 1981, p. 332-339. 12 refs.

The secondary flow downstream of a rotor row in a single-stage axial flow fan with a stator row ahead of the fan wheel is investigated. A circulating flow due to the apparent vorticity is found behind the rotor row when observed in a rotating frame fixed to the rotor. The averaged outlet angle from the rotor row is larger near the outer casing but smaller in the main flow region compared with the designed value. The loss in the vicinities of the inner and outer end walls as well as in the wakes of the moving blades is large, particularly in the neighborhood of the outer casing wall. As the hub ratio increases, the flow rate of the secondary flow decreases, and loss in the annular passage increases. L.S.

A81-31799 # **Principles of aircraft-engine assembly (Osnovy sborki aviatsionnykh dvigatelei).** A. I. Il'iankov and M. E. Levit. Moscow, Izdatel'stvo Mashinostroenie, 1980. 248 p. 15 refs. In Russian.

Various aspects of aircraft-engine assembly are considered. These include assembly engineering procedures, the organization of assembly operations, the overall and component assembly of piston engines and gas turbine engines, reassembly after testing, and safety measures relating to assembly. The quality and reliability of engines, the mechanical properties of engine materials, and engine design are also examined. B.J.

A81-31800 # **Principles of aircraft structural design /2nd revised and enlarged edition/ (Osnovy konstruirovaniia v samoletostroenii /2nd revised and enlarged edition/).** A. L. Gimmel'farb. Moscow, Izdatel'stvo Mashinostroenie, 1980. 368 p. 35 refs. In Russian.

Various aspects of aircraft structural design are reviewed. Consideration is given to the design of joints for profiles and tube elements, riveted joints, structures with welded joints, adhesive bonds, composite structures, butt joints, monolithic structures, panels, and the choice of construction materials. B.J.

A81-31823 # **Aircraft equipment /2nd revised and enlarged edition/ (Oborudovanie samoletov /2nd revised and enlarged edition/).** A. P. Volkoedov and E. G. Palenyi. Moscow, Izdatel'stvo Mashinostroenie, 1980. 232 p. 33 refs. In Russian.

The work considers aircraft electrical, radioelectronic, navigation, control, and safety equipment. The theoretical concepts underlying this equipment are discussed along with design principles, operation, construction, and assembly. B.J.

A81-31872 # **Aircraft assembly (Sborka letatel'nykh apparatov).** V. A. Tur'ian. Moscow, Izdatel'stvo Mashinostroenie, 1980. 176 p. 6 refs. In Russian.

The principles of aircraft assembly are reviewed. Attention is given to principles of aircraft design, pre-assembly procedures, engineering features of the assembly procedure, the assembly of structures with riveted joints, welding procedures, adhesive bonding, mechanical assembly work, the overall assembly of aircraft, mounting, and quality and reliability of assembly. B.J.

A81-32006 **Crashworthiness versus cost based on a study of severe Army helicopter accidents during 1970 and 1971.** J. L. Haley (U.S. Army, Aeromedical Research Laboratory, Fort Rucker, Ala.) and J. E. Hicks (U.S. Army, Safety Center, Fort Rucker, Ala.). *American Helicopter Society, Journal*, vol. 25, Apr. 1980, p. 10-16. 6 refs.

This paper discusses the economic benefits of providing improvements in crashworthiness within future Army aircraft. The crashworthiness improvements considered are those of Military Standard 1290, 'Light Fixed- and Rotary-Wing Aircraft Crashworthiness'. *The benefits in reduced personnel losses and airframe damage* were studied, using 299 severe accidents occurring to Army rotary-wing aircraft, during 1970 and 1971. The benefits of crashworthiness are compared with the costs of providing them in Army UH-60A Black Hawk aircraft. The features which contribute most heavily to the projected personnel and hardware savings are discussed in an estimated order of priority according to their relative cost effectiveness. Crashworthiness features are shown to be cost effective within the life span of the Black Hawk. (Author)

A81-32007 **Design and testing of float landing gear systems for helicopters.** A. M. Alcedo (Bell Helicopter Textron, Fort Worth, Tex.). *American Helicopter Society, Journal,* vol. 25, July 1980, p. 3-9.

Since the use of helicopters over water has become wide-spread, the U.S. Federal Aviation Agency and the British Civil Aviation Authority have developed new regulations for flotation capabilities and ditching operations. These requirements and the design and testing of flotation landing gear systems are discussed. Differences in flotation systems pertaining to cost, weight, efficiency, and capability are presented, including differences in their supporting systems; such as, float, inflation, and actuation system designs. Model tests used to verify the capability of the designs are also discussed. Flotation and ditching model tests, methods, and scaling laws are described. (Author)

A81-32008 **The bearingless main rotor.** P. G. C. Dixon and H. E. Bishop (Boeing Vertol Co., Philadelphia, Pa.). *American Helicopter Society, Journal,* vol. 25, July 1980, p. 15-21.

The design, development, and flight-testing of a bearingless helicopter main rotor intended to have loads, stability, flying qualities and vibrational characteristics similar to those of conventional rotors is described. It was found that ground resonance damping is inadequate, and that air resonance and vibration levels are similar to the baseline, conventional blade. Maneuvering stability showed a significant improvement. Improvements to the bearingless rotor, such as advanced airfoil profiles and integrated, high-modulus composite single-beam flexure, are recommended for the achievement of significant reductions in hub size and resultant torsional stiffness. O.C.

A81-32009 **Reduction of helicopter vibration through control of hub-impedance.** S. P. Viswanathan and A. W. Myers (Bell Helicopter Textron, Fort Worth, Tex.). *American Helicopter Society, Journal,* vol. 25, Oct. 1980, p. 3-12. 15 refs.

A mathematical model of a vibration problem in a 206L Bell helicopter encountered in transition is presented. The model has one degree of freedom to represent the rotor and another degree of freedom to represent the nonrotating system. The model indicates that the magnitude of hub impedance is the single most dominant variable in determining the vertical hub shear on a given rotor in the transitional flight regime. The hub shear can vary from very small to very large magnitudes depending on hub impedance. Hub-mounter bifilar pendulum absorbers increase the hub impedance because of their large damping-type impedance. The resulting hub shear distributes itself between the absorbers and the fuselage in the same ratio as their impedances. Hence, in order for the absorbers to be efficient, their impedance must be high compared to that of the pylon-fuselage system. L.S.

A81-32010 * **Use of multiblade sensors for on-line rotor tip-path plane estimation.** R. W. Du Val (NASA, Ames Research Center, Helicopter Technology Div., Moffett Field, Calif.). *American Helicopter Society, Journal,* vol. 25, Oct. 1980, p. 13-21. 5 refs.

Techniques are investigated for on-line estimation of rotor states in the nonrotating frame from multiple, simultaneous measurements in the rotating frame. The multiblade coordinate transformation is first applied to transform both flapping and flapping rate measurements into the nonrotating frame. The 'observer' approach is then used to generate algorithms for estimating tip-path plane rate and attitude from transformed flapping and flapping rate measurements. *A numerical evaluation using simulated measurements is conducted* to evaluate the performance of the algorithms and recommendations are made. (Author)

A81-32013 **Application of an aerodynamic configuration modeling technique to the design and analysis of X-Wing aircraft configurations.** D. R. Clark (Analytical Methods, Inc., Bellevue, Wash.) and R. T. Leitner (U.S. Naval Material Command, David W. Taylor Naval Ship Research and Development Center, Bethesda, Md.). *(European Rotorcraft and Powered Lift Aircraft Forum, 5th, Amsterdam, Netherlands, Sept. 4-7, 1979.) American Helicopter Society, Journal,* vol. 26, Apr. 1981, p. 3-8. 14 refs. Research supported by the Lockheed-California Co. and DARPA.

The correlation of an advanced aerodynamic configuration modeling method with wind-tunnel data for a baseline X-Wing flight demonstrator aircraft model is discussed. Modifications to the method required to handle circulation control airfoils are also described. In general, the predicted pressures are in close agreement with the experimental values on both the wing and body. Also accurately predicted are the three-dimensional separation locations. This correlated method is then used to design an unconstrained separation free hub-pylon, which is then modified to include the constraints of rotor rotation. Comparisons of pressure distributions of the baseline and new designs show significant improvement in eliminating or reducing the adverse pressure gradients at the leading and trailing edges of the hub-pylon, reducing the separation contour to a manageable thick trailing edge airfoil type. The analysis shows that a practical low drag X-Wing configuration is indeed possible. (Author)

A81-32014 **Modern techniques of conducting a flight loads survey based on experience gained on the Black Hawk helicopter.** W. P. Groth, G. M. Chuga, and V. S. Nelson (United Technologies Corp., Sikorsky Aircraft Div., Stratford, Conn.). *(American Helicopter Society, Specialists' Meeting on Helicopter Fatigue Methodology, St. Louis, Mo., Mar. 1980.) American Helicopter Society, Journal,* vol. 26, Apr. 1981, p. 9-17. 5 refs.

Flight loads survey methods developed and utilized during the U.S. Army Black Hawk qualification program are described. The role of the flight loads survey in flight envelope definition, mission utilization, fatigue analysis as well as in providing correlation data to update predicted loads is discussed. It is demonstrated that new equipment and methods can be used effectively to provide standardization in the areas of data acquisition and processing. Similar standardization of procedures is recommended in the areas of data analysis and application. L.S.

A81-32015 **Drive system technology advancements.** C. Albrecht and J. Mack (Boeing Vertol Co., Philadelphia, Pa.). *American Helicopter Society, Journal,* vol. 26, Apr. 1981, p. 18-24.

The most recent state-of-the-art drive system advancements have been applied to the design and development of the CH-47D transmission. The gearing-related developments include the use of high-hot-hardness, premium quality steel, gear stress measurement and correlation with material allowables, elimination of fretting and wear surfaces, and control of resonant stresses. Testing that developed and qualified this new drive system is discussed, and the methodology of analysis and test substantiation is described. (Author)

A81-32016 **Floor and fuel vibration isolation systems for the Boeing Vertol commercial Chinook.** R. A. Desjardins and V. Sankewitsch (Boeing Vertol Co., Philadelphia, Pa.). *(European Rotorcraft and Powered Lift Aircraft Forum, 5th, Amsterdam, Netherlands, Sept. 4-7, 1979.) American Helicopter Society, Journal,* vol. 26, Apr. 1981, p. 25-30.

A vibration isolation system is in development for the passenger cabin and the long-range fuel tanks of the Boeing commercial Chinook. The passenger floor is isolated from the airframe on a series of passive isolation units. The fuel tanks are also isolated so that their dynamic mass is effectively nulled at all fuel levels, thereby avoiding any deleterious effect on airframe natural frequency placement. Analyses, component tests, and an aircraft shake test were conducted to verify the effectiveness of the system. The aircraft test demonstrated that the floor isolation could lower the 0.15-g midcabin airframe vibration to an average of 0.05G on the passenger floor. The fuel isolation also was successful, maintaining an important airframe natural frequency within + or - 0.2 Hz of its normal value for any fuel level from 0 to 100 percent. (Author)

A81-32017 **Unsteady aerodynamics of an aerofoil at high angle of incidence performing various linear oscillations in a uniform stream.** C. A. Maresca, D. J. Favier, and J. M. Rebont (Aix-Marseille I, Université, Marseille, France). *(European Rotorcraft and Powered Lift Aircraft Forum, 5th, Amsterdam, Netherlands, Sept. 4-7, 1979.) American Helicopter Society, Journal,* vol. 26, Apr. 1981, p. 40-45. 8 refs.

The basic features of complex three-dimensional unsteady flows over advancing or retreating helicopter blade sections are investigated using two-dimensional models for aerofoils performing various linear oscillations in a uniform airstream. Three kinds of cyclic time-dependent motions are studied to simulate the variations of incidence and velocity simultaneously and separately. If velocity fluctuations at very low Mach numbers only are considered, the unsteady effects are weak if the incidence remains below the angle of static stall. Above the angle of static stall, the effects of unsteadiness are very strong and depend on the frequency and amplitude of the velocity fluctuations. L.S.

A81-32018 ***Comparison of calculated and measured helicopter rotor lateral flapping angles.*** W. Johnson (U.S. Army, Research and Technology Laboratories, Moffett Field, Calif.). *American Helicopter Society, Journal,* vol. 26, Apr. 1981, p. 46-50. 7 refs.

Calculated and measured values of helicopter rotor flapping angles in forward flight are compared for a model rotor in a wind tunnel and an autogyro in gliding flight. The lateral flapping angles can be accurately predicted when a calculation of the nonuniform wake-induced velocity is used. At low advance ratios, it is also necessary to use a free wake geometry calculation. For the cases considered, the tip vortices in the rotor wake remain very close to the tip-path plane, so the calculated values of the flapping motion are sensitive to the details of the wake structure, specifically the viscous core radius of the tip vortices. (Author)

A81-32252 **A review of current and future components for electronic warfare receivers.** J. H. Collins and P. M. Grant (Edinburgh, University, Edinburgh, Scotland). *IEEE Transactions on Microwave Theory and Techniques,* vol. MTT-29, May 1981, p. 395-403. 38 refs.

This paper addresses the role of conventional and new components in passive electronic warfare (EW) receivers. The various areas of EW are defined before restricting the discussion predominantly to the radar intercept problem at microwave frequencies. The operational parameters of conventional components are then reviewed including the multiplexer; crystal video, instantaneous frequency measurement (IFM), and scanning superheterodyne receivers. The significance of modularity, digital control, and hybrid combinations of components is highlighted. A brief description follows of the operational Cutlass EW equipment. New components based on surface-acoustic waves (SAW) and acoustooptic (AO) Bragg cells are then presented and their particular importance in channelized receivers, IFM's, and microscan receivers noted. Finally, a number of conclusions are drawn covering likely trends in EW receivers and the need for continuing development of large-scale integrated (LSI) circuits for signal sorting and overall digital management. (Author)

A81-32401 **Measurement of aircraft speed and altitude.** W. Gracey. New York, Wiley-Interscience, 1981. 276 p. 151 refs. $29.95.

Among the topics discussed are typical aircraft speed and altitude instrument systems and their errors; the 'standard atmosphere' concept and equations for airspeed, Mach number, and true airspeed; total- and static-pressure measurement; static pressure tubes and installations; and the aerodynamic compensation of position errors. Also considered are flight calibration methods; errors due to pressure-system lag and leaks; mechanical and electrical instrument errors; operational aspects of altimetry; and a variety of other altitude-measuring methods such as radio, radar and laser altimetry. O.C.

A81-32490 **Forward-looking infrared /FLIR/ sensor for autonomous vehicles.** S. R. King and A. E. Asch (Ford Aerospace and Communications Corp., Aeronutronic Div., Newport Beach, Calif.). In: Electro-optical technology for autonomous vehicles; Proceedings of the Seminar, Los Angeles, Calif., February 6, 7, 1980. Bellingham, Wash., Society of Photo-Optical Instrumentation Engineers, 1980, p. 66-68.

A compact, lightweight, reliable, high performance Mini-FLIR designed for autonomous operation is described. The heart of the unit is the scanner which includes the mechanical raster scanner, the detector array, and the electronics. The basic scanner unit is a cylinder 4 inches in diameter by 5 inches long, weighing only 3.5 lb. It operates in the 8 to 12 microns spectral region and has a field of view (FOV) of 30 by 40 degrees. It can be combined with different optical systems to provide a wide range of capability for a variety of military and commercial applications. Mechanical scanning of the FOV is accomplished with a 525-line raster a field/frame rate of 60/30 per second. Serial scan techniques are employed, using two multi-element arrays of mercury cadmium telluride (HgCdTe) detectors, with the two arrays time-shared and combined through an acoustic delay line. The number of detectors can be chosen for the degrees of sensitivity required. Thermal compensation of the optical system is provided to maintain the FLIR in focus over a wide temperature range. (Author)

A81-32491 **Charge-coupled device /CCD/ camera/memory optimization for expendable autonomous vehicles.** A. Roberts and B. Mathews (Fairchild Camera and Instrument Corp., Syosset, N.Y.). In: Electro-optical technology for autonomous vehicles; Proceedings of the Seminar, Los Angeles, Calif., February 6, 7, 1980. Bellingham, Wash., Society of Photo-Optical Instrumentation Engineers, 1980, p. 69-76.

An expendable, autonomous vehicle by definition and implication will require small, low-cost sensors for observation of the outside world and interface to smart, decision-making avionics. This paper describes results of several interrelated CCD camera projects directed toward achieving such an integrated sensor package. A shuttered high resolution CCD detector combined with a CCD analog frame store memory is described. This system results in a full resolution frame rate reduced, deinterlaced image. This image data is suitable for transform or differential pulse code data compression as well as various other 3 x 3 element operators directed at extracting image intelligence for on-board decision-making. (Author)

A81-32492 **Analysis, design and simulation of line scan aerial surveillance systems.** M. Oron (Technion - Israel Institute of Technology, Haifa, Israel) and M. Abraham (Fibronics, Ltd., Haifa, Israel). In: Electro-optical technology for autonomous vehicles; Proceedings of the Seminar, Los Angeles, Calif., February 6, 7, 1980. Bellingham, Wash., Society of Photo-Optical Instrumentation Engineers, 1980, p. 77-84.

The analysis of an airborne line-scan surveillance system based on a linear-array solid state sensor mounted parallel to the longitudinal axis of the aircraft with a scanning mirror providing cross-track area coverage, resulted in a simple kinematic model which can be useful in the systematic design of such systems. Practical implementation of the model using state-of-the-art technology was considered prior to the actual design and construction of a laboratory prototype and simulation system. Experimental evaluation of the system confirmed that a digital data rate of 4-8 Mbit per second is feasible for acquisition and realtime display of visual information at a ground area coverage rate of almost 200 sq km/hr for relative flight altitude of 3000 ft and velocity of 80 knots, attaining a ground pixel size of 0.25 m. A digital image processing facility was interfaced to the system providing off-line processing capabilities for selected image-frames. On-line analog and digital processing was performed to provide compensation for errors due to image motion and aircraft attitude, as well as acquisition errors due to uneven illumination. Restoration of some geometrical distortions was also performed. (Author)

A81-32496 **Airborne ground velocity determination by digital processing of electro-optical line sensor signals.** M. Oron and O. Firschein (Lockheed Research Laboratories, Palo Alto, Calif.). In: Electro-optical technology for autonomous vehicles; Proceedings of the Seminar, Los Angeles, Calif., February 6, 7, 1980. Bellingham, Wash., Society of Photo-Optical Instrumentation Engineers, 1980, p. 112-120.

Signals from a solid state electro-optical line sensor, which samples a two-dimensional image brightness function in time and space, can be digitally processed to extract the ground velocity vector of relatively slow, autopilot-controlled aircraft such as mini-RPVs. This sensor can be rotated into the direction of motion by a stepping motor which is controlled by a computational unit using simple easily realizable algorithms to keep the sensor in alignment with the velocity vector as well as to compute its magnitude. Together with other instruments already installed on-board the aircraft, this combination of sensor and computational unit may form an instrumentation setup which can be used in passive, autonomous navigation systems. Computer simulated experimental runs proved that a sufficient degree of directional sensitivity and overall accuracy can be attained with the proposed method. (Author)

A81-32498 **Autonomous target handoff from an airborne sensor to a missile seeker.** L. E. Kossa and G. E. Tisdale (Westinghouse Electric Corp., Systems Development Div., Baltimore, Md.). In: Electro-optical technology for autonomous vehicles; Proceedings of the Seminar, Los Angeles, Calif., February 6, 7, 1980. Bellingham, Wash., Society of Photo-Optical Instrumentation Engineers, 1980, p. 142-147. 6 refs.

The need for handoff capability arises when a target is acquired with an aircraft sensor (e.g., a FLIR) and it is desired to transfer the target position data to a second imaging sensor associated with an onboard missile, or possibly another aircraft. This paper describes Westinghouse scene-matching algorithms which can accomplish this task. It is noted that, for reasons of survivability and successful attack, target transfer should be accomplished within a fraction of a second; for tracking purposes, a precision of less than one pixel is required. A laboratory demonstration of handoff capability has been implemented as a result of an Army problem. B.J.

A81-32499 **Advanced target tracking by dynamic scene analysis.** P. M. Narendra, B. Westover, and D. P. Panda (Honeywell Systems and Research Center, Minneapolis, Minn.). In: Electro-optical technology for autonomous vehicles; Proceedings of the Seminar, Los Angeles, Calif., February 6, 7, 1980. Bellingham, Wash., Society of Photo-Optical Instrumentation Engineers, 1980, p. 148-155. Grant No. DAAK70-79-C-0150.

An integrated approach to the target tracker and target screener functions based on dynamic scene analysis is described. Computer simulations on FLIR imagery demonstrated the viability of the approach for tracking multiple targets in highly cluttered environments and with fast-moving high-speed sensor platforms, conditions typical of the combat vehicle, AAH, and high-speed air-to-ground fighter scenarios. This approach eliminates the need for separate tracker hardware, because it can be implemented as an integral part of the Honeywell target screener and shares a substantial part of the computational load with the screener. In addition, the integrated approach results in improved target screener performance through moving target detection, which was demonstrated in the presence of significant platform motion. B.J.

A81-32502 **Moving target identification /MTI/ algorithm for passive sensors.** R. D. Holben (Ford Aerospace and Communications Corp., Aeronutronic Div., Newport Beach, Calif.). In: Electro-optical technology for autonomous vehicles; Proceedings of the Seminar, Los Angeles, Calif., February 6, 7, 1980. Bellingham, Wash., Society of Photo-Optical Instrumentation Engineers, 1980, p. 165-172.

An algorithm has been developed to compensate for apparent background motion in images taken from a moving platform by a passive sensor. Correlation tracking over subregions in a scene is used to determine a model for the velocity changes in the entire scene. The algorithm was tested on three short sequences of infrared imagery taken from an airborne FLIR. Successful scene registration has been demonstrated for translation, scene growth, and spatially nonuniform rotation measured in the images. The method was also used to extract moving objects which are not detectable by simpler means. B.J.

A81-32504 **Optics in metrology and quality assurance; Proceedings of the Seminar, Los Angeles, Calif., February 6, 7, 1980.** Seminar sponsored by the Society of Photo-Optical Instrumentation Engineers. Edited by H. L. Kasdan (Recognition Systems, Inc., Van Nuys, Calif.). Bellingham, Wash., Society of Photo-Optical Instrumentation Engineers (SPIE Proceedings. Volume 220), 1980. 202 p. Members, $30; nonmembers, $37.

Optical technology used in metrology and quality assurance is reviewed with reference to specific techniques and approaches, methods of distance, surface, and profile analysis, circuit inspection, and image processing. Papers are presented on computer image processing and recognition, techniques for evaluation of aircraft windscreen optical distortion, aircraft quality assurance using close-range photogrammetry, and image processing applications in nondestructive examination. V.L.

A81-32507 **Techniques for evaluation of aircraft windscreen optical distortion.** J. S. Harris, K. G. Harding, and S. H. Mersch (Dayton, University, Dayton, Ohio). In: Optics in metrology and quality assurance; Proceedings of the Seminar, Los Angeles, Calif., February 6, 7, 1980. Bellingham, Wash., Society of Photo-Optical Instrumentation Engineers, 1980, p. 56-70. 29 refs.

Results of a program to experimentally evaluate existing techniques and develop new high-speed techniques for evaluation of optical distortion in aircraft windscreens are described. Present techniques for evaluation of aircraft windscreens' optical quality are based on grid board photography and point-by-point measurement of optical deviation errors. Experimental evaluation of the grid board techniques have shown them to be simple and easy to perform, but errors as large as 20 percent occur because of the associated data reduction. The approaches to point-by-point measurement of windscreen deviation errors provide high accuracy, but the time required to evaluate a single windscreen is typically eight to 24 hours. New techniques were studied, developed, and evaluated in order to permit real-time evaluation of aircraft windscreens. Two approaches described will provide the capability for high speed evaluation of windscreen optical distortion. These techniques utilize raster scanned laser probe beams in conjunction with retro-reflecting screens and holographic lenses. In addition to high-speed scanning techniques, a speckle photographic technique is described that can be used to evaluate binocular disparity in a transparent aircraft windscreen. (Author)

A81-32508 **Aircraft quality assurance using close-range photogrammetry.** G. L. Danielson (General Dynamics Corp., Fort Worth, Tex.). In: Optics in metrology and quality assurance; Proceedings of the Seminar, Los Angeles, Calif., February 6, 7, 1980. Bellingham, Wash., Society of Photo-Optical Instrumentation Engineers, 1980, p. 89-94.

Possible applications of close-range industrial photogrammetry as a basic metrology tool in support of airframe design, manufacture, and quality control are discussed. Special reference is made to the direct linear transformation technique which establishes a direct linear relationship (ratio) between film plane coordinates and other space coordinates. Aside from dimensional integrity of production tooling, another short-range goal for photogrammetry is major assembly coordination, i.e., mating of primary aircraft sections. Some of the longer-term goals include: calibration of aircraft control surface position, proof load and deflection testing, and detailed parts inspection in conjunction with real-time optical scanners and image recognition devices. V.L.

A81-32521 * # **Quiet propulsive-lift technology ready for civil and military applications.** J. A. Cochrane (NASA, Ames Research Center, Moffett Field, Calif.) and S. J. Queen (U.S. Naval Air Test Center, Patuxent River, Md.). *Astronautics and Aeronautics,* vol. 19, Apr. 1981, p. 42-45. 7 refs.

The Quiet Short-Haul Research Aircraft (QSRA) was designed as research aircraft for investigating terminal-area operations with an advanced propulsive-lift aircraft. The QSRA is a modified De Havilland C-8 Buffalo. The modification to the C-8 consisted of adding a new swept wing with four top-mounted Lycoming YF-102 turbofan engines to provide high levels of propulsive-lift through upper-surface blowing. The state of the art has reached the point where consideration can be given to various applications, including military transport aircraft, civil transports, and business jets. Attention is also given to a ground attack plane with QSRA, the payload advantage resulting from applying propulsive-life technology, and aspects of takeoff performance. G.R.

A81-32534 # **Improvement of the imaging of moving acoustic sources by the knowledge of their motion.** J. Hay (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *(Institute of Electrical and Electronics Engineers, International Conference on Acoustics, Speech and Signal Processing, Atlanta, Ga., Mar. 30-Apr. 1, 1981.) ONERA, TP* no. 1981-17, 1981. 7 p. 7 refs.

An analytical and experimental study is presented showing that, due to a more precise definition of nonstationary noises of a certain class, and to the preprocessing of microphone signals (termed 'coherent dedopplerization'), one can obtain acoustic imaging for sources whose velocity is greater than may be processed by conventional methods without the generation of blurrs of the same order as the antenna field. A useful application of these techniques would be to two-dimensional antennas. O.C.

A81-32541 # **Comparison of computed and measured unsteady pressure fields on a supercritical wing.** M. Couston, J. J. Angélini, and J. L. Meurzec. *(Cycle de Conférences, 81st, Rhode-Saint-Genèse, Belgium, Mar. 9-13, 1981.) ONERA, TP* no. 1981-12, 1981. 29 p. 16 refs. Research sponsored by the Bundesministerium für Forschung und Technologie and Office National d'Etudes et de Recherches Aérospatiales.

Unsteady pressure fields for supercritical wings of transport aircraft were computed and then experimentally measured. A basic two-dimensional method was used to solve the nonlinear transonic small perturbation equation. A steady pressure field was generated by its parameters and the concept of unsteady three-dimensional induced incidence as evaluated by a three-dimensional doublet lattice calculation was introduced in the nonlinear method as a three-dimensional correction. This correction was found to be adequate even when there were shock waves. If unsteady three-dimensional effects are not introduced, computed pressures are higher than experimental results. Viscosity is also significant. It is thought that the method can also deal with flutter as lifts and moments can be superimposed and show harmonic and linear characteristics. D.B.

A81-32547 * # **High temperature electronic requirements in aeropropulsion systems.** W. C. Nieberding and J. A. Powell (NASA, Lewis Research Center, Cleveland, Ohio). *NASA, DOE, and IEEE, High-Temperature Electronics Conference, Tucson, Ariz., Mar. 25-27, 1981, Paper.* 3 p.

This paper discusses the needs for high temperature electronic and electro-optic devices as they would be used on aircraft engines in either research and development applications, or operational applications. The conclusion reached is that the temperature at which the devices must be able to function is in the neighborhood of 500 to 600 C either for R&D or for operational applications. In R&D applications the devices must function in this temperature range when in the engine but only for a moderate period of time. On an operational engine, the reliability requirements dictate that the devices be able to be burned-in at temperatures significantly higher than those at which they will function on the engine. The major point made is that semiconductor technology must be pushed well beyond the level at which silicon will be able to function. (Author)

A81-32549 * # **Factors which influence the behavior of turbofan forced mixer nozzles.** B. H. Anderson and L. A. Povinelli (NASA, Lewis Research Center, Aerodynamics Analysis Section, Cleveland, Ohio). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0274.* 28 p. 14 refs.

A finite difference procedure was used to compute the mixing for three experimentally tested mixer geometries. Good agreement was obtained between analysis and experiment when the mechanisms responsible for secondary flow generation were properly modeled. Vorticity generation due to flow turning and vorticity generated within the centerbody-lobe passage were found to be important. Results are presented for two different temperature ratios between fan and core streams and for two different free-stream turbulence levels. It was concluded that the dominant mechanisms in turbofan mixers is associated with the secondary flows arising within the lobe region and their development within the mixing section. (Author)

A81-32642 **Application of the parameter space method to aerospace vehicle digital control system design.** S. M. Seltzer (Control Dynamics Co., Huntsville, Ala.). *IEEE Transactions on Automatic Control,* vol. AC-26, Apr. 1981, p. 530-534. Grant No. DAAK40-78-C-0226.

The parameter space method is a technique for determining stability and dynamic characteristics of a control system in terms of several selected system parameters. The digital form of the technique requires that the system characteristic equation be available in the complex z-domain. The method is extended and applied to a model of a digitally controlled aerospace vehicle. (Author)

A81-32691 **Maximum likelihood elevation angle estimates of radar targets using subapertures.** B. H. Cantrell, W. B. Gordon, and G. V. Trunk (U.S. Navy, Naval Research Laboratory, Washington, D.C.). *IEEE Transactions on Aerospace and Electronic Systems,* vol. AES-17, Mar. 1981, p. 213-221. 18 refs.

The paper considers the maximum likelihood estimation of the elevation angles of two closely spaced targets within the beamwidth. For an array divided into three subapertures, a simple closed form solution is obtained, the accuracy of which compares favorably with the maximum likelihood estimate that uses all the individual elements. Furthermore, since the complex reflection coefficient is estimated, the system can be used to characterize forward scatter. Simulation results are presented for the case of a radar target located over a smooth reflecting surface. B.J.

A81-32694 **Accuracy of noise-modulated radio altimeter.** S. A. El-Soud, E. Garas (Military Technical College, Cairo, Egypt), and I. M. El-Dokany (Menufia University, Menufia, Egypt). *IEEE Transactions on Aerospace and Electronic Systems,* vol. AES-17, Mar. 1981, p. 248-253.

The operation of a noise-modulated radio altimeter is based on the dependence of the cross-correlation function of the random modulation (Gaussian noise) on the finite correlator bandwidth, the smoothing time, the effect of extraneous noise disturbance, and the change of altitude of the aircraft during measurement. An optimum value of integration time is determined which minimizes the errors that enable the meter to measure short and very short distances. It is suggested that the correlation method of height measurement is sufficiently accurate to be used in systems of automatic aircraft landing. B.J.

A81-32695 **Application of endfire arrays at contemporary glide-slope problem sites.** R. H. McFarland (Ohio University, Athens, Ohio). *IEEE Transactions on Aerospace and Electronic Systems,* vol. AES-17, Mar. 1981, p. 261-270. 18 refs. Research sponsored by the Watts Antenna Co. and FAA.

It is shown that the endfire glide-slope system using slotted cables as radiating elements can provide a very high quality glide-slope structure for the user despite limited real estate for the transmitting system. An endfire glide-slope system has been successfully evaluated and tested at a problem site (Sweetwater County Airport, Rock Springs, Wyoming), using conventional image system transmitting equipment, including the second transmitter typically used for clearance with the capture-effect system. It is found that, unless spare monitor channels are available, it is necessary to time-multiplex sample signals for adequate monitoring of the relatively large aperture associated with the slotted-cable array. In addition, it is found that the endfire system produces a path in space that is completely compatible with contemporary airborne equipment. B.J.

A81-32696 **Detection of target multiplicity using monopulse quadrature angle.** S. J. Asseo (Northrop Corp., Hawthorne, Calif.). *IEEE Transactions on Aerospace and Electronic Systems,* vol. AES-17, Mar. 1981, p. 271-280. 5 refs. Research supported by Calspan Corp.

An analysis is presented of the feasibility of using the indicated quadrature angle of arrival of a monopulse radar to discriminate a single target from multiple targets, separated in angle within a radar resolution cell. The analysis is carried out for fixed and Rayleigh fluctuating targets, which cover a broad range of target characteristics. Detection and false alarm probabilities are determined analytically and the receiver operating characteristics are obtained for both fixed and fluctuating target cases. It is shown that multiple targets can be discriminated from a single target condition by integrating the indicated monopulse quadrature angle of arrival from several independent pulses. The probability of detecting multiple targets increases as the fluctuation in the target radar cross section decreases, approaching the fixed amplitude case in the limit. B.J.

A81-32697 **Orientation of measurement sensors for optimum end-of-life performance.** P. K. Mazaika (Aerospace Corp., Los Angeles, Calif.). *IEEE Transactions on Aerospace and Electronic Systems,* vol. AES-17, Mar. 1981, p. 281-287. 8 refs.

Relative orientations of onboard measurement sensors are derived that optimize end-of-life measurement accuracy in the worst case when all but three sensors have failed. For five and six sensors, the results are the well-known single-cone and dodecahedron configurations, respectively. New configurations are found for seven and eight sensors. The seven-sensor configuration is roughly described as six vectors lying unequally spaced on a cone with a half-angle of 61.2 deg while the seventh points 24.3 deg away from the cone axis. The eight-sensor configuration somewhat resembles a ten-sensor icosahedron arrangement with two sensors removed. The new configurations are at least 20% more accurate in end-of-life performance than previously proposed configurations, but are less accurate in the intermediate lifetimes when only two or three sensors have failed. B.J.

A81-32777 # **Experimental investigation of oscillating subsonic jets.** D. J. Collings, M. F. Platzer (U.S. Naval Postgraduate School, Monterey, Calif.), J. C. S. Lai, and J. M. Simmons (Queensland, University, Brisbane, Australia). In: Symposium on Numerical and Physical Aspects of Aerodynamic Flows, Long Beach, Calif., January 19-21, 1981, Proceedings. Long Beach, Calif., California State University, 1981. 10 p. 30 refs. Research supported by the Australian Research Grants Committee, University of Queensland, and U.S. Navy.

The entrainment mechanisms in turbulent jets and methods to increase the entrainment have been a subject of considerable basic and applied interest for many years. Recently, this problem has attracted increased attention because of the need to develop compact, yet highly efficient thrust augmenting ejectors for VSTOL applications. Several new techniques have been introduced or proposed to increase the jet entrainment, e.g. hypermixing, swirling, acoustic interactions, and unsteady jet flows. Measurements are described for two-dimensional turbulent free jets which are excited by forced vibration of a small vane located in the jet potential core. Mean velocity measurements using pitot tubes and hot wire or laser-doppler anemometry show significantly increased entrainment rates over the steady turbulent jet. Measurement details and the effect of various parameters, such as nozzle pressure ratio, amplitude and frequency of vane oscillation, are summarized. (Author)

A81-32779 * # **Fluid mechanics mechanisms in the stall process of airfoils for helicopters.** W. H. Young, Jr. (NASA, Langley Research Center, Hampton, Va.). In: Symposium on Numerical and Physical Aspects of Aerodynamic Flows, Long Beach, Calif., January 19-21, 1981, Proceedings. Long Beach, Calif., California State University, 1981. 10 p. 19 refs.

Phenomena that control the flow during the stall portion of a dynamic stall cycle are analyzed, and their effect on blade motion is outlined. Four mechanisms by which dynamic stall may be initiated are identified: (1) bursting of the separation bubble, (2) flow reversal in the turbulent boundary layer on the airfoil upper surface, (3) shock wave-boundary layer interaction behind the airfoil crest, and (4) acoustic wave propagation below the airfoil. The fluid mechanics that contribute to the identified flow phenomena are summarized, and the usefulness of a model that incorporates the required fluid mechanics mechanisms is discussed. V.L.

A81-32825 * # **Concepts for improving the damage tolerance of composite compression panels.** M. D. Rhodes and J. G. Williams (NASA, Langley Research Center, Structures and Dynamics Div., Hampton, Va.). *U.S. Department of Defense and NASA, Conference on Fibrous Composites in Structural Design, 5th, New Orleans, La., Jan. 27-29, 1981, Paper.* 42 p. 11 refs.

The results of an experimental evaluation of graphite-epoxy composite compression panel impact damage tolerance and damage propagation arrest concepts are reported. The tests were conducted on flat plate specimens and blade-stiffened structural panels such as those used in commercial aircraft wings, and the residual strength of damaged specimens and their sensitivity to damage while subjected to in-plane compression loading were determined. Results suggest that matrix materials that fail by delamination have the lowest damage tolerance, and it is concluded that alternative matrix materials with transverse reinforcement to suppress the delamination failure mode and yield the higher-strain value transverse shear crippling mode should be developed. O.C.

A81-32833 **A microprocessor based land navigator.** L. J. Little and J. Ingegneri (U.S. Army, Missile Laboratory, Redstone Arsenal, Ala.). In: International Instrumentation Symposium, 26th, Seattle, Wash., May 5-8, 1980, Proceedings. Part 1. Research Triangle Park, N.C., Instrument Society of America, 1980, p. 77-82.

This paper presents the development of a microprocessor based land navigator. The navigator is to have the virtue of low cost, reliability, less mechanical parts, portable and minimum operator's effort. One gyro and one odometer are used as primary sensors. The former provides the heading information and the latter tracks the distance traveled. Using the microprocessor's rapid computation capability, the navigator gives the present position on a grid system, navigator's heading, distance traveled, and the distance-to-go for a given destination. (Author)

A81-32847 # **Centralized in-place pressure calibration system for multiple turbine engine aerodynamic pressure measurement systems.** W. N. Brock (ARO, Inc., Arnold Engineering Development Center, Arnold Air Force Station, Tenn.). In: International Instrumentation Symposium, 26th, Seattle, Wash., May 5-8, 1980, Proceedings. Part 1. Research Triangle Park, N.C., Instrument Society of America, 1980, p. 353-360.

A81-32849 # **An opto-electronic method for wind tunnel model alignment.** C. B. Jett (ARO, Inc., Arnold Engineering Development Center, Arnold Air Force Station, Tenn.). In: International Instrumentation Symposium, 26th, Seattle, Wash., May 5-8, 1980, Proceedings. Part 1. Research Triangle Park, N.C., Instrument Society of America, 1980, p. 379-392.

Application of optical sensors and fiber optics to the problem of aligning the store model with the carriage mechanism on the parent aircraft is discussed. The optical sensors tested included a sensor consisting of a gallium arsenide, infrared, light-emitting diode mounted with a silicone N-P-N phototransistor in a single plastic package; a sensor identical to the above except that a photodarlington circuit replaces the phototransistor; and an emitter-photodiode pair mounted in a locally designed and fabricated enclosure. The thermal stabilities and long-term amplitude stabilities of the phototransistor optical sensor and the fiber-optics sensor are found to be adequate for the application. V.L.

A81-32857 **In-flight fatigue crack monitoring using acoustic emission.** P. H. Hutton and J. R. Skorpik (Battelle Pacific Northwest Laboratories, Richland, Wash.). In: International Instrumentation Symposium, 26th, Seattle, Wash., May 5-8, 1980, Proceedings. Part 2. Research Triangle Park, N.C., Instrument Society of America, 1980, p. 553-560. Research supported by the Department of Defence of Australia and DARPA.

A program has been designed to develop, fabricate, and use routinely in flight on a small high-performance jet aircraft a miniaturized acoustic emission (AE) monitor system to detect fatigue crack growth in aircraft structure during operation. AE detected during these tests has shown direct correlation with slow crack growth over the past year and a half. Analysis of AE results relative to sustained load versus varying load conditions suggests that continuous in-flight AE monitoring would be more effective than proof load monitoring in detecting subcritical cracks. V.L.

A81-32858 **Microprocessor-based digital air data computer for flight test.** R. M. Lundy and M. L. Roginsky (Lockheed-Georgia Co., Marietta, Ga.). In: International Instrumentation Symposium, 26th, Seattle, Wash., May 5-8, 1980, Proceedings. Part 2. Research Triangle Park, N.C., Instrument Society of America, 1980, p. 561-571.

This paper describes the development of a highly accurate airborne digital air data computer useful for general flight tests. This device has pressure inputs for aircraft static and aircraft total pressures, and analog voltage inputs for aircraft gross weight, free air temperature, and wing flap position. Its outputs consist of indicated and corrected altitude, airspeed, true airspeed, Mach number, and rate-of-climb. Its embedded microprocessor performs the conversions from pressure measurements to engineering parameters, and corrects for the position error and system lag that are inherent in the pressure system plumbing of the aircraft. The microprocessor software employs a sophisticated table look-up technique to solve the complicated mathematical formulae necessary for the instrument corrections. This paper includes an error analysis of the system. (Author)

A81-32859 **Measuring dynamic stresses on helicopter transmission gear teeth utilizing telemetry.** R. F. McCann (Boeing Vertol Laboratory Operations and Electronics Test Engineering Laboratory, Ridley Township, Pa.). In: International Instrumentation Symposium, 26th, Seattle, Wash., May 5-8, 1980, Proceedings. Part 2. Research Triangle Park, N.C., Instrument Society of America, 1980, p. 573-582. 5 refs.

The implementation of a radio telemetry system for use in testing helicopter transmissions is discussed with reference to system design, transmitter tuning and installation, data acquisition system, and test data. It is shown that the use of telemetry to obtain gear tooth stresses from an operating helicopter transmission makes it possible to evaluate dynamic tooth load effects and actual temperature effects on gear stresses as well as gear resonance characteristics over the operating rpm range. V.L.

A81-32860 **A flight test real-time GW-CG computing system.** D. M. Brockman (Boeing Commercial Airplane Co., Seattle, Wash.). In: International Instrumentation Symposium, 26th, Seattle, Wash., May 5-8, 1980, Proceedings. Part 2. Research Triangle Park, N.C., Instrument Society of America, 1980, p. 583-589.

A real-time, distributed microprocessor system has been developed to compute gross weight and center-of-gravity for display (for test conduct) and recording (for postflight processing) on flight test aircraft. The various transducer-level processors (up to eight) are connected in a star configuration to a master processor by a simple, serial communications network. The system performance has been verified by extensive laboratory and flight testing and is now in routine service. (Author)

A81-32872 **A mobile emissions laboratory for on-line analysis of combustion products from gas turbine engines.** J. L. Mathason, R. C. Backer, and D. G. Gardner (United Technologies Corp., Pratt and Whitney Aircraft Group, West Palm Beach, Fla.). In: International Instrumentation Symposium, 26th, Seattle, Wash., May 5-8, 1980, Proceedings. Part 2. Research Triangle Park, N.C., Instrument Society of America, 1980, p. 731-737.

A Mobile Emissions Laboratory for on-line analysis of combustion products from gas turbine engines is described. The Mobile Laboratory comprises a self-propelled, noise insulated vehicle equipped with an emissions measurement system, a data acquisition system and all support equipment necessary for performing accurate on-line emissions measurements. Special features of the facility and the supporting data system are presented. (Author)

A81-32874 # **Development of a noninterference compressor blade stress measurement system.** P. E. McCarty, J. W. Thompson, Jr., and R. S. Ballard (ARO, Inc., Arnold Engineering Development Center, Arnold Air Force Station, Tenn.). In: International Instrumentation Symposium, 26th, Seattle, Wash., May 5-8, 1980, Proceedings. Part 2. Research Triangle Park, N.C., Instrument Society of America, 1980, p. 745-757. 7 refs.

A noninterference technique for measuring stress in compressor blades of turbine engines is being developed to alleviate disadvantages associated with conventional strain-gage measurement systems. This technique utilizes blade-tip deflection measurements and special data-processing algorithms to infer local blade stress. A prototype noninterference processing system for inferring blade stress from a single compressor stage has been developed for blade vibrations nonintegral to engine speed. (Future efforts will address vibrations integral to engine speed). Blade stress amplitude and spectral information is displayed on conventional strain-gage-type displays, with which the blade stress analyst is intimately familiar. The prototype noninterference system with the nonintegral blade vibration data processing algorithm has been field validated by comparing the test results of the noninterference system and strain-gage blade stress data system during an aeromechanical test of a turbine engine instrumented with both strain gages and blade-tip deflection sensors. (Author)

A81-32886 # **High frequency angular vibration measurements in vehicles.** L. Sher and P. Merritt (USAF, Weapons Laboratory, Kirtland AFB, N. Mex.). *American Astronautical Society, Annual Rocky Mountain Guidance and Control Conference, Keystone, Colo., Jan. 31-Feb. 4, 1981, Paper 81-024.* 17 p. 8 refs.

The requirements for accurate and high-frequency response angular sensing in vehicles are examined. It is demonstrated that, in connection with the growth in the size of optical systems, it will not be sufficient any longer to provide devices for wide-bandwidth angular measurements, correlated about each axis. It will be necessary to conduct measurements at several locations of interest and to correlate the measurements from location to location. A description is given of results obtained with angular sensors capable of these measurements. The sensors have been used to measure several aircraft at the Air Force Weapons Laboratory. Attention is given to strapdown sensor errors, strapdown system level errors, the design of angular sensing devices, and information provided by measurements in vehicles. G.R.

A81-32909 # **The impact of the All Electric Airplane on production engineering.** M. J. Cronin (Lockheed-California Co., Burbank, Calif.). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display on Frontiers of Achievement, Long Beach, Calif., May 12-14, 1981, Paper 81-0848.* 9 p. 22 refs.

The emergence of an All Electric Airplane in the role of an energy efficient transport is described in relation to the increasing fuel problems, which are impacting on the economic viability of the aerospace industry. The paper reviews the All Electric Airplane (which performs electrically all those functions normally powered by hydraulics, pneumatics and engine bleed air) for its impact upon the design/implementation of the aircraft systems, the advanced technology engines, the aircraft's ground-logistic support, and the producibility aspects of these advanced transport aircraft. The simplification of engine design and the prospective improvements in its specific-fuel-consumption are highlighted along with the overall simplification of the aircraft production aspects of the All Electric Airplane. (Author)

A81-32910 # **Control, navigation, and guidance.** C. S. Draper (Charles Stark Draper Laboratory, Inc., Cambridge, Mass.). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display on Frontiers of Achievement, Long Beach, Calif., May 12-14, 1981, Paper 81-0859.* 16 p.

A comprehensive theoretical introduction is presented for the family of self-contained systems, providing control and navigation for vehicles that uses gyroscopic elements to maintain reference directions with respect to inertial space. In these, sensors for resultant gravity field and inertial reaction forces along input axes determine the vertical and linear velocities with respect to inertial space, which, divided by an equivalent earth radius, transfer the motion to earth coordinates in which integration gives location. Corrections for earth's rotation, projected in and perpendicular to the horizontal plane, are made as computed cosine and sine projections of the earth's angular velocity. Current systems based on these principles are routinely capable of fractional-miles-per-hour accuracies. O.C.

A81-32918 # **Aircraft applications of titanium - A review of the past and potential for the future.** F. A. Crossley. *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display on Frontiers of Achievement, Long Beach, Calif., May 12-14, 1981, Paper 81-0893.* 14 p. 32 refs.

The historical development of the titanium alloys industry, its products, and their applications is related, and existing and prospective developments in alloy compositions, fabrication methods, and aerospace application of numerous components are discussed. Major problems encountered have been hydrogen embrittlement, sea water stress-corrosion, and low cycle fatigue under plane strain conditions, to which may be added current difficulties with long lead times and materials costs. The most attractive of the new alloys and advantages of their applications over competing alternatives are considered for next-generation aircraft component designs. O.C.

A81-32920 # **Advanced composites - Evolution of manufacturing technology.** R. L. Rapson (USAF, Materials Laboratory, Wright-Patterson AFB, Ohio). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display on Frontiers of Achievement, Long Beach, Calif., May 12-14, 1981, Paper 81-0895.* 10 p.

A detailed introduction is presented of the Automated Integrated Manufacturing System (AIMS) for advanced graphite-epoxy composite structures fabrication development. The purpose of the system is the demonstration of significant savings in labor costs, which have thus far been a major disadvantage. The recent incorporation of robotic laminating and drilling devices is also discussed. It is concluded that the test facility will demonstrate not only reduced costs, but increased and more easily verifiable quality. O.C.

A81-32921 # **Past and future trends in structures and dynamics.** R. M. Bader, W. H. Goesch, and J. J. Olsen (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display on Frontiers of Achievement, Long Beach, Calif., May 12-14, 1981, Paper 81-0896.* 7 p.

An historical review and a series of prognostications based on current developments are presented for the fields of structural design and structural dynamics analysis. It is shown that while weight and cost reduction and improved durability have been the primary forces in structural technology development in the past, emphasis has shifted to such things as productivity, quality assurance, low observables for military aircraft and increased fuel efficiency. Prominent among recent advances in future developments are damage tolerance durability, computer-aided design, active flutter suppression, adhesive bonding of primary structures, cast aluminum structures, titanium and graphite-epoxy primary aircraft structures, aeroelastic tailoring composites, metal matrix composites, and radar-absorbing structures. O.C.

A81-32922 # **Structural optimization - Past, present and future.** G. N. Vanderplaats (U.S. Naval Postgraduate School, Monterey, Calif.). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display on Frontiers of Achievement, Long Beach, Calif., May 12-14, 1981, Paper 81-0897.* 10 p. 60 refs.

A review is given of developments from the 1960s to date, and into the foreseeable future, of the use of numerical methods in structural optimization. It is shown that an automated structural synthesis technology already exists with which to efficiently design structures defined by several hundred design variables under multiple loading conditions and subject to sizing, stress, displacement, buckling, frequency and flutter constraints. Two recommendations are made for numerical method development: (1) the realization of computer codes incorporating a variety of state of the art algorithms, with a clear set of guidelines for their coding, testing and documentation; and (2) the development of algorithms for the efficient solution of large-scale nonlinear programming problems. O.C.

A81-32926 # **Design of low powered aircraft, a philosophy for future personal sport aircraft.** J. T. Monnett (Monnett Experimental Aircraft, Inc., Elgin, Ill.). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display on Frontiers of Achievement, Long Beach, Calif., May 12-14, 1981, Paper 81-0905.* 6 p.

An approach to design for low cost kit built personal aircraft accepting the challenges of airframe, fuel and production efficiency, FAA regulations, and the limits of the average home-builder is discussed. Methods of blending traditional construction techniques with advanced technology materials and new lightweight power plants toward the future development of a series of lightweight 'interchangeable modular component' kit aircraft are examined relative to the goals of such aircraft. (Author)

A81-32930 # **Jet aircraft design.** D. J. Grommesh and R. E. Etherington (Gates Learjet Corp., Wichita, Kan.). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display on Frontiers of Achievement, Long Beach, Calif., May 12-14, 1981, Paper 81-0912.* 7 p.

The purpose of this paper is to trace the process of design of a business jet aircraft from conception through development and certification. The process involves determination of market and marriage of available engines and technology. Some systems design considerations that are the results of high altitude performance requirements are discussed. The effect of the certification process and certification requirements are reviewed. Finally, some observations toward future evolution will be discussed. (Author)

A81-32931 # **Commuter aircraft design.** R. E. McKelvey (Fairchild Swearingen Corp., San Antonio, Tex.). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display on Frontiers of Achievement, Long Beach, Calif., May 12-14, 1981, Paper 81-0913.* 4 p.

The design of commuter aircraft is strongly influenced by conditions in demography, regulatory agencies, economic policies, fuel supply, and technology. Demand for safe and economical transportation to and from metropolitan areas emphasizes the necessity for throughly researched designs. Regulatory agencies continue to take active roles in passenger safety. Operating costs affect both current and potential commuter airlines, as do conditions in fuel producing countries. Interrelationships among these factors result in greater use of analysis in determining optimum commuter design criteria. Advances in design, analysis and technology will continue to make significant contributions to the growth of the commuter industry. (Author)

A81-32932 * # **Sun powered aircraft design.** P. B. MacCready, P. B. S. Lissaman (AeroVironment, Inc., Pasadena, Calif.), W. R. Morgan (AeroVironment, Inc., Sun Valley, Calif.), and J. D. Burke (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display on Frontiers of Achievement, Long Beach, Calif., May 12-14, 1981, Paper 81-0916.* 14 p.

Two piloted aircraft have been developed and flown powered solely by photovoltaic cells in a program sponsored by the DuPont Company. The 30.8-kg (68-lb), 21.6-m (71-ft) span, Gossamer Penguin was used as a solar test bed, making a 2.6-km (1.6-mile) flight in August 1980. The 88.1-kg (194-lb), 14.3-m (47-ft) span Solar Challenger was developed for long flights in normal turbulence. Stressed to +9 G, it utilizes Kevlar, Nomex honeycomb-graphite sandwich wall tubes, expanded polystyrene foam ribs, and Mylar skin. With a 54.9-kg (121-lb) airframe, 33.1-kg (73-lb) propulsion system, and a 45.4-kg (100-lb) pilot, it flies on 1400 watts. In summer, the projected maximum climb is 1.0 m/s (200 ft/min) at 9,150 m (30,000 ft). Sixty purely solar-powered flights were made during winter 1980-1981. Using thermals, 1,070 m (3,500 ft) was reached with 115-minute duration. (Author)

A81-32933 # **Aircraft design then and now.** E. H. Heinemann (Heinemann Associates, Rancho Santa Fe, Calif.). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Displav on Frontiers of Achievement, Long Beach, Calif., May 12-14, 1981, Paper 81-0917.* 7 p.

An autobiographical account is given of important trends in the design of military and experimental aircraft, covering the period from 1927 to 1970. Stress is placed on such social aspects of design work as the gradual promotion of the most successful aeronautical engineers to administrative positions, the increasing costs of experimental and prototype aircraft development that prevents the emergence of such innovative designers as those of the older generation, an overemphasis on academic credentials that cannot directly reflect the true aptitude of an aircraft designer, and a strict adherence to the letter of requests for proposals rather than a determination to design beyond mere requirements. The A4 Skyhawk design,. for example, weighed 14,600 pounds, yet met all requirements of the Navy's 30,000 pound aircraft specifications and had 100 mph greater speed. O.C.

A81-32934 # **European approaches to transport aircraft design.** R. H. Beteille (Airbus Industrie, Blagnac, Haute-Garonne, France). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display of Frontiers of Achievement, Long Beach, Calif., May 12-14, 1981, Paper 81-0926.* 12 p.

An historical account is presented of the unique-development path taken by European transport aircraft shaped by the economic, political and military experiences of the European aircraft industries since before the First World War. Among the aircraft reviewed are such early designs as the Breguet 14T, Junkers F.13, and Fokker F.II; airliners of the 1920s such as the Farman Goliath, A.W. 155 Argosy, Leo 213 and Fokker FVII-3m; among trimotors, the Junkers Ju 52, S.M. 73, and Dewoitine D.338; modern transports such as the Fiat G.18V, Bloch 220 and Fw 200A Condor; and the Viscount and Fokker F.27 turboprops and first-generation Comet, Caravelle and BAC 111 jet airliners of the 1950s. The value of exerience with the first SST, the Concorde, is touched upon, and the extensive and more economically realistic development program of the multinational Airbus is discussed. O.C.

A81-32935 # **Army aviation - A perspective into the eighties.** R. D. Kenyon (U.S. Army, Washington, D.C.). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display on Frontiers of Achievement, Long Beach, Calif., May 12-14, 1981, Paper 81-0931.* 6 p.

A brief review of Army Aviation, which came into its own during the Vietnam conflict, is presented. Army Aviation elements are employed with the intent of optimizing the ability of the ground commander to accomplish his mission to close with and capture or destroy the enemy, and to gain hold of the terrain. The Army aircraft fleet consists of over 8,000 aircraft, about 90% of which are helicopters. A brief description of the aircraft is given, including scout/observation helicopters, attack helicopters, utility helicopters (the Sikorsky UH-60A Black Hawk provides the Army with greatly enhanced speed, payload, and flexibility), cargo helicopters, and electronic warfare aircraft (the RV-1D Quicklook aircraft can detect and identify hostile radar). Attention is given to research and development in areas such as lightweight composites, rotors and fuel efficient engines, and to the modernization program begun in the 1970's. The Army has set design parameters for new aircraft which include features to facilitate loading, transporting, and unloading of aircraft when using strategic air or sea lift for deployment; and it is developing the capability to self-deploy helicopters in Europe. K.S.

A81-32937 # **Iecnnology growth in mini-RPV systems.** G. F. Christensen (U.S. Army, Aviation Research and Development Command, St. Louis, Mo.), F. D. Schnebly, and R. J. Niewald (Lockheed Missiles and Space Co., Inc., Sunnyvale, Cali:.). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display on Frontiers of Achievement, Long Beach, Calif., May 12-14, 1981, Paper 81-0936.* 8 p.

A review is presented of the technological evolution of the mini-RPVs (weighing 100 to 300 lbs and flying at low subsonic speeds) being developed for the U.S. Army. The initial mini-RPV activities utilized remotely controlled models as a basis for their aerodynamic configuration, engines, and radio link for command and control. The Aequare, developed in 1973-1974, included such technological improvements as an aerodynamic configuration in which the wings were telescoped and rotated to stow in a pod, and the use of elevators and rudders in a rear propeller duct for control. The Acquila target acquisition and reconnaissance system, initiated by the Army in 1974, to determine the feasibility and utility of a mini-RPV system for future Army missions, consisted of a ground control station, an air vehicle, a launcher, and a recovery system. The current Aquila development, begun in September, 1979, is a militarized version of the earlier Aquila system with greater emphasis on mobility, reliability, and maintainability, having additional performance capabilities for meeting mission requirements in target location accuracy, target designation, and enhanced survivability. The impact of technology on air vehicle structure, propulsion system, electrical power requirements, navigation, guidance and flight control system, and payloads is discussed. In the future, the RPV may be used for harassment missions or to carry ECM equipment for radar or communications jamming. K.S.

A81-32939 # **The art of designing experimental aircraft - An overview.** P. H. Poberezny (Experimental Aircraft Association, Hales Corners, Wis.). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display on Frontiers of Achievement, Long Beach, Calif., May 12-14, 1981, Paper 81-0944.* 8 p.

The history of the homebuilt aircraft movement is surveyed, with attention given to the changing technology, the need to adjust to dwindling but more expensive aviation gasoline supplies, and the effect of the search for alternate lightweight materials and energy sources on safety factors relating to aircraft design. Emphasis is placed on the basic craftsmanship required to sustain the experimental aircraft movement into the future. Predictions are made of the design characteristics of tomorrow's sport, racing, and recreational aircraft. C.R.

A81-32999 **Airborne electronic displays.** G. H. Hunt (Royal Aircraft Establishment, Flight Systems Dept., Farnborough, Hants., England). *IEE Proceedings, Part A - Physical Science, Measurement and Instrumentation, Management and Education, Reviews,* vol. 128, pt. A, no. 4, May 1981, p. 225-243. 79 refs.

The paper reviews available and potentially promising display technologies and the possible integration of electronic displays into the total avionic systems. It is shown that improvements in on-board data processing relieves the crew of much routine monitoring. The efforts of the crew can therefore be directed to displays requiring more intelligence in design and interpretation of usage of applied symbology. The complexity of the human visual system is analyzed, taking into consideration the physical characteristics of the eye itself, and the perceptual mechanisms of the eye and brain together as an optical sensor and interpreter of visual images. The electronic display devices described include monochrome and color CRTs, digitally addressed CRTs, besides a range of solid-state matrix and alphanumeric displays, both emissive and reflective. Additionally, image intensifiers for use in night operations are discussed. Some displays reviewed incorporate optical elements for magnification, collimation and image combination, and the use of both refractive and diffractive optical techniques. Integration of electronic displays with digital data highways in the design of future complete display systems is considered one of the greatest potential advantages. E.B.

A81-33047 **Helicopter vibration control - A survey.** G. Reichert (Messerschmitt-Bölkow-Blohm GmbH, Munich, West Germany). *(Royal Aeronautical Society, Society of British Aerospace Companies, and University of Bristol, European Rotorcraft and Powered Lift Aircraft Forum, 6th, University of Bristol, Bristol, England, Sept. 16-19, 1980.) Vertica,* vol. 5, no. 1, 1981, p. 1-20. 44 refs.

The complexity of the helicopter vibration problem and the procedures necessary for considering vibration throughout the development phase are presented. The stringent vibration requirements of modern helicopters necessitate special methods and devices to control and reduce vibration to an acceptable level. A review of past, current and future possibilities and methods for reducing helicopter vibrations is given, 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 also the possibilities of active isolation devices. In the whole field, the helicopter industry has obtained a broad experience from special test programs as well as from new development programs with installed antivibration devices. Vibration will always remain a helicopter problem. There are effective means of reducing the levels, but vibration specifications must be realistically determined to avoid excessive weight penalties and development costs. (Author)

A81-33049 **Transonic rotor noise - Theoretical and experimental comparisons.** F. H. Schmitz and Y. H. Yu (U.S. Army, Aeromechanics Laboratory, Moffett Field, Calif.). *(Royal Aeronautical Society, Society of British Aerospace Companies, and University of Bristol, European Rotorcraft and Powered Lift Aircraft Forum, 6th, University of Bristol, Bristol, England, Sept. 16-19, 1980.) Vertica,* vol. 5, no. 1, 1981, p. 55-74. 17 refs.

Two complementary methods of describing the high-speed rotor noise problem are discussed. The first method uses the second-order transonic potential equation to define and characterize the nature of the aerodynamic and acoustic fields and to explain the appearance of radiating shock waves. The second employs the Ffowcs Williams and Hawkings equation to successfully calculate the acoustic far-field. Good agreement between theoretical and experimental waveforms is shown for transonic hover tip Mach numbers from 0.8 to 0.9. (Author)

A81-33050 * **A Galerkin type finite element method for rotary-wing aeroelasticity in hover and forward flight.** F. K. Straub and P. P. Friedmann (California, University, Los Angeles, Calif.). *(Royal Aeronautical Society, Society of British Aerospace Companies, and University of Bristol, European Rotorcraft and Powered Lift Aircraft Forum, 6th, University of Bristol, Bristol, England, Sept. 16-19, 1980.) Vertica,* vol. 5, no. 1, 1981, p. 75-98. 24 refs. Army-supported research; Grant No. NsG-1578.

A Galerkin finite element method for the spatial discretization of the nonlinear, nonselfadjoint, partial differential equations governing rotary-wing aeroelasticity is presented. This method reduces algebraic manipulative labor significantly when compared to the global Galerkin method based on assumed modes. Furthermore, the Galerkin finite element method is ideally suited to treat rotor blades with discontinuous mass and stiffness distribution and structurally redundant configurations as they appear in bearingless rotors. Implementation of the method is illustrated for the coupled flap-lag aeroelastic problem of hingeless rotor blades in hover and forward flight. Numerical results for stability and response illustrate the numerical properties and convergence behavior of the method. It is concluded that the Galerkin finite element method is a practical tool for solving rotary-wing aeroelastic stability and response problems. (Author)

A81-33149 **SIMCAT - A modular air traffic control simulator.** G. Denancé (Thomson-CSF, Paris, France). *The Controller,* vol. 20, Mar. 1981, p. 5-8.

A modular air traffic control simulator (SIMCAT), used as a teaching aid in the training of future air traffic controllers and refresher training for operational controllers is discussed. The design principles of SIMCAT are treated from the educational and technical point of view, providing realistic situation capabilities during training, resembling those during high density traffic and peak periods at the control tower. The system is programmable, and all data required can be stored, retrieved, and modified at any time. Details on the control consoles equipped with radar screens, the pilot positions, and the central unit are given. E.B.

A81-33150 **The use of airspace - One way to save fuel.** J. S. Savage. *The Controller,* vol. 20, Mar. 1981, p. 9-11, 13.

An apparent disagreement between airlines and pilots on the topics of optimal fuel consumption and the present use of airspace is discussed from the viewpoint of a pilot. The problems are seen mostly in terms of restrictions imposed upon the pilot by Air Traffic Services and the Performance Management Systems of Airlines. Some requirements for an ideal flight and economic use of airspace and fuel are briefly outlined. They include: (1) air traffic control clearance to be given before the engine is started; (2) take-off, climb-out, and descent to be as unrestricted as possible; (3) initial cruise at optimum level for fuel economy and access to higher levels as weight is reduced; (4) freedom to deviate from track to avoid weather build-ups. To economize fuel consumption a complete redesigning of airways and the introduction of one-way airways in areas of high traffic density is proposed. Comparative data are given to support the proposal with regard to actual fuel cost savings during climb and descent phases and cruising. E.B.

A81-33168 **Method for evaluating the resistance of gas-turbine installation disks to thermal cycling.** L. B. Getsov, M. G. Kabelevskii, V. K. Dondoshanskii, O. F. Cherniavskii, A. E. Ginzburg, L. I. Stoliarova, and E. F. Cherniaev (Tsentral'nyi Nauchno-Issledovatel'skii Institut Tekhnologii i Mashinostroeniia, Moscow; Cheliabinskii Politekhnicheskii Institut, Chelyabinsk, USSR). *(Problemy Prochnosti,* Sept. 1980, p. 46-53.) *Strength of Materials,* vol. 12, no. 9, May 1981, p. 1105-1113. 9 refs. Translation.

Various aspects are considered of the methods used for numerical determinations of disk resistance to thermal cycling. The results for disk cyclic tests are compared with calculated data. The methods include disk evaluation by adaptability theory, evaluation of irreversible disk strains, evaluation of conditions for crack formation at the rim, and evaluation of crack propagation rate. It is contended that the problem of disk damage connected with low-cycle or thermal fatigue can be solved only through an approach involving several methods. C.R.

A81-33169 **Thermoplastic strengthening of a gas-turbine engine disk lock joint - Determination of the residual stresses.** B. A. Kravchenko, G. N. Gutman, L. E. Batrin, and V. G. Fokin (Kuibyshevskii Politekhnicheskii Institut, Kuibyshev, USSR). *(Problemy Prochnosti,* Sept. 1980, p. 54-56.) *Strength of Materials,* vol. 12, no. 9, May 1981, p. 1113-1116. Translation.

A unit is created for investigating thermoplastic strengthening of turbine disk lock grooves in special imitator samples. A method is then developed for determining the residual stresses at the bottom of a disk lock groove with consideration given to the influence of the cutting of a sample. The residual stresses occurring in lock grooves after various thermoplastic strengthening cycles are investigated on disk imitators. C.R.

A81-33173 **Efficiency of the methods and algorithms used for estimating the reliability in aviation techniques.** A. K. Ianko (Kiivs'kii Institut Inzheneriv Tsivil'noi Aviatsii, Kiev, Ukrainian SSR). *(Problemy Prochnosti,* Sept. 1980, p. 102-106.) *Strength of Materials,* vol. 12, no. 9, May 1981, p. 1169-1175. 5 refs. Translation.

The various methods and algorithms used in estimating the generalized exponential distribution (GED) are compared in order to work out practical recommendations for selecting the most efficient method for estimating the reliability in aviation technique. The required analytic relationships are derived and algorithms are developed for estimating the parameters of the GED by applying the method of moments, the method of quantiles, and the method of maximum probability. The efficiency of the algorithms is determined by applying the method of numerical statistical modeling, which requires the derivation and application of an algorithm formulating the sequential statistics of the GED. C.R.

A81-33174 **Increasing the strength properties of sheet parts by explosive forming of them with optimization of the production parameters.** V. K. Borisevich, S. N. Solodiankin, V. P. Sabel'kin, and V. I. Isaenko (Khar'kovskii Aviatsionnyi Institut, Kharkov, Ukrainian SSR). *(Problemy Prochnosti,* Sept. 1980, p. 113-116.) *Strength of Materials,* vol. 12, no. 9, May 1981, p. 1184-1188. 8 refs. Translation.

A method is presented of promoting an increase in the strength properties of sheet parts by explosive forming with optimization of production parameters. This approach makes it possible to incorporate, even in the design stage, a substantial increase in strength properties. It is pointed out that explosive forming makes it possible to obtain parts with a high surface quality and in a single piece without breaks and welded and riveted joints. C.R.

A81-33245 # **On St. Venant flexure and torsion problem for symmetrical airfoil sections.** K.-F. Wang (Fudan University, Shanghai, Communist China). *Acta Mechanica Solida Sinica,* Nov. 1980, p. 218-233. In Chinese, with abstract in English.

The St. Venant torsion and flexure problem of a cantilever beam comprising a series of symmetrical airfoil cross sections and loaded at the free end perpendicular to the plane of symmetry is treated. A mathematical form assigned to the cross sectional shape is derived through the inversion of a hyperbola. The form contains a single parameter k for adjusting the thickness of the airfoil. It is noted that an exact solution was obtained by Stevenson (1938) for the case of k = 1 and that Lin and Whitehead (1951) obtained a torsion function for the case where k = 2. An exact solution was obtained by Lin (1956) for the case in which k is a positive integer. Here, an exact solution is obtained for the case where k is a positive rational number. C.R.

A81-33281 # **Experimental study of the separation at the trailing edge of an axisymmetrical contoured after-body.** J.-L. Solignac (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *(La Recherche Aérospatiale,* May-June 1980, p. 205-211.) *La Recherche Aérospatiale* (English Edition), May-June 1980, p. 65-71. Translation.

External flow separation upstream of the trailing edge of a profiled body has been experimentally analyzed on an axisymmetric afterbody. The aerodynamic field has been investigated with various measuring means: pressure probes, hot wires, laser velocimeter. These measurements were supplemented by visualizations. The overall results have made it possible to define the structure of the mean flow and characterize turbulence properties in the separation and the adjacent mixing zones. Furthermore, a special study has been devoted to the low frequency unsteady aspects which are seemingly associated with the generation of large turbulent structures in the mixing zone of the internal flow. (Author)

A81-33285 # **O.N.E.R.A. ramjet test facilities.** P. Berton and D. Regard (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *(La Recherche Aérospatiale,* July-Aug. 1980, p. 241-258.) *La Recherche Aérospatiale* (English Edition), Aug.-Sept. 1980, p. 25-44. Translation.

Complementary ramjet test facilities have been built at Palaiseau near Paris (basic tests and component development) and at Modane in the Alps (industrial and synthesis tests). At Palaiseau, five benches are devoted to tests ranging from new configurations to technical assistance to industry in developing an operational missile. At Modane, the S4 supersonic wind tunnel has been modified to allow the testing of an actual ramjet missile scale model with its solid propellant booster. B.J.

A81-33288 # **Contribution to the study of non stationary signals emitted by moving jet engine - Application to special analysis and imaging. I.** J. Hay and M. Ernoult (Electricité de France, Clamart, Hauts-de-Seine, France). *(La Recherche Aérospatiale,* July-Aug. 1980, p. 283-296.) *La Recherche Aérospatiale* (English Edition), Aug.-Sept. 1980, p. 69-82. 32 refs. Translation.

In order to install microphones closer to the trajectory of a swiftly moving noise source and deduce the directivities comparable to those measured in the far field but less sensitive to propagation conditions, a special class of nonstationary random processes has been studied. Conventional short time spectral analysis is discussed (periodogram smoothing and autoregressive model evaluation), and a time frequency spectrum is defined which is shown capable of giving back the correct results of the stationary case (far field). Knowing the motion of the source helps in improving the spectral resolution and particularly the spatial resolution of a synthetic antenna. The so-called 'de-Dopplerization' signal processing provides resolutions similar to those obtained in static tests. Some results of experiments on a point source and a jet are given to illustrate these reflections. (Author)

A81-33291 # **Pressure distribution computation on a non-lifting symmetrical helicopter blade in forward flight.** J.-J. Chattot and J.-J. Philippe (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *La Recherche Aérospatiale* (English Edition), no. 5, 1980, p. 19-33. 15 refs. Research supported by the Direction des Recherches, Etudes et Techniques.

Three dimensional unsteady transonic flows past helicopter rotor blades are analyzed. A computer program solving the three-dimensional unsteady transonic small disturbance equation is described in detail. It can be applied to a blade of almost arbitrary geometry in the case of a non-lifting rotor. The numerical results are compared with experimental data as well as computations made at RAE and NASA. Finally, another example of application of the code is presented concerning a new blade tip which results in weaker transonic phenomena on the advancing blade. (Author)

A81-33293 # **A new method for modal identification.** G. Coupry (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *La Recherche Aérospatiale* (English Edition), no. 5, 1980, p. 51-56.

Modal identification of a structure has always been based on the phase criterion technique, which imposes the choice of an excitation configuration for which no phase shift appears between the different responses at resonance. The method proposed here is completely new - it defines an iterative process that determines an excitation configuration that 'blocks' all the modes, except one which is then isolated. The generalized mass and damping are measured by smoothing the response to this excitation by a least squares technique based on a one-degree-of-freedom model. The method was evaluated on the occasion of the ground vibration testing of two airplanes. The quality of the results has been proved by calculating, with the help of these generalized parameters, the response to a one point excitation, and by comparing this with actual results. (Author)

A81-33294 # **Contribution to the study of non-stationary signals emitted by moving jet engines - Application to spectral analysis and imaging. II.** J. Hay (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France) and M. Ernoult (Electricité de France, Centre de Recherche, Clamart, Hauts-de-Seine, France). *La Recherche Aérospatiale (English Edition),* no. 5, 1980, p. 57-73. 32 refs.

An examination of the nonstationary noise spectrum for the class of quasi-stationary and quasi-white processes has made it possible to deal with more strongly nonstationary signals than usually possible in the study of flyover noises, thereby making it possible to bring the microphone closer to the trajectory of the noise source. A time frequency spectrum is defined, which can give the correct results of the stationary case (far field). Spectral resolution, particularly the spatial resolution of a synthetic antenna, can be improved by information on the motion of the source. Dedopplerization signal processing provides resolutions similar to those obtained in static tests. Results of experiments on a point source and a jet are presented. K.S.

A81-33673 **Study of a propulsive system (Etude d'un système propulsif).** G. Couchet. *Journal de Mécanique,* vol. 20, no. 1, 1981, p. 169-178. 5 refs. In French.

Adaptable planar systems have been defined as mechanical systems comprising a wing profile moving in a perfect incompressible fluid which are capable of functioning in irrotational flow. The present paper discusses the conditions under which such systems may lead to propulsive systems. The existence of adaptable systems with time-dependent connections is demonstrated, and examples of adaptable systems with null circulation around the profile are presented. The formation of a turbulent wake is then considered, and it is shown that if circulation around the profile is positive but at rest at infinity, the wake will exert force on the profile and propulsion will result. A.L.W.

A81-33687 # **Dynamic errors of the Kalman filtering of trajectory parameters (Dinamicheskie pogreshnosti Kalmanovskoi fil'tratsii parametrov traektorii).** N. F. Vollerner and V. M. Lavrinchuk. *Radioelektronika,* vol. 24, Apr. 1981, p. 75-80. 7 refs. In Russian.

An analysis is presented of dynamic errors arising during the discrete Kalman filter tracking of nonlinearly varying parameters. Errors arising in the filtering of the coordinates and trajectories of radar-tracked objects are evaluated. It is shown that dynamic errors can be commensurate with statistical errors in the case of the uniform rectilinear motion and maneuvering of the tracked objects. B.J.

A81-33696 # **Propeller and wing (Vint i krylo).** M. Arlazorov. Moscow, Izdatel'stvo Znanie, 1980. 192 p. In Russian.

The evolution of ideas, concepts, and designs in the field of aviation is traced through five centuries, starting from the 15th century to the present times. Attention is given to the history of the helicopter which dates back to the designs by Leonardo da Vinci. Emphasis is placed on the history of aircraft construction in the USSR, including the development of the IL line and MIG fighter aircraft. V.L.

A81-33700 # **Bonded laminated structures in aircraft manufacture (Sloistye kleenye konstruktsii v samoletostroenii).** V. N. Krysin. Moscow, Izdatel'stvo Mashinostroenie, 1980. 232 p. 19 refs. In Russian.

The book deals with the design, fabrication and applications of bonded laminated structures in aircraft industry. The topics discussed include: classification of bonded laminated structures, their cost, theory of adhesion, adhesives used, bonding technology, honeycomb structures and their mechanical properties, and methods of quality assurance. V.L.

A81-33717 * # **Vortex-flow aerodynamics - An emerging design capability.** J. F. Campbell (NASA, Langley Research Center, Subsonic-Transonic Aerodynamics Div., Hampton, Va.). *Astronautics and Aeronautics,* vol. 19, May 1981, p. 54, 56, 58.

Promising current theoretical and simulational developments in the field of leading edge vortex-generating delta, arrow ogival wings are reported, along with the history of theory and experiment leading to them. The effects of wing slenderness, leading edge nose radius, Mach number and incidence variations, and planform on the onset of vortex generation and redistribution of aerodynamic loads are considered. The range of design possibilities in this field are consequential for the future development of strategic aircraft, supersonic transports and commercial cargo aircraft which will possess low-speed, high-lift capability by virtue of leading edge vortex generation and control without recourse to heavy and expensive leading edge high-lift devices and compound airfoils. Attention is given to interactive graphics simulation devices recently developed. O.C.

A81-33718 # **The rise of air and space.** R. P. Hallion. *Astronautics and Aeronautics,* vol. 19, May 1981, p. 64-77, 87.

An historical account is given of the development of aeronautical and astronautical engineering, with emphasis on the economic, political, and military influences on creative contributors and the preeminent role played by U.S. researchers and constructors. The current economic importance of aerospace industries and the transformation of the energy climate are in conclusion stressed as the focus of national attention and effort. O.C.

A81-33736 # **Finite element analysis of asymmetric, lateral natural vibrations of a deformable aeroplane.** Z. Dzygadlo and J. Blaszczyk. *Journal of Technical Physics,* vol. 21, no. 3, 1980, p. 349-366. 11 refs.

The dynamic model of an aircraft considered by Dzygadlo and Blaszczyk (1977) is generalized. Deformable parts of the aircraft are made discrete by introducing one-dimensional finite elements. It is assumed that the aircraft is composed of rigid parts and deformable units. Attention is given to the formulation of the problem, equations for the deformable units, equations of motion for the rigid parts of the aircraft, dynamic and kinematic coupling conditions, frequency equation, natural modes, and numerical analysis. The computational method used for the numerical analysis was implemented with the aid of an Algol program. The correctness of algorithm and program were tested by performing a number of computations for a hypothetical aircraft with uniform mass and rigidity distribution along the deformable assemblies. G.R.

A81-33789 **Is it safe - The safety assessment of aircraft systems. IV - Methods, techniques, and organisation.** W. Tye and T. Lloyd. *Aircraft Engineering,* vol. 53, Apr. 1981, p. 2-4.

Essential aspects of satisfactory safety assessment methods are discussed with the formulation of a complete definition of the system to be analyzed seen as a preliminary step. It is noted that the identification of possible hazards arising from failure conditions determine the extent of necessary test programs. Revealed hazards are then compared to the permissible risk levels quoted in the safety requirements for instruments and equipment of the aircraft. Numerical calculations, using probability methods, are suggested when doubt exists whether a given system will comply with the 'Catastrophic Effect' requirements. The two most frequently used methods in failure analysis, 'top-down' and 'bottom-up', are mentioned, and the dependence diagram, converted engineering drawings, and the Fault Tree are recommended as aids in determining the consequences of combined failures. A technique called Zonal

Analysis, helpful in organizing the search for potential risks, is discussed in detail. The formation of a separate safety assessment group to advise the main design groups is suggested as an important aspect in the coordination of the work of safety assessment. E.B.

A81-33790 **Maintenance tomorrow and the day after.** E. A. Green and A. W. Turner (Lockheed-California Co., Burbank, Calif.). *(International Aircraft Maintenance Engineering Exhibition and Conference, Zurich, Switzerland, Feb. 11-13, 1981.) Aircraft Engineering,* vol. 53, Apr. 1981, p. 5-15. 12 refs.

The impact of an accelerated introduction of alternate fuels, such as synthetic hydrocarbon and cryogenic fuels, is discussed and possible effects on airline fleets, design modification plans, and maintenance are analyzed. Global availability, environmental suitability, and technical and economical feasibility are mentioned as criteria determining the choices of future alternate fuels. The characteristics of two of the most promising cryogenic fuels, liquid methane (from coal or oil shale) and liquid hydrogen (from coal and water), are compared and the latter reviewed in terms of fuel system design, maintenance, service, facilities, and equipment. The analysis suggests that from the environmental pollution and safety points of view, liquid hydrogen is seen as the more promising choice as a long-term fuel for transportation, while liquid methane is considered a better choice for industrial purposes. Current long-range aircraft will continue to serve until replaced by aircraft using cryogenic fuel while the shorter-range aircraft will be replaced with more advanced types using new propulsion systems, new materials, and greatly simplified subsystems, but still running on synjet fuel. In the interim, avionic system changes and airframe modification programs are seen to dominate the field. E.B.

A81-33844 # **A new method of airfoil flutter control (Nowa metoda syntezy ukladu sterowania flatterem profilu).** J. Pietrucha and Z. Szewczyk. *Mechanika Teoretyczna i Stosowana,* vol. 18, no. 4, 1980, p. 577-586. 13 refs. In Polish.

The theory of modal control was applied to the synthesis of an active flutter suppressor under the assumption of linear unsteady aerodynamics. The linearity and stability of the flutter control system were demonstrated by Jones' approximation of Wagner's function. B.J.

A81-33868 **Bearing wear detection using radioactive iron-55 tagging.** J. A. Alcorta, J. H. Mohn (United Technologies Corp., Pratt and Whitney Aircraft Group, West Palm Beach, Fla.), and L. L. Packer (United Technologies Research Center, East Hartford, Conn.). *American Society of Lubrication Engineers, Annual Meeting, 36th, Pittsburgh, Pa., May 11-14, 1981, Preprint 81-AM-6A-3.* 8 p. 13 refs. Contract No. F33615-78-C-2008.

A tagging technique, using the iron-55 radioisotope (chosen for its low-energy X-ray emissions, long half-life, and the isotope homogeneity), for the detection and simultaneous locating of initial wear of oil-wetted turbine engine mainshaft bearings, has been developed and tested in a simulated gas turbine engine bearing environment. Two state-of-the-art high-speed bearing rollers were modified prior to irradiation to ensure the desired distress mode of the rig, and two levels of wear were introduced. A description and analysis of the test are presented, including oil analysis, wear metal debris recovery, and nuclear measurements of the metal debris. No neutron irradiation effects on the metallurgical properties, such as grain size and hardness, were observed. It was concluded that the tagging method allows identification of tagged rollers experiencing abnormal wear at the plus or minus 0.5 part per million iron level. K.S.

A81-33876 # **Future U.S. jet fuels - A refiner's viewpoint.** K. H. Strauss (Texaco, Inc., Beacon, N.Y.). *AIAA, SAE, ASCE, ATRIF, and TRB, International Air Transportation Conference, Atlantic City, N.J., May 26-28, 1981, AIAA Paper 81-0770.* 7 p. 6 refs.

Future trends in jet fuel quality are examined in terms of available refinery charge stocks and competition with other products. The processing requirements of differing alternative crude sources are reviewed, highlighting the problem of hydrogen availability for anticipated processing. The role and impact of alternatives to petroleum crudes are reviewed and the resultant effect on jet fuel quality is presented. Increasing competition for middle distillates and decreasing competition for lighter naphtha fractions is pointed out as is the importance of balancing jet fuel quality against aircraft and engine development and operating costs. Continuing research to develop information for such studies is recommended. (Author)

A81-33877 # **Airliner maintenance for fuel efficiency.** D. J. Goldsmith (Eastern Airlines, Inc., Miami, Fla.). *AIAA, SAE, ASCE, ATRIF, and TRB, International Air Transportation Conference, Atlantic City, N.J., May 26-28, 1981, AIAA Paper 81-0787.* 8 p. 10 refs.

A review is presented of the measures, related to the maintenance of aircraft hardware rather than the modification of operational habits, which airlines may use to lower fuel consumption. The program presented covers four main areas: (1) the accurate calibration of flight instruments, especially the airspeed indicator/Machmeter and altimeter; (2) reductions of empty weight, through the use of lighter cabin materials and cargo containers, and by dispensing with exterior paint; (3) reduction of airframe drag, by means of careful control surface rigging and greater skin smoothness; and (4) the minimization of engine specific fuel consumption (SFC) deterioration, through the increase of clearances in turbine sections and aerodynamic degradation of compressor sections. O.C.

A81-33878 # **Prop-Fan technical progress leading to technology readiness.** B. S. Gatzen and W. M. Adamson (United Technologies Corp., Hamilton Standard Div., Windsor Locks, Conn.). *AIAA, SAE, ASCE, ATRIF, and TRB, International Air Transportation Conference, Atlantic City, N.J., May 26-28, 1981, AIAA Paper 81-0810.* 18 p. 74 refs.

It is noted that a potential exists for saving six billion gallons of commercial aviation fuel in the 1990's provided the remaining technology readiness programs are accelerated to permit timely industry development of new Prop-Fan propulsion and aircraft systems starting in the mid-1980's. The basis of the fuel savings potential is presented, as is the status of the technology programs and future programs required to demonstrate technology readiness. A summary is given of the remaining unresolved issues and the programs required for Prop-Fan technology readiness. It is pointed out that installation aerodynamics and source noise can be adequately resolved with the small-scale programs already in progress. A large-scale rotor program is considered necessary to make the Prop-Fan industrially viable. C.R.

A81-33879 # **Federal policies affecting airport noise compatibility programs.** J. E. Wesler (FAA, Washington, D.C.). *AIAA, SAE, ASCE, ATRIF, and TRB, International Air Transportation Conference, Atlantic City, N.J., May 26-28, 1981, AIAA Paper 81-0829.* 5 p. 5 refs.

Airport noise compatibility programs as affected by federal policies are discussed, and local planning and control to mitigate residual noise impacts are investigated. Three concepts proposed by the Federal Aviation Administration (FAA) as part of the federal plan to combat airport noise, are analyzed. They stipulate control of noise at its source - the aircraft, local controls over the use of aircraft at each airport, and the use of land around airports which is left to local authorities. Source-noise control and limitations through a series of regulations are reviewed. New regulations, describing the procedures, standards, and methodology for the development, submission and review of airport noise exposure maps and airport noise compatibility programs are mentioned. E.B.

A81-33882 * # **Designing for aircraft structural crashworthiness.** R. G. Thomson (NASA, Langley Research Center, Hampton, Va.) and C. Caiafa (FAA Technical Center, Atlantic City, N.J.). *AIAA, SAE, ASCE, ATRIF, and TRB, International Air Transportation Conference, Atlantic City, N.J., May 26-28, 1981, AIAA Paper 81-0803.* 10 p. 32 refs.

This report describes structural aviation crash dynamics research activities being conducted on general aviation aircraft and transport aircraft. The report includes experimental and analytical correlations of load-limiting subfloor and seat configurations tested dynamically in vertical drop tests and in a horizontal sled deceleration facility. Computer predictions using a finite-element nonlinear computer program, DYCAST, of the acceleration time-histories of these innovative seat and subfloor structures are presented. Proposed application of these computer techniques, and the nonlinear lumped mass computer program KRASH, to transport aircraft crash dynamics is discussed. A proposed FAA full-scale crash test of a fully instrumented radio controlled transport airplane is also described. (Author)

A81-33883 # **Energy modeling for aviation fuel efficiency.** B. P. Collins (Mitre Corp., McLean, Va.). *AIAA, SAE, ASCE, ATRIF, and TRB, International Air Transportation Conference, Atlantic City, N.J., May 26-28, 1981, AIAA Paper 81-0789.* 11 p. 10 refs. U.S. Department of Transportation Contract No. RS57-80C-00103.

The use of the energy balance concept in the analysis and determination of energy-efficient flight path profiles is treated as a classical optimal control problem. An optimal energy path is initially planned, based on anticipated flight path conditions. Once the journey along the planned path is started, feedback information indicative of both progress and encountered flight conditions allows the updating of a dynamic future optimal plan and, in some cases, a modification of the optimal policy. This concept is embodied in a set of equations that can be used to analyze the energy efficiency of propeller and turbojet aircraft during various operating conditions. The set of equations comprises turbojet core, turboprop and pistonprop core equations, and turbojet fuel flow equations for idle throttle setting and maximum thrust. O.C.

A81-33884 # **Fuel conservation integrated into airline economics.** D. R. Ferguson (Eastern Airlines, Inc., Miami, Fla.). *AIAA, SAE, ASCE, ATRIF, and TRB, International Air Transportation Conference, Atlantic City, N.J., May 26-28, 1981, AIAA Paper 81-0831.* 7 p. 7 refs.

A method is proposed for determining the value of time to input into the least cost method of computer flight planning that will optimize the fuel-time trade-offs available over the planning time horizon. It provides a consistent yardstick for achieving consistency in all regimes of flight, between different aircraft types, and across a wide range of wind, temperature and weight conditions. K.S.

A81-33885 # **Some design and procedural aspects of in-flight collision avoidance.** T. K. Vickers. *AIAA, SAE, ASCE, ATRIF, and TRB, International Air Transportation Conference, Atlantic City, N.J., May 26-28, 1981, AIAA Paper 81-0805.* 8 p.

This paper presents an overview of the requirements for an in-flight collision avoidance system, and some of the basic problems relating to its implementation. The evolution of the FAA's ground-based approach to collision avoidance, leading to the development of DABS/ATARS and the airborne beacon collision avoidance system (BCAS) is described. The possible roles of BCAS are discussed, with emphasis on the procedural aspects. (Author)

A81-33886 # **Rolls-Royce RB 211-535 power plant.** D. J. Pickerell (Rolls-Royce, Ltd., Derby, England). *AIAA, SAE, ASCE, ATRIF, and TRB, International Air Transportation Conference, Atlantic City, N.J., May 26-28, 1981, AIAA Paper 81-0807.* 10 p.

This paper describes the derivation of the RB 211-535 power plant as a fuel efficient intermediate thrust size engine for short haul twin-engined aircraft. It traces the basic -535C from its conception giving a low risk engine with 25% better fuel burn than existing engines in this category, through to engine certification this year and service in 1983. The paper then describes the later version of the engine, the -535E4, generated in response to the increasing importance of fuel burn as oil prices and scarcity increase. This engine maintains the proven background of the RB 211 family but incorporates further advanced technology giving rise to additional fuel burn improvements and thrust growth potential. By using some of this thrust growth it is shown that this engine is capable of powering existing medium haul wide body trijets to produce fuel burn savings of 10%. (Author)

A81-33887 # **An aircraft manufacturer's view of airport R&D needs.** B. R. Hoy and M. L. Schoen (Douglas Aircraft Co., Long Beach, Calif.). *AIAA, SAE, ASCE, ATRIF, and TRB, International Air Transportation Conference, Atlantic City, N.J., May 26-28, 1981, AIAA Paper 81-0793.* 5 p.

In view of escalating aircraft delay costs at airports, the fact that many U.S. airports are nearing their saturation capacity, and the possibility of reducing environmental impact and increasing passenger service and safety, a series of recommendations is made regarding research and development of advanced airport designs. Among the measures called for are: (1) a better understanding of the relationship between the physical and operational characteristics of aircraft and airport airside geometrics; (2) a better understanding of the economic impacts caused by airport environmental and weather constraints and future aircraft design requirements; (3) more efficient airport planning; (4) the elimination of duplicate research efforts; (5) improved determination of aircraft design criteria taking into account both direct and indirect operating costs; and (6) increased safety for aircraft and passengers as a focus of research. O.C.

A81-33889 # **CFM56-3 high by-pass technology for single aisle twins.** N. Epstein (CFM International, Evendale, Ohio). *AIAA, SAE, ASCE, ATRIF, and TRB, International Air Transportation Conference, Atlantic City, N.J., May 26-28, 1981, AIAA Paper 81-0808.* 8 p.

Key design details and the program to develop and certificate (in 1983) the CFM56-3 engine, recently selected by airlines to power the new Boeing 737-300, are presented. A historical overview, beginning with the CFM56-2 engine, is given, key milestones prior to the certification are projected, and current and potential applications of the CFM56-3 engine are shown. Key design features include 20,000 lb thrust, 60 in. diameter, 5.1 bypass ratio, 4,278 lb weight, 93.0 in. length, cruise performance at 25,000 ft and 0.72 Mach, low noise characteristics, and fuel burn improvement. At the time the CFM56-3 engine enters service, the CFM56 engines will have completed 18,000 hours of factory testing, 36,000 extra severity endurance cycles, 30,000 hours of core testing, and extensive abusive tests. K.S.

A81-33890 # **Increasing capacity at Paris airports.** A. L. Haines and R. M. Harris (Mitre Corp., McLean, Va.). *AIAA, SAE, ASCE, ATRIF, and TRB, International Air Transportation Conference, Atlantic City, N.J., May 26-28, 1981, AIAA Paper 81-0802.* 6 p. 5 refs.

Mitre conducted a study of instrument approaches to Charles-de-Gaulle and Le Bourget Airports. The solution to the existing conflicting approach patterns was to design triple parallel approaches jointly to the two airports. The analysis of these approaches considered factors of surveillance, navigation, communication, airspace design, and control procedures. The recommended solutions illustrate application of several new concepts for parallel approaches. These include use of triple approaches, coordination between airports, use of other than Instrument Landing System (ILS) guidance, slightly converging flight paths, and a final turn to runway aligned course. (Author)

A81-33891 # **Airport capacity enhancement by innovative use of runway geometry.** A. L. Haines and A. N. Sinha (Mitre Corp., McLean, Va.). *AIAA, SAE, ASCE, ATRIF, and TRB, International Air Transportation Conference, Atlantic City, N.J., May 26-28, 1981, AIAA Paper 81-0801.* 6 p. 21 refs. U.S. Department of Transportation Contract No. FA01-81-C-0001.

Enhancement of airport capacity by new approaches in the use of runway geometry are explored, and requirements for varying concepts, such as dependent alternating parallel arrivals, triple parallel and converging approaches, are analyzed. Estimates of expected capacity benefits in the application of new approaches at 30 air carrier airports are presented. It is noted that annual airline delay costs, caused by airport congestion, exceed 1 billion dollars. A long term relief plan, provided by technology and high capital options, should include all phases of aircraft flow to the airport, with regard to integrated flow management, configuration management systems, reductions in instrument flight rules final approach spacing, specialized microwave landing system application, and multiple instrument flight rules operations. Criteria are discussed for multiple arrival streams to counteract the critical capacity problems during arrival processes at major U.S. airports, and specifications in the use of multiple arrival runway geometry are schematically presented. E.B.

A81-33923 # **The optimal lift-drag ratio of a civil aircraft (Finesse optimale d'un avion civil).** Ch. Saulas (Avions Marcel Dassault-Breguet Aviation, Vaucresson, Hauts-de-Seine, France). *Association Aéronautique et Astronautique de France, Colloque d'Aérodynamique Appliquée, 17th, Grenoble, France, Nov. 12-14, 1980, Paper NT 80-35.* 37 p. In French.

The optimization of civil aircraft lift-drag ratios is considered in terms of the polar curve relating the lift coefficient to the drag coefficient. Various experimental and comparative methods for obtaining the polar are discussed, and a model for polar calculation is presented which is based on analyses of the contributions of aircraft form, friction, interactions, roughness, equilibrium, elliptical, non-elliptical, separation and wave drag to the total drag, and the variation of these contributions as a function of lift. Means for optimizing the lift-drag ratios for each particular component of the aircraft are then examined, with attention given to the lifting surfaces, fuselage, pylonnacelle assembly and aircraft as a whole. It is concluded that although gains in lift-drag ratio for current aircraft may be slight, they would be advantageous. A.L.W.

A81-33927 # **Study of the characteristics of a base-vented wing in nonlinear theory (Etude des caractéristiques d'une aile à base ventilée en théorie non linéaire).** C. Pellone and A. Rowe (Grenoble, Institut de Mécanique, Grenoble, France). *Association Aéronautique et Astronautique de France, Colloque d'Aérodynamique Appliquée, 17th, Grenoble, France, Nov. 12-14, 1980, Paper NT 80-40.* 27 p. 20 refs. In French. Direction des Recherches, Etudes et Techniques Contract No. 78-490.

A numerical method is developed for the nonlinear problem of two-dimensional supercavitating flow past a base-vented wing of simple geometry. The nonlinearity made it necessary to use an iterative procedure; good convergence was achieved. The extension of the method to the three-dimensional case is considered. B.J.

A81-33928 # **Generalized active control - Its potential and directions of research (Contrôle actif généralisé: Potentialités - Axes d'efforts).** Y. Negre. *Association Aéronautique et Astronautique de France, Colloque d'Aérodynamique Appliquée, 17th, Grenoble, France, Nov. 12-14, 1980, Paper NT 80-29.* 21 p. In French.

The concept of generalized active control is defined, and the technical and economic possibilities of this technique are considered with particular reference to applications in transport aircraft and in such short-term areas as instability control, load control, and wing camber control. The research undertaken by Aérospatiale in these various areas is considered. B.J.

A81-33931 # **Investigation of instantaneous distortions in air intakes at high angles of attack (Etude des distorsions instationnaires dans les prises d'air à forte incidence).** G. Laruelle (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *Association Aéronautique et Astronautique de France, Colloque d'Aérodynamique Appliquée, 17th, Grenoble, France, Nov. 12-14, 1980, Paper NT 80-38.* 36 p. In French. Research supported by the Direction des Recherches, Etudes et Techniques.

Instantaneous distortions arising in compressor inlet sections play an important role in the characterization of internal flow in air intakes because of their effect on engine performance; engine compressor stall is generally related to the onset of strong distortions. This paper describes flow visualizations and wind tunnel tests conducted by ONERA to investigate instantaneous distortion in air intakes. Particular attention was given to the characterization of the flow in a cylindrical air intake at angle of attack, and the simulation of instantaneous distortion in static conditions. B.J.

A81-33933 # **Improvement of the energy efficiency of helicopters (Amélioration du bilan propulsif d'un hélicoptère).** J. Gallot (Société Nationale Industrielle Aérospatiale, Marignane, Bouches-du-Rhône, France). *Association Aeronautique et Astronautique de France, Colloque d'Aérodynamique Appliquée, 17th, Grenoble, France, Nov. 12-14, 1980, Paper NT 80-33.* 19 p. 15 refs. In French.

Ways in which aerodynamic design can improve the energy efficiency of present-day helicopters are examined. Methods discussed include minimization of helicopter drag, improvement of engine air-intake operation, and optimization of the aerodynamic design of the main rotor. These aerodynamic improvements have been applied to the new generation of helicopters, with the SA 365N considered as an example. These improvements make it possible to increase helicopter energy efficiency by 30 percent at the present time, with an additional increase of 20 percent expected in the next decade. B.J.

A81-33936 # **Propellers for economic flight at high speeds (Hélices pour vol économique à grandes vitesses).** J.-M. Bousquet (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *Association Aéronautique et Astronautique de France, Colloque d'Aérodynamique Appliquée, 17th, Grenoble, France, Nov. 12-14, 1980, Paper NT 80-34.* 28 p. 23 refs. In French. Research supported by the Direction des Recherches, Etudes et Techniques and Direction Générale de l'Aviation Civile.

Results of studies by the NASA-ATP (from 1976 on) and the ONERA-Aérospatiale programs for design and performance of transonic propeller blades are presented. Efficiencies of turboprops, turboreactors, and prop-fans are compared, and NASA studies are shown to indicate 80 percent efficiency for a Mach 0.8 prop-fan, with a 10-15 percent improvement in fuel efficiency over turboprops, using a thin profile, reinforced composite, multibladed configuration. ONERA is examining prop-fans to improve aerodynamic and acoustic codes for the purpose of testing a 1:5.4 scale model in the Modane S1 wind tunnel, where six different composites, drag forces through pressure measurements, wakes in stable and unstable modes, and fuselage panel behavior will be tested. D.H.K.

A81-33937 # **Global optimization of a glider (Optimisation globale d'un planeur).** M. Collard. *Association Aéronautique et Astronautique de France, Colloque d'Aérodynamique Appliquée, 17th, Grenoble, France, Nov. 12-14, 1980, Paper NT 80-36.* 23 p. In French.

Improvements to the design of gliders which have resulted in remarkable performances in the areas of distance, velocity, and power efficiencies obtained are discussed. Attention is given to developments in the fields of wing profiles, induced drag, fuselage configurations, empennages and ballasting for unfavorable weather conditions, with particular emphasis on aerodynamic properties. It is concluded that present-day technology has arrived at a level of perfection difficult to surpass, and the advent of motorized gliders, which would represent a significant savings in the fuel required to reach altitude, is noted. A.L.W.

A81-33943 # **Aerodynamic trials with the linear motor-driven platform at the Toulouse Aeronautic Testing Center (Essais aérodynamiques avec la plate-forme à moteur linéaire du Centre d'Essais Aéronautique de Toulouse).** J.-P. Vaunois (Toulouse, Centre d'Essais Aéronautique, Toulouse, France) and Mr. Januel. *Association Aéronautique et Astronautique de France, Colloque d'Aérodynamique Appliquée, 17th, Grenoble, France, Nov. 12-14, 1980, Paper NT 80-41.* 35 p. In French.

A streamlined, linear induction motor-powered underground rail platform, equipped with a central, rectangular, gradually cambered planform, an electronic trailing edge damper, and longitudinal guides is described. Uses for hydrodynamics, shell and antenna tests at high speeds, for research complementary to wind tunnel and catapult experiments, and for fighter arrest barrier studies are listed. The reversible synchronous motor has a maximum power of 6,000 daN, consumes 2 MW from 0 to 100 Hz at 0 to 5,000 V, and uses 10 kWh for a trial run of 40 m/s, one-half that of the S5 wind tunnel. Its use for take-off and landing acceleration and deceleration studies are expressed and the addition of an arm to support models plus the installation of a gust generator will allow tests of inclination angles at various times and speeds and the behavior of combat aircraft under various battlefield conditions. D.H.K.

A81-33948 **Analysis of axial fan noise with the help of the Lowson formalism (Analyse du bruit des ventilateurs axiaux à l'aide du formalisme de Lowson).** J. P. Bridelance. *Association Aéronautique et Astronautique de France, Colloque d'Acoustique Aéronautique, 7th, Lyons, France, Nov. 4, 5, 1980, Paper NT 80-54.* 28 p. 7 refs. In French. Research supported by the Délégation Générale à la Recherche Scientifique et Technique.

Slow rotation velocity, high lift profile blades are studied as a means of reducing specific acoustic power, shown in empirical studies of axial fans and helicopter blades to be highly correlated with rotational speed. Results for a new blade design are compared with classic axial fans for flow, pressure, efficiency, and noise. The Lowson method is used to extend Lighthill's (1952) work on acoustic fields generated by constant speed rotors, to rotors under acceleration. The source is considered as a point on the blades undergoing periodic fluctuations due to upstream turbulence, definable by a Fourier series, and the acoustic emissions result from unstable changes whose amplitude depends on the order of the Bessel function. D.H.K.

A81-33949 **Broadband helicopter rotor noise (Bruit large-bande des rotors d'hélicoptères).** A. Damongeot (Société Nationale Industrielle Aérospatiale, Division Hélicoptères, Marignane, Bouches-du-Rhône, France). *Association Aéronautique et Astronautique de France, Colloque d'Acoustique Aéronautique, 7th, Lyons, France, Nov. 4, 5, 1980, Paper NT 80-58.* 16 p. 14 refs. In French.

A method is proposed for the calculation of the broadband noise emitted from a helicopter rotor on the basis of the investigation and modeling of the source region. The method involves the measurement of the intensity of the pressure fluctuations induced at the wall of the wing profile by the turbulent boundary layer, which was performed for two NACA 0012 profiles with large chords in a low-velocity subsonic wind tunnel in the incompressible regime, and in the compressible regime at higher velocities. The measured wall pressure spectra are then reduced with respect to the local boundary layer displacement, allowing the representation of wall pressure spectra for profiles with arbitrary chords, Mach numbers, operating Reynolds numbers and angles of attack by a single curve. Convection rates and correlation lengths are also obtained. The Lowson formulation is then used to calculate the noise emitted by the fluctuating load distributions, and results are shown to be in good agreement with experimental noise measurements made for the metal-bladed SA 330 rotor. A.L.W.

A81-33950 **Analysis of total and static pressure fluctuations in an air intake at high incidence (Analyse des fluctuations de pression totale et statique dans une entrée d'air à grande incidence).** J. Delville and M. Bouriot (Poitiers, Université, Poitiers, France). *Association Aéronautique et Astronautique de France, Colloque d'Acoustique Aéronautique, 7th, Lyons, France, Nov. 4, 5, 1980, Paper NT 80-61.* 36 p. 15 refs. In French. Direction des Recherches, Etudes et Techniques Contract No. 79-515.

The paper presents studies of pressure fluctuations in turbulent flow at low speed gathered by microphones placed in the flow at incidence angles of 20, 30, and 40 deg. Results are given for the 30 deg readings and dynamic pressure fluctuation measurements are compared with those taken by hot wire techniques. Graphs of the rms fluctuations are given for dynamic and static pressure and the probability density functions of the dynamic pressure are compared with the probabilities of velocity fluctuations. It was found that the zone of maximum fluctuation is characterized by intermittent forces translated by a flatness coefficient of 18, and near the end of the test channel the PDF approached a normal distribution. D.H.K.

A81-33952 * # **Acoustic performance evaluation of an advanced UH-1 helicopter main rotor system.** D. R. Hoad and D. A. Conner (NASA, Langley Research Center, Structures Laboratory, Hampton, Va.). *American Helicopter Society, Annual Forum, 37th, New Orleans, La., May 17-19, 1981, Paper 81-58.* 10 p. 14 refs.

An experimental investigation of the high-speed impulsive noise characteristics of an advanced main rotor system for the UH-1 helicopter has been conducted. Models of both the advanced main rotor system and the UH-1 main rotor system were tested at one-quarter scale in the Langley 4- by 7-meter (V/STOL) Tunnel using the General Rotor Model System (GRMS). Tests were conducted over a range of simulated flight and descent velocities. The tunnel was operated in the open-throat configuration with acoustic treatment to improve the acoustic characteristics of the test chamber. In-plane acoustic measurements of the high-speed impulsive noise demonstrated a 7 to 8 dB reduction in noise generation is available by using the advanced rotor system on the UH-1 helicopter. (Author)

STAR ENTRIES

N81-22000*# Massachusetts Inst. of Tech., Cambridge. Flight Transportation Lab.
INVESTIGATION OF AIR TRANSPORTATION TECHNOLOGY AT MASSACHUSETTS INSTITUTE OF TECHNOLOGY, 1980
Robert W. Simpson *In* NASA. Langley Research Center Joint Univ. Program for Air Transportation Res., 1980 Mar. 1981 p 3-4
Avail: NTIS HC A07/MF A01 CSCL 01B

Several technological aspects governing air transportation at major airports were investigated. Three major areas were emphasized: (1) development of automated decision making for dynamic scheduling of runway operations at a major airport; (2) flight evaluation of the performance of low cost Loran C receivers; and (3) design of microcomputer based electronic flight displays for general aviation aircraft. R.C.T.

N81-22001*# Massachusetts Inst. of Tech., Cambridge.
MIT ANNOTATED BIBLIOGRAPHY
In NASA. Langley Research Center Joint Univ. Program for Air Transportation Res., 1980 Mar. 1981 p 5-11

Avail: NTIS HC A07/MF A01 CSCL 01B

A bibliography is presented which covers a wide variety of navigation, guidance, control, and display research. Fifteen citations are included. R.C.T.

N81-22002*# Massachusetts Inst. of Tech., Cambridge. Flight Transportation Lab.
USE OF LORAN-C FOR GENERAL AVIATION AIRCRAFT NAVIGATION
Krishnan Natarajan *In* NASA. Langley Research Center Joint Univ. Program for Air Transportation Res., 1980 Mar. 1981 p 13-18 refs
(Grant NGL-22-009-640)
Avail: NTIS HC A07/MF A01 CSCL 17G

Quantitative and qualitative observations were made on the Loran-C in general aviation aircraft. The evaluation of Loran-C for both cross country flights and nonprecision approaches was conducted under simulated instrument flight rules conditions. Particular emphasis was placed on the reliability and failure of Loran-C equipment as well as its susceptibility to atmospheric effects such as P static. Efforts were made to quantify the long term stability of the Loran-C time difference grid. Several E field antenna configurations were also evaluated in terms of performance. Significant results are reported. R.C.T.

N81-22003*# Massachusetts Inst. of Tech., Cambridge. Flight Transportation Lab.
AN ANALYSIS OF THE ADAPTABILITY OF LORAN-C TO AIR NAVIGATION
James A. Littlefield *In* NASA. Langley Research Center Joint Univ. Program for Air Transportation Res., 1980 Mar. 1981 p 19-42
(Grant NGR-36-009-017)
Avail: NTIS HC A07/MF A01 CSCL 17G

The sources of position errors characteristics of the Loran-C navigation system were identified. Particular emphasis was given to their point on entry as well as their elimination. It is shown that the ratio of realized accuracy to theoretical accuracy of the Loran-C is highly receiver dependent. R.C.T.

N81-22004*# Massachusetts Inst. of Tech., Cambridge. Flight Transportation Lab.
THE P/POD PROJECT: PROGRAMMABLE/PILOT ORIENTED DISPLAY
James A. Littlefield *In* NASA. Langley Research Center Joint Univ. Program for Air Transportation Res., 1980 Mar. 1981 p 43-50
Avail: NTIS HC A07/MF A01 CSCL 09B

A pilot orientated display system was developed for general aviation aircraft in order to reduce cockpit workloads. Emphasis was placed on the optimization of flight procedural aspects (i.e., interpretation of Loran data). Low cost hardware/software were utilized in the system to reduce developmental costs. Parallel development and testing were conducted on the ground (simulator) and in the air using the same hardware. R.C.T.

N81-22005*# Ohio Univ., Athens. Avionics Engineering Center.
INVESTIGATION OF AIR TRANSPORTATION TECHNOLOGY AT OHIO UNIVERSITY, 1980
Richard H. McFarland *In* NASA. Langley Research Center Joint Univ. Program for Air Transportation Res., 1980 Mar. 1981 p 53-73 refs
Avail: NTIS HC A07/MF A01 CSCL 01C

Specific configurations of first and second order all digital phase locked loops were analyzed for both ideal and additive Gaussian noise inputs. In addition, a design for a hardware digital phase locked loop capable of either first or second order operation was evaluated along with appropriate experimental data obtained from testing of the hardware loop. All parameters chosen for the analysis and the design of the digital phase locked loop were consistent with an application to an Omega navigation receiver although neither the analysis nor the design are limited to this application. For all cases tested, the experimental data showed close agreement with the analytical results indicating that the Markov chain model for first and second order digital phase locked loops are valid. R.C.T.

N81-22006*# Ohio Univ., Athens. Avionics Engineering Center.
RESULTS OF A LORAN-C FLIGHT TEST USING AN ABSOLUTE DATA REFERENCE
Joseph P. Fischer *In* NASA. Langley Research Center Joint Univ. Program for Air Transportation Res., 1980 Mar. 1981 p 75-90 refs
Avail: NTIS HC A07/MF A01 CSCL 17G

A closed circuit flight test was conducted using VORs and NDBs as reference points. The Loran-C data collected during the flight was then compared against a reference provided by a discrete address beacon system facility. Information on the equipment configuration in the aircraft, the flight procedure, and the results obtained are presented. R.C.T.

N81-22007*# Ohio Univ., Athens. Avionics Engineering Center.
MICROCOMPUTER PROCESSING FOR LORAN-C
Robert W. Lilley, Daryl L. McCall, and Stanley M. Novacki, III *In* NASA. Langley Research Center Joint Univ. Program for Air Transportation Res., 1980 Mar. 1981 p 97-100

Avail: NTIS HC A07/MF A01 CSCL 17G

Schematic diagrams are presented for the microcomputer processing for Loran-C. Diagrams are included for the following: microcomputer Loran-C loop improvements; Loran-C receiver commutated AGC; and dc-dc power supply R.C.T.

N81-22008*# Princeton Univ., N. J. Dept. of Mechanical and Aerospace Engineering.
INVESTIGATION OF AIR TRANSPORTATION TECHNOLOGY AT PRINCETON UNIVERSITY, 1980
Robert F. Stengel *In* NASA. Langley Research Center Joint Univ. Program for Air Transportation Res., 1980 Mar. 1981 p 107-113 refs
Avail: NTIS HC A07/MF A01 CSCL 01C

Several aspects of air transportation technology are discussed. The following are included: evaluation of an OMEGA-dead reckoning hybrid navigation system; implementation of a microprocessor controlled flight research ground station; investigation of fuel use characteristics of general aviation aircraft; investigation of a dead reckoning concept incorporating a fluidic rate sensor; experimentation related to ultrasonic altimetry; and concept development for a laser based collision avoidance system. R.C.T.

N81-22009*# Princeton Univ., N. J.
LASER BEACON COLLISION AVOIDANCE SYSTEMS
L. M. Sweet, R. B. Miles, E. Wong, and M. Tomeh *In* NASA. Langley Research Center Joint Univ. Program for Air Transportation Res., 1980 Mar. 1981 p 115-122

Avail: NTIS HC A07/MF A01 CSCL 17G
The development objectives for a laser beacon collision avoidance system are outlined. A system suitable to general aviation aircraft is briefly described. M.G.

N81-22010*# Princeton Univ., N. J.
DEAD RECKONER NAVIGATION PROJECT
R. Ellis and L. Sweet *In* NASA. Langley Research Center Joint Univ. Program for Air Transportation Res. 1980 Mar. 1981 p 123-130
Avail: NTIS HC A07/MF A01 CSCL 17G
A previous dead reckoner involved a classical gyrocompass, a Hewlett-Packard minicomputer, and a true airspeed sensor. In an effort to bring the cost of this system more in line with the realities of general aviation, recent work was done on replacing the minicomputer with a microcomputer and implementing a fluidic rate sensor in the compass system in place of the directional gyro. E.D.K.

N81-22011*# Princeton Univ., N. J.
GENERAL AVIATION AIRPLANE FUEL ECONOMY SYSTEM MODEL
L. Sweet and H. Curtis *In* NASA. Langley Research Center Joint Univ. Program for Air Transportation Res., 1980 Mar. 1981 p 133-142
Avail: NTIS HC A07/MF A01 CSCL 01C
The aerodynamic characteristics which affect the fuel consumption of general aviation aircraft are outlined. All data are presented in the form of graphs. R.C.T.

N81-22015*# Mississippi State Univ., Mississippi State.
AN EXPERIMENTAL INVESTIGATION OF THE AERODYNAMICS AND COOLING OF A HORIZONTALLY-OPPOSED AIR-COOLED AIRCRAFT ENGINE INSTALLATION Final Report
Stan J. Miley (Texas A and M Univ., College Station), Ernest J. Cross, Jr. (Texas A and M Univ., College Station), John K. Owens, and David L. Lawrence (Turbo West Corporate Aircraft Center, Broomfield, Colo.) Washington NASA Mar. 1981 152 p refs
(Grant NsG-1083)
(NASA-CR-3405) Avail: NTIS HC A08/MF A01 CSCL 01A
A flight-test based research program was performed to investigate the aerodynamics and cooling of a horizontally-opposed engine installation. Specific areas investigated were the internal aerodynamics and cooling mechanics of the installation, inlet aerodynamics, and exit aerodynamics. The applicable theory and current state of the art are discussed for each area. Flight-test and ground-test techniques for the development of the cooling installation and the solution of cooling problems are presented. The results show that much of the internal aerodynamics and cooling technology developed for radial engines are applicable to horizontally opposed engines. Correlation is established between engine manufacturer's cooling design data and flight measurements of the particular installation. Also, a flight-test method for the development of cooling requirements in terms of easily measurable parameters is presented. The impact of inlet and exit design on cooling and cooling drag is shown to be of major significance. Author

N81-22016*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
PRESSURE AND FORCE DATA FOR A FLAT WING AND A WARPED CONICAL WING HAVING A SHOCKLESS RECOMPRESSION AT MACH 1.62
David S. Miller, Emma Jean Landrum, James C. Townsend, and William H. Mason, (Grumman Aerospace Corp, Bethpage, N.Y.) Apr. 1981 333 p refs
(NASA-TP-1759; L-13856) Avail: NTIS HC A15/MF A01 CSCL 10A
A conical nonlinear flow computer code was used to design a warped (cambered) wing which would produce a supercritical expansion and shockless recompression of the crossflow at a lift coefficient of 0.457, an angle of attack of 10 deg, and a Mach number of 1.62. This cambered wing and a flat wing the same thickness distribution were tested over a range of Mach numbers from 1.6 to 2.0. For both models the forward 60 percent is purely conical geometry. Results obtained with the cambered wing demonstrated the design features of a supercritical expansion and a shockless recompression, whereas results obtained with the flat wing indicated the presence of crossflow shocks. Tables of experimental pressure, force, and moment data are included, as well as selected oil flow photographs. E.D.K.

N81-22023# ILC Industries, Inc., Frederica, Del.
AIR FORCE GEOPHYSICS LABORATORY AERODYNAMICALLY TETHERED BALLOON, 45,000 CUBIC FEET Final Report, Feb. 1973 - Jun. 1979
G. P. Durney and R. W. Lawrence Hanscom, AFB., Mass. AFGL Dec. 1980 103 p refs
(Contract F19628-73-C-0155; AF Proj. 6665)
(AD-A096758; AFGL-TR-80-0367) Avail: NTIS HC A06/MF A01 CSCL 04/1
An empennage ripstop fabric of combined Kevlar and pre-heat set Dacron yarns, and a hull fabric which is a biaxially woven fabric stabilized with an oriented non-woven polyester fabric, were developed. A 45,000 cu. ft. balloon was designed, fabricated and tested. The new material is suitable for construction of balloons in the 100,000 cu. ft. range. The hull fabric developed on this program was later scaled-up and is currently used in USAF 250,000 cu. ft. Seek Skyhook Aerostats. GRA

N81-22029# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Abteilung Entwurfsaerodynamik.
COMPUTATION OF PRESSURE DISTRIBUTION ON THE DFVLR WING-BODY MODEL BY THE PANEL METHOD
Romesh Kumar Jain (National Aeronautical Lab.), Guenter Redeker, and Syed Rafeeq Ahmed Nov. 1979 36 p refs
Sponsored in part by DAAD, Bonn
(DFVLR-FB-80-02) Avail: NTIS HC A03/MF A01
The panel method is based on a discrete singularity distribution. The complete surface of a given configuration is divided into a large number of plane quadrilateral or triangular panels and the singularity strength on each of these panels is obtained as a solution of an integral equation. A control point is selected on each panel in order to satisfy the boundary condition. Viscous effects are shown very important for supercritical wings having a large amount of rear loading, and the need to modify the panel method to include boundary layer calculations is highlighted. Author (ESA)

N81-22031*# Battelle Columbus Labs., Mountain View, Calif.
A REVIEW OF IN-FLIGHT EMERGENCIES IN THE ASRS DATA BASE Final Report
Richard F. Porter 3 Apr. 1981 25 p
(Contract NAS2-10060)
(NASA-CR-166166) Avail: NTIS HC A02/MF A01 CSCL 01C
A series of 154 in-flight emergencies as reported to the Aviation Safety Reporting System are described. The various types of emergencies are examined and an attempt is made to determine the human errors and other factors associated with each incident, as well as the measures taken to resolve the emergency. It is concluded that nearly one half of those emergencies reported were related to failure or malfunction of aircraft subsystems. Of all the emergencies, nearly one quarter were associated with power plant failure. Other frequently encountered emergency types are associated with operation in instrument meteorological conditions without appropriate clearance or qualification, and with low fuel state situations.

Human error is prominently featured in many of the incidents, appearing in the actions of pilots and air traffic controllers. E.D.K.

N81-22032*# Systems Control, Inc., West Palm Beach, Fla. Technology Industries Div.
CANDIDATE CDTI PROCEDURES STUDY Final Report
R. E. Ace Hampton, Va. NASA. Langley Research Center Jan. 1981 80 p refs
(Contract NAS1-16247)
(NASA-CR-165673) Avail: NTIS HC A05/MF A01 CSCL 01C

A concept with potential for increasing airspace capacity by involving the pilot in the separation control loop is discussed. Some candidate options are presented. Both enroute and terminal area procedures are considered and, in many cases, a technologically advanced Air Traffic Control structure is assumed. Minimum display characteristics recommended for each of the described procedures are presented. Recommended sequencing of the operational testing of each of the candidate procedures is presented. S.F.

N81-22033# Boeing Military Airplane Development, Seattle, Wash.
ANALYSIS OF EJECTION SEAT STABILITY USING EASY PROGRAM, VOLUME 1 Final Report, May 1979 - Sep. 1980
Christopher L. West, Brian R. Ummel, and Roger F. Yurczyk Wright-Patterson AFB, Ohio AFWAL Sep. 1980 691 p refs
(Contract F33615-79-C-3407; AF Proj. 2402)
(AD-A096597; AFWAL-TR-80-3014-Vol-1) Avail: NTIS HC A99/MF A01 CSCL 01/3

High performance combat aircraft have extended the maneuvering/operating range into regimes that exceed the capabilities of current ejection seat systems. One of the problems encountered involves the unstable rotational characteristics of the typical ejection seat, resulting in a decreased probability of survival due to the reorientation of the ejecting crewmember into an attitude less tolerant to acceleration. Furthermore, an unstable ejection seat may neither clear the airframe, nor provide adequate ground clearance. The capability to simulate the trajectory of an escape system, and to determine its stability characteristics using classical stability and control methods, is required to enhance the development of both active and passive stability augmentation systems. The objective of this development effort was to develop an ejection seat classical stability analysis capability by incorporating SAFEST computerized simulation subroutines into the EASY program standard component library. The resultant computer program described in this User Manual/document is EASY and SAFEST Integration for the Evaluation of Stability and Trajectory (EASIEST). Volume 1 is a 'stand-alone' user manual describing the EASIEST program characteristics and complete information on the use of the program and how to apply it to ejection seat dynamics and control analysis. It contains listings of the procedure files, models, analysis, standard components, and subroutines. Volume 2 is Boeing proprietary and contains only the source code listings of EASY 5. GRA

N81-22034# Air Force Academy, Colo. Dept. of Mathematical Sciences.
AN INVESTIGATION OF TWO SAFE ESCAPE FROM BASE FLIGHT PROFILES Final Report
Robert A. Rappold Jan. 1981 24 p refs
(AD-A096571; USAFA-TR-81-3) Avail: NTIS HC A02/MF A01 CSCL 01/2

This research establishes two base case scenarios for 'safe escape' profiles for large conventional aircraft. The profiles considered were: (1) a constant altitude dash, and (2) a constant airspeed climb. The flight profile modeling assumed the aircraft had first reached a safe maneuvering airspeed and altitude. Other assumptions were consistent with aerodynamic and pilot limitations and operational considerations. The governing differential equations of motion are derived and the Runge-Kutta numerical solution technique applied. GRA

N81-22035# Air Force Armament Lab., Eglin AFB, Fla.
VELOCITY TOLERANCE OF ESCAPE SYSTEMS Final Report, 1977 - 1979
C. D. Gragg 1 Dec. 1980 28 p refs
(AF Proj. 9993)
(AD-A096881; AD-E800237; AD-TR-80-59) Avail: NTIS HC A03/MF A01 CSCL 01/3

Eighty-four (84) Air Force escape system tests were analyzed for velocity tolerance. The target velocity should not be stated in terms of per cent. This practice has led to some serious under testing of maximum velocities. The velocity tolerance is essentially independent of the magnitude of the velocity. A velocity tolerence of plus/minus 23.5 KEAS (Knots Equivalent Air Speed) will prevent excessive over or under testing. GRA

N81-22036*# National Aeronautics and Space Administration. Pasadena Office, Calif.
LOW-FREQUENCY RADIO NAVIGATION SYSTEM Patent Application
David E. Wallis, inventor (to NASA) (JPL) Filed 6 Mar. 1981 26 p
(Contract NAS7-100)
(NASA-Case-NPO-15264-1; US-Patent-Appl-SN-241154) Avail: NTIS HC A03/MF A01 CSCL 17G

A method of continuous wave navigation using four transmitters operating at sufficiently low frequencies to assure essentially pure groundwave operation is described. The transmitters are keyed to transmit constant bursts (1/4 sec) in a time-multiplexed pattern with phase modulation of at least one transmitter for identification of the transmitters and with the ability to identify the absolute phase of the modulated transmitter and the ability to modulate low rate data for transmission. The transmitters are optimally positioned to provide groundwave coverage over a service region of about 50 by 50 km for the frequencies selected in the range of 200 to 500 kHz, but their locations are not critical because of the beneficial effect of overdetermination of position of a receiver made possible by the fourth transmitter. Four frequencies are used, at least two of which are selected to provide optimal resolution. All transmitters are synchronized to an average phase as received by a monitor receiver. NASA

N81-22037*# Battelle Columbus Labs., Mountain View, Calif.
POTENTIAL EFFECTS OF THE INTRODUCTION OF THE DISCRETE ADDRESS BEACON SYSTEM DATA LINK ON AIR/GROUND INFORMATION TRANSFER PROBLEMS
Ralph L. Grayson 30 Mar. 1981 47 p ref
(Contract NAS2-10060)
(NASA-CR-166165) Avail: NTIS HC A03/MF A01 CSCL 17G

This study of Aviation Safety Reporting System reports suggests that benefits should accure from implementation of discrete address beacon system data link. The phase enhanced terminal information system service is expected to provide better terminal information than present systems by improving currency and accuracy. In the exchange of air traffic control messages, discrete address insures that only the intended recipient receives and acts on a specific message. Visual displays and printer copy of messages should mitigate many of the reported problems associated with voice communications. The problems that remain unaffected include error in addressing the intended recipient and messages whose content is wrong but are otherwise correct as to format and reasonableness. Author

N81-22038# European Space Agency, Paris (France).
FUNCTIONAL ANALYSIS AND OPERATIONAL ASSESSMENT OF AN ONBOARD GLIDE PATH GUIDANCE SYSTEM FOR VISUAL APPROACHES (VISUAL APPROACH MONITOR VAM)
Josef Thomas and Helmut Stein Dec. 1980 103 p refs
Transl. into ENGLISH of 'Funktionanal. u. Operationelle Bewertung eines Bordgestuetzten Gleitpfadfuehrungssystems fuer Sichtanfluege (Visual Approach Monitor VAM)", Rept. DFVLR-FB-79-38 DFVLR, Brunswick, Oct. 1979 Original report in GERMAN previously announced as N81-10043
(ESA-TT-655; DFVLR-FB-79-38) Avail: NTIS HC A06/MF A01

A function and error analysis was carried out on the visual approach monitor (VAM), a head-up display system for manual visual approaches. Its operational characteristics as regards guidance performance and stability were investigated in simulation and flight tests. Flight tests show that under the chosen test conditions the VAM system produces no detectable increase in accuracy compared to visual approaches. However, it leads to significantly reduced scatter and extreme values in almost all flight guidance parameters. The VAM system is approximately comparable to instrument landing systems in its overall guidance performance. Author (ESA)

N81-22039*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
KINEMATIC PROPERTIES OF THE HELICOPTER IN COORDINATED TURNS
Robert T. N. Chen and James A. Jeske Apr. 1981 41 p refs
(NASA-TP-1773; A-8399) Avail: NTIS HC A03/MF A01 CSCL 01C

A study on the kinematic relationship of the variables of helicopter motion in steady, coordinated turns involving inherent sideslip is described. A set of exact kinematic equations which govern a steady coordinated helical turn about an Earth referenced vertical axis is developed. A precise definition for the load factor parameter that best characterizes a coordinated turn is proposed. Formulas are developed which relate the aircraft angular rates and pitch and roll attitudes to the turn parameters, angle of attack, and inherent sideslip. A steep, coordinated helical turn at extreme angles of attack with inherent sideslip is of primary interest. The bank angle of the aircraft can differ markedly from the tilt angle of the normal load factor. The normal load factor can also differ substantially from the accelerometer reading along the vertical body axis of the aircraft. Sideslip has a strong influence on the pitch attitude and roll rate of the helicopter. Pitch rate is independent of angle of attack in a coordinated turn and in the absence of sideslip, angular rates about the stability axes are independent of the aerodynamic characteristics of the aircraft. S.F.

N81-22040*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ANALYTICAL STUDY OF THE CRUISE PERFORMANCE OF A CLASS OF REMOTELY PILOTED, MICROWAVE-POWERED, HIGH-ALTITUDE AIRPLANE PLATFORMS
Charles E. K. Morris, Jr. Apr. 1981 78 p refs
(NASA-TM-81969) Avail: NTIS HC A05/MF A01 CSCL 01C

Each cycle of the flight profile consists of climb while the vehicle is tracked and powered by a microwave beam, followed by gliding flight back to a minimum altitude. Parameter variations were used to define the effects of changes in the characteristics of the airplane aerodynamics, the power transmission systems, the propulsion system, and winds. Results show that wind effects limit the reduction of wing loading and increase the lift coefficient, two effective ways to obtain longer range and endurance for each flight cycle. Calculated climb performance showed strong sensitivity to some power and propulsion parameters. A simplified method of computing gliding endurance was developed. T.M.

N81-22041# Boeing Vertol Co., Philadelphia, Pa.
CRASHWORTHINESS DESIGN PARAMETER SENSITIVITY ANALYSIS Final Report, Sep. 1979 - Aug. 1980
Anthony E. Tanner Feb. 1981 281 p refs
(Contract DAAK51-79-C-0042; DA Proj. 1L1-62209-AH-76)
(AD-A096550; D210-11676-1; USAAVRADCOM-TR-80-D-31)
Avail: NTIS HC A13/MF A01 CSCL 01/2

This program investigated the relationships between aircraft weight, the level of crashworthiness in the design, and the cost and weight associated with crashworthiness elements of the design. Accident and research data were reviewed and actual aircraft designs were analyzed with respect to their levels of crashworthiness and potential improvements. Processing of the data yielded cost and weight curves for use in preliminary design. The curves provide the relationships between gross weight, mean empty weight, levels of crashworthiness, and selected design elements that contribute to crashworthiness for designs employing metallic or composite materials and having gross weights up to 50,000 pounds. Comparisons were made with the current ACAP analyses and results showed good agreement for the weight values and level of crashworthiness. The intent of the curves is to allow the designer to rapidly optimize the weights of a preliminary design with respect to performance and utility, and to assess the impact on crashworthiness of reducing the weight of the structure or other crashworthiness contributions. When weight values are resolved, cost curves are then used. A 'Scout' helicopter was defined for both a metallic and composite structure and comparisons were made using the curves generated in this report. GRA

N81-22042# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.
CALIBRATION OF AN AXIAL FAN AT VARIOUS POWER SETTINGS FOR USE ON A QUARTER SCALE XC-8A AIR CUSHION MODEL Final Report, 1 Oct. 1977 - 1 May 1979
David L. Fischer Nov. 1980 49 p refs
(AF Proj. 2402)
(AD-A097043; AFWAL-TR-80-3094) Avail: NTIS HC A03/MF A01 CSCL 01/3

A method was developed to measure volume flow from electrically powered fans during model testing of a dynamically scaled, quarter-scale XC-8A air cushion model. To measure the volume flow during model operation, the static pressure at a point along the fan inlet duct was correlated with volume flow. Correlation of the fan inlet static pressure with volume flow was performed using one of the two fans used on the model and a fan calibration rig. The fan calibration rig is independent of the model and used the orifice plate method to measure volume flow. Correlation was performed at five different input voltage settings to the fan from 100 volts/200 cycles to the normal rated voltage input of 200 volts/400 cycles. Reduction of the normal rated voltage was investigated so that the volume flow could be controlled during model operation to more accurately simulate the XC-8A fan performance maps. The results of this work are five sets of graphical data illustrating the fan output static pressure and inlet static pressure versus volume flow. This data will be a key to future research using the quarter-scale XC-8A air cushion model for development of air cushion technology. GRA

N81-22043# Aeronautical Research Labs., Melbourne (Australia).
SEA KING MATHEMATICAL MODEL VALIDATION TRIALS. FLIGHT DATA CHANNEL CALIBRATION
D. T. Hourigan Sep. 1980 44 p refs
(AD-A096587; ARL/AERO-TM-325) Avail: NTIS HC A03/MF A01 CSCL 14/2

Thirty-two channels of flight data were recorded to validate a mathematical model of an R.A.N. Sea King Mk. 50 helicopter. Described is the calibration procedure used for each channel. GRA

N81-22044# Dayton Univ., Ohio.
STRUCTURAL FLIGHT LOADS SIMULATION CAPABILITY, VOLUME 1 Final Report, Jun. 1977 - Sep. 1980
Fred K. Bogner Wright-Patterson AFB, Ohio AFWAL Nov. 1980 190 p refs 2 Vol.
(Contract F33615-76-C-3135; AF Proj. 2402)
(AD-A096572; UDR-TR-80-73-Vol-1; AFWAL-TR-80-3118-Vol-1) Avail: NTIS HC A09/MF A01 CSCL 01/3

An experimental test facility has been developed for performing realistic simulation of flight loads on sections of aircraft wing structures. Concurrently, an analytical technique was developed for predicting the internal load distributions of ballistically damaged, multiple load path aircraft wing structures. In all, six replica wing structures and one T-38 wing structure were tested in the loads facility. The analytically predicted stresses were satisfactory, especially when the response was in the linear range. However, with a substantial amount of damage present and/or when the response was nonlinear, the experimental and analytical results differed substantially. This is thought to be caused by oversimplified finite element models. Further testing is forthcoming. GRA

N81-22045# Dayton Univ., Ohio. Aerospace Mechanics Div.
STRUCTURAL FLIGHT LOADS SIMULATION CAPABILITY. VOLUME 2: STRUCTURAL ANALYSIS COMPUTER PROGRAM USER'S MANUAL Final Report, Aug. 1977 - Sep. 1980
T. S. Bruner, M. P. Bouchard, J. G. Gebara, M. J. Hecht, and Fred K. Bogner Wright-Patterson AFB, Ohio AFWAL Nov. 1980 358 p refs 2 Vol.
(Contract F33615-76-C-3135)
(AD-A096594; UDR-TR-80-73-Vol-2; AFWAL-TR-80-3118-Vol-2) Avail: NTIS HC A16/MF A01 CSCL 01/3

A complete system for the modeling, analysis and post-analysis of wing structures utilizing finite elements in simulated flight loads testing has been developed. The preprocessor incorporated the MAGNA element types 3, 4 and 5 (2-D membrane, truss and thin shells) into three predefined wing class models and allows for the conversion of existing wing models to be analyzed by MAGNA. MAGNA is a very powerful and flexible material and geometrical nonlinear analysis program capable of solving a wide variety of finite element problems. Two postprocessors are coupled to the modeling and analysis of the wing structures to provide model geometry, stress or strain contour or relief displacement plots of the model and analysis results. GRA

N81-22046# Bristol Univ. (England). Dept. of Aeronautical Engineering.
THE DEVELOPMENT OF THE SECONDARY WING STRUCTURE FOR A RIGID WING HANG GLIDER B.S. Thesis
C. P. Blackman and I. Grant Jun. 1980 39 p refs
(BU-251) Avail: NTIS HC A03/MF A01

The design, construction and testing of a secondary wing structure using foam and glass fiber sandwich construction are described. Materials and construction techniques used were those readily available to the amateur. The wing section, an FX 72-MS-150B, was modified to simplify construction. Load tests were conducted on the iron on plastic film covering material. Static loading tests and an aerodynamic loading test in a wind tunnel were carried out, the latter on a 1.52 m span, section of the full scale wing. The structure proves to be more than adequately strong, although its weight would be only 4.14 kg. Author (ESA)

N81-22047*# Sperry Flight Systems, Phoenix, Ariz.
V/STOLAND DIGITAL AVIONICS SYSTEM FOR XV-15 TILT ROTOR Final Report
Sam P. Liden Jan. 1980 381 p
(Contract NAS2-10326)
(NASA-CR-152320) Avail: NTIS HC A17/MF A01 CSCL 01D

A digital flight control system for the tilt rotor research aircraft provides sophisticated navigation, guidance, control, display and data acquisition capabilities for performing terminal area navigation, guidance and control research. All functions of the XV-15 V/STOLAND system were demonstrated on the NASA-ARC S-19 simulation facility under a comprehensive dynamic acceptance test. The most noteworthy accomplishments of the system are: (1) automatic configuration control of a tilt-rotor aircraft over the total operating range; (2) total hands-off landing to touchdown on various selectable straight-in glide slopes and on a flight path that includes a two-revolution helix; (3) automatic guidance along a programmed three-dimensional reference flight path; (4) navigation data for the automatic guidance computed on board, based on VOR/DME, TACAN, or MLS navid data; and (5) integration of a large set of functions in a single computer, utilizing 16k words of storage for programs and data. A.R.H.

N81-22048*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.
AIRCRAFT BODY-AXIS ROTATION MEASUREMENT SYSTEM Patent Application
Kenneth T. Cowdin, inventor (to NASA) Filed 11 Mar. 1981 22 p
(NASA-Case-FRC-11043-1; US-Patent-Appl-SN-242790) Avail: NTIS HC A02/MF A01 CSCL 01D

A two-gyro four-gimbal attitude sensing system providing continuous aximuth information as the aircraft turns on its roll axis while the near vertical flight, and for preventing tumble of platforms in gyro systems upon departure from near vertical flight, is described. The provision of continuous azimuth information allows recovery from vertical on a desired heading. The system is comprised of means for stabilizing an outer roll gimbal that is common to a vertical gyro and a directional gyro with respect to the aircraft platform which is being angularly displaced about an axis substantially parallel to the outer roll gyro axis, and means for producing a signal indicative of the magnitude of such displacement as an indication of aircraft heading. Means are provided to cause stabilization of the outer roll gimbal prior to entering vertical flight and destabilization of the outer roll gimbal when departing vertical flight. J.D.H.

N81-22049# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
LASER DOPPLER AIRSPEED AND ALTITUDE SENSOR Final Report, 15 Oct. 1977 - 15 Nov. 1980
M. J. Rudd Feb. 1981 72 p refs
(Contract F49620-78-C-0023; AF Proj. 2305)
(AD-A096980; AFOSR-81-0309TR) Avail: NTIS HC A04/MF A01 CSCL 17/8

The feasibility of an air data system based on the measurement of the resonant fluorescence of carbon dioxide in the atmosphere is discussed. The Doppler shift of the fluorescence gives the air velocity and the linewidth gives the pressure altitude. A system using a tunable diode laser has been set-up and characterized. Attempts to measure back-scattered fluorescence were unsuccessful, but inelastic scattering in the forward direction was observed. Mechanisms for this are discussed but no firm conclusion is reached. A correlation technique for processing the data is discussed and its accuracy computed. GRA

N81-22050# Defence and Civil Inst. of Environmental Medicine, Downsview (Ontario).
FLIGHT EVALUATION OF THE CONCEPT OF THE STAGE A PERIPHERAL VISION HORIZON DEVICE (PVHD) USING THE CH 135 AIRCRAFT OF 403 SQUADRON - CEB GAGETOWN
R. C. Rud and R. D. Michas 8 Dec. 1980 9 p refs
(AD-A096870; DCIEM-TC-80-C-66) Avail: NTIS HC A02/MF A01 CSCL 01/4

The PVHD is an aircraft flight attitude instrument which uses the principle that visual sensory orientation information reaches the brain via the peripheral visual pathways. The instrument is currently in a developmental stage but six workable models have been manufactured under contract for the Department of National Defence (DND) by Varian Canada Incorporated (VCI). In order to evaluate the concept under operational conditions, it was necessary to install the system in an aircraft and fly it under variable weather conditions in various types of missions. The CH 135 (Huey) helicopter was chosen for the conceptual flight trials and 403 Squadron (CFB Gagetown) was tasked to fly the system. The system was flown for approximately 35 hours by several different pilots under visual meteorological conditions, (VMC), instrument meteorological conditions (IMC), simulated instrument flying (SIF), in many missions both day and night. Daily and weekly utilization logs and reports were recorded by the pilots. At the end of the flight trial, each pilot reported his impressions on a questionnaire. Flying times under various conditions are reported along with the impressions of the pilots who flew the system. Recommendations for further operational studies are made. GRA

N81-22051*# General Electric Co., Cincinnati, Ohio.
ENERGY EFFICIENT ENGINE FLIGHT PROPULSION SYSTEM: AIRCRAFT/ENGINE INTEGRATION EVALUATION Status Report, Jan. 1978 - Nov. 1978
R. F. Patt Jun. 1980 328 p refs
(Contract NAS3-20643)
(NASA-CR-159584; R79AEG274) Avail: NTIS HC A15/MF A01 CSCL 21E

Results of aircraft/engine integration studies conducted on an advanced flight propulsion system are reported. Economic evaluations of the preliminary design are included and indicate that program goals will be met. Installed sfc, DOC, noise, and emissions were evaluated. Aircraft installation considerations and growth were reviewed. J.M.S.

N81-22052*# General Electric Co., Lynn, Mass.
QUIET CLEAN GENERAL AVIATION TURBOFAN (QCGAT) TECHNOLOGY STUDY, VOLUME 1 Final Report
Dec. 1975 193 p refs
(Contract NAS3-19429)
(NASA-CR-164222; R75AEG026-Vol-1) Avail: NTIS HC A09/MF A01 CSCL 21E

The preliminary design of an engine which satisfies the requirements of a quiet, clean, general aviation turbofan (QCGAT) engine is described. Also an experimental program to demonstrate performance is suggested. The T700 QCGAT engine preliminary design indicates that it will radiate noise at the same level as an aircraft without engine noise, have exhaust emissions within the EPA 1981 Standards, have lower fuel consumption than is available in comparable size engines, and have sufficient life for five years between overhauls. M.G.

N81-22053*# General Electric Co., Evendale, Ohio.
DESIGN CONCEPTS FOR LOW-COST COMPOSITE TURBOFAN ENGINE FRAME Final Report
S. C. Mitchell and L. J. Stoffer Oct. 1980 70 p refs
(Contract NAS3-22160)
(NASA-CR-165217; R81AEG311) Avail: NTIS HC A04/MF A01 CSCL 21E

Design concepts for low cost, lightweight composite engine frames were applied to the design requirements for the frame of a commercial, high bypass engine. Four alternative composite frame design concepts identified which consisted of generic type components and subcomponents that could be adapted to use in different locations in the engine and the different engine sizes. A variety of materials and manufacturing methods were projected with a goal for the lowest number of parts at the lowest possible cost. After a preliminary evaluation of all four frame concepts, two designs were selected for an extended design and evaluation which narrowed the final selection down to one frame that was significantly lower in cost and slighty lighter than the other frame. An implementation plan for this lowest cost frame is projected for future development and includes prospects for reducing its weight with proposed unproven, innovative fabrication techniques. Author

N81-22054*# National Aeronautics and Space Administration, Washington, D. C.
PROCEDURE FOR PRESSURE CONTACT ON HIGH-POWER SEMICONDUCTOR DEVICES FREE OF THERMAL FATIGUE Final Report
Joachim Knobloch Dec. 1979 20 p refs Transl. into ENGLISH of "Verfahren zur lastwechselfesten Druckkon-taktie-rung an Leistungs-Halbleiter-Bauelementen" BMFT-FB-T-78-02 Bundesministerium fuer Forschung und Technologie, Bonn, Nov. 1978 p 1-29 Translation was announced as N79-27418 Transl. by Kanner (Leo) Associates, Redwood City, Calif. Original doc. prep. by Brown, Boveri and Cie, A.G., Lampertheim
(Contract NASw-3199)
(NASA-TM-75733; BMFT-FB-T-78-02) Avail: NTIS HC A02/MF A01 CSCL 21E

To eliminate thermal fatigue, a procedure for manufacturing semiconductor power devices with pure pressure contact without solid binding was developed. Pressure contact without the use of a solid binding to avoid a limitation of the maximum surface in the contact was examined. A silicon wafer covered with a relatively thick metal layer is imbedded with the aid of a soft silver foil between two identically sized hard contact discs (molybdenum or tungsten) which are rotationally symmetrical. The advantages of this concept are shown for large diameters. The pressure contact was tested successfully in many devices in a large variety of applications. E.A.K.

N81-22055*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPONENT RESEARCH FOR FUTURE PROPULSION SYSTEMS
C. L. Walker, G. J. Weden, and J. Zuk 1981 16 p refs Presented at Fifty-seventh Specialists' Meeting, Toulouse, 11-14 May 1981; sponsored by AGARD Prepared in cooperation with NASA. Ames Research Center and Army Aviation Research and Development Command, Cleveland, Ohio
(NASA-TM-82613; AVRADCOM-TR-81-C-12) Avail: NTIS HC A02/MF A01 CSCL 21E

Factors affecting the helicopter market are reviewed. The trade-offs involving acquisition cost, mission reliability, and life cycle cost are reviewed, including civil and military aspects. The potential for advanced vehicle configurations with substantial improvements in energy efficiency, operating economics, and characteristics to satisfy the demands of the future market are identified. Advanced propulsion systems required to support these vehicle configurations are discussed, as well as the component technology for the engine systems. Considerations for selection of components in areas of economics and efficiency are presented. S.F.

N81-22056*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THERMAL AND FLOW ANALYSIS OF A CONVECTION AIR-COOLED CERAMIC COATED POROUS METAL CONCEPT FOR TURBINE VANES
Francis S. Stepka 1981 12 p refs Presented at the 20th Natl. Heat Transfer Conf., Milwaukee, 2-5 Aug. 1981; sponsored by the ASME and the American Inst. of Chemical Engineers
(NASA-TM-81749; E-815) Avail: NTIS HC A02/MF A01 CSCL 21E

The heat transfer and pressure drop through turbine vanes made of a sintered, porous metal coated with a thin layer of ceramic and convection cooled by spanwise flow of cooling air were analyzed. The analysis was made to determine the feasibility of using this concept for cooling very small turbines, primarily for short duration applications such as in missile engines. The analysis was made for gas conditions of approximately 10 and 40 atm and 1644 K and with turbine vanes made of felt type porous metals with relative densities from 0.2 to 0.6 and ceramic coating thicknesses of 0.076 to 0.254 mm. J.M.S.

N81-22057 Dayton Univ., Ohio.
MAXIMUM LIKELIHOOD IDENTIFICATION OF AIRCRAFT LATERAL PARAMETERS WITH UNSTEADY AERODYNAMIC MODELLING Ph.D. Thesis
Siva Subrahmanyam Banda 1980 198 p
Avail: Univ. Microfilms Order No. 8107428

A simplified aerodynamic force and moment model for unsteadiness in the sideslipping flight was developed via an indicial sidewash function and an indicial sideforce function. The presence of convolution integrals in the equations of motion led to the Fourier transformation of these equations into the frequency domain. A parameter extraction algorithm based on the maximum likelihood estimation technique was developed in the frequency domain. This algorithm was applied to pseudo data as well as real flight data. The results indicated that, for the cases considered, inclusion of unsteady aerodynamics showed significant difference in some of the parameters, in various flights. The parameters extracted whowed less variation for different control inputs when unsteady aerodynamic modelling was included in the extraction algorithm. Dissert. Abstr.

N81-22058 Princeton Univ., N. J.
THE DEVELOPMENT OF A THEORETICAL AND EXPERIMENTAL MODEL FOR THE STUDY OF ACTIVE SUPPRESSION OF WING FLUTTER Ph.D. Thesis
David Eric Dashcund 1981 432 p
Avail: Univ. Microfilms Order No. 8108087

A wind tunnel model was used to study active suppression of classical bending torsion wing flutter using feedback control. Modeling the unsteady aerodynamics in the Laplace domain in terms of an irrational, exact representation of the generalized Theodorsen's function shows the presence of additional stability roots of the system which are not associated with the structural modes of the system nor with the feedback compensation or control surface actuator dynamics. A set of open loop system equations can be formulated from the derived closed loop system equations. Use of a rational, Pade approximation of the unsteady aerodynamics then permits the application of either classical control theory or state vector methods to feedback flutter control system synthesis and optimization. The model is applicable to a study of the effect of various active control system parameters such as control surface size and location, wing motion sensor and its location, feedback control law, feedback compensation, and actuator dynamics. Dissert. Abstr.

N81-22059*# Honeywell Systems and Research Center, Minneapolis, Minn.

F-8C ADAPTIVE CONTROL LAW REFINEMENT AND SOFTWARE DEVELOPMENT Final Report, Jun. 1976 - Jun. 1977

Gary L. Hartmann and Gunter Stein Apr. 1981 184 p refs
(Contract NAS4-2344)
(NASA-CR-163093; HONEYWELL-77SRC53) Avail: NTIS HC A09/MF A01 CSCL 01C

An explicit adaptive control algorithm based on maximum likelihood estimation of parameters was designed. To avoid iterative calculations, the algorithm uses parallel channels of Kalman filters operating at fixed locations in parameter space. This algorithm was implemented in NASA/DFRC's Remotely Augmented Vehicle (RAV) facility. Real-time sensor outputs (rate gyro, accelerometer, surface position) are telemetered to a ground computer which sends new gain values to an on-board system. Ground test data and flight records were used to establish design values of noise statistics and to verify the ground-based adaptive software. T.M.

N81-22060*# National Aeronautics and Space Administration, Washington, D. C.

A DIGITAL-ANALOG HYBRID SYSTEM AND ITS APPLICATION TO THE AUTOMATIC FLIGHT CONTROL SYSTEM SIMULATION RESEARCH

Jan. 1981 23 p refs Transl. into ENGLISH of "Shu-mo hun-he xi-tong ji chi jai zi-dong feishin kong-zhi xi-tong fang-jan yen-jiu jun de ying-yung" Rept. HK-80072 Communist China, Aug. 1980 9 p Transl. by Scientific Translation Service, Santa Barbara, Calif. Original doc. prep. by Chinese Academy of Aeronautics, Communist China
(Contract NASw-3198)
(NASA-TM-76457; HK-80072) Avail: NTIS HC A02/MF A01 CSCL 01C

The characteristics of a digital-analog hybrid system composed of a DJS-8 digital computer and a HMJ-200 analog computer are described as well as its applications to simulation research for an automatic flight control system. A hybrid computational example is included to illustrate the application. A.R.H.

N81-22061*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

DESCRIPTION OF 0.186-SCALE MODEL OF HIGH-SPEED DUCT OF NATIONAL TRANSONIC FACILITY

Carl L. Gentry, Jr., William B. Igoe, and Dennis E. Fuller May 1981 49 p refs
(NASA-TM-81949; L-13523) Avail: NTIS HC A03/MF A01 CSCL 14B

The National Transonic Facility (NTF) is a pressurized cryogenic wind tunnel with a 2.5 m square test section. A 0.186-scale model of the NTF was used to simulate the aerodynamic performance of the components of the high-speed duct of the NTF. These components consist of a wide-angle diffuser, settling chamber, contraction section, test section, model support section, and high-speed diffuser. The geometry of the model tunnel, referred to as the diffuser flow apparatus is described, and some of its operating characteristics are presented. Author

N81-22063# Aeronautical Research Labs., Melbourne (Australia).

APPLICATION OF COMPUTER COLOUR RASTER DISPLAYS IN THE COCKPIT IN RESEARCH FLIGHT SIMULATION

H. A. Thelander Mar. 1980 40 p refs
(AD-A096542; ARL/SYS-71; AR-001-798) Avail: NTIS HC A03/MF A01 CSCL 09/2

This paper describes an experimental investigation of the factors influencing the use of computer driven color raster displays for the provision of cockpit displays and instrumentation in manned flight simulation research. Cockpit information presentation requirements and raster display methods are discussed. The findings of the study are that the method has applicability to research simulaton, with economic advantages over the conventional approach. The main factors affecting its use are quantified. GRA

N81-22095 Georgia Inst. of Tech., Atlanta.

BEHAVIOR OF CONTINUOUS FILAMENT ADVANCED COMPOSITE ISOGRID STRUCTURE Ph.D. Thesis

Ambur Damodara Reddy 1980 110 p
Avail: Univ. Microfilms Order No. 8107287

To realize the full potential of continuous filament advanced composite isogrid (CPACI), basic data on the load bearing structure must be acquired and evaluated in conjunction with current theoretical models and analysis methods. The data base established through such an effort is of great importance in order to inspire confidence in the use of the concept. Both strength and stiffness controlled behavior was studied. Three large panels were tested previously as wide columns in uniaxial compression with fixed loaded ends. A variety of element tests including assessment of fiber content are performed to determine a maximum of information from the three original panels. The experimental data obtained are self consistent and show good agreement with theoretical predictions. The pronounced effect of transverse shear flexibility is evident in the bend tests and in the correlation of buckling data. The scaling law suggested is useful as buckling tests of complex structures may sometimes be avoided. Manufacturing inconsistencies are clearly identified as the primary reason for the scatter in test data. Dissert. Abstr.

N81-22098*# National Aeronautics and Space Administration, Washington, D. C.

EROSION RESISTANT COATINGS

Leonello Falco and Alessandro Cushini Jan. 1981 14 p refs Transl. into ENGLISH from Proc. Assoc. Ital. di Aeron. Astronautics (Turin), v. 1, 1979 p 335-344 Presented at the 3rd Natl. Congr. Assoc. Ital. di Aeron. e Astronautics, Turin, 30 Sep. - 3 Oct. 1975 Original language document was announced as A78-19056 Transl. by Scientific Translation Service, Santa Barbara, Calif. Original doc. prep. by Univ. Levrotto e Bella, Italy
(Contract NASw-3198)
(NASA-TM-75870) Avail: NTIS HC A02/MF A01 CSCL 11D

Apparatus for measuring the resistance of materials to erosion is examined and a scheme for standardization of the test parameters is described. Current materials being used for protecting aircraft parts from erosion are surveyed, their chief characteristics being given. The superior properties of urethane coatings are pointed out. The complete cycle for painting areas subject to erosion is described. Author

N81-22106# Boeing Co., Seattle, Wash. Boeing Military Airplane Development Dept.

ADVANCED FIBER REINFORCED THERMOPLASTIC STRUCTURES Final Report, 1 Aug. 1976 - 1 Aug. 1979

J. T. Hoggatt, S. Oken, and E. E. House Apr. 1980 289 p
(Contract F33615-76-C-3048; AF Proj. 2401)
(AD-A096759; AFWAL-TR-80-3023) Avail: NTIS HC A13/MF A01 CSCL 11/4

The objective of the program was to demonstrate the performance and cost savings of graphite/polysulfone. This objective was attained through a thirteen task program which cultimated in the design, fabrication and test of a full scale elevator torque box. The P-1700 polysulfone resin was selected and used with A-S unidirectional graphite fibers (Hercules 3004/A-S/P1700 prepreg) and with T-300 woven graphite fibers (Hexcel T-3004/23x24, 811 Satin Prepreg). Tooling concepts, consolidation and post forming processes, and field repair procedures were developed. The graphite/thermoplastic elevator had a 27% weight savings as compared to the aluminum elevator, and a cost saving of 20%, by the tenth elevator shipset. A limited study of a Union Carbide proprietary thermoplastic, known as PKXA, which has much improved solvent resistance as compared to P-1700 polysulfone, was conducted. This limited study showed that PKXA appeared to be a viable substitute for P-1700 polysulfone. It is recommended that a further study of PKXA be made in order to further optimize the manufacturing procedures for it. GRA

N81-22129*# Boeing Co., Seattle, Wash.
SERVICE EVALUATION OF ALUMINUM-BRAZED TITANIUM (ABTI)
S. D. Elrod Washington NASA May 1981 43 p refs
(Contract NAS1-13681)
(NASA-CR-3418; D6-48609) Avail: NTIS HC A03/MF A01 CSCL 11F

Long term creep-rupture, flight service and jet engine exhaust tests on aluminum-brazed titanium (ABTi), originally initiated under the DOT/SST follow-on program, were completed. These tests included exposure to natural airline service environments for up to 6 years. The results showed that ABTi has adequate corrosion resistance for long time commercial airplane structural applications. Special precautions are required for those sandwich structures designed for sound attenuation that utilize perforated skins. ABTi was also shown to have usable creep-rupture strength and to be metallurgically stable at temperatures up to 425 C (800 F). A.R.H.

N81-22130*# Pennsylvania State Univ., University Park. Dept. of Mechanical Engineering.
INVESTIGATION OF AIR SOLUBILITY IN JET A FUEL AT HIGH PRESSURES Final Report
S. D. Rupprecht and G. M. Faeth Washington NASA May 1981 111 p refs
(Grant NsG-3306)
(NASA-CR-3422) Avail: NTIS HC A06/MF A01 CSCL 07D

The solubility and density properties of saturated mixtures of fuels and gases were measured. The fuels consisted of Jet A and dodecane, the gases were air and nitrogen. The test range included pressures of 1.03 to 10.34 MPa and temperatures of 298 to 373 K. The results were correlated successfully, using the Soave equation of state. Over this test range, dissolved gas concentrations were roughly proportional to pressure and increased slightly with increasing temperature. Mixture density was relatively independent of dissolved gas concentration. Author

N81-22282*# Old Dominion Univ., Norfolk, Va. Dept. of Physics.
ANTENNA DESIGN AND DEVELOPMENT FOR THE MICROWAVE SUBSYSTEM EXPERIMENTS FOR THE TERMINAL CONFIGURED VEHICLE PROJECT Final Report, 1 Aug. 1976 - 31 Dec. 1979
Jacob Becher, Norman Cohen, and Jim Rublee Mar. 1981 158 p refs
(Grant NsG-1331)
(NASA-CR-164220; PTR-81-7) Avail: NTIS HC A08/MF A01 CSCL 09C

The feasibility of classifying an airport-terminal area for multipath effects, i.e., fadeout potentials or limits of video resolution, is examined. Established transmission links in terminal areas were modeled for landing approaches and overflight patterns. A computer program to obtain signal strength based on a described flight path was written. The application of this model to evaluate the signal transmission obtained in an actual flight equipped with additional signal strength monitoring equipment is described. The actual and computed received signal are compared, and the feasibility of the computer simulation for predicting signal amplitude fluctuation is evaluated. J.D.H.

N81-22358*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
APPARATUS FOR AND METHOD OF COMPENSATING DYNAMIC UNBALANCE Patent Application
John A. Hrastar, Sr., inventor (to NASA) Filed 27 Feb. 1981 29 p
(NASA-Case-GSC-12550-1; US-Patent-Appl-SN-238888) Avail: NTIS HC A03/MF A01 CSCL 13I

An apparatus to stabilize a fine platform that carries a parabolic reflecting dish, utilized in connection with the large aperture, multichannel microwave radiometer, is discussed. It provides compensation for dynamic unbalance imparted to a fixed body by a shaft about which the rotating body rotates. Force components exerted on the fixed body by the rotating body in a plane at right angles to the axis are determined. In response to the determined force components, the rotational speed and effective direction of mass means mounted on the rotating body are controlled. The mass means has an effective axis of rotation in a plane at right angles to the longitudinal axis. NASA

N81-22400*# Lockheed-Georgia Co., Marietta.
HIGH FREQUENCY DRIVE MECHANISM FOR AN ACTIVE CONTROLS SYSTEMS AIRCRAFT CONTROL SURFACE
Hugh E. Smith *In* NASA. Marshall Space Flight Center The 15th Aerospace Mech. Symp. May 1981 p 173-188

Avail: NTIS HC A19/MF A01 CSCL 01C

The mechanism was successfully utilized on a wind tunnel model tested in the transonic blow down tunnel. The mechanism is also applicable to a flying aircraft. Several interrelated mechanical subsystems were utilized, including a low inertia antibacklash drive mechanism for high frequency oscillation and a compact antibacklash drive mechanism for conversion of rotary motion to linear motion. E.D.K.

N81-22419*# Lockheed-California Co., Burbank.
DESIGN CONSIDERATIONS FOR COMPOSITE FUSELAGE STRUCTURE OF COMMERCIAL TRANSPORT AIRCRAFT
G. W. Davis and I. F. Sakata Hampton, Va. NASA. Langley Research Center Mar. 1981 51 p refs
(Contract NAS1-15949)
(NASA-CR-159296; LR-29540) Avail: NTIS HC A04/MF A01 CSCL 20K

The structural, manufacturing, and service and environmental considerations that could impact the design of composite fuselage structure for commercial transport aircraft application were explored. The severity of these considerations was assessed and the principal design drivers delineated. Technical issues and potential problem areas which must be resolved before sufficient confidence is established to commit to composite materials were defined. The key issues considered are: definition of composite fuselage design specifications, damage tolerance, and crashworthiness. E.A.K.

N81-22420# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
STRUCTURES AND MATERIALS PANEL
1980 97 p Presented at the 50th Meeting of the Struct. and Mater. Panel, Athens, Greece, Spring 1980
(AD-A089019) Avail: NTIS HC A05/MF A01 CSCL 20/11

Partial contents: Group and Committee Reports; (1) Aeroelasticity, (2) Impact Damage Tolerance, (3) Fracture Mechanics Design Methodology, (4) Composite Materials, (5) Critically Loaded Hole Technology, (6) Corrosion Fatigue, (7) Factors of Safety, (8) Corrosion, (9) R and D Cooperation, (10) Standard Aeroelastic Configurations, (11) Helicopter Fatigue, (12) Dynamic Environmental Qualification Techniques, (13) Dimensionally Stable Structures for Space, (14) Dynamic Response to Damaged Runways, (15) Advanced Casting Technology, (16) Maintenance in Service of High Temperature Parts, and (17) Fatigue Rated Fastener Systems. Proposals for New Activities: (1) Effects of Short Cracks, (2) NDT of Ceramic Materials, (3) CAD/CAM. GRA

N81-22437# Lockheed-California Co., Burbank.
AIRCRAFT CRASH DYNAMICS: SOME MAJOR CONSIDERATIONS
In The Shock and Vibration Inform. Center The Shock and Vibration Digest, Vol. 13, No. 3 Mar. 1981 p 3-6 refs

Avail: SVIC, Code 5804, Naval Research Lab., Washington, D. C. $15.00/set CSCL 01/9

The considerations are aircraft crash environments, available analytical methods, and occupant protection. The aircraft crash environment varies depending on aircraft size, configuration, and usage. Current crash design requirements for military and civil helicopters, small airplanes, and large airplanes are presented. Analytical modeling of crash behavior requires three levels of capability: simple, intermediate, and detailed. Brief descriptions of methods and reference simulations are provided. Occupant protection, which is the goal of the crash design effort, is related to a design in which the load capability of the various systems is compatible with the crash environment. T.M.

N81-22589*# National Aeronautics and Space Administration, Washington, D. C.

ANNOYANCE CAUSED BY LIGHT AIRCRAFT NOISE

Mar. 1981 134 p refs Transl. into ENGLISH of "Stoerwirkungen Durch den Laerm der Kleinaviatik" Switzerland, Jun. 1980 p 1-132 Transl. by Scientific Translation Service, Santa Barbara, Calif. Original doc. prep. by Inst. fur Prazisorientierte Sozialforschung, Zurich, Switzerland and Mitwirkung der Eidg. Materialpurefungsanstalt, Dueden dorf, Switzerland

(Contract NASw-3198)

(NASA-TM-76533) Avail: NTIS HC A07/MF A01 CSCL 13B

The correlation between objective and noise stresses and subjectively perceived disturbance from general aviation aircraft was studied at 6 Swiss airports. Noise levels calculated for these airports are given. Survey results are analyzed. A.R.H.

N81-22590*# National Aeronautics and Space Administration, Washington, D. C.

THE ANNOYANCE CAUSED BY AIRPLANE NOISE IN THE VICINITY OF ORLY AIRPORT AND THE REACTION OF NEIGHBORING RESIDENTS

J. Francois Apr. 1981 16 p Transl. into ENGLISH of "La Gene Causee par le Bruit des Avions au Voisinage de l'Aeroport d'Orly et les Reactions des Riverains" Paris, Aug. 1972 15 p Transl. by Kanner (Leo) Associates, Redwood City, Calif. Original doc. prep. by Inst. Francais d'Opinion Publique, Paris

(Contract NASw-3199)

(NASA-TM-76575) Avail: NTIS HC A02/MF A01 CSCL 13B

General conclusions and the technical appendix of a report on the attitudes of people living near Orly Airport (Paris) toward airplane noise are presented. The noise was found to be very disruptive of residents' lifestyle and well being, although differences in perceived nuisance were noted. The factors inducing people to protest and who they blame for the present situation are discussed. It was found that the public image of protestors was generally positive and that people who did not protest were viewed as passive, uncaring, or else connected to aviation. A.R.H.

N81-22593*# National Aeronautics and Space Administration, Washington, D. C.

THE EFFECT OF AIRPLANE NOISE ON THE INHABITANTS OF AREAS NEAR OKECIE AIRPORT IN WARSAW

Zbigniew Koszarny, Stefan Maziarka, and Wanda Szata May 1981 17 p refs Transl. into ENGLISH from Rocznik Panstwowego Zakladu Hygieny (Poland), v. 27, no. 2, 1976 p 113-121 Transl. by Scientific Translation Service, Santa Barbara, Calif. Original doc. prep. by National Inst of Hygiene, Warsaw

(Contract NASw-3198)

(NASA-TM-75879) Avail: NTIS HC A02/MF A01 CSCL 13B

The state of health and noise annoyance among persons living in areas near Okecie airport exposed to various intensities of noise was evaluated. Very high annoyance effects of airplane noise of intensities over 100 dB (A) were established. A connection between the airplane noise and certain ailments complained about by the inhabitants was demonstrated. A.R.H.

N81-22594*# National Aeronautics and Space Administration, Washington, D. C.

THE RELATIONSHIP BETWEEN NOISE AND ANNOYANCE AROUND ORLY

J. Francois and J. P. Roche May 1981 90 p Transl. into ENGLISH of 'Liaison dentre le bruit et la gene autour d'Orly" Paris, Jan. 1973 p 76 Transl. by Scientific Translation Service, Santa Barbara, Calif. Original doc. prep. by Inst. Francois d'Opinion Publique, Paris

(Contract NASw-3198)

(NASA-TM-76573) Avail: NTIS HC A05/MF A01 CSCL 13B

The extent to which annoyance estimated by an isopsophic index is a good forecaster for annoyance perceived near airport approaches was investigated. An index of sensed annoyance is constructed, and the relationship between the annoyance index and the isopsophic index is studied. A.R.H.

N81-22666# Deutscher Wetterdienst, Offenbach am Main (West Germany).

INVESTIGATIVE TECHNICAL MEASUREMENTS OF THE PLANETARY BOUNDARY LAYER MADE ONBOARD AN INSTRUMENTED MOTORIZED GLIDER [MESSTECHNISCHE UNTERSUCHUNG DER PLANETARISCHEN GRENZCHICHT MIT HILFE EINES INSTRUMENTIERTEN MOTORSEGLERS]

Heinz Fortak (Freie Univ., West Germany) 1980 167 p In GERMAN; ENGLISH summary Sponsored by Deutsche Forschungsgemeinschaft (DFG)

(Rept-149; ISBN-3-88149-174-5; ISSN-0072-4130) Avail: NTIS HC A08/MF A01

Research into the planetary boundary layer is described. An instrumented motorized glider was used in making observations. The most important task of the experiment was the investigation of convective processes and their interactions with neighboring scales. Results show the strong variability of the vertical structure of the atmosphere caused by convection, the life cycle of individual convective cells, the two dimensional distribution of those cells, and their dependence on surface properties as well as the interactions between convection and lee waves, including cloud streets. Author (ESA)

N81-22722*# Systems Control, Inc., Palo Alto, Calif.

DEKFIS USER'S GUIDE: DISCRETE EXTENDED KALMAN FILTER/SMOOTHER PROGRAM FOR AIRCRAFT AND ROTORCRAFT DATA CONSISTENCY

Nov. 1979 69 p

(Contract NAS1-14549)

(NASA-CR-159081) Avail: NTIS HC A04/MF A01 CSCL 09B

The computer program DEKFIS (discrete extended Kalman filter/smoother), formulated for aircraft and helicopter state estimation and data consistency, is described. DEKFIS is set up to pre-process raw test data by removing biases, correcting scale factor errors and providing consistency with the aircraft inertial kinematic equations. The program implements an extended Kalman filter/smoother using the Friedland-Duffy formulation. M.G.

N81-22723*# Systems Control, Inc., Palo Alto, Calif.

SCI IDENTIFICATION (SCIDNT) PROGRAM USER'S GUIDE

Nov. 1979 50 p

(Contract NAS1-14549)

(NASA-CR-159082) Avail: NTIS HC A03/MF A01 CSCL 09B

The computer program Linear SCIDNT which evaluates rotorcraft stability and control coefficients from flight or wind tunnel test data is described. It implements the maximum likelihood method to maximize the likelihood function of the parameters based on measured input/output time histories. Linear SCIDNT may be applied to systems modeled by linear constant-coefficient differential equations. This restriction in scope allows the application of several analytical results which simplify the computation and improve its efficiency over the general nonlinear case. M.G.

N81-22724*# Systems Control, Inc., Palo Alto, Calif.
NLSCIDNT USER'S GUIDE MAXIMUM LIKEHOOD PARAMETER IDENTIFICATION COMPUTER PROGRAM WITH NONLINEAR ROTORCRAFT MODEL
Nov. 1979 121 p refs
(Contract NAS1-14549)
(NASA-CR-159083) Avail: NTIS HC A06/MF A01 CSCL 09B

A nonlinear, maximum likelihood, parameter identification computer program (NLSCIDNT) is described which evaluates rotorcraft stability and control coefficients from flight test data. The optimal estimates of the parameters (stability and control coefficients) are determined (identified) by minimizing the negative log likelihood cost function. The minimization technique is the Levenberg-Marquardt method, which behaves like the steepest descent method when it is far from the minimum and behaves like the modified Newton-Raphson method when it is nearer the minimum. Twenty-one states and 40 measurement variables are modeled, and any subset may be selected. States which are not integrated may be fixed at an input value, or time history data may be substituted for the state in the equations of motion. Any aerodynamic coefficient may be expressed as a nonlinear polynomial function of selected 'expansion variables'. M.G.

N81-22725*# Systems Control, Inc., Palo Alto, Calif.
SCI MODEL STRUCTURE DETERMINATION PROGRAM (OSR) USER'S GUIDE
Nov. 1979 29 p
(Contract NAS1-14549)
(NASA-CR-159084) Avail: NTIS HC A03/MF A01 CSCL 09B

The computer program, OSR (Optimal Subset Regression) which estimates models for rotorcraft body and rotor force and moment coefficients is described. The technique used is based on the subset regression algorithm. Given time histories of aerodynamic coefficients, aerodynamic variables, and control inputs, the program computes correlation between various time histories. The model structure determination is based on these correlations. Inputs and outputs of the program are given. M.G.

N81-22726*# Systems Control, Inc., Palo Alto, Calif.
INDES USER'S GUIDE MULTISTEP INPUT DESIGN WITH NONLINEAR ROTORCRAFT MODELING
Nov. 1979 54 p ref Sponsored in part by Army
(Contract NAS1-14549)
(NASA-CR-159085) Avail: NTIS HC A04/MF A01 CSCL 09B

The INDES computer program, a multistep input design program used as part of a data processing technique for rotorcraft systems identification, is described. Flight test inputs base on INDES improve the accuracy of parameter estimates. The input design algorithm, program input, and program output are presented. M.G.

N81-22727*# North Carolina State Univ., Raleigh. Dept. of Electrical Engineering.
A STUDY OF REAL-TIME COMPUTER GRAPHIC DISPLAY TECHNOLOGY FOR AERONAUTICAL APPLICATIONS Progress Report, 1 Oct. 1980 - 31 Mar. 1981
S. A. Rajala 30 Apr. 1981 67 p refs
(Grant NsG-1355)
(NASA-CR-164221) Avail: NTIS HC A04/MF A01 CSCL 09B

The development, simulation, and testing of an algorithm for anti-aliasing vector drawings is discussed. The pseudo anti-aliasing line drawing algorithm is an extension to Bresenham's algorithm for computer control of a digital plotter. The algorithm produces a series of overlapping line segments where the display intensity shifts from one segment to the other in this overlap (transition region). In this algorithm the length of the overlap and the intensity shift are essentially constants because the transition region is an aid to the eye in integrating the segments into a single smooth line. E.A.K.

N81-22832*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AIRFRAME NOISE OF A SMALL MODEL TRANSPORT AIRCRAFT AND SCALING EFFECTS
John G. Shearin May 1981 27 p refs
(NASA-TP-1858; L-14257) Avail: NTIS HC A03/MF A01 CSCL 20A

Airframe noise of a 0.01 scale model Boeing 747 wide-body transport was measured in the Langley Anechoic Noise Facility. The model geometry simulated the landing and cruise configurations. The model noise was found to be similar in noise characteristics to that possessed by a 0.03 scale model 747. The 0.01 scale model noise data scaled to within 3 dB of full scale data using the same scaling relationships as that used to scale the 0.03 scale model noise data. The model noise data are compared with full scale noise data, where the full scale data are calculated using the NASA aircraft noise prediction program. Author

N81-22833*# Texas A&M Univ., College Station. Dept. of Mechanical Engineering.
THE ROLE OF COHERENT STRUCTURES IN THE GENERATION OF NOISE FOR SUBSONIC JETS Semiannual Report
G. L. Morrison 1 May 1981 24 p refs Original contains color illustrations
(Grant NAG1-112)
(NASA-CR-164214) Avail: NTIS HC A02/MF A01 CSCL 20A

Results from mean flow field surveys are reported. Flow fluctuation amplitude measurements and acoustic measurements are presented. The organized structure was characterized in terms of axial flow and radial flow. T.M.

N81-22836*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AN EVALUATION OF A SIMPLIFIED NEAR FIELD NOISE MODEL FOR SUPERSONIC HELICAL TIP SPEED PROPELLERS
James H. Dittmar Mar. 1981 24 p refs
(NASA-TM-81727; E-768) Avail: NTIS HC A02/MF A01 CSCL 20A

Existing propeller noise models are versatile and complex but require large computational times, therefore a simplified noise model that could be used to obtain quick noise estimates for these propellers was evaluated. This simplified noise model compared favorably with a complex model for a straight blade propeller and for swept propeller blades when the propeller sweep was properly considered. The simplified model can thus be used as an approximation to the complex model. Comparisons of either the complex or simplified noise models with the available noise data are not good for supersonic propeller helical tip speeds. By adjusting various constants in the simplified model, the noise estimates can be brought into the same range as the data at the propeller design point but the variation of the model with helical tip Mach number remains different than the data. A.R.H.

N81-22838*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THE PROPELLER TIP VORTEX. A POSSIBLE CONTRIBUTOR TO AIRCRAFT CABIN NOISE
Brent A. Miller, James H. Dittmar, and Robert J. Jeracki Apr. 1981 11 p refs
(NASA-TM-81768; E-821) Avail: NTIS HC A02/MF A01 CSCL 20A

Although the assumption is generally made that cabin noise levels are governed by the transmission of propeller generated noise through the fuselage sidewall, it was postulated that the propeller wake striking the wing, in particular pressure disturbances generated downstream of the propeller by the action of the propeller tip vortex, could be strong enough to excite the aircraft structure and contribute to the cabin noise level. Tests conducted to measure the strength of the propeller tip vortex support this hypothesis. It was found that the propeller tip vortex can produce a fluctuation pressure on a simulated wing surface in the wake of a propeller that exceeds by more than 15 dB the maximum direct noise that would strike the fuselage. Wing surface response to propeller tip vortex induced excitations, and the effectiveness of this response in radiating noise to the cabin interior, must be established to assess the full significance of these results. A.R.H.

N81-22839*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPARISON OF PREDICTED ENGINE CORE NOISE WITH PROPOSED FAA HELICOPTER NOISE CERTIFICATION REQUIREMENTS
U. vonGlahn and D. Groesbeck 1981 19 p refs Presented at the 101st Meeting of the ASA, Ottawa, Ontario, 18-22 May 1981
(NASA-TM-81739; E-791) Avail: NTIS HC A02/MF A01 CSCL 20A

Calculated engine core noise levels, based on NASA-Lewis prediction procedures, for five representative helicopter engines are compared with measured total helicopter noise levels and proposed FAA helicopter noise certification requirements. Comparisons are made for level flyover and approach procedures. The measured noise levels are generally significantly greater than those predicted for the core noise levels, except for Sikorsky S-61 and S-64 helicopters. However, the predicted engine core noise levels are generally at or within 3 db of the proposed FAA noise rules. Consequently, helicopter engine core noise can be a significant contributor to the overall helicopter noise signature and, at this time, will provide a limiting floor to a further decrease in future noise regulations. Author

N81-22969*# National Academy of Sciences - National Research Council, Washington, D. C.
NASA'S AERONAUTICS RESEARCH AND TECHNOLOGY BASE Final Report
Apr. 1979 52 p
(Contract NASw-2342)
(NASA-CR-164195; PB81-134686) Avail: NTIS HC A04/MF A01 CSCL 05A

NASA's research technology base in aeronautics is assessed in terms of: (1) US aeronautical technology needs and requirements in the future; (2) objectives of the aeronautics program; (3) magnitude and scope of the program; and (4) research and technology performed by NASA and other research organizations. S.F.

N81-22971# Boeing Co., Seattle, Wash. Product Support/ Experience Analysis Center.
DEVELOPMENT OF MAINTENANCE METRICS TO FORECAST RESOURCE DEMANDS OF WEAPON SYSTEMS. ANALYSIS AND EVALUATION, REVISION A Interim Report, 1 Mar. 1978 - 15 Oct. 1979
Donald K. Hindes, Gary A. Walker, David H. Wilson, and Frank Maher (AF Human Resources Lab., Wright-Patterson AFB, Ohio) Feb. 1980 156 p refs Revised
(Contract F33615-77-C-0075)
(AD-A096688; D194-10089-1) Avail: NTIS HC A08/MF A01 CSCL 05/1

This report describes the results of the first four tasks of an eight task study. The total effort is intended to develop more accurate metrics and weightings to be incorporated into the Air Force method (Logistics Composite Model (LCOM)) for determining manpower and other resource requirements for operational and developing weapon systems. The approach taken for this portion of the study effort was to identify, obtain, review and catalog related research and/or descriptive studies; select a representative cross section of aircraft and subsystems/equipments; identify and select applicable study parameters/variables; and acquire field experience data from various maintenance management information systems and on-site visits to operational units. The data base thus accumulated was computer processed via LCOM criteria in preparation for follow-on analysis. GRA

N81-22972# Boeing Co., Seattle, Wash. Product Support/ Experience Analysis Center.
DEVELOPMENT OF MAINTENANCE METRICS TO FORECAST RESOURCE DEMANDS OF WEAPON SYSTEM. MAINTENANCE METRICS AND WEIGHTINGS, REVISION A Interim Report, 1 Nov. 1978 - 1 Oct. 1979
Donald K. Hindes, Gary A. Walker, David H. Wilson, and Frank Maher (AF Human Resources Lab., Wright-Patterson AFB) Oct. 1980 383 p refs Revised
(Contract F33615-77-C-0075)
(AD-A096689; D194-10089-3) Avail: NTIS HC A17/MF A01 CSCL 05/1

The approach taken for this portion of the study effort was to utilize the source data identified in Task V as inputs to develop statistical models for the estimation and prediction of the maintenance action demands of the equipment items selected for study. The data case values acquired for the lists of hardware, operational parameters which were found in Task V (Analyzing and Prioritizing Parameters) to be directly and strongly related to the maintenance demand rates of the selected equipment items were reconstituted into input data sets for the modeling process. This process resulted in one hardware, one operational, and one environmental data set being associated with each aircraft subsystem studied. Step-wise regression analysis was then applied to each data set for each subsystem's equipment to obtain best fit multiple regression equations explaining maintenance action demand as a function of equipment characteristic parameters, as a function of operational characteristic parameters, and as a function of environmental characteristic parameters. These separate equations for each type of parameter consitute 'generic' Maintenance Metrics and Weightings Models which facilitate the estimation of expected maintenance action demand for any aircraft subsystem when only equipment characteristics, only operational characteristics, or only environmental characteristics are known. GRA

N81-22973# Boeing Co., Seattle, Wash. Product Support/ Experience Analysis Center.
DEVELOPMENT OF MAINTENANCE METRICS TO FORECAST RESOURCE DEMANDS OF WEAPON SYSTEMS. ANALYSIS AND RESULTS OF METRICS AND WEIGHTINGS, REVISION A Interim Report, 1 Nov. 1978 - 1 Oct. 1979
Donald K. Hindes, Gary A. Walker, David H. Wilson, and Frank Maher (AF Human Resources Lab., Wright-Patterson, AFB, Ohio) Nov. 1980 164 p refs Revised
(Contract F33615-77-C-0075)
(AD-A096690; D194-10089-4) Avail: NTIS HC A08/MF A01 CSCL 05/1

This report describes the method and results of the eighth task to Develop Maintenance Metrics to Forecast Resource Demands of Weapon Systems. The purpose of this task was to perform simulation experiments with existing LCOM aircraft simulators using the newly developed maintenance metrics and weightings in order to validate the techniques and data developed during the course of this study. The findings indicate that the new maintenance metrics predictor equations can provide acceptable estimations of overall aircraft maintenance demand rates under a wide variety of equipment, operational, and environmental characteristics. These general models could be used for predicting equipment failure rates in many user situations such as LCOM analyses and new aircraft concept definition. GRA

N81-22974# Arinc Research Corp., Annapolis, Md.
AIRCRAFT MODIFICATION MANAGEMENT EVALUATION Final Report
S. Baily Dec. 1980 115 p refs
(Contract F33615-80-C-5102)
(AD-A096458) Avail: NTIS HC A06/MF A01 CSCL 05/1

Because of the long lead times and large budgetary outlays associated with major weapon system acquisitions, it is planned that most of the current inventory of US Air Force aircraft types will remain in service through the 1990s. As a result of this continued use of existing aircraft, the Air Force must pursue an aggressive modernization program to maintain the force structure at a high level of operational readiness. Rapidly expanding technology is being exploited to maintain a high degree of capability in an aging force. These factors are expected to result in an extensive aircraft retrofit program at least through the year 2000. To ensure the smooth implementation of this modification effort for aircraft weapon systems, the Air Force must continue to improve modification management techniques. Fundamental problem areas exist in current Air Force management techniques for aircraft modification. Therefore, this analysis was undertaken (1) to identify, define, and validate the most significant problem areas in aircraft modification management; (2) to examine the cause-and-effect relationship of identified problems and develop a structured approach to their resolution; and (3) to identify topics requiring research and initiatives leading to improvement in aircraft modification management. GRA

N81-23008# European Space Agency, Paris (France).
CONTRIBUTIONS TO THE 9TH SYMPOSIUM ON AIRCRAFT INTEGRATED DATA SYSTEMS
Feb. 1981 370 p refs Transl. into ENGLISH of "Beitrage zum 9 Symp. Bordintergrierte Flugdatensysteme" DFVLR, Brunswick Report DFVLR-Mitt-79-03, Feb. 1978 p 7-362 Proceedings held at Friedrichshafen, West Germany, 26-27 Sep. 1978 Original report in GERMAN previously announced as N80-25275
(ESA-TT-532; DFVLR-Mitt-79-03) Avail: NTIS HC A16/MF A01
Aircraft subsystems which are required for the detection, description, and recording of the aircraft operating conditions as well as the flight events are addressed. These systems supply the crew with flight information necessary for an effective execution of the flight mission. Safety and economics are among the factors considered. For individual titles, see N81-23009 through N81-23023.

N81-23009# European Space Agency, Paris (France).
EXPERIENCES WITH A FLIGHT DATA RECORDING SYSTEM (FDRS) IN A GERMAN AIRFORCE FIGHTER BOMBER WING AFTER FIELD TRIALS
H. Harsch (Jagdbombergeschwader 34 Memmingen) *In its* Contrib. to the 9th Symp. on Aircraft Integrated Data Systems (ESA-TT-532) Feb. 1981 p 10-24 Transl. into ENGLISH of "Beitrage zum 9 Symp. Bordintegrierte Flugdatensysteme" (Brunswick) DFVLR-Mitt-79-03, Feb. 1979 p 11-26

Avail: NTIS HC A16/MF A01
A one year test of the LEADS-200 digital flight data recording and processing system was carried out. Both hardware and software aspects of the system are described. The test data are given and discussed in detail. Accident and maintenance aspects, flight safety, and operational management are emphasized. Author (ESA)

N81-23010# European Space Agency, Paris (France).
ENGINE PARAMETER TREND ANALYSIS WITH LEADS 200: POSSIBILITIES AND LIMITATIONS
W. Koschel (Lehrstuhl und Inst. fuer Strahlantriebe und turboarbeitsmaschinen der Technischen Hochschule Aachen) *In its* Contrib. to the 9th Symp. on Aircraft Integrated Data Systems (ESA-TT-532) Feb. 1981 p 25-52 Transl. into ENGLISH of "Beitrage zum 9 Symp. Bordintegrierte Flugdatensysteme" (Brunswick) DFVLR-Mitt-79-03, Feb. 1979 p 27-52

Avail: NTIS HC A16/MF A01
Causes of fighter aircraft engine damage were analyzed in order to identify engine components that should be monitored over the long term so as to ensure aircraft safety. The possibility of recognizing deterioration of these components using data from the LEADS 200 flight recorder system is discussed and illustrated using performance data from the J79-MTU-K1K engine system. Author (ESA)

N81-23011# European Space Agency, Paris (France).
INVESTIGATIONS INTO LOCAL FAULT DETECTION ON TURBOJET ENGINES
H. Toenskoetter (Inst. fuer Strahlantriebe und Turboarbeitsmaschinen Rheinisch-Westfaelische Technische Hochschule Aachen) *In its* Contrib. to the 9th Symp. on Aircraft Integrated Data Systems (ESA-TT-532) Feb. 1981 p 53-79 Transl. into ENGLISH of "Beitrage zum 9 Symp. Bordintegrierte Flugdatensysteme" (Brunswick) DFVLR-Mitt-79-03, Feb. 1979 p 57-83
Avail: NTIS HC A16/MF A01
Results of the experimental investigations carried out with simulated faults in a single spool turbojet engine are presented. The effect of small disturbances, such as low compressor air bleed, a single removed turbine guide vane, or one plugged fuel nozzle on local and circumferentially averaged aerothermodynamic parameters are described. The location of the investigated faults by an engine condition monitoring system is studied and the possibility of including an analysis of circumferential flow nonuniformities at turbine exit for fault detection in the hot section of an engine is discussed. Author (ESA)

N81-23012# European Space Agency, Paris (France).
LOCATION OF FAULTS IN JET ENGINES BY CALCULATION OF COMPONENT CHARACTERISTICS
G. Dahl (Brunswick Univ.) *In its* Contrib. to the 9th Symp. on Aircraft Integrated Data Systems (ESA-TT-532) Feb. 1981 p 80-106 Transl. into ENGLISH of "Beitrage zum 9 Symp. Bordintegrierte Flugdatensysteme" (Brunswick) DFVLR-Mitt-79-03, Feb. 1979 p 85-112

Avail: NTIS HC A16/MF A01
A method to calculate the component characteristics of single spool jet engines was developed using measured engine data. The method was tested by simulating many different faults on a J-65 engine, recording measured engine data, and performing a fault diagnosis on the basis of the measured data. The method is capable of locating single and multiple faults of arbitrary nature and magnitude. Author (ESA)

N81-23013# European Space Agency, Paris (France).
THE ENGINE USAGE MONITORING SYSTEM: AN HEURISTIC APPROACH TO COST EFFECTIVE DATA MONITORING AND ANALYSIS
F. Robinson (Rolls Royce, Ltd., Bristol) *In its* Contrib. to the 9th Symp. on Aircraft Integrated Data Systems ESA-TT-532) Feb. 1981 p 107-134 Transl. into ENGLISH of "Beitrage zum 9 Symp. Bordintergrierte Flugdatensysteme" (Brunswick) DFVLR-Mitt-79-03, Feb. 1979 p 113-138

Avail: NTIS HC A16/MF A01
An engine monitoring system is described that is capable of accurately measuring low cycle fatigue during service operations. Up to 16 parameters relating to engine reliability can be recorded at intervals 0.5 sec. Data are recorded on cassettes for ground processing. Author (ESA)

N81-23014# European Space Agency, Paris (France).
RELATIONSHIPS FOR A FLIGHT PERFORMANCE COMPUTER
M. Kloster *In its* Contrib. to the 9th Symp. on Aircraft Integrated Data Systems (ESA-TT-532) Feb. 1981 p 135-146 Transl. into ENGLISH of "Beitrage zum 9 Symp. Bordintergrierte Flugdatensysteme" (Brunswick) DFVLR-Mitt-79-03, Feb. 1979 p 139-150
Avail: NTIS HC A16/MF A01
Formulas which approximate drag, thrust, and fuel consumption as functions of altitude and Mach number are discussed. Flight performance in the case of steepest climb and greatest acceleration is derived. It is shown that the resulting equations can be numerically solved by a small onboard computer. The formulas are simplified in order to obtain analytic relations. Author (ESA)

N81-23015# European Space Agency, Paris (France).
CLASSIFICATION OF OPERATING CONDITIONS OF TURBOMACHINES FROM SOLID BORNE SOUND
D. Barschdorf (Karlsruhe Univ.), B. Stuehlen (Karlsruhe Univ.), and W. Mach (Karlsruhe Univ.) *In its* Contrib. to the 9th Symp. on Aircraft Integrated Data Systems (ESA-TT-532) Feb. 1981 p 147-164 Transl. into ENGLISH of "Beitrage zum 9 Symp.

Bordintergrierte Flugdatensysteme" (Brunswick) DFVLR-Mitt-79-03, Feb. 1979 p 151-168

Avail: NTIS HC A16/MF A01

A method for continuously monitoring turbine engine conditions using acoustic signature procedures is presented. Rotor synchronous measurement of accelerometer values and formal pattern recognition methods are used. Correlation between measured data and certain working or fault machine conditions is accomplished by data collection during a learning phase. Only small computers are needed to implement the method. Author (ESA)

N81-23016# European Space Agency, Paris (France).
REDUCTION OF MEASURED DATA AND POSSIBILITIES FOR EARLY DETECTION OF SENSOR BREAK-DOWN
G. Dahl (Technische Univ., Brunswick) *In its* Contrib. to the 9th Symp. on Aircraft Integrated Data Systems (ESA-TT-532) Feb. 1981 p 165-181 Transl. into ENGLISH of "Beitrage zum 9 Symp. Bordintergrierte Flugdatensysteme" (Brunswick) DFVLR-Mitt-79-03, Feb. 1979 p 169-185

Avail: NTIS HC A16/MF A01

Procedures were developed that prepare and reduce automatically recorded data in order to assess the reliability of sensors. The data were divided into blocks of constant levels and statistical methods were used to determine their mean value, standard deviation, and regression line. A strong increase in the variation coefficient is found to indicate sensor faults. Author (ESA)

N81-23017# European Space Agency, Paris (France).
DESCRIPTION OF THE BRITISH CIVIL AVIATION AIRWORTHINESS DATA RECORDING PROGRAMME (CAADRP)
H. D. Ruben (Civil Aviation Authority, Redhill, England) *In its* Contrib. to the 9th Symp. on Aircraft Integrated Data Systems (ESA-TT-532) Feb. 1981 p 182-209 Transl. into ENGLISH of "Beitrage zum 9 Symp. Bordintergrierte Flugdatensysteme" (Brunswick) DFVLR-Mitt-79-03, Feb. 1979 p 187-214

Avail: NTIS HC A16/MF A01

The application of routine operational flight recorder data to airworthiness problems and the maintenance of safety standards are described. The various ways in which the data are analyzed, are illustrated with examples. A brief history of airworthiness data recording is presented as well. Author (ESA)

N81-23018# European Space Agency, Paris (France).
THE SYDAS FLIGHT DATA PROCESSING SYSTEM
C. Dupuy (Enertec Schlumberger, Paris) *In its* Contrib. to the 9th Symp. on Aircraft Integrated Data Systems (ESA-TT-532) Feb. 1981 p 210-229 Transl. into ENGLISH of "Beitrage zum 9 Symp. Bordintergrierte Flugdatensysteme" (Brunswick) DFVLR-Mitt-79-03, Feb. 1979 p 215-235

Avail: NTIS HC A16/MF A01

The use of the SYDAS system for the maintenance and safety of aircraft is shown. Data from a variety of aircraft types are processed automatically and completely. The system checks syncword and aircraft data system calibration, verifies time sequencing, displays documentary data, converts parameters into engineering units, identifies flight modes, checks limit exceedances, and records condensed data as well as flight anomalies separately. Data may be presented as lists, or graphs and plots of flight paths while statistical calculations are possible. Unique features of the system include both bit and frame synchronizers. The functions of the system during the data acquisition and reduction phase are also described. Author (ESA)

N81-23019# European Space Agency, Paris (France).
THE USE OF AIRCRAFT INTEGRATED DATA SYSTEM AT KLM
R. A. Hartman (KLM Royal Dutch Airlines, Schiphol Airport) *In its* Contrib. to the 9th Symp. on Aircraft Integrated Data Systems (ESA-TT-532) Feb. 1981 p 230-262 Transl. into ENGLISH of "Beitrage zum 9 Symp. Bordintergrierte Flugdatensysteme" (Brunswick) DFVLR-Mitt-79-03, Feb. 1979 p 237-268

Avail: NTIS HC A16/MF A01

An aircraft integrated data system that is able to interrogate up to 350 parameters of some 40 aircraft systems is described. Sampled flight data are recorded and subsequently analyzed by special ground based computer programs. The use of the output of these programs by engineering and operational departments to investigate incidents, aircraft, and flight crew performance, and flight safety is described. Author (ESA)

N81-23020# European Space Agency, Paris (France).
NAVAIDS CALIBRATION EVALUATION WITH A COMPUTER-CONTROLLED AVIONICS DATA ACQUISITION SYSTEM
F. J. Abbink (Nationaal Lucht-en Ruimtevaartlaboratorium, Amsterdam) and R. Krijn (Nationaal Lucht-en Ruimtevaartlaboratorium, Amsterdam) *In its* Contrib. to the 9th Symp. on Aircraft Integrated Data Systems (ESA-TT-532) Feb. 1981 p 263-324 Transl. into ENGLISH of "Beitrage zum 9 Symp. Bordintergrierte Flugdatensysteme" (Brunswick) DFVLR-Mitt-79-03, Feb. 1979 p 269-311

Avail: NTIS HC A16/MF A01

A computer system is described that allows the acquisition of aircraft data and their use to evaluate the applicability and accuracy of multidistance measuring equipment positioning. The system was also used as a reference for the calibration of both Doppler and standard VOR stations in the Netherlands and for the calibration of an inertial sensor system. The system is also used for the measurement of air traffic control radar signals. The power density of the pulses of the primary and secondary radar are presented as time histories, antenna patterns, and vertical coverage diagrams. Author (ESA)

N81-23021# European Space Agency, Paris (France).
THE RECONSTRUCTION OF FLIGHT PATHS FROM AIDS DATA WITH THE AID OF MODERN FILTERING METHODS
W. Benecke and K. Hurrass *In its* Contrib. to the 9th Symp. on Aircraft Integrated Data Systems (ESA-TT-532) Feb. 1981 p 325-337 refs Transl. into ENGLISH of "Beitrage zum 9 Symp. Bordintergrierte Flugdatensysteme" (Brunswick) DFVLR-Mitt-79-03, Feb. 1979 p 313-326

Avail: NTIS HC A16/MF A01

A method is described that allows the reconstruction of the flight path of an aircraft in cases when a modern, airborne, autonomous navigation system is unavailable. The method uses the true airspeed, the VOR bearing, and the DME distance and applies optimum smoothing techniques. The smoothing operation consists of two steps: (1) forward filtering (the Kalman filter equations are solved for the point in time considered, estimated values and the corresponding co-variance matrices are obtained as results), and (2) backward smoothing (the equations and the backward filter are solved backward in terms of time, the estimated values of the forward filter being used and improved). Data from a test flight are used to illustrate the method. Author (ESA)

N81-23022# European Space Agency, Paris (France).
DETECTION AND LOCATION OF FAULTS IN ONBOARD AIRCRAFT SYSTEMS WITH THE AID OF THE AUTOMATIC FAULT IDENTIFICATION SYSTEM (AFIS)
H. Kalbe (MBB, Hamburg) and F. Hildebrandt (MBB, Hamburg) *In its* Contrib. to the 9th Symp. on Aircraft Integrated Data Systems (ESA-TT-352) Feb. 1981 p 338-354 Transl. into ENGLISH of "Beitrage zum 9 Symp. Bordintergrierte Flugdatensysteme" (Brunswick) DFVLR-Mitt-79-03, Feb. 1979 p 327-344
Avail: NTIS HC A16/MF A01

A device to monitor aircraft systems performance is described. Operation modes include the continuous monitoring of aircraft systems, automatic fault identification, trend data sampling, and single signal interrogations. The microcomputer based system is operated onboard and results in improved maintenance activity, reduces the crew workload, and leads to increased dispatch reliability. Author (ESA)

N81-23023# European Space Agency, Paris (France).
PROCESSING OF AIDS FLIGHT RECORDER DATA FOR A QUICK LOOK WITH THE AID OF A HYBRID COMPUTER SYSTEM
H. Hoffman *In its* Contrib. to the 9th Symp. on Aircraft Integrated Data Systems (ESA-TT-532) Feb. 1981 p 355-370 Transl. into ENGLISH of "Beitrage zum 9 Symp. Bordintergrierte Flugdatensysteme" (Brunswick) DFVLR-Mitt-79-03, Feb. 1979 p 345-362
Avail: NTIS HC A16/MF A01
The translation of flight data recorder information into data which are stored in 12 bit words on computer compatible magnetic tape is described. The translation makes use of a hybrid computer and passes through the following steps: active filtering, use of a one bit analog to digital converter, and change from serial to parallel data. Author (ESA)

N81-23024# Aeronautical Research Labs., Melbourne (Australia).
STRUCTURAL DESIGN OF BFRP PATCHES FOR MIRAGE WING REPAIR
R. Jones and R. J. Callinan Jul. 1980 21 p refs
(AD-A097195; ARL/Struc-Note-461) Avail: NTIS HC A02/MF A01 CSCL 01/3
This paper is concerned with the design aspects of two repair schemes developed for application to the lower wing skin of Mirage aircraft. Both repairs involve bonding a boron fiber reinforced plastic (BFRP) patch to the wing skin. In one instance the skin is cracked and the patch is acting as a crack stopper, while in the other instance the patch covers a series of holes and its prime purpose is to lower the stress field. Author (GRA)

N81-23025# Missouri Univ. -Columbia. Dept. of Industrial Engineering.
AN ANALYSIS OF OPPORTUNISTIC MAINTENANCE POLICY FOR THE F100PW100 AIRCRAFT ENGINE Final Report, 1 Jan. - 31 Dec. 1980
Michael C. Smith 31 Dec. 1980 51 p refs
(Grant AF-AFOSR-0102-80; AF Proj. 2304)
(AD-A097548; AFOSR-81-0313TR) Avail: NTIS HC A04/MF A01 CSCL 01/3
An analytic model for computing optimal screening intervals for replacing life-limited parts in the F100PW100 aircraft engine is presented. The model involves determining the point in advance of a part life limit where the marginal cost of replacing a part equals the marginal expected cost of not replacing the part. The policy results in a set of Conditional Part Level (CPL) screens conditioned o- the status of the module and engine at the time of engine removal. The policy is evaluated through comparison with a base/depot screening approach. The evaluation is accomplished through a simulation of the 20-year life cycle of the F100 engine. The evaluation demonstrates the economic and performance advantages of the CPL screening policy. Model assumptions include independent part failures and exponential failure distributions for parts without life limits. Further investigation of the impact of the assumptions is suggested.
Author (GRA)

N81-23030*# General Dynamics Corp., Fort Worth, Tex.
ANALYSIS OF WIND TUNNEL TEST RESULTS FOR A 9.39-PER CENT SCALE MODEL OF A VSTOL FIGHTER/ATTACK AIRCRAFT. VOLUME 1: STUDY OVERVIEW Final Report, 10 Sep. 1979 - 10 Feb. 1981
J. R. Lummus, G. T. Joyce, and C. D. OMalley Oct. 1980 97 p 4 Vol.
(Contract NAS2-10344)
(NASA-CR-152391-Vol-1) Avail: NTIS HC A05/MF A01 CSCL 01A
The ability of current methodologies to accurately predict the aerodynamic characteristics identified as uncertainties was evaluated for two aircraft configurations. The two wind tunnel models studied horizontal altitude takeoff and landing V/STOL fighter aircraft derivatives. R.C.T.

N81-23031*# General Dynamics Corp., Fort Worth, Tex.
ANALYSIS OF WIND TUNNEL TEST RESULTS FOR A 9.39-PER CENT SCALE MODEL OF A VSTOL FIGHTER/ATTACK AIRCRAFT. VOLUME 2: EVALUATION OF PREDICTION METHODOLOGIES Final Report, 10 Sep. 1979 - 10 Feb. 1981
J. R. Lummus, G. T. Joyce, and C. D. OMalley Oct. 1980 139 p 4 Vol.
(Contract NAS2-10344)
(NASA-CR-152391-Vol-2) Avail: NTIS HC A07/MF A01 CSCL 01A
An evaluation of current prediction methodologies to estimate the aerodynamic uncertainties identified for the E205 configuration is presented. This evaluation was accomplished by comparing predicted and wind tunnel test data in three major categories: untrimmed longitudinal aerodynamics; trimmed longitudinal aerodynamics; and lateral-directional aerodynamic characteristics. R.C.T.

N81-23032*# General Dynamics Corp., Fort Worth, Tex.
ANALYSIS OF WIND TUNNEL TEST RESULTS FOR A 9.39-PER CENT SCALE MODEL OF A VSTOL FIGHTER/ATTACK AIRCRAFT. VOLUME 3: EFFECTS OF CONFIGURATION VARIATIONS FROM BASELINE Final Report, 10 Sep. 1970 - 11 Nov. 1980
J. R. Lummus, G. T. Joyce, and C. D. OMalley Oct. 1980 373 p 4 Vol.
(Contract NAS2-10344)
(NASA-CR-152391-Vol-3) Avail: NTIS HC A16/MF A01 CSCL 01A
The aerodynamic characteristics of the components of the baseline E205 configuration is presented. Geometric variations from the baseline E205 configuration are also given including a matrix of conrad longitudinal locations and strake shapes. R.C.T.

N81-23033*# General Dynamics Corp., Fort Worth, Tex.
ANALYSIS OF WIND TUNNEL TEST RESULTS FOR A 9.39-PER CENT SCALE MODEL OF A VSTOL FIGHTER/ATTACK AIRCRAFT. VOLUME 4: RALS R104 AERODYNAMIC CHARACTERISTICS AND COMPARISONS WITH E205 CONFIGURATION AERODYNAMIC CHARACTERISTICS Final Report, 10 Sep. 1979 - 10 Feb. 1981
J. R. Lummus, G. T. Joyce, and C. D. OMalley Oct. 1980 136 p 4 Vol.
(Contract NAS2-10344)
(NASA-CR-152391-Vol-4) Avail: NTIS HC A07/MF A01 CSCL 01A
The longitudinal and lateral-directional aerodynamic characteristics of the RALS R104 wind tunnel model are summarized. Configurations for the E205 are also presented for comparison.
R.C.T.

N81-23034*# Old Dominion Univ., Norfolk, Va.
INVESTIGATION OF AERODYNAMIC CHARACTERISTICS OF WINGS HAVING VORTEX FLOW USING DIFFERENT NUMERICAL CODES Progress Report, 1 Sep. 1978 - 31 Aug. 1979
C. Subba Reddy and G. L. Goglia Apr. 1981 59 p refs
(Grant NsG-1561)
(NASA-CR-165706) Avail: NTIS HC A04/MF A01 CSCL 01A
The aerodynamic characteristics of highly sweptback wings having separation-induced vortex flow were investigated by employing different numerical codes with a view to determining some of the capabilities and limitations of these codes. Flat wings of various configurations-strake wing models, cropped, diamond, arrow and double delta wings, were studied. Cambered and cranked planforms have also been tested. The theoretical results predicted by the codes were compared with the experimental data, wherever possible, and found to agree favorably for most of the configurations investigated. However, large cambered wings could not be successfully modeled by the codes. It appears that the final solution in the free vortex sheet method is affected by the selection of the initial solution. Accumulated span loadings estimated for delta and diamond wings were found to be unusual in comparison with attached flow results in that

the slopes of these load curves near the leading edge do not tend to infinity as they do in the case of attached flow. Author

N81-23035*# Massachusetts Inst. of Tech., Cambridge. Dept. of Aeronautics and Astronautics.

AN ASYMPTOTIC UNSTEADY LIFTING-LINE THEORY WITH ENERGETICS AND OPTIMUM MOTION OF THRUST-PRODUCING LIFTING SURFACES Thesis

Ali Reza Ahmadi Apr. 1981 345 p refs
(Grant NGR-22-009-818)
(NASA-CR-165679) Avail: NTIS HC A15/MF A01 CSCL 01A

A low frequency unsteady lifting-line theory is developed for a harmonically oscillating wing of large aspect ratio. The wing is assumed to be chordwise rigid but completely flexible in the span direction. The theory is developed by use of the method of matched asymptotic expansions which reduces the problem from a singular integral equation to quadrature. The wing displacements are prescribed and the pressure field, airloads, and unsteady induced downwash are obtained in closed form. The influence of reduced frequency, aspect ratio, planform shape, and mode of oscillation on wing aerodynamics is demonstrated through numerical examples. Compared with lifting-surface theory, computation time is reduced significantly. Using the present theory, the energetic quantities associated with the propulsive performance of a finite wing oscillating in combined pitch and heave are obtained in closed form. Numerical examples are presented for an elliptic wing. M.G.

N81-23036*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

TWO-DIMENSIONAL AERODYNAMIC CHARACTERISTICS OF THE NACA 0012 AIRFOIL IN THE LANGLEY 8 FOOT TRANSONIC PRESSURE TUNNEL

Charles D. Harris Apr. 1981 139 p refs
(NASA-TM-81927) Avail: NTIS HC A07/MF A01 CSCL 01A

Data are presented for lift coefficients from near zero through maximum values at Mach numbers from 0.30 to 0.86 and Reynolds numbers of 3.0 x 10 to the sixth power with transition fixed. A limited amount of data is presented near zero and maximum lift for a Reynolds number of 6.0 x 10 to the sixth power with transition fixed. In addition, transition free data is presented through the Mach number range from 0.30 to 0.86 for near zero lift and a Reynolds number of 3.0 x 10 to the sixth power. T.M.

N81-23037*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

TOPOLOGY OF THREE-DIMENSIONAL SEPARATED FLOWS

Murray Tobak and David J. Peake Apr. 1981 46 p refs
(NASA-TM-81294; A-8554) Avail: NTIS HC A03/MF A01 CSCL 01A

Based on the hypothesis that patterns of skin-friction lines and external streamlines reflect the properties of continuous vector fields, topology rules define a small number of singular points (nodes, saddle points, and foci) that characterize the patterns on the surface and on particular projections of the flow (e.g., the crossflow plane). The restricted number of singular points and the rules that they obey are considered as an organizing principle whose finite number of elements can be combined in various ways to connect together the properties common to all steady three dimensional viscous flows. Introduction of a distinction between local and global properties of the flow resolves an ambiguity in the proper definition of a three dimensional separated flow. Adoption of the notions of topological structure, structural stability, and bifurcation provides a framework to describe how three dimensional separated flows originate and succeed each other as the relevant parameters of the problem are varied. Author

N81-23039*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

FULL-SCALE AERODYNAMIC CHARACTERISTICS OF A PROPELLAR INSTALLED ON A SMALL TWIN-ENGINE AIRCRAFT WING PANEL

Philip R. Barlow, Victor R. Corsiglia, and Joseph Katz May 1981 22 p refs
(NASA-TM-81285; A-8478) Avail: NTIS HC A02/MF A01 CSCL 01A

Full-scale measurements of shaft thrust and torque were made. Wind-tunnel speeds and blade angles were set for full-scale flight conditions. Excellent quality measurements were obtained of the thrust coefficient, the power coefficient, and the propeller efficiency for various values of the advance ratio and the blade incidence angle at 3/4-blade radius. A conventional propeller theory found in the literature was applied to the present results. Although thrust, power, and efficiency were somewhat overpredicted, the advance ratio for maximum efficiency was predicted quite accurately. It was found that, for some conditions, spinner drag could be significant. A simple correction that was based on the spinner base pressure substantially accounted for the changes in efficiency that resulted from this cause. T.M.

N81-23043# Naval Air Development Center, Warminster, Pa. Aircraft and Crew Systems Technology Directorate.

METHOD FOR PREDICTING THE JET-INDUCED AERODYNAMICS OF V/STOL CONFIGURATIONS IN TRANSITION Interim Report

Marvin M. Walters and Robert E. Palmer 30 Jan. 1981 41 p refs
(WF41400000)
(AD-A097356; NADC-80205-60) Avail: NTIS HC A03/MF A01 CSCL 20/4

A method for predicting the propulsive induced aerodynamics of a VSTOL aircraft in the transition flight regime is presented. This method is applicable to low-wing, circular jet subsonic VSTOL configurations with normally exhausting jets. Validation results for various VSTOL configurations are also presented. Author (GRA)

N81-23052# Royal Aircraft Establishment, Farnborough (England). Structures Dept.

EXPERIMENTAL FLUTTER AT HIGH SUBSONIC SPEEDS AND ITS THEORETICAL PREDICTION, TAKING INTO ACCOUNT WING THICKNESS AND REYNOLDS NUMBER

H. C. Garner and B. W. Payne (British Aerospace Aircraft Group, Weybridge, England) *In* AGARD Boundary Layer Effects on Unsteady Airloads Feb. 1981 21 p refs

Avail: NTIS HC A08/MF A01

Half model flutter tests of a symmetrical high aspect ratio wing at stream Mach numbers M sub infinity between 0.75 and 0.90 are described. Equivalent air speeds at flutter, calculated with aerodynamics from subsonic lifting surface theory, are in fairly good agreement with the measured values up to M sub infinity = 0.86 In the range 0.86 < M sub infinity 0.89 the measured flutter speed increases rapidly until the flow is stable, contrary to the predictions with the linear theoretical aerodynamics. However, the use of approximate theories compatible with steady and quasi-steady aerodynamics flow transonic small perturbation (TSP) theory leads to the correct qualitative behavior of flutter speed. With inviscid TSP aerodynamics the rapid rise in flutter speed is anticipated by about 0.02 in M sub infinity, but allowance for the boundary layers is shown to halve this discrepancy. T.M.

N81-23053*# Scientific Research Associates, Inc., Glastonbury, Conn.

ANALYSIS OF TURBULENT FLOW ABOUT AN ISOLATED AIRFOIL USING A TIME DEPENDENT NAVIER-STOKES PROCEDURE

S. J. Shamroth and H. J. Gibeling *In* AGARD Boundary Layer Effects on Unsteady Airfoils Feb. 1981 14 p refs Sponsored in cooperation with Army Research and Technology Lab.

(Contract NAS1-15214)
Avail: NTIS HC A08/MF A01 CSCL 01A

The procedure solves the Navier-Stokes equations by the consistently split linearized block implicit method of Briley and McDonald in a body fitted coordinate system. The procedure is described and results are presented for flow about an airfoil whose incidence changes from 6 degrees to 19 degrees at a Reynolds number of one million and Mach number of 0.2. In addition, the unsteady flow about an airfoil held at a constant 19 degree incidence is examined and compared to data. T.M.

N81-23054*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EXPERIMENTAL STUDIES OF SCALE EFFECTS ON OSCILLATING AIRFOILS AT TRANSONIC SPEEDS
Sanford S. Davis *In* AGARD Boundary Layer Effects on Unsteady Airfoils Feb. 1981 13 p refs
N81-23044 14-02)
Avail: NTIS HC A08/MF A01 CSCL 01A
Scale effects are discussed with reference to a conventional airfoil (NACA 64A010) and a supercritical airfoil (NLR 7301) at mean flow conditions that support both weak and strong shock waves. During the experiment the Reynolds number was varied from 3 x 10 to the sixth power at time history data are presented over the range of reduced frequencies that are important in aeroelastic applications. The experimental data show that viscous effects are important in the case of the supercritical airfoil at all flow conditions and in the case of the conventional airfoil under strong shock wave conditions. Some frequency dependent viscous effects were also observed. T.M.

N81-23055# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Inst. fuer Aeroelastik.
SOME REMARKS ON THE UNSTEADY AIRLOADS ON OSCILLATING CONTROL SURFACES IN SUBSONIC FLOW
H. Foersching *In* AGARD Boundary Layer Effects on Unsteady Airloads Feb. 1981 8 p refs

Avail: NTIS HC A08/MF A01
Parameters which are neglected within the framework of linearized potential flow theory, but which are highly influential in the development of unsteady airloads on oscillating control surfaces in subsonic flow are discussed. Based on theoretical and experimental results the effects of gap width and slot geometry, finite thickness, flow viscosity, and incidence of both wing and control surface are explained. Some topics for further research work with regard to active control applications are indicated. Author

N81-23056# Royal Aircraft Establishment, Bedford (England). Structures Dept.
OSCILLATORY FLOWS FROM SHOCK INDUCED SEPARATIONS ON BICONVEX AEROFOILS OF VARYING THICKNESS IN VENTILATED WIND TUNNELS
D. G. Mabey *In* AGARD Boundary Layer Effects on Unsteady Airfoils Feb. 1981 14 p refs

Avail: NTIS HC A08/MF A01
The flow instability boundaries on a series of biconvex airfoils with thickness/chord ratios varying from 10 to 20%, set at zero incidence, were measured in a small transonic tunnel. The region of flow instability with laminar boundary layer/shock wave interactions was a little wider than the corresponding region with turbulent boundary layer/shock wave interactions. A criterion for the occurrence of the instability was developed from the measurements. Some interesting examples of dynamic wall interference effects were observed in the slotted working sections with hard slats, which were greatly reduced in the alternative slotted working sections with slats made from sound absorbing laminates. Interesting examples of dynamic interference were also observed in special comparative tests in closed working sections formed by hard or laminate walls. T.M.

N81-23058*# Douglas Aircraft Co., Inc., Long Beach, Calif.
STUDY TO DEVELOP IMPROVED FIRE RESISTANT AIRCRAFT PASSENGER SEAT MATERIALS Final Report, 4 Dec. 1979 - 30 Sep. 1980
Fred E. Duskin, Kenneth J. Schutter, Howard H. Sieth, and Edward L. Trabold Aug. 1980 128 p refs
(Contract NAS2-9337)
(NASA-CR-152408; MDC-J4665) Avail: NTIS HC A07/MF A01 CSCL 01C
The Phase 3 study of the NASA 'Improved Fire Resistant Aircraft Seat Materials' involved fire tests of improved materials in multilayered combinations representative of cushion configurations. Tests were conducted to determine their thermal, smoke, and fire resistance characteristics. Additionally, a 'Design Guideline' for Fire Resistant Passenger Seats was written outlining general seat design considerations. Finally, a three-abreast 'Tourist Class' passenger seat assemmbly fabricated from the most advanced fire-resistant materials was delivered. Author

N81-23059*# Boeing Commercial Airplane Co., Seattle, Wash.
MLS: AIRPLANE SYSTEM MODELING
A. D. Thompson, B. P. Stapleton, D. B. Walen, P. F. Rieder, and D. G. Moss Apr. 1981 133 p refs
(Contract NAS1-14880)
(NASA-CR-165700; D6-48724) Avail: NTIS HC A07/MF A01 CSCL 17G
Analysis, modeling, and simulations were conducted as part of a multiyear investigation of the more important airplane-system-related items of the microwave landing system (MLS). Particular emphasis was placed upon the airplane RF system, including the antenna radiation distribution, the cabling options from the antenna to the receiver, and the overall impact of the airborne system gains and losses upon the direct-path signal structure. In addition, effort was expended toward determining the impact of the MLS upon the airplane flight management system and developing the initial stages of a fast-time MLS automatic control system simulation model. Results ot these studies are presented. A.R.H.

N81-23060# Federal Aviation Administration, Atlantic City, N.J.
A MICROCOMPUTER-BASED SIGNAL DATA CONVERTER FOR RUNWAY VISUAL RANGE MEASUREMENTS Final Report, Oct. 1979 - Apr. 1980
David M. Wainland, Glenn J. Horton, and Howard J. Meeks Feb. 1981 43 p refs
(FAA Proj. 219-151-200)
(AD-A097568; FAA-CT-80-43) Avail: NTIS HC A03/MF A01 CSCL 09/2
A laboratory model microcomputer-based Runway Visual Range (RVR) System was designed and built at the Federal Aviation Administration (FAA) Technical Center. The system includes a Microcomputer Signal Data Converter (SDC), a Remote Display, a local maintenance terminal, a cassette storage unit, a Transmissivity Display, and a Transmissometer Simulator. The Microcomputer SDC computes RVR values for up to 12 transmissometers; previous SDC designs can calculate RVR values for only 1 transmissometer. Furthermore, the microcomputer-based RVR System provides alarm checking, data storage, and RS-232 compatible data outputs that are not available in other RVR systems. Based on the improved capabilities and the microcomputer's low cost, it is concluded that Microcomputer SDC's would be cost effective at airports using more than three transmissometers. Author (GRA)

N81-23061# Federal Aviation Administration, Atlantic City, N.J.
SUMMARY OF TRANSPONDER DATA, MAY 1979 - NOVEMBER 1979
Max Greenberg Feb. 1981 29 p refs
(AD-A097569; FAA-CT-81-5) Avail: NTIS HC A03/MF A01 CSCL 17/7
The purpose of this effort was to determine the performance characteristics of air traffic control radar beacon transponders in an operational environment in general aviation aircraft. A transponder performance analyzer (TPA) was developed at the Federal Aviation Administration Technical Center to measure performance parameters of transponders installed in aircraft. The TPA was installed in a bus for mobility and simulates an air traffic control beacon interrogator (ATCBI) to facilitate measurement of 15 transponder parameters in approximately 30 seconds. A standard gain horn antenna is utilized to couple the signals between the TPA bus and the aircraft. Transponder data were collected at six different geographic locations resulting

in more than 690 samples of general aviation transponders. Results show that 42 percent of the transponders met all measured parameters. This is a slight improvement over the 1977/1978 data and is attributed to inclusion of data collected at general aviation airports in the Atlanta area. It is recommended that a study be conducted to determine the effects of transponder performance on the air traffic control systems (Automated Radar Terminal System (ARTS) and National Airspace System (NAS)) by individually varying each of the 15 parameters outside of their specification limits. Author (GRA)

N81-23062# Army Aviation Development Test Activity, Fort Rucker, Ala.
FUNCTIONAL TESTING AIRBORNE NAVIGATION EQUIPMENT Final Report
3 Mar. 1981 35 p refs
(AD-A097115; TOP-6-3-205; DARCOM-R-310-6; DRSTE-RP-702-105) Avail: NTIS HC A03/MF A01 CSCL 17/7

This document provides guidance and procedures for performance testing airborne navigation equipment. The document addresses the following: Flight Planning, Range Test, Rotor Modulation, Accuracy, and Influence of Weather. It provides the test officer with general information and guidance in test preparation, test controls, test conduct, and data reduction. Author (GRA)

N81-23063# Lincoln Lab., Mass. Inst. of Tech., Lexington.
ELECTRONIC FLIGHT RULES: AN ALTERNATIVE SEPARATION ASSURANCE CONCEPT
John W. Andrews and Walter M. Hollister 31 Dec. 1980 99 p refs
(Contracts F19628-80-C-0002; DOT-FA72WAI-261)
(AD-A097570; ATC-93; FAA-RD-80-2) Avail: NTIS HC A05/MF A01 CSCL 17/7

This report presents results of a study of alternative concepts for tactically separating aircraft in low altitude en route airspace. It describes a concept designated Electronic Flight Rules (EFR) which allows aircraft to fly under instrument meteorological conditions in a manner that retains most of the freedom and flexibility of VFR flight. Feasibility considerations, potential benefits, applicable technologies, and alternative system configurations are evaluated. Author (GRA)

N81-23064*# Boeing Vertol Co., Philadelphia, Pa.
PRELIMINARY DESIGN STUDY OF ADVANCED COMPOSITE BLADE AND HUB AND NONMECHANICAL CONTROL SYSTEM FOR THE TILT-ROTOR AIRCRAFT. VOLUME 1: ENGINEERING STUDIES Final Report
H. R. Alexander, K. E. Smith, M. A. McVeigh, P. G. Dixon, and B. L. McManus Nov. 1979 263 p refs 2 Vol.
(Contract NAS2-10160)
(NASA-CR-152336-1; D210-11569-1-Vol-1) Avail: NTIS HC A12/MF A01 CSCL 01C

Composite structures technology is applied in a preliminary design study of advanced technology blades and hubs for the XV-15 tilt rotor research demonstrator aircraft. Significant improvements in XV-15 hover and cruise performance are available using blades designed for compatibility with the existing aircraft, i.e., blade installation would not require modification of the airframe, hub or upper controls. Provision of a low risk nonmechanical control system was also studied, and a development specification is given. Author

N81-23065*# Boeing Vertol Co., Philadelphia, Pa.
PRELIMINARY DESIGN STUDY OF ADVANCED COMPOSITE BLADE AND HUB AND NONMECHANICAL CONTROL SYSTEM FOR THE TILT-ROTOR AIRCRAFT. VOLUME 2: PROJECT PLANNING DATA
Feb. 1980 65 p refs 2 Vol.
(Contract NAS2-10160)
(NASA-CR-152336-2; D210-11569-2-Vol-2) Avail: NTIS HC A04/MF A01 CSCL 01C

Project planning data for a rotor and control system procurement and testing program for modifications to the XV-15 tilt-rotor research demonstrator aircraft is presented. The design, fabrication, and installation of advanced composite blades compatible with the existing hub, an advanced composite hub, and a nonmechanical control system are required. J.D.H.

N81-23066*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.
COMPARISON OF THEORETICAL PREDICTIONS OF ORBITER AIRLOADS WITH WIND TUNNEL AND FLIGHT TEST RESULTS FOR A MACH NUMBER OF 0.52
Alan L. Carter and Robert L. Sims May 1981 33 p refs
(NASA-TM-81358) Avail: NTIS HC A03/MF A01 CSCL 01C

The measurement and prediction of wing airloads for space shuttle orbiter 101 during approach and landing tests is discussed. Strain gage instrumentation, calibration, and flight data processing are covered along with wind tunnel and simulator results. The generation of theoretical predictions using the FLEXSTAB computer program is described, and the results are compared to experimental measurements. A.R.H.

N81-23067*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.
A COMPARISON OF LABORATORY MEASURED TEMPERATURES WITH PREDICTIONS FOR A SPAR/SKIN TYPE AIRCRAFT STRUCTURE
Jerald M. Jenkins May 1981 23 p refs
(NASA-TM-81359) Avail: NTIS HC A02/MF A01 CSCL 01C

A typical spar/skin aircraft structure was heated nonuniformly in a laboratory and the resulting temperatures were measured. The heat transfer NASTRAN computer program was used to provide predictions. Calculated temperatures based on a thermal model with conduction, radiation, and convection features compared closely to measured spar temperatures. Results were obtained without the thermal conductivity, specific heat, or emissivity with temperature. All modes of heat transfer (conduction, radiation, and convection) show to affect the magnitude and distribution of structural temperatures. E.A.K.

N81-23068*# Grumman Aerospace Corp., Bethpage, N.Y.
AIRCRAFT WING WEIGHT BUILD-UP METHODOLOGY WITH MODIFICATION FOR MATERIALS AND CONSTRUCTION TECHNIQUES Final Report
Peter York and Raymond W. Labell Sep. 1980 120 p refs
(Contract NAS2-9805)
(NASA-CR-166173) Avail: NTIS HC A06/MF A01 CSCL 01C

An aircraft wing weight estimating method based on a component buildup technique is described. A simplified analytically derived beam model, modified by a regression analysis, is used to estimate the wing box weight, utilizing a data base of 50 actual airplane wing weights. Factors representing materials and methods of construction were derived and incorporated into the basic wing box equations. Weight penalties to the wing box for fuel, engines, landing gear, stores and fold or pivot are also included. Methods for estimating the weight of additional items (secondary structure, control surfaces) have the option of using details available at the design stage (i.e., wing box area, flap area) or default values based on actual aircraft from the data base. Author

N81-23069*# Douglas Aircraft Co., Inc., Long Beach, Calif.
COMMERCIAL AVIATION ICING RESEARCH REQUIREMENTS
L. P. Koegeboehn Apr. 1981 59 p refs
(Contract NAS3-22361)
(NASA-CR-165336) Avail: NTIS HC A04/MF A01 CSCL 01C

A short range and long range icing research program was proposed. A survey was made to various industry and goverment agencies to obtain their views of needs for commercial aviation ice protection. Through these responsed, other additional data, and Douglas Aircraft icing expertise; an assessment of the state-of-the-art of aircraft icing data and ice protection systems was made. The information was then used to formulate the icing research programs. S.F.

N81-23070*# Boeing Vertol Co., Philadelphia, Pa.
ROTORCRAFT AVIATION ICING RESEARCH REQUIREMENTS: RESEARCH REVIEW AND RECOMMENDATIONS Final Report
A. A. Peterson, L. Dadone, and A. Bevan May 1981 116 p refs
(Contract NAS3-22384)
(NASA-CR-165344; D210-11662-1) Avail: NTIS HC A06/MF A01 CSCL 01C

The status of rotorcraft icing evaluation techniques and ice protection technology was assessed. Recommendations are made for near and long term icing programs that describe the needs of industry. These recommended programs are based on a consensus of the major U.S. helicopter companies. Specific activities currently planned or underway by NASA, FAA and DOD are reviewed to determine relevance to the overall research requirements. New programs, taking advantage of current activities, are recommended to meet the long term needs for rotorcraft icing certification. A.R.H.

N81-23071*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
TRANSONIC FLUTTER STUDY OF A WIND-TUNNEL MODEL OF AN ARROW-WING SUPERSONIC TRANSPORT
Charles L. Ruhlin and Charles R. Pratt-Barlow (Boeing Commercial Airplane Co., Seattle) Apr. 1981 16 p refs Presented at the AIAA Struct. Dyn. Spec. Meeting, Atlanta, 9-10 Apr. 1981
(NASA-TM-81962) Avail: NTIS HC A02/MF A01 CSCL 01C

A 1/20-size, low-speed flutter model of the SCAT-15F complete airplane was tested on cables to simulate a near free-flying condition. Only the model wing and fuselage were flexible. Flutter boundaries were measured for a nominal configuration and a configuration with wing fins removed at Mach numbers M from 0.76 to 1.2. For both configurations, the transonic dip in the wing flutter dynamic pressure q boundary was relatively small and the minimum flutter q occurred near M = 0.92. Removing the wing fins increased the flutter q about 14 percent and changed the flutter mode from symmetric to antisymmetric. Vibration and flutter analyses were made using a finite-element structural representation and subsonic kernel-function aerodynamics. For the nominal configuration, the analysis (using calculated modal data) predicted the experimental flutter q levels within 10 percent but did not predict the correct flutter mode at the higher M. For the configuration without wing fins, the analysis predicted 16 to 36 percent unconservative (higher than experimental) flutter q levels and showed extreme sensitivity to mass representation details that affected wing tip mode shapes. For high subsonic M, empennage aerodynamics had a significant effect on the predicted flutter boundaries of several symmetric modes. A.R.H.

N81-23072*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
TRANSONIC FLUTTER AND GUST-RESPONSE TESTS AND ANALYSES OF A WIND-TUNNEL MODEL OF A TORSION FREE WING AIRPLANE
Charles L. Ruhlin and Arthur C. Murphy (General Dynamics/Fort Worth, Tex.) Apr. 1981 17 p refs Presented at the AIAA Dyn. Spec. Conf., Atlanta, 9-10 Apr. 1981
(NASA-TM-81961) Avail: NTIS HC A02/MF A01 CSCL 01C

An exploratory study of a 1/5.5 size, complete airplane version of a torsion free wing (TFW) fighter aircraft was conducted. The TFW consisted of a wing/boom/canard assembly on each fuselage side that was interconnected by a common pivot shaft so that the TFW could rotate freely in pitch. The effect of the TFW was evaluated by comparing data obtained with the TFW free and the TFW locked to the fuselage. With the model mounted on cables to simulate an airplane free flying condition, flutter boundaries were measured at Mach number (M) from 0.85 to 1.0 and gust responses at M = 0.65 and 0.90. The critical flutter mode for the TFW free configuration was found experimentally to occur at M = 0.95 and had the rigid TFW pitch mode as its apparent aerodynamic driver. R.C.T.

N81-23073# Douglas Aircraft Co., Inc., Long Beach, Calif.
FUEL/ENGINE/AIRFRAME TRADE OFF STUDY Final Report, 1 May 1978 - 1 Oct. 1980
A. T. Peacock, H. Hennig, N. C. Burmaster, E. R. Brown, R. M. Matsuo, J. R. Herrin, S. A. Mosier, J. R. Grant, J. E. Drever, and J. J. Snider Sep. 1980 260 p refs Prepared in cooperation with Union Oil Co. of Calif., Los Angeles and Pratt and Whitney Aircraft Group, East Hartford
(Contract F33615-78-C-2001; AF Proj. 3048)
(AD-A097391; AFWAL-TR-80-2038) Avail: NTIS HC A12/MF A01 CSCL 21/4

This report covers a study of the effects of broadening the specifications for JP-4 and JP-8, by increasing the freeze point, decreasing the smoke point, and extending the end point on minimizing costs and maximizing fuel availability. The study considered the impact on the engines and airframes. It was concluded that the specification maximum allowable freeze point of JP-4 or JP-8 could not be increased without degrading aircraft system performance and safety on the basis of criteria available to this study. Increases in availability were predicted for JP-4 of up to 9% and for JP-8 between 41% and 62%. A fuel price analysis was performed based on prices through 1978. Price changes subsequent to the analysis have been so rapid and so unbalanced between products that predictions cannot be made of price changes resulting from specification changes. Author (GRA)

N81-23074# General Accounting Office, Washington, D. C. Mission Analysis and Acquisition Div.
DOD'S USE OF REMOTELY PILOTED VEHICLE TECHNOLOGY OFFERS OPPORTUNITIES FOR SAVING LIVES AND DOLLARS
3 Apr. 1981 43 p
(AD-A097419; GAO/MASAD-81-20) Avail: NTIS HC A03/MF A01 CSCL 01/3

Contents: The Status of RPV Technology: Proven, Available, and Little Used; RPVs not Popular with the Military; and Civil Use of RPVs not Likely without Military Development. GRA

N81-23075# Rockwell International Corp., Columbus, Ohio. North American Aircraft Div.
DESIGN, DEVELOPMENT, AND EVALUATION OF LIGHTWEIGHT HYDRAULIC SYSTEM, PHASE 1 Final Report, 16 Aug. 1978 - 30 Jan. 1981
Joseph N. Demarchi and Robert K. Haning Jan. 1981 273 p refs
(Contract N62269-78-C-0363)
(AD-A097505; NR81H-2; NADC-77108-30) Avail: NTIS HC A12/MF A01 CSCL 13/7

The Lightweight Hydraulic System (LHS) program assesses the advantages of using an 8000 psi operating pressure level in Navy aircraft instead of the conventional 3000 psi level. This report presents the results of Phase I of a program to design, fabricate, and test a full scale 8000 psi system in a ground simulator and A-7E flight test aircraft. Two independent lightweight hydraulic systems, powered by variable delivery 8000 psi pumps, utilize twenty 8000 psi actuators and fourteen types of LHS minor hardware items. A steel framework ground simulator was designed with LHS component installation and hydraulic distribution systems similar to the A-7E aircraft. Laboratory tests conducted on components fabricated Phase I include rod seal development, servo valve erosion, compatibility, pressure impulse, and endurance. A math model of the compatibility system was verified. Test results demonstrated that the Phase II simulator will function as designed. Weight and space analyses made on LHS components projected the 30% weight and 40% space saving goals can be achieved. Based on preliminary R M assessments of the development hardware, the MFHBF and MMH/FH improvements goal of 15% will be obtained. Author (GRA)

N81-23076# Naval Postgraduate School, Monterey, Calif. Dept. of Aeronautical Engineering.
ATTACK VS SCAN: A COMPARISON OF ENDGAME AIRCRAFT SURVIVABILITY COMPUTER PROGRAMS M.S. Thesis

James Earl Parr Dec. 1980 121 p refs
(AD-A097663) Avail: NTIS HC A06/MF A01 CSCL 09/2

This study compares two computer programs, ATTACK and SCAN, with respect to the utility and validity of each program. The comparison is made from two points of view; a model developer and a consumer. The utility considers six subject areas: (1) documentation, (2) geometric modeling, (3) P(K)/Vulnerable Area Modeling, (4) Missile, Warhead and Fuze Modeling, (5) Scenario Simulation and (6) Program Output. SCAN was determined to be superior in every area except for the missile, warhead and fuze modeling area. For the validity evaluation, equivalent models were developed for a show box target and a simple warhead for both programs. A separate plot technique was used to verify the program results. For the sample models used in the comparison, the results agreed qualitatively with those from the plot technique. Author (GRA)

N81-23077# Aeronautical Research Labs., Melbourne (Australia).
AN ANALYSIS OF THERMAL BALANCE IN THE COOLED CABIN OF A SEA KING HELICOPTER
Brian Rebbechi Mar. 1980 28 p refs
(AD-A097199; ARL/MECH-ENG-NOTE-378; AR-001-811)
Avail: NTIS HC A03/MF A01 CSCL 01/3

This study arose from problems of excessive cabin temperatures encountered by the Royal Australian Navy during operation of Sea King Mk. 50 helicopters. These high temperatures were producing adverse effects on crew efficiency, particularly during flights of long duration experienced in anti-submarine missions. The Aeronautical Research Laboratories recorded cabin temperatures and humidities in one Sea King helicopter of the RAN fleet over an extended period; these measurements are reported by Rebbechi and Edwards (1979). A preliminary estimate of the cabin heat loads, together with suggestions for partially alleviating the problem, was made by Rebbechi (1977). The conclusions of this earlier work, however, were that an acceptable cabin environment could only be attained by the use of refrigeration to cool the cabin air. A vapor cycle cooling unit was subsequently built by ARL for feasibility studies of cabin cooling, and was flight tested in a Sea King helicopter. These flight trials were intended to establish the cooling capacity required in a permanently fitted installation and to evaluate the overall suitability of electrically powered vapor cycle systems. The results of these trials are reported. GRA

N81-23078# National Academy of Sciences - National Research Council, Washington, D. C. Aeronautics and Space Engineering Board.
AN EVALUATION OF NASA'S PROGRAM FOR ADVANCING ROTORCRAFT TECHNOLOGY Final Report
1978 19 p
(Contract NASw-2342)
(PB81-144180) Avail: NTIS HC A02/MF A01 CSCL 01C

A survey is made of the technological needs and opportunities for improving various types of rotorcraft over the next two decades and the adequacy of NASA's proposed research effort to provide the necessary technology in that period. GRA

N81-23079# General Accounting Office, Washington, D. C. Logistics and Communications Div.
F-16 INTEGRATED LOGISTICS SUPPORT: STILL TIME TO CONSIDER ECONOMICAL ALTERNATIVES
20 Aug. 1980 56 p
(PB81-137473; LCD-80-89) Avail: NTIS HC A04/MF A01 CSCL 01C

While the Air Force's integrated logistics support plan for the F-16 should ensure that the aircraft will be adequately maintained, there is still time and opportunity to improve its effectiveness and reduce support costs. Several alternative operational and support concepts which Department of Defense and Air Force logistics planners need to consider for the still developing F-16 program are recommended. GRA

N81-23080*# Honeywell, Inc., Minneapolis, Minn. Avionics Div.
DEMONSTRATION ADVANCED AVIONICS SYSTEM (DAAS) FUNCTIONAL DESCRIPTION Interim Report
15 Oct. 1980 197 p Prepared jointly with King Radio Corp., Olathe, Kans.
(Contract NAS2-10021)
(NASA-CR-152405) Avail: NTIS HC A09/MF A01 CSCL 01D

A comprehensive set of general aviation avionics were defined for integration into an advanced hardware mechanization for demonstration in a Cessna 402B aircraft. Block diagrams are shown and system and computer architecture as well as significant hardware elements are described. The multifunction integrated data control center and electronic horizontal situation indicator are discussed. The functions that the DAAS will perform are examined. This function definition is the basis for the DAAS hardware and software design. A.R.H.

N81-23081# Transportation Systems Center, Cambridge, Mass. Statistical Design and Analysis Branch.
GENERAL AVIATION ACTIVITY AND AVIONICS SURVEY Annual Summary Report, CY 1979
Judith C. Schwenk Jan. 1981 165 p refs Survey held in 1980; sponsored by FAA
(AD-A097604; TSC-FAA-81-1; FAA-MS-81-1) Avail: NTIS HC A08/MF A01 CSCL 01/2

This report presents the results and a description of the 1979 General Aviation Activity and Avionics Survey. The survey was conducted during 1980 by the FAA to obtain information on the activity and avionics of the United States registered general aviation aircraft fleet, the dominant component of civil aviation in the U.S. The survey was based on a statistically selected sample of about 14.2% of the general aviation fleet and obtained a response rate of 71%. Survey results are based upon responses but are expanded upward to represent the total population. Survey results revealed that during 1979 an estimated 43.3 million hours of flying time were logged by the 210,339 active general aviation aircraft in the U.S. fleet, yielding a mean annual flight time per aircraft of 203.5 hours. The active aircraft represented about 85% of the registered general aviation fleet. The report contains breakdowns of these and other statistics by manufacturer/model group, aircraft type, state and region of based aircraft, and primary use. Also included are fuel consumption, lifetime airframe hours, avionics, and engine hours estimates. Author (GRA)

N81-23082# Naval Air Systems Command, Washington, D. C.
NAVAIR AVIONICS MASTER PLAN
26 Feb. 1981 243 p
(AD-A097522) Avail: NTIS HC A11/MF A01 CSCL 09/5

The purpose of the NAVAIR Avionics Master Plan (NAMP) is to: Disseminate Naval Air Systems Command (NAVAIR) policy and guidance in all aspects of the development of Naval avionic equipment; Provide a single comprehensive document highlighting all aspects of Naval avionics - its current status, its requirements, and its long range objectives; Establish a planning baseline to serve as a foundation for overall advanced planning; Focus attention on management issues and technological problems that require resolution in the near term and on those special issues that require immediate attention to solve critical problems that require resolution in the near term and on those special issues that required immediate attention to solve critical problems to ensure the orderly availability of needed avionic equipment. Author (GRA)

N81-23083# Dynamics Research Corp., Wilmington, Mass.
DIGITAL AVIONICS INFORMATION SYSTEM (DAIS). VOLUME 1: IMPACT OF DAIS CONCEPT ON LIFE CYCLE COST Final Report
John C. Goclowski, John M. Glasier, Marjorie A. Bristol, Jonathan T. Frueh, and H. Anthony Baran (Logistics and Technical Training Div., Wright-Patterson AFB, Ohio) Brooks AFB, Tex. Air Force Human Resources Lab. Mar. 1981 72 p refs 2 Vol.
(Contract F33615-75-C-5218; AF Proj. 2051)
(AD-A097339; AFHRL-TR-81-4-(I)-Vol-1) Avail: NTIS HC A04/MF A01 CSCL 09/3

The Digital Avionics Information System (DAIS) approach to avionics design is a total system concept rather than a functional subsystem or hardware-oriented system. DAIS uses common processing, information transfer, control and display, and support software elements to service all avionics functional areas on an integrated basis. Thus, the DAIS architecture and core elements are not dedicated to any one specific avionic function, but are used to perform the tasks of many avionic functions with the avionic sensors and subsystems. This systems approach provides flexibility to accommodate a wide variety of avionic configurations and missions, as well as redundancy to improve availability. Standardization and replication of the core elements can reduce the life cycle costs when major modifications/retrofits of an avionic configuration are considered, or when applied across the fleet by reducing unnecessary development proliferation and reducing maintenance costs. GRA

N81-23084# Dynamics Research Corp., Wilmington, Mass.
DIGITAL AVIONICS INFORMATION SYSTEM (DAIS). VOLUME 2: IMPACT OF DAIS CONCEPT ON LIFE CYCLE COST. SUPPLEMENT Final Report
John C. Goclowski, John M. Glasier, Marjorie A. Bristol, Jonathan T. Frueh, and H. Anthony Baran (Logistics and Technical Training Div., Wright-Patterson AFB, Ohio) Brooks AFB, Tex. Air Forces Human Resources Lab. Mar. 1981 136 p refs 2 Vol.
(Contract F33615-75-C-5218; AF Proj. 2051)
(AD-A097438; AFHRL-TR-81-4-(II)-Vol-1) Avail: NTIS HC A07/MF A01 CSCL 09/3

The Digital Avionics Information System (DAIS) approach to avionics design is a total system concept rather than a functional subsystem or hardware-oriented system. DAIS uses the common processing, information transfer, control and display, and support software elements to service all avionics functional areas on an integrated basis. Thus, the DAIS architecture and core elements are not dedicated to any one specific avionic function, but are used to perform the tasks of many avionic functions with the avionic sensors and subsystems. This system approach provides flexibility to accommodate a wide variety of avionic configurations and missions, as well as redundancy to improve availability. Standardization and replication of the core elements can reduce the life cycle costs when major modifications/retrofits of an avionic configuration are considered, or when applied across the fleet by reducing unnecessary development proliferation and reducing maintenance costs. A limited assessment of the potential effects of the DAIS concept on avionics system life cycle cost is assessed in this report by a cost comparison of a hypothetical application of a conceptual mid-1980's DAIS suite versus a conventional avionics suite used in a close-air-support (CAS) aircraft both with one major modification/retrofit. The first volume of this two volume technical report describes the cost comparison and its results. This volume supplements the first by providing additional details of the comparison, appendices, model output reports of the Life Cycle Cost Impact Modeling System (LCCIM), and data used in the comparison. Author (GRA)

N81-23085*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A NONLINEAR PROPULSION SYSTEM SIMULATION TEHNIQUE FOR PILOTED SIMULATORS
James R. Mihaloew 1981 14 p refs Presented at the 12th Ann. Pittsburgh Conf. on Modelling and Simulation, 30 Apr. 1 May 1981; sponsored by IEEE, ISA, SCS, SMCS
(NASA-TM-82600; E-847) Avail: NTIS HC A02/MF A01 CSCL 21E

In the past, propulsion system simulations used in flight simulators have been extremely simple. This resulted in a loss of simulation realism since significant engine and aircraft interactions were neglected and important internal engine parameters were not computed. More detailed propulsion system simulators are needed to permit evaluations of modern aircraft propulsion systems in a simulated flight environment. A real time digital simulation technique has been developed which provides the capabilities needed to evaluate propulsion system performance and aircraft system interaction on manned flight simulators. A parameter correlation technique is used with real and pseudo dynamics in a stable integration convergence loop. The technique has been applied to a multivariable propulsion system for use in a piloted NASA flight simulator program. Cycle time is 2.0 ms on a Univac 1110 computer and 5.7 ms on the simulator computer, a Xerox Sigma 8. The model is stable and accurate with time steps up to 50 ms. The program evaluated the simulation technique and the propulsion system digital control. The simulation technique and model used in that program are described and results from the simulation are presented. Author

N81-23086*# United Technologies Corp., East Hartford, Conn. Commercial Products Div.
PERFORMANCE DETERIORATION BASED ON SIMULATED AERODYNAMIC LOADS TEST, JT9D JET ENGINE DIAGNOSTICS PROGRAM Final Report
W. J. Stromberg 9 Feb. 1981 301 p refs
(Contract NAS3-20632)
(NASA-CR-165297; PWA-5512-75) Avail: NTIS HC A14/MF A01 CSCL 21E

An engine was specially prepared with extensive instrumentation to monitor performance, case temperatures, and clearance changes. A special loading device was used to apply known loads on the engine by the use of cables placed around the flight inlet. These loads simulated the estimated aerodynamic pressure distributions that occur on the inlet in various segments of a typical airplane flight. Test results indicate that the engine lost 1.3 percent in take-off thrust specific fuel consumption (TSFC) during the course of the test effort. Permanent clearance changes due to the loads accounted for 1.1 percent; increase in low pressure compressor airfoil roughness and thermal distortion in the high pressure turbine accounted for 0.2 percent. Pretest predicted performance loss due to clearance changes was 0.9 percent in TSFC. Therefore, the agreement between measurement and prediction is considered to be excellent. Author

N81-23087# Defence Research Establishment Atlantic, Dartmouth (Nova Scotia). Research and Development Branch.
X-RAY FLUORESCENCE SPECTROMETRIC ANALYSIS OF WEAR METALS IN USED LUBRICATING OILS
Dwight E. Veinot Dec. 1980 20 p refs
(AD-A097552; DREA-TM-80/J) Avail: NTIS HC A02/MF A01 CSCL 07/4

An X-ray fluorescence spectrometric technique was developed for the direct determination of iron and copper wear metal concentrations in used lubricating oils from CH 124 'Sea King' helicopter engines. The X-ray fluorescence wear metal levels were compared to the atomic absorption wear metal levels determined on corresponding samples. In general, the X-ray fluorescence results indicated higher levels of wear metal contamination and also provided earlier indications of abnormal wear based on more pronounced changes in detected wear metal production than did the results obtained by atomic absorption analysis. Author (GRA)

N81-23088# National Aeronautical Establishment, Ottawa (Ontario). Structures and Materials Lab.
THE REJUVENATION OF PROPERTIES IN TURBINE ENGINE HOT SECTION COMPONENTS BY HOT ISOSTATIC PRESSING
P. H. Floyd, W. Wallace, and J-P. A. Immarigeon Feb. 1981 26 p refs Presented at the NATO Defence Res. Board Seminar, Bremen, West Germany, 6-10 Apr. 1981
(AD-A097551; NAE-LR-605; NRC-19164) Avail: NTIS HC A03/MF A01 CSCL 21/5

A significant factor in the cost of ownership of industrial, marine and aircraft gas turbine engines is the high price of replacement of parts that have reached the limit of their original design life. Many parts, particularly those operating in the hot sections of gas turbine engines, will be replaced on a routine basis, even though they may have many thousands of safe operating hours remaining. In order to reduce costs, and to conserve materials that are rapidly becoming scarce, a great deal of effort is being expended to develop treatments that allow used parts to be refurbished and their original properties restored by regenerative heat treatments. A significant development has occurred recently in this area with the introduction of hot isostatic pressing. With hot isostatic pressing it is possible to reheat-treat service exposed parts under pressure so that precipitate structures are restored, and internal defects such as creep voids and cavities are eliminated. As a result, new metal properties can be restored in many cases. However, during hot isostatic pressing there is a tendency for grain growth to occur, for changes in grain boundary structure to occur, and for irreversible changes in carbide morphology and distribution to occur. Consequently, the effective processing of materials requires that careful control of the time, temperature and pressure conditions used in the autoclave be achieved. The particular conditions used must be established for each individual alloy of interest in order to develop the appropriate microstructural features required and thereby obtain the desired improvements in mechanical properties. Author (GRA)

N81-23089# Naval Postgraduate School, Monterey, Calif.
INVESTIGATION OF THE USE OF LIQUID CRYSTAL THERMOGRAPHY TO STUDY FLOW OVER TURBOMACHINERY BLADES M.S. Thesis
Roy L. Brennon Sep. 1980 68 p refs
(AD-A097289) Avail: NTIS HC A04/MF A01 CSCL 14/2

The use of liquid crystal thermography was investigated as a technique for visualizing the flow over a NACA series 65 compressor blade. The demonstration of the feasibility of the technique was conducted in the low turbulence wind tunnel at the U.S. Naval Postgraduate School. Local heat transfer coefficients were obtained for Reynolds numbers varying from 100,000 to 600,000 with the angle of incidence of the blade varying from 0 degrees to 30 degrees. Author (GRA)

N81-23093*# Drexel Univ., Philadelphia, Pa. Dept. of Mechanical Engineering and Mechanics.
APPLICATION OF VARIABLE STRUCTURE SYSTEM THEORY TO AIRCRAFT FLIGHT CONTROL Interim Report
Anthony J. Calise, Isaac Kadushin, and Fred Kramer May 1981 42 p refs
(Contract NAG2-8)
(NASA-CR-164321) Avail: NTIS HC A03/MF A01 CSCL 01C

The current status of research on the application of variable structure system (VSS) theory to design aircraft flight control systems is summarized. Two aircraft types are currently being investigated: the Augmentor Wing Jet STOL Research Aircraft (AWJSRA), and AV-8A Harrier. The AWJSRA design considers automatic control of longitudinal dynamics during the landing phase. The main task for the AWJSRA is to design an automatic landing system that captures and tracks a localizer beam. The control task for the AV-8A is to track velocity commands in a hovering flight configuration. Much effort was devoted to developing computer programs that are needed to carry out VSS design in a multivariable frame work, and in becoming familiar with the dynamics and control problems associated with the aircraft types under investigation. Numerous VSS design schemes were explored, particularly for the AWJSRA. The approaches that appear best suited for these aircraft types are presented. Examples are given of the numerical results currently being generated. A.R.H.

N81-23095*# Gjerding (B. K.) Simulation Electronics, Seattle, Wash.
USER'S MANUAL FOR FLIGHT SIMULATOR DISPLAY SYSTEM (FSDS)
Connie C. Egerdahl 18 Nov. 1979 14 p
(Contract NAS2-9434)
(NASA-CR-164295) Avail: NTIS HC A02/MF A01 CSCL 14B

The capabilities of the flight simulator display system (FSDS) are described. FSDS is a color raster scan display generator designed to meet the special needs of Flight Simulation Laboratories. The FSDS can update (revise) the images it generates every 16.6 mS, with limited support from a host processor. This corresponds to the standard TV vertical rate of 60 Hertz, and allows the system to carry out display functions in a time critical environment. Rotation of a complex image in the television raster with minimal hardware is possible with the system. M.G.

N81-23096*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
DESCRIPTION OF RECENT CHANGES IN THE LANGLEY 6- BY 28-INCH TRANSONIC TUNNEL
William G. Sewall May 1981 45 p refs
(NASA-TM-81947; L-13609) Avail: NTIS HC A03/MF A01 CSCL 14B

Calibrations were obtained in the Langley 6 by 28-inch transonic tunnel with newly installed controllable reentry flaps and test section floor and ceiling. Using available theory, the top and bottom slotted walls were redesigned for minimum wind tunnel interference errors of blockage and stream-line curvature. To minimize Mach number gradients along the tunnel axis downstream of the model, controllable flaps were installed to regulate the flow reentering the test section through the slotted walls. The flap setting is independent of stagnation pressure and varies only with Mach number. The freestream Mach number is determined from the pressrue measured at a station 66.04 cm upstream of the model station. The model has no significant influence on the vertical Mach number distribution at this station. This method of Mach number determination appears to be more accurate than one using the plenum pressure. R.C.T.

N81-23097# Hickok (Eugene A.) and Associates, Wayzata, Minn.
NATIONAL RUNWAY FRICTION MEASUREMENT PROGRAM Final Report, Sep. 1978 - Dec. 1980
John R. MacLennan, Norman C. Wenck, Paul D. Josephson, and John B. Erdmann Dec. 1980 121 p refs
(Contract DOT-FA78WA-4242)
(AD-A097334; FAA-AAS-80-1) Avail: NTIS HC A06/MF A01 CSCL 01/5

Measurements of runway friction, pavement surface conditions and engineering data for 491 runways at 268 U.S. airports are used for statistical analysis to develop guidance materials to insure the design and maintenance of nonslippery surfaces at United States airports. Friction values are analyzed as they relate to pavement type, texture depth, grooving, and rubber accumulation. The basic concepts of Advisory Circular 150/5320-12 are supported by the data. Corrective maintenance action is recommended for runways with friction values less than the recommended value of 0.50. Author (GRA)

N81-23243*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMBUSTION SYSTEM PROCESSES LEADING TO CORROSIVE DEPOSITS
Carl A. Stearns, Fred J. Kohl, and Daniel E. Rosner (Yale Univ.) 1981 25 p refs Presented at the NACE Intern. Conf. on High Temp. Corrosion, San Diego, Calif., 2-6 Mar. 1981
(Contract EF-77-A-01-2593)
(NASA-TM-81752; DOE/NASA/2593-27; E-744) Avail: NTIS HC A02/MF A01 CSCL 11F

Degradation of turbine engine hot gas path components by high temperature corrosion can usually be associated with deposits even though other factors may also play a significant role. The origins of the corrosive deposits are traceable to chemical reactions which take place during the combustion process. In the case of hot corrosion/sulfidation, sodium sulfate was established as the deposited corrosive agent even when none of this salt enters the engine directly. The sodium sulfate is formed during the combustion and deposition processes from compounds of sulfur contained in the fuel as low level impurities and sodium compounds, such as sodium chloride, ingested with intake air. In other turbine and power generation situations, corrosive and/or fouling deposits can result from such metals as potassium, iron, calcium, vanadium, magnesium, and silicon. Author

N81-23249# Aeronautical Research Labs., Melbourne (Australia).
FATIGUE LIFE VARIABILITY IN ALUMINUM ALLOY AIRCRAFT STRUCTURES
G. S. Jost and S. P. Costolloe Jan. 1980 24 p refs
(AD-A097198; ARL/STRUC-381) Avail: NTIS HC A02/MF A01 CSCL 11/6

A survey of variability in the fatigue lives of aluminium alloy aircraft structures tested under gust and maneuver loadings using programmed and random sequences has shown that scatter associated with gust loading is significantly higher than that for maneuver loading. By contrast, there appears to be no systematic effect of loading sequence. The data have been treated both as lognormal and Weibull distributed. Author (GRA)

N81-23269# Bureau of Mines, Albany, Oreg. Albany Research Center.

SILVER RECOVERY FROM AIRCRAFT SCRAP

D. Harry Chambers and B. W. Dunning, Jr. 1980 29 p refs (PB81-150021; BM-RI-8477) Avail: NTIS HC A03/MF A01 CSCL 11F

Silver was recovered by an electrolytic method from stainless steel honeycomb sections separated from aircraft scrap. These sections had been constructed by sandwiching a stainless steel honeycomb core between stainless steel sheets and then brazing the assembly with a silver alloy. Over 300 pounds of silver was used in the B-58 bomber, concentrated in certain honeycomb sections of the aircraft. Following shredding of the aircraft parts, an average of 95 percent (ranging 67 to 100 percent) of the silver was recovered in a single electrorefining step. After the electrorefined product was magnetically cleaned, purity of the recovered silver was greater than 99.3 percent. GRA

N81-23288# Naval Air Development Center, Warminster, Pa. Aircraft and Crew Systems Technology Directorate.

DEVELOPMENT OF A WATER DISPLACING, TOUCH-UP PAINT Final Report

Charles R. Hegedus 24 Feb. 1981 30 p refs (WF61562001) (AD-A097125; NADC-80207-60) Avail: NTIS HC A03/MF A01 CSCL 11/3

A water displacing paint has been developed for touch-up of existing paint which has cracked or chipped. Laboratory results illustrate that this coating has good adhesion, flexibility, and chemical, heat and weather resistance. The coating will displace water from a substrate upon application and will subsequently afford corrosion protection to the underlying metal. The developed coating can be applied by aerosol, conventional or airless spray techniques. GRA

N81-23325# Boeing Aerospace Co., Seattle, Wash. Experience Analysis Center.

DEVELOPMENT OF MAINTENANCE METRICS TO FORECAST RESOURCE DEMANDS OF WEAPON SYSTEMS (PARAMETER POLARIZATION), REVISION A Interim Report, 1 Aug. 1978 - 15 Oct. 1979

Donald K. Hindes, Gary A. Walker, David H. Wilson, and Frank Maher Oct. 1980 320 p refs (Contract F33615-77-C-0075) (AD-A097692; D94-10089-2-Rev-A) Avail: NTIS HC A14/MF A01 CSCL 01/3

This report describes the method and results of the fifth of eight tasks to 'Develop Maintenance METRICS To Forecast Resource Demands of Weapon Systems'. The purpose of this task was to analyze the data collected in tasks 1 through 4 to detect, test, and rank relationships between the study parameters and maintenance demand rates. GRA

N81-23358# Army Aviation Development Test Activity, Fort Rucker, Ala.

FUNCTIONAL TESTING AIRBORNE RADARS Final Report

27 Mar. 1981 37 p refs (AD-A097562; TOP-6-3-223; DARCOM-R-310-6; DRSTE-RP-702-105) Avail: NTIS HC A03/MF A01 CSCL 17/9

This document provides guidance and procedures for planning and conducting performance tests on airborne radar systems. The document addressed the following radar systems: Weather, Terrain Avoidance, and Airborne Transponders. It provides the test project officer with general information and guidance in test preparation, test controls, test implementation/conduct and data reduction. Author (GRA)

N81-23410*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

MEAN-FLOW AND TURBULENCE MEASUREMENTS IN THE VICINITY OF THE TRAILING EDGE OF AN NACA (63 SUB 1)-012 AIRFOIL

James C. Yu Washington May 1981 45 p refs (NASA-TP-1845; L-13959) Avail: NTIS HC A03/MF A01 CSCL 20D

The Langley aircraft noise reduction laboratory was used to measure mean flow and turbulence in the vicinity of a cusped-trailing edge of two dimensional NACA 631-012 airfoil at zero angle of attack. Naturally transitioned flow and artificially tripped flow were investigated. Flow regions studied include the boundary layer and the near wake. Measurements were made at a free stream Reynolds number based on airfoil chord of 1.25 x 10 to the 6th power and a free stream Mach number of 0.1. Distributions of streamwise mean velocity, integral properties of the mean flow, turbulent intensities, and Reynolds shear stress are reported. For the naturally transitioned flow, the general trends observed are similar to those reported for a fully developed turbulent boundary layer over a flat plate under zero pressure gradient, with the exception of the notable streamwise variations in the turbulence properties for the airfoil flow. The main effect of flow tripping is to eliminate these streamwise variations. Observed changes in the mean flow and turbulence fields caused by tripping are expected on the basis of the Reynolds number based on the boundary layer thickness. A.R.H.

N81-23411*# Science Applications, Inc., Canoga Park, Calif. Dept. of Combustion Science and Advanced Technology.

MULTIPLE-SCALE TURBULENCE MODELING OF BOUNDARY LAYER FLOWS FOR SCRAMJET APPLICATIONS

G. Fabris, P. T. Harsha, and R. B. Edelman Washington NASA May 1981 74 p refs (Contract NAS1-15988) (NASA-CR-3433; SAI-80-022-CP) Avail: NTIS HC A04/MF A01 CSCL 20D

As part of an investigation into the application of turbulence models to the computation of flows in advanced scramjet combustors, the multiple-scale turbulence model was applied to a variety of flowfield predictions. The model appears to have a potential for improved predictions in a variety of areas relevant to combustor problems. This potential exists because of the partition of the turbulence energy spectrum that is the major feature of the model and which allows the turbulence energy dissipation rate to be out of phase with turbulent energy production. The computations were made using a consistent method of generating experimentally unavailable initial conditions. An appreciable overall improvement in the generality of the predictions is observed, as compared to those of the basic two-equation turbulence model. A Mach number-related correction is found to be necessary to satisfactorily predict the spreading rate of the supersonic jet and mixing layer. S.F.

N81-23431# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).

TECHNICAL EVALUATION REPORT ON THE FLUID DYNAMIC PANEL SYMPOSIUM ON SUBSONIC/TRANSONIC CONFIGURATION/AERODYNAMICS

Horst Koerner Jan. 1981 19 p refs (AGARD-AR-146; ISBN-92-835-1380-0) Avail: NTIS HC A02/MF A01

Papers presented at the various sessions are highlighted. Topics cover prediction methods, weapons carriage, configuration optimization, powered jet interaction, and multicomponent interference. Conclusions from the discussion are considered from the point of view of computational fluid dynamics, interference aspects, and optimization. Recommendations are offered. A.R.H.

N81-23433*# Stanford Univ., Calif. Dept. of Aeronautics and Acoustics.

APPLICATION OF HOLOGRAPHY TO THE STUDY OF HELICOPTER ROTOR FLOW FIELDS Semiannual Progress Report, 1 Jul. - 31 Dec. 1980

Donald Baganoff 29 May 1981 37 p refs (Grant NAG2-45) (NASA-CR-164293) Avail: NTIS HC A03/MF A01 CSCL 20F

The feasibility of an experiment which is intended to measure the density field about a model helicopter rotor using holographic interferometry is considered. The numerical simulation used to study the experiment is described as well as the measurement technique itself. Data generated by the simulation are presented and prospects for both determining the density field from these data, and for actually obtaining such data in practice are assessed. A few significant problems which may be expected to arise are indicated and discussed. Author

N81-23438# Technology, Inc., Dayton, Ohio.
STRUCTURAL INTEGRITY RECORDING SYSTEM (SIR) FOR U.S. ARMY AH-1G HELICOPTERS Final Report, Jul. 1976 - Nov. 1979
Thomas G. Farrell, Raymond B. Johnson, and Michael C. Tyler Mar. 1981 216 p refs
(Contract DAAJ02-75-C-0050; DA Proj. 1F2-62209-AH-76)
(AD-A097283; USAAVRADCOM-TR-80-D-15) Avail: NTIS HC A10/MF A01 CSCL 01/3

A Structural Integrity Recording System (SIRS) was designed and developed to track the fatigue damage accumulation on 10 critical helicopter components for the subsequent timely replacement of such components for safer and more economical helicopter operation. SIRS comprises three discrete but interrelated subsystems: an airborne microprocessor-based recorder, a portable flight-line data retrieval unit, and a software system. The validation of SIRS, initially configured for the AH-1G helicopter, consisted of two phases. Phase I (Development Test and Evaluation - DT E) covered the design, fabrication, laboratory qualification testing, reliability analysis, and flight-testing of the prototype SIRS recorder. Phase II (Initial Operational Test and Evaluation - IOT E) covered the evaluation of the entire system operation and the resultant data acquired during a 3-month recording period with five AH-1G's, each equipped with a SIRS recorder. As the documentation of both DT E and IOT E, this report describes the characteristics and functions of the entire system and details the successful performance of the SIRS recorder in the laboratory qualification testing and the flight environment. The SIRS recorder performed as designed, operated reliably, and yielded valid data. Author (GRA)

N81-23461*# Michigan Univ., Ann Arbor. Dept. of Mechanical Engineering and Applied Mechanics.
HEAT GENERATION IN AIRCRAFT TIRES UNDER FREE ROLLING CONDITIONS
Samuel K. Clark and Richard N. Dodge Dec. 1980 90 p Sponsored by NASA
(NASA-CR-164273) Avail: NTIS HC A05/MF A01 CSCL 01C

Effort is directed toward construction of a rational method for evaluating internal temperatures of aircraft tires. Enhanced predictability of tire temperature buildup is a design tool in both the tire and airframe industries. S.F.

N81-23466# Naval Research Lab., Washington, D. C. Materials Modification and Analysis Branch.
APPLICATION OF ION IMPLANTATION FOR THE IMPROVEMENT OF LOCALIZED CORROSION RESISTANCE OF M50 STEEL BEARINGS Interim Report
G. K. Hubler, J. K. Hirvonen, I. Singer, C. R. Gossett, C. R. Clayton, Y. F. Wang, H. E. Munson, and G. Kuhlman 30 Mar. 1981 48 p refs
(RR0220844; WF4140100)
(AD-A097230; NRL-MR-4481) Avail: NTIS HC A03/MF A01 CSCL 11/6

A program is currently underway to use ion implantation to improve the tribiological and corrosion characteristics of load bearing surfaces in both rolling element bearings and gears used in aircraft propulsion systems. This report describes that aspect of the program concerned with the use of ion implantation for surface alloying of bearing components in order to alleviate the problem of corrosion in M50 steel mainshaft aircraft engine bearings. Author (GRA)

N81-23486*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MEGA16 - COMPUTER PROGRAM FOR ANALYSIS AND EXTRAPOLATION OF STRESS-RUPTURE DATA
C. Robert Ensign May 1981 46 p refs
(NASA-TP-1809; E-495) Avail: NTIS HC A03/MF A01 CSCL 20K

The computerized form of the minimum commitment method of interpolating and extrapolating stress versus time to failure data, MEGA16, is described. Examples are given of its many plots and tabular outputs for a typical set of data. The program assumes a specific model equation and then provides a family of predicted isothermals for any set of data with at least 12 stress-rupture results from three different temperatures spread over reasonable stress and time ranges. It is written in FORTRAN 4 using IBM plotting subroutines and its runs on an IBM 370 time sharing system. M.G.

N81-23487*# Kaman Aerospace Corp., Bloomfield, Conn.
ANALYTICAL TESTING Final Report, 27 Jun. 1978 - 15 Sep. 1980
W. G. Flannelly, J. A. Fabunmi, and E. J. Nagy Washington NASA May 1981 154 p refs
(Contract NAS1-15414)
(NASA-CR-3429; R-1614) Avail: NTIS HC A08/MF A01 CSCL 20K

Analytical methods for combining flight acceleration and strain data with shake test mobility data to predict the effects of structural changes on flight vibrations and strains are presented. This integration of structural dynamic analysis with flight performance is referred to as analytical testing. The objective of this methodology is to analytically estimate the results of flight testing contemplated structural changes with minimum flying and change trials. The category of changes to the aircraft includes mass, stiffness, absorbers, isolators, and active suppressors. Examples of applying the analytical testing methodology using flight test and shake test data measured on an AH-1G helicopter are included. The techniques and procedures for vibration testing and modal analysis are also described. Author

N81-23713*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AN AIRPORT COMMUNITY NOISE-IMPACT ASSESSMENT MODEL
Richard DeLoach Jul. 1980 21 p refs Presented at the 98th Acoust. Soc. of Am. Meeting, Salt Lake City, Utah, 26-30 Nov. 1979
(NASA-TM-80198) Avail: NTIS HC A02/MF A01 CSCL 13B

A computer model was developed to assess the noise impact of an airport on the community which it serves. Assessments are made using the Fractional Impact Method by which a single number describes the community aircraft noise environment in terms of exposed population and multiple event noise level. The model is comprised of three elements: a conventional noise footprint model, a site specific population distribution model, and a dose response transfer function. The footprint model provides the noise distribution for a given aircraft operating scenario. This is combined with the site specific population distribution obtained from a national census data base to yield the number of residents exposed to a given level of noise. The dose response relationship relates noise exposure levels to the percentage of individuals highly annoyed by those levels. Author

N81-23768# Federal Aviation Administration, Atlantic City, N.J.
GROUNDSPEED/AIRSPEED DIFFERENCES AS A WIND SHEAR INDICATOR AND FLIGHT EVALUATION OF A DME-DERIVED SYSTEM TO DETERMINE GROUNDSPEED Final Report, Feb. 1978 - Feb. 1980
David M. Lawrence Feb. 1981 64 p refs
(FAA Proj. 154-451-180)
(AD-A097566; FAA-CT-80-29; FAA-RD-81-1) Avail: NTIS HC A04/MF A01 CSCL 01/3

The use of groundspeed in conjunction with airspeed as a wind shear indicator is discussed. It is shown that a satisfactory indication of headwind can be obtained using indicated airspeed and a low-cost groundspeed measurement device. This report describes the flight test and evaluation of a distance measuring equipment (DME) range-rate derived system for measuring airplane groundspeed. The system consists of a specially developed airborne unit operating in conjunction with unmodified very high frequency omnidirectional radio range (VOR)/DME ground stations. Operating at ranges up to 50 nautical miles in level flight directly toward or away from the ground station, the root mean square (RMS) groundspeed error is 3 to 5 knots. In landing approaches or climbout, the RMS error is 4 to 8 knots. Author (GRA)

N81-23862*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
LATERAL ATTENUATION OF HIGH-BY-PASS RATIO ENGINED AIRCRAFT NOISE
William L. Willshire, Jr. Apr. 1981 38 p refs
(NASA-TM-81968) Avail: NTIS HC A03/MF A01 CSCL 20A

A flight experiment was conducted to investigate the lateral attenuation of high by pass ratio engined airplanes. A B-747 was flown at low altitudes over the ends of two microphone arrays. One array covering a lateral distance of 1600 m consisted of 14 microphones positioned over grass. The second array covered a lateral distance of 1200 m and consisted of 6 microphones positioned over a concrete runway. Sixteen runs were flown at altitudes ranging from 30 to 960 m. The acoustic information recorded in the field was reduced to one third octave band spectral time histories and synchronized with tracking and weather information. Lateral attenuation as a function of elevation angle was calculated in overall, A-weighted, tone-corrected perceived noise level, and effective perceived noise level units. The B-747 results are compared with similar results for a turbojet-powered T-38 airplane and the SAE recommended lateral attenuation prediction procedure. Less lateral attenuation was measured for the B-747 than for the T-38. The B-747 lateral attenuation values also fell below the SAE curve. Author

N81-23864# Boeing Vertol Co., Philadelphia, Pa.
A STUDY OF THE EFFECT OF TERRAIN ON HELICOPTER NOISE PROPAGATION BY ACOUSTICAL MODELING Final Report
Harry Sternfeld, Jr. 23 Mar. 1981 57 p refs
(Contract DAAG29-78-C-0002)
(AD-A097626; ARO-14795.1-E) Avail: NTIS HC A04/MF A01 CSCL 17/1

An experimental program was conducted to evaluate the applicability of acoustical modeling techniques to study the effects of terrain on helicopter noise propagation. Comparison of model results with flyover data of a full scale UH-1 helicopter showed very good correlation with 500 ft altitude data and moderately good correlation with 50 ft altitude data. Model studies of the effects of the blocking and channeling of sound by barriers, such as hills, shows good correlation with expected results for simple cases with the model providing useful results for more complex cases. Author (GRA)

N81-23937# Boeing Aerospace Co., Seattle, Wash.
WEAPONS SYSTEM SUPPORT RESOURCES DEMAND PARAMETERS - LOGISTICS Progress Report, Jan. - Dec. 1980
G. A. Walker 1 Feb. 1981 231 p refs
(AD-A097517; D194-10074-2) Avail: NTIS HC A11/MF A01 CSCL 01/3

This document presents preliminary results for Phase 3 of a study to seek ways of developing more accurate measures and weightings to improve resource requirement predictions for operational and emerging weapon systems. These improved measures can then be used on new programs to predict maintenance demands (human and material), for design tradeoff studies early in the system development process to reduce the overall weapon system life cycle cost and increase mission readiness. During Phase 3 (1980) follow-on in-depth statistical analysis of the preliminary findings was performed to identify various subsystem equipment maintenance resource demand vs generic parameter(s) sub-set(s) relationships, such as equipment, operational, environmental, maintenance, and general characteristics. The plan for the second half of Phase 3 (1981) is to further investigate those maintenance resource demands that have strongly correlated impact parameters within the various subsystems and equipments for identification of positive relationships and their cause factors. Author (GRA)

N81-23966# Clemson Univ., S.C. Dept. of Mathematical Sciences.
A COST FUNCTION FOR MILITARY AIRFRAMES
Norman K. Womer May 1980 12 p refs Presented at the 9th Ann. DOD/FAI Acquisition Res. Symp., Annapolis, 9-11 Jun. 1981
(Contract N00014-75-C-0451; NR Proj. 047-202)
(AD-A097538; N122) Avail: NTIS HC A02/MF A01 CSCL 12/1

Recent theoretical and empirical work in the areas of learning curves, production rate and cost estimation of airframes has seemed to yield contradictory conclusions. A model of acquisition process that captures the interaction between learning and both endogenous and exogenous production rate changes is developed by modifying a previous model to include production experience and yearly production targets. This permits a production program to be modeled as a series of discrete tasks connected by experience. The impacts of an exogenous increase or decrease in deliveries, of stretching a lot out over a longer period of time, and of several restrictions on production can be modeled by this procedure. Author (GRA)

N81-23967# Clemson Univ., S.C. Dept. of Mathematical Sciences.
A COST FUNCTION FOR AN AIRFRAME PRODUCTION PROGRAM
Norman K. Womer and Thomas R. Gulledge Aug. 1980 17 p refs
(Contract N00014-75-C-0451; NR Proj. 047-202)
(AD-A097540; N125) Avail: NTIS HC A02/MF A01 CSCL 12/1

This research represents the expansion of previous work in the area of estimating program cost in military airframe production. The effort is unique in that it yields a model of the production process that considers the impact of learning and production rate on total program costs. To provide an empirical test of model validity, the parameters are estimated for the C141 airframe program. The empirical work is instructive in that it shows how particular care must be taken in formulating models of this type. This model should be particularly useful as a prototype for models of on going production programs. In particular, it can be used to estimate the cost impact of exogenous changes in the program delivery schedule, the 'crashes' and 'stretch-outs' that frequently characterize military aircraft programs. Author (GRA)

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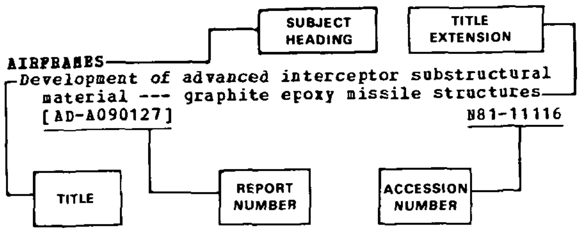

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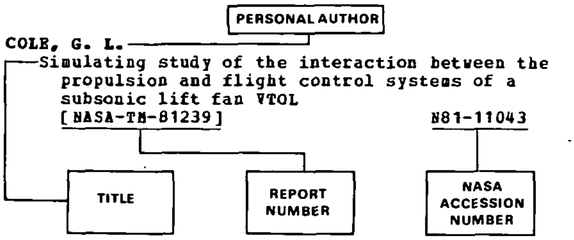

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