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A Continuing Bibliography with Indexes

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NASA SP-7037(123)

AERONAUTICAL ENGINEERING

A Continuing Bibliography

Supplement 123

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 May 1980 in

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

NASA Scientific and Technical Information Branch 1980
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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 529 reports, journal articles, and other documents originally announced in May 1980 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*.

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

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

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

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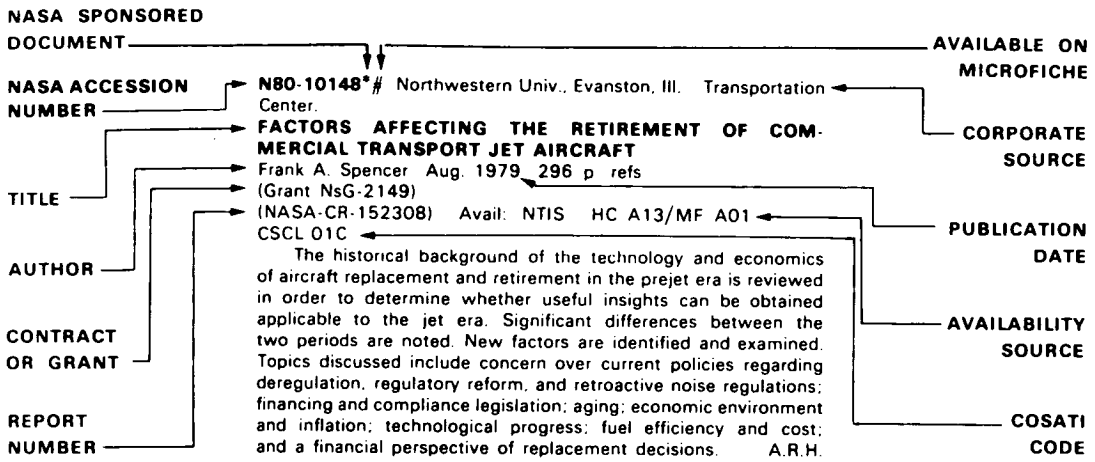

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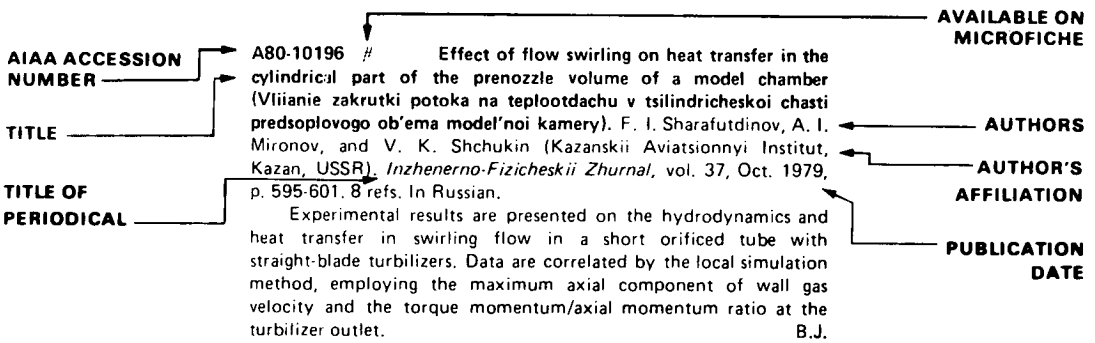

AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 123)

JUNE 1980

IAA ENTRIES

A80-24739 **NAVAIR pushes SPF/DB for structures.** W. T. Highberger (U.S. Naval Air Systems Command, Engineering Support Management Div., Washington, D.C.). *ManTech Journal,* vol. 4, no. 1, 1979, p. 36-39.

Superplastic forming/diffusion bonding (SPF/DB) of titanium alloys is discussed with regard to NAVAIR applications, including missile technology. Fine grain size is easily obtained using titanium alloys, which have the capacity for self diffusion bonding at SPF temperatures; the diffusion bonds are self inspecting. Project plans at NAVAIR for SPF/DB include demonstrating an ultrahigh strength SPF/DB titanium sandwich construction, making a glove vane for the F-14, and constructing bubble core sandwich panels of graduated weights and corresponding mechanical strengths. J.P.B.

A80-24740 **Fiberglass rotor produced.** P. S. Baumgardner (Bell Helicopter Textron, Fort Worth, Tex.). *ManTech Journal,* vol. 4, no. 1, 1979, p. 45-48.

The design and manufacture of fiberglass helicopter rotor blades are discussed. Fiberglass blades (FBs) offer higher fatigue strength than conventional metal blades, as well as insensitivity to small defects, gradual failure modes, freedom from corrosion, and damage tolerance. Blades were not damaged structurally by lightning strikes of 200,000 amperes, and passed a ballistics test by swallowing a 23 mm high explosive impact round rather than permitting it to exit. In the manufacture of FBs, upper and lower spar caps are wound on an orbital pin winding machine, and a filament winding machine is used for the trailing edges and the inner and outer torque tubes. J.P.B.

A80-24746 **Optical design of airport control tower cabs.** P. D. Carman and H. W. Budde (National Research Council, Div. of Physics, Ottawa, Canada). *Applied Optics,* vol. 19, Feb. 15, 1980, p. 490-498.

A study has been made of optical aspects of airport control towers as part of a planned general optimization of control towers by Transport Canada. Problems found were reflections, glare, visual obstructions, identification of distant objects, and excessive solar heat. The study makes recommendations on cab shape, tower height, glazing, shades, sunglasses, binoculars, and internal lighting. Proper choice of cab shape (e.g., 30 deg window inclination and 12-28 sides) provided effective control of reflections. Some plastic shades were found to increase the risk of eye damage. Two tower cabs incorporating the recommendations have been built and were found to be satisfactory. (Author)

A80-24817 **Characteristics of burning Jet A fuel and Jet A fuel-water emulsion sprays.** H. Jahani and S. R. Gollahalli (Oklahoma, University, Norman, Okla.). *Combustion and Flame,* vol. 37, Feb. 1980, p. 145-154. 18 refs.

An investigation has been conducted into the effects of emulsion characteristics on the flame structure of pure Jet A fuel, Jet A fuel and surfactant blend, and Jet A fuel-water-surfactant emulsion sprays burning over an air-blast atomizer in quiescent and swirling surroundings. The effects of surfactant concentration and water concentration on the characteristics of emulsions, flame stability, axial and radial temperature profiles, the total radiation emitted, and the soot concentration are documented. It is concluded that the addition of surfactant alone to fuel changes the flame characteristics very slightly, whereas changes in both surfactant and water concentrations in emulsions affect the flame structure considerably. (Author)

A80-24819 **Local laminarization in turbulent diffusion flames.** T. Takafi, H.-D. Shin, and A. Ishio (Osaka University, Suita, Japan). *Combustion and Flame,* vol. 37, Feb. 1980, p. 163-170. 11 refs.

The turbulence in round fuel jets with and without flame is examined experimentally considering the characteristic difference of turbulence due to the existence and nonexistence of flame. Measurements of flow velocity, turbulence intensity, gas temperature and species concentration are carried out and quantitative verification is presented for the effects of flame on turbulence. Visual study by schlieren photography shows the local laminarization phenomena due to the existence of flame at lower nozzle flow Reynolds number and the apparent laminarization which exists pertinaciously even at higher Reynolds number in the outer layer just near the nozzle exit. (Author)

A80-24899 **Increasing aircraft efficiency through laminar flow control.** R. Cotta. *Aviation Engineering and Maintenance,* vol. 4, Jan. 1980, p. 12-15.

The article discusses recent work in improving laminar flow in order to reduce drag and thereby overall fuel consumption. Attention is given to NASA's laminar flow control project (LFC), the object of which is to demonstrate that the technology required to incorporate LFC into long-range commercial jet transports of the 1990's is available. Discussion covers LFC aircraft configurations proposed by Boeing, Lockheed, and Douglas. Also covered are computer aided design, possible materials, and compromises for maintenance access. Finally attention is given to losses in aerodynamic efficiency which stem from insect accumulation of wind leading edges, dents, mismatched surface panels, and leaking pressurization of aerodynamic seals. M.E.P.

A80-25059 **Rain erosion of lightning protection coatings for carbon fibre composites.** H. W. Schröder (Dornier System GmbH, Friedrichshafen, West Germany). In: International Conference on Erosion by Liquid and Solid Impact, 5th, Cambridge, England, September 3-6, 1979, Proceedings. Cambridge, Cambridge University, 1979, p. 74-1 to 74-8. 7 refs.

In the future large parts of the outer skin of aircraft will be made of carbon fibre composites. In areas where the probability of lightning strikes is high, carbon fibre materials have to be protected by lightning protection systems. The erosion resistance of different lightning protection systems consisting of aluminum foils, flame-sprayed aluminum, aluminum-mesh and metal powder loaded paints was investigated, using a rotating arm apparatus. In the same way,

the use of polyurethane coatings for enhancing the rain erosion resistance was investigated. (Astrocoat 7100 and 7200, Chemglaze M213 and M313 and ICI F407-636). Special attention was paid to the influence of the drop diameter and to the different modes of failure which were observed. (Author)

A80-25093 # A rotary inverter system for a multiple-electrode MHD generator. C. S. J. Lamb, S. Ramakrishnan, and H. K. Messerle (Sydney, University, Sydney, Australia). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 18th, Butte, Mont., June 18-20, 1979, Preprints. Bozeman, Mont., Montana State University, 1979, p. F.2.1-F.2.3.

Coupling of magnetohydrodynamic generators to existing power grids requires dc to ac conversion. Most of the present day research teams are considering the use of solid-state inverters for this task. In this paper, a rotary inverter system is proposed which makes use of a parallel-connected rotary motor driving a conventional alternator. The advantages are direct connection to a multiple-electrode MHD generator, simple construction, and easy operation. (Author)

A80-25141 Navigation satellite users; Proceedings of the National Aerospace Symposium, Springfield, Va., March 6-8, 1979. Symposium sponsored by the Institute of Navigation. Washington, D.C., Institute of Navigation, 1979. 218 p.

Topics addressed include shipboard antenna tests for GPS; the use of Transit for time dissemination; geodetic uses of the NNSS by European agencies; the role of navigation satellites in oil exploration; the outlook for the GPS in civil aircraft operations; and GPS satellite selection for sequential receivers. Also discussed are NNSS application research in Japan, a collision avoidance system using GPS and ATCRBS, and ionospheric measurements from Navstar satellites. B.J.

A80-25143 # Navstar field test results. D. W. Henderson and J. A. Strada (USAF, Space and Missile Systems Organization, El Segundo, Calif.). In: Navigation satellite users; Proceedings of the National Aerospace Symposium, Springfield, Va., March 6-8, 1979. Washington, D.C., Institute of Navigation, 1979, p. 8-44.

After a brief description of the Navstar Global Positioning System the paper presents some of the significant field test results. Attention is given to Navstar accuracy, the landing approach, rendezvous, shipboard operations, foliage attenuation, and time transfer. The results are summarized in a series of figures. B.J.

A80-25144 # Shipboard antenna tests for GPS. R. W. Major and R. M. Akita (U.S. Naval Ocean Systems Center, San Diego, Calif.). In: Navigation satellite users; Proceedings of the National Aerospace Symposium, Springfield, Va., March 6-8, 1979. Washington, D.C., Institute of Navigation, 1979, p. 45-56. 5 refs.

Shipboard antenna tests for the Global Positioning System (GPS) were performed to determine the multipath effects on a prototype antenna for submarine use and to compare the performance of prototype surface ship GPS antennas. This paper describes the details of planning, installation, testing, and analysis of test results; in-plant, dockside, and at-sea tests are discussed. B.J.

A80-25146 # The Navstar Global Positioning System and time. D. J. Henson, J. T. Dolloff, and D. D. Thornburg (General Dynamics Corp., Electronics Div., San Diego, Calif.). In: Navigation satellite users; Proceedings of the National Aerospace Symposium, Springfield, Va., March 6-8, 1979. Washington, D.C., Institute of Navigation, 1979, p. 65-73.

The GPS uses a network of highly stable spaceborne and ground-based atomic clocks. This paper describes the precise time and time interval characteristics of GPS; a method of using GPS precise time transfer both for users with accurately known locations and for users requiring GPS for both position and time is considered. An error model for precise time transfer using GPS is presented in terms of satellite clock and ephemeris prediction errors, user position and clock errors, atmospheric errors, and random noise. Expected time transfer errors for the operational GPS user are less than 100 ns relative to UTC and less than 30 ns relative to GPS time. B.J.

A80-25149 # Applications of the spread-spectrum signals from the NOVA satellites. E. F. Prozeller (Johns Hopkins University, Laurel, Md.). In: Navigation satellite users; Proceedings of the National Aerospace Symposium, Springfield, Va., March 6-8, 1979. Washington, D.C., Institute of Navigation, 1979, p. 93-100. 9 refs.

High-precision timing signals from the NOVA satellites will offer several new options to a Transit system user. Experiments using spread-spectrum signals from TIP satellites (prototypes of the production NOVA satellites) have demonstrated the use of these signals for real-time ionospheric correction, worldwide time dissemination fron a single satellite, and the elimination of interference between covisible satellites. This paper discusses the characteristics of the NOVA spread-spectrum signals and describes typical ground equipment modifications that allow simple recovery of the new precision ranging/timing signals. B.J.

A80-25157 # A collision avoidance system using Navstar/GPS and ATCRBS. P. S. Noe (Texas A & M University, College Station, Tex.) and A. W. Yendrey (U.S. Navy, Naval Training Center, Orlando, Fla.). In: Navigation satellite users; Proceedings of the National Aerospace Symposium, Springfield, Va., March 6-8, 1979. Washington, D.C., Institute of Navigation, 1979, p. 157-160. 26 refs.

The proposed airborne collision avoidance system, based on the use of the Navstar/GPS navigation satellite system, can determine the aircraft position with an accuracy of 10 to 100 meters. Position data will be transmitted on an unassigned civil mode (mode D), using the ATC Radar Beacon System. The design can be economically implemented for aircraft equipped with a GPS receiver and a beacon transponder, with collision avoidance warning provided by ground control. A beacon receiver could also be designed, based on avoidance algorithms, which would automatically provide the pilot warning. It is shown that the proposed system is more economical than other collision avoidance concepts. V.L.

A80-25158 # Outlook for Global Positioning System /GPS/ in civil aircraft operations. D. J. Sheftel (FAA, Washington, D.C.). In: Navigation satellite users; Proceedings of the National Aerospace Symposium, Springfield, Va., March 6-8, 1979. Washington, D.C., Institute of Navigation, 1979, p. 161, 162.

The evaluation of the GPS for use in domestic and international civil aviation by the Federal Aviation Administration (FAA) is discussed. Operational and economic reasons for the replacement of present systems (primarily VORTAC) with the GPS are considered, and the performance, cost, compatibility, operational suitability and institutional requirements for a replacement system are indicated. The FAA program currently under way to investigate these factors is outlined, and it is predicted that, with a basic finding on the suitability of the GPS for civil aviation arrived at by 1983 and a final selection for a VORTAC replacement made by 1985, an official system change on national and international basis can be accomplished by 1995. A.L.W.

A80-25162 # On-board precision approach system using NAVSTAR GPS. R. E. Harper (OAO Corp., Atlantic City, N.J.). In: Navigation satellite users; Proceedings of the National Aerospace Symposium, Springfield, Va., March 6-8, 1979. Washington, D.C., Institute of Navigation, 1979, p. 183-188. 5 refs.

The paper describes a model used to verify the feasibility of a method of providing an IFR precision approach system, using the Global Positioning System, to replace or supplement the existing ILS system. Similarly the method described could be used to replace or supplement the MLS system (under development at this time). The technique described uses an on-board computer and a GPS receiver

to establish a flight path and glide slope for a landing aircraft. The computer uses GPS receiver input data and information which could be entered via keyboard or magnetic strip, as well as resident data base within the on-board computer that contains dynamic vehicle parameters. (Author)

A80-25164 # **On the NNSS application research in Japan.** K. Kimura, S. Nishi, and H. Nasu (Ministry of Transport, Electronic Navigation Research Institute, Tokyo, Japan). In: Navigation satellite users; Proceedings of the National Aerospace Symposium, Springfield, Va., March 6-8, 1979. Washington, D.C., Institute of Navigation, 1979, p. 191-197. 5 refs.

The paper presents several studies carried out by the Electronic Navigation Research Institute, Japan, concerning the Navy Navigation Satellite System (NNSS). Evaluation of the actual receiving system installed at an automated tanker is outlined along with the study of the NNSS position-fixing accuracy of different parameters. The results of a three-dimensional positioning experiment are discussed and application of the Kalman filter technique to the NNSS-Omega Hybrid Navigation System is also investigated. V.T.

A80-25165 # **The impact of GPS on CV mission effectiveness.** J. H. Fagan, M. D. Gaphardt, and P. E. Connolly (Analytic Sciences Corp., Reading, Mass.). In: Navigation satellite users; Proceedings of the National Aerospace Symposium, Springfield, Va., March 6-8, 1979. Washington, D.C., Institute of Navigation, 1979, p. 198-207. 7 refs. Contract No. N62269-77-D-0118.

The impact of NAVSTAR Global Positioning System (GPS) on the general purpose aircraft carrier (CV) is assessed on three performance levels: navigation equipment, tactical operations and mission effectiveness. Several uses of GPS-derived position and velocity information to augment both the current and the projected mid-1980 CV navigation system are compared to current capabilities. The potential impacts of the addition of GPS to the CV on existing navigation equipment and shipboard systems which use navigation data are summarized. Four general areas of CV tactical operations that could benefit from GPS are alignment of aircraft inertial navigation systems, post-mission recovery of aircraft, command and control, and over-the-horizon targeting. Within these areas, the performance of GPS-augmented tactical operations are compared to pre-GPS tactical capabilities. Relative measures of effectiveness are presented for three typical mission scenarios, each of which exercises a number of tactical operations. The three scenarios deal with local warfare, task force transit and aircraft rendezvous and recovery. (Author)

A80-25214 # **An induction gyrocompass (Busola giroindukcyjna).** A. Radon. *Instytut Lotnictwa, Prace,* no. 77-78, 1979, p. 53-59. In Polish.

The paper deals with the design and principle of an induction gyrocompass intended for light aircraft. A distinctive feature of the device is the use of a dc torque motor as the azimuthal corrector. The torque characteristic varies as a function of the angular displacement. V.P.

A80-25220 # **A mass flowmeter with compensation for thermal density variations of the fluid (Przeplywomierz masowy z korekcja temperaturowych zmian gestosci cieczy).** Z. Szymanski. *Instytut Lotnictwa, Prace,* no. 77-78, 1979, p. 127-137. 6 refs. In Polish.

The mass flowmeter discussed in the present paper was designed for measuring the flow rate of aircraft fuels by multiplying the volume flow rate by the actual fuel density. The fuel density is monitored by fixing an initial fuel density at a temperature of 293 K and automatically compensating for the thermal density variations on the basis of its mean linear dependence on the measured fuel temperature. V.P.

A80-25221 # **A system for measuring and recording wind-tunnel balance data (Zestaw do pomiaru i rejestracji danych z wagi aerodynamicznej).** D. Konopska and I. Osipiak-Chmielewska. *Instytut Lotnictwa, Prace,* no. 77-78, 1979, p. 139-153. 5 refs. In Polish.

The system described will measure simultaneously the pitching, rolling, and yawing moments, the three force components, the ambient temperature, and the chamber temperature. The data are printed and recorded on perforated tape. V.P.

A80-25245 # **The re-organization of airport administration in Canada.** D. Varty. In: Annals of air and space law. Volume 4. Montreal, McGill University; Toronto, Carswell Co., Ltd.; Paris, Editions A. Pedone, 1979, p. 359-365. 11 refs.

The centrally controlled administrative organization of Canada's airports is discussed, as well as the changes recommended by a Task Force on Airport Management (TFAM). The objectives of the TFAM included finding a management structure that emphasized local autonomy, financial viability, managerial efficiency, effectiveness and accountability, with the constraint that land ownership at principal airports remain federal. To provide more local direction of operations at each major airport, the Airport Commission concept was proposed. This commission would consist of members of the local community and would not be subject to federal public service acts or directions from an Ottawa headquarters, but would be accountable to the Minister of Transportation. J.P.B.

A80-25445 # **Problems of older jet aeroplanes - A regulatory authority view.** J. C. Chaplin (Civil Aviation Authority, London, England). *Aircraft Engineering,* vol. 52, Feb. 1980, p. 2-5.

Some problems of older jet airplanes are reviewed, with particular reference to matters concerning airworthiness and operation. Particular attention is given to the problem of airplane structure and to the design standard and physical standard of the airplane. The role of the operator is discussed for a particular airplane. V.P.

A80-25446 # **A scientific approach to defeating helicopter vibration.** N. E. Trigg (Helitune, Ltd., Fleet, Hants., England). *Aircraft Engineering,* vol. 52, Feb. 1980, p. 6-9.

The essence of combatting helicopter vibration is to remove out-of-balance mechanical and aerodynamic forces which cause vibration, using trim tabs and balance weights. Past methods of applying these correctives were essentially experimental. In the present paper, it is shown how scientific tuning methods developed over the past decade can provide remedy to the vibration problem in a precise and rapid way. Some illustrative examples are presented. V.P.

A80-25447 # **Transparent engines at Rolls-Royce - The application of high energy X-ray technology to gas turbine development.** P. A. E. Stewart (Rolls-Royce, Ltd., Advanced Projects Dept., Bristol, England). *Aircraft Engineering,* vol. 52, Feb. 1980, p. 10-13.

Experience with work directed to provide direct viewing of the growths, flexures, or movements in a gas-turbine engine operated in a test facility is reviewed. Prior to the advent of high-energy radiography, the standard practice was to infer information by modifying an engine specially and inserting retractable wearaway probes to measure gap clearances. Alternatively, induction probes were used, but the need to specially prepare an engine still remained. In the mid-1960s, exploratory work with X-rays was conducted, but the X-ray energy level attainable was insufficient. Better results were obtained in 1969 with a flash pulsed high energy X-ray source of about 2.3 million electron volts. The discussion is focused on a successful experiment carried out on the M-45 engine, using iridium 192 and cobalt 60 radioactive isotopes with energy levels ranging from 1 to 2 MeV. V.P.

A80-25448 # **Pratt and Whitney innovations.** *Aircraft Engineering,* vol. 52, Feb. 1980, p. 21-23.

The paper deals with a completely automated casting facility capable of producing strong, efficient turbine blades of advanced

metallurgical structure and exceptional uniformity. The blades, produced in two parts, require less cooling air, resulting in more efficient aircraft engine operation. The casting facility provides casting process control and individual part accountability never possible with conventional casting methods. The details of the production process are outlined. V.P.

A80-25449 # **Improved MPG for the BAe 146 feeder-jet.** G. Giles. *Aircraft Engineering,* vol. 52, Feb. 1980, p. 28, 29.

For the BAe 146, a short-haul pressurized civil transport, the air conditioning system must be compatible with high by-pass turbofan engines and with an onboard auxiliary power unit. The considerations underlying the design of the air system are outlined, and the operating costs of a baseline system are identified as a requirement for evaluating the net gains. The reduced cost of operation provided by a reduced engine bleed system is an attractive feature of the air system under consideration. V.P.

A80-25498 **Measurement of stress distribution in sandwich beams under four-point bending.** K. Kemmochi (Agency of Industrial Science and Technology, Ibaraki, Japan) and M. Uemura (Tokyo, University, Tokyo, Japan). *Experimental Mechanics,* vol. 20, Mar. 1980, p. 80-86. 8 refs.

The bending-stress distributions through thickness in sandwich-composite beams are different from those obtained by conventional composite-beam theory because of the shear effect of the core. The stress distributions in sandwich beams of composite materials with various combinations of face and core materials subjected to four-point bending are analyzed by introducing the multilayer-builtup theory. Photoelastic measurements were carried out on model specimens having four different k-values and the applicable ranges of the two theories are discussed on the basis of the experimental results. It is shown that the experimental-stress distributions in sandwich-composite beams having k-values larger than 120 can be explained by the multilayer-builtup theory. (Author)

A80-25945 **Error rate performance of M-ary DPSK systems in satellite/aircraft communications.** Y. Miyagaki (Okayama University of Science, Okayama, Japan), N. Morinaga, and T. Namekawa (Osaka University, Suita, Japan). In: ICC '79; International Conference on Communications, Boston, Mass., June 10-14, 1979, Conference Record. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 34.6.1-34.6.6. 16 refs.

This paper treats the performance of the M-ary DPSK systems at low band rate in the L-band satellite/aircraft channel. The symbol error rate, the double symbol error rate, and the error rate in dual diversity reception are theoretically evaluated. The comparison with the M-ary CPSK systems is made under a certain condition. (Author)

A80-26085 * # **The Surface Contour Radar, a unique remote sensing instrument.** J. E. Kenney, E. A. Uliana (U.S. Navy, Naval Research Laboratory, Washington, D.C.), and E. J. Walsh (NASA, Wallops Flight Center, Wallops Island, Va.). *(Institute of Electrical and Electronics Engineers, International Microwave Symposium, Orlando, Fla., Apr. 30-May 2, 1979.) IEEE Transactions on Microwave Theory and Techniques,* vol. MTT-27, Dec. 1979, p. 1080-1092. 6 refs.

A 36 GHz computer controlled airborne Surface Contour Radar (SCR) is described, which was developed by the Naval Research Laboratory and NASA. The system uses pulse-compression techniques and dual frequency carriers spaced far enough apart to be decorrelated on the sea surface. The continuous wave transmitter is biphase modulated, the return signal is autocorrelated, and the code length and clock rate are variable, providing selectable range resolutions of 0.15, 0.30, 0.61 and 1.52 m. The SCR generates a false-color coded elevation map of the sea surface below the aircraft in real time, and can routinely produce ocean directional wave spectra with off-line data processing. J.P.B.

A80-26193 # **Evaluation of the effectiveness of case-hardening gas-turbine-engine components on the basis of fatigue-failure similarity equations (Otsenka effektivnosti poverkhnostnogo uprochneniia detalei GTD s pomoshch'iu uravneniia podobiia ustalostnogo razrusheniia).** V. K. Iatsenko (Zaporozhskii Mashinostroitel'nyi Institut, Zaporozhe, Ukrainian SSR). *Problemy Prochnosti,* Jan. 1980, p. 56-58. In Russian.

The paper deals with an experimental investigation of the fatigue strength of EI961 steel specimens, carried out to obtain data for evaluating the effectiveness of case-hardening components made of this steel on the basis of a fatigue-failure similarity equation proposed by Serensen, Kogaev, and Shneiderovich (1975). The results of the fatigue tests are tabulated. V.P.

A80-26195 # **Crack development in panels of a pressurized fuselage under the combined effect of pressurization-induced cyclic loads and high-frequency vibrations (Razvitie treshchin v paneliakh germofiuzeliazha pri sovmestnom deistvii tsiklicheskikh nagruzok ot nadduva i vysokochastotnykh vibratsii).** N. A. Mozzherova (Tsentral'nyi Aerogidrodinamicheskii Institut, Zhukovskiy, USSR). *Problemy Prochnosti,* Jan. 1980, p. 63-66. 8 refs. In Russian.

In the experiments described, 86 x 100 cm thin-walled cylindrical panels with a radius of curvature of 17.5 cm, prepared of D16AT aluminum alloy, were used to study the influence of high-frequency vibrations induced by a turboprop engine on the rate of crack growth in the panels. Vibrations superposed on pressurization-induced cyclic loads are shown to result in a drastic (two to three orders of magnitude) increase in crack propagation rate. V.P.

A80-26206 **Local ground noise generated by supersonic transport planes.** E. M. Zhmulin, A. G. Munin, A. A. Tupolev, and G. A. Cheremukhin. *(Akusticheskii Zhurnal,* vol. 25, July-Aug. 1979, p. 521-527.) *Soviet Physics - Acoustics,* vol. 25, July-Aug. 1979, p. 297-301. Translation.

In the present paper, the noise characteristics of the Tu-144 and the Concorde are analyzed, and noise abatement methods are examined. The noise characteristics of supersonic and subsonic aircraft are compared. The expected noise levels of second-generation SSTs are assessed, and some suggestions concerning SST noise regulations are proposed. V.P.

A80-26221 # **Present-day problems of air traffic control in ground-to-air communications (Problemi odierni nelle comunicazioni terra-aria nel controllo del traffico aereo).** G. B. Stracca (Milano, Politecnico, Milan, Italy). *Alta Frequenza,* vol. 48, Dec. 1979, p. 706-713. 5 refs. In Italian.

The problems of the present-day system which utilizes radio channels allocated in the VHF and UHF bands for civilian ground-aircraft communication purposes over metropolitan areas are discussed. Radio channel overload, interference, gaps in coverage, and breakdowns in two-way radio transmission are considered. Attention is given to the possible future advantages of a ground-air data link in addition to voice channels. J.P.B.

A80-26268 **Yawed slender wings at small angles of attack (Schiebende schlanke Flügel mit kleinem Anstellwinkel).** B. Wagner (Dornier GmbH, Friedrichshafen, West Germany). *Zeitschrift für Flugwissenschaften und Weltraumforschung,* vol. 4, Jan.-Feb. 1980, p. 16-27. 21 refs. In German. Research supported by the Deutsche Forschungsgemeinschaft.

Jones' slender wing theory is extended to include a free vortex sheet leaving a lateral edge because of a sideslip. The integral equation of the vortex strength in the wake is solved by iterative

processes. Formulas for vortex strengths, pressure distributions, and aerodynamic coefficients are developed for such wings; theoretical results are compared with those from experiments. C.F.W.

A80-26269 Unsteady pressure measurements on wing-store combinations in incompressible flow. H. Triebstein (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Aeroelastik, Göttingen, West Germany). *Zeitschrift für Flugwissenschaften und Weltraumforschung,* vol. 4, Jan.-Feb. 1980, p. 28-38. 10 refs.

The present paper deals with the measurements of unsteady pressures on harmonically oscillating wing-store combinations in incompressible flow. The experiments were made in the 3 by 3 m subsonic wind tunnel of the DFVLR in Göttingen. The pressure was measured for yaw-, pitch- and heave-oscillations of the store at different locations of the store. The pitching and yawing oscillations were performed about two different axes. Further unsteady pressure distributions were measured on the wing-store combination at harmonically pitching oscillations of the wing and on the store at pitching and heaving oscillations of the store without the wing.

(Author)

A80-26305 # One-dimensional aerodynamic control calculations for cooled gas turbines (Odnomernyi proverochnyi aerodinamicheskii raschet okhlazhdaemykh gazovykh turbin). Ia. A. Sirotkin. *Akademiia Nauk SSSR, Izvestiia, Energetika i Transport,* Jan.-Feb. 1980, p. 137-149. 15 refs. In Russian.

The paper deals with a one-dimensional control method developed for air-cooled gas-turbine stages. Detailed attention is given to such features as air injection, flow, and mixing. The method is developed on the basis of irreversible thermodynamics, with separate consideration of aerodynamic and thermodynamic losses in the analysis. Instead of the conventional conservation laws, use is made of the balance, entropy and moment of momentum (with respect to the axis of rotation) equations. This provides a better treatment of the complex physical flow pattern in a stage than the theory of viscous, thermal, and mass interaction. V.P.

A80-26325 # On the equations of motion about the mass centre of the jet aircraft considered as variable mass system. M. M. Nita (Bucuresti, Institutul Politehnic, Bucharest, Rumania). *Revue Roumaine des Sciences Techniques, Série de Mécanique Appliquée,* vol. 24, July-Aug. 1979, p. 527-536.

Equations of motion of a jet aircraft about its center of mass are presented. The aircraft is considered a mass system that is variable owing to continuous air capture and gas ejection. There is an additional term in the equation of motion which may have an effect of positive or negative damping on the spinning motion of the aircraft, depending on the position of the jet engines and fuel tanks. Under certain conditions this effect is so significant that it may influence aircraft flight performance. B.J.

A80-26342 # Breaking V/STOL free of Catch 22. D. C. Hazen (Princeton University, Princeton, N.J.). *Astronautics and Aeronautics,* vol. 18, Mar. 1980, p. 24-30.

The article examines the problem that no mission role has been determined that clearly makes V/STOL aircraft worth the additional cost, noting that no overwhelming demand for V/STOL has yet emerged from the civilian world. Attention is given to the use of the Harrier AV-8A by the Marine Corps. It is shown that unconventional mission profiles can allow the V/STOL to be used to its best advantage, noting that short distance missions allow some fuel to be replaced by ordinance. Comparisons are also made between mission requirements of the Navy, and Air Force. M.E.P.

A80-26343 # The cautious course to introducing new SDM technology into production systems. R. N. Hadcock (Grumman Aerospace Corp., Bethpage, N.Y.). *Astronautics and Aeronautics,* vol. 18, Mar. 1980, p. 31-33.

The article reviews major improvements in structural efficiency, durability, and cost effectiveness which have been realized during the past fifty years through a series of continuing advances in SDM technology. It is concluded that the emergence of advanced composites and advanced metallic structures offers significant additional improvements, provided opportunities are made available for using them. M.E.P.

A80-26344 # New approaches to sailing. B. Smith. *Astronautics and Aeronautics,* vol. 18, Mar. 1980, p. 36-47.

It is noted that sailing involves no thermodynamic cycle and generates little heat, and that sailboats react mechanically to the force of the wind without any train of energy-losing conversions in the path of the action. The paper investigates some possible configurations for sail powered vessels, such as a blimp sail boat, hybrid motor-sailer, and a tanker sailed with the gases derived from the well yielding the oil. Attention is also given to some model aerohydrofoils which have been experimented with. M.E.P.

A80-26345 # CADD on the F-18 program. J. H Zadarnowski (McDonnell Aircraft Co., St. Louis, Mo.). *Astronautics and Aeronautics,* vol. 18, Mar. 1980, p. 48-51, 61.

The paper examines the application of computer-aided design drafting to the development of the F-18, noting that much traditional boardwork was made obsolete. It is shown that CADD was principally used in the design and fabrication of advanced composites, sheet metal parts, and aircraft tubing. To a lesser degree, the system was applied to honeycomb structure and machined parts. Attention is given to manufacturing benefits, and cost analysis. Finally, it is reported that cost effectiveness of CADD is confirmed for small aircraft components, noting however, that cost effectiveness will always depend on schedule coordination and can be affected by a number of design criterions. M.E.P.

A80-26349 # Theory of by-pass ducted-fan engines (Teoriia dvukhkonturnykh turboreaktivnykh dvigatelei). V. P. Demenchenok, L. N. Druzhinin, A. L. Parkhomov, V. A. Sosunov, M. M. Tskhovrebov, S. M. Shliakhtenko, and A. S. El'perina. Moscow, Izdatel'stvo Mashinostroenie, 1979. 432 p. 76 refs. In Russian.

The book deals with the general aspects of ducted-fan-engine theory and with methods of optimizing the operational parameters of subsonic and supersonic ducted-fan engines. The operational, control, and noise characteristics of low and high bypass ratio engines are examined. Attention is given to the correlation of gas-turbine and compressor weights and dimensions. V.P.

A80-26350 # Aircraft instruments and automatic systems /3rd revised and enlarged edition/ (Aviatsionnye pribory i avtomaty /3rd revised and enlarged edition/). D. A. Braslavskii, S. S. Logunov, and D. S. Pel'por. Moscow, Izdatel'stvo Mashinostroenie, 1978. 428 p. 35 refs. In Russian.

The book deals with the fundamentals of the theory of aircraft instruments and the principles of designing manometric, electric, and gyroscopic instruments for measuring the position and motion of aircraft (altitude, heading, airspeed, angles of pitch, roll, and yaw, and angular velocities). Autopilots, navigation systems, and control systems are discussed, along with instruments for monitoring engine operation. V.P.

A80-26471 Design of an electronic model of a microwave aircraft landing system. A. I. Nikitin. *(Radiotekhnika,* vol. 34, June 1979, p. 39-41.) *Telecommunications and Radio Engineering, Part 2 - Radio Engineering,* vol. 34, June 1979, p. 83-85. 5 refs. Translation.

A algorithm is presented for the electronic simulation of microwave landing systems. The method involves simulation of MLS signals on the second intermediate frequency of the onboard receiver. The proposed model makes it possible to evaluate the accuracy and noise immunity of microwave landing systems. B.J.

A80-26630 **Constant speed 400 Hz aircraft electric generation system.** R. C. McClung (Sundstrand Corp., Sundstrand Aviation Electric Power Group, Rockford, Ill.). *Society of Automotive Engineers, Aerospace Meeting, Los Angeles, Calif., Dec. 3-6, 1979, Paper 791067.* 11 p.

The purpose of this paper is to examine recent innovations in the state-of-the-art of aircraft constant speed drive alternating current electric power generation systems. An engineering problem was posed by the concepts used in designing the latest generation of commercial aircraft. The approach to solving the problem and the solutions chosen have offered the opportunity to further increase the reliability of the aircraft secondary power system. The maintenance required has been decreased by simplifying the system, and much of the error potential involved in fault isolation has been eliminated by a reliable Built-In Test (BITE) system. (Author)

A80-26631 **Air supply system approach for the Boeing Model 767 Airplane.** J. P. Patrick (United Technologies Corp., Hamilton Standard Div., Windsor Locks, Conn.) and A. K. Trikha (Boeing Commercial Airplane Co., Seattle, Wash.). *Society of Automotive Engineers, Aerospace Meeting, Los Angeles, Calif., Dec. 3-6, 1979, Paper 791068.* 13 p.

The purpose of the paper is to describe the salient features of the Boeing 767 air supply system and to present data that illustrate its steady state and dynamic performance characteristics. The air supply system consists of two engine bleed air systems and a remotely built-in-test equipment module. Attention is given to the electrical systems and to the digital module that indicate failures to the line replaceable unit level. C.F.W.

A80-26632 **Development and flight test of a two-place night/adverse weather A-10 for the close-air support and battlefield attack mission.** J. M. Williamson and W. Shawler (Fairchild Republic Co., Farmingdale, N.Y.). *Society of Automotive Engineers, Aerospace Meeting, Los Angeles, Calif., Dec. 3-6, 1979, Paper 791069.* 9 p. 6 refs.

The paper discusses the development, building and critical evaluation of a cost-effective solution to a critical void in battlefield support tactical air capacity in night and adverse weather. The objective is to incorporate an effective integration of proven avionics with appropriate displays and presentations into a modified A-10 system, and to demonstrate night/adverse weather tactical effectiveness using this system to exploit the A-10's tactics and munitions. C.F.W.

A80-26633 **AV-8B - A second generation V/STOL.** J. Warakomski (McDonnell Aircraft Co., St. Louis, Mo.). *Society of Automotive Engineers, Aerospace Meeting, Los Angeles, Calif., Dec. 3-6, 1979, Paper 791070.* 20 p.

State-of-the-art technology developments have enabled the enhancement of an operationally proven, superior weapon system to provide next generation capability. Significant advances applicable to vertical and short take-off and landing (V/STOL) aircraft have been made in aerodynamic, propulsion, composite structure and avionics technologies. These have been incorporated into the AV-8B Weapon System, whose performance has been demonstrated through the YAV-8B prototype flight program. (Author)

A80-26634 **Production Eagle and its potential.** R. W. White (McDonnell Aircraft Co., St. Louis, Mo.). *Society of Automotive Engineers, Aerospace Meeting, Los Angeles, Calif., Dec. 3-6, 1979, Paper 791071.* 9 p. 7 refs.

The USAF F-15A/B air superiority fighter, built by the McDonnell Aircraft Company and introduced into active service in 1974, has demonstrated exceptional performance and combat readiness. Recent introduction of the F-15C/D with increased internal fuel, provisions for conformal fuel tanks, increased takeoff gross weight plus incorporation of a Radar Programmable Signal Processor provides improvement in range and mission flexibility. These improvements will enhance already demonstrated capabilities for performing other roles, i.e., in-weather strike, defense suppression and real-time reconnaissance in the post 1983 time period at a fraction of the cost to develop a new aircraft. (Author)

A80-26636 **The practical aircraft hydraulic test stand.** R. A. Morley (Teledyne Sprague Engrg., Gardena, Calif.). *Society of Automotive Engineers, Aerospace Meeting, Los Angeles, Calif., Dec. 3-6, 1979, Paper 791079.* 9 p.

An approach to the design of the portable hydraulic test stand is presented, with the basic test-stand circuit expected to perform satisfactorily on 90% of the commercial and military aircraft now in use. The subsystems are discussed with respect to the cost reduction, power requirements, fluid cleanliness, instrumentation, and the simplified and noisefree operations. Consideration is given to the selection and location of the filters and pumps, as well as the heat exchanger and valves. The system has been used successfully in the manufacture and care of utility, transport and military aircraft up to the Mach 2 class. A schematic diagram of the test stand is provided along with diagrams of the subsystems. L.M.

A80-26637 **MCAIR design philosophy for fighter aircraft departure and spin resistance.** J. Mello and J. Agnew (McDonnell Aircraft Co., St. Louis, Mo.). *Society of Automotive Engineers, Aerospace Meeting, Los Angeles, Calif., Dec. 3-6, 1979, Paper 791081.* 11 p.

The McDonnell Aircraft Company (MCAIR) design philosophy pertaining to the departure and spin resistance and out-of-control recovery characteristics of fighter aircraft is presented. The more important military specification requirements are reviewed and their influence on this philosophy is discussed. Aerodynamic stability and control criteria and control system design guidelines are presented which are used to assure that a fighter aircraft will exhibit a high level of departure and spin resistance and rapid recovery from out-of-control situations. (Author)

A80-26638 **Effects of forebody, wing and wing-body-LEX flowfields on high angle of attack aerodynamics.** W. A. Moore, G. E. Erickson, D. J. Lorincz, and A. M. Skow (Northrop Corp., Aircraft Group, Hawthorne, Calif.). *Society of Automotive Engineers, Aerospace Meeting, Los Angeles, Calif., Dec. 3-6, 1979, Paper 791082.* 27 p. 11 refs.

The effects of forebody, wing, and wing-body-LEX flowfields on high angle of attack aerodynamics are examined. Vortex flows emanating from the forebody and hybrid wings can affect the high angle-of-attack handling qualities and the departure and spin resistance of fighter aircraft. Depending on the strengths, orientation, and breakdown characteristics of these vortices, an aircraft may be departure-prone or departure-resistant. Studies were conducted to determine the effect of shed vortices, and guidelines were developed for the design of forebody and hybrid-wing shapes so that aircraft stability will be enhanced. A.T.

A80-26639 * **Control system techniques for improved departure/spin resistance for fighter aircraft.** L. T. Nguyen (NASA, Langley Research Center, Hampton, Va.). *Society of Automotive Engineers, Aerospace Meeting, Los Angeles, Calif., Dec. 3-6, 1979, Paper 791083.* 25 p. 6 refs.

Some fundamental information on control system effects on controllability of highly-maneuverable aircraft at high angles of attack and techniques for enhancing fighter aircraft departure/spin resistance using control system design is summarized. The discussion includes: (a) a brief review of pertinent high angle-of-attack phenomena including aerodynamics, inertia coupling, and kinematic coupling; (b) effects of conventional stability augmentation systems at high-alpha; (c) high-alpha control system concepts designed to enhance departure/spin resistance; and (d) the outlook for applications of these concepts to future fighters, particularly those designs which incorporate relaxed static stability. (Author)

A80-26640 **High-angle-of-attack flying qualities - An overview of current design considerations.** R. K. Heffley and D. E. Johnston (Systems Technology, Inc., Hawthorne, Calif.). *Society of Automotive Engineers, Aerospace Meeting, Los Angeles, Calif., Dec. 3-6, 1979, Paper 791085.* 8 p. 15 refs. Contract No. F33615-78-C-3604.

An overview is presented on the design for high-angle-of-attack flying qualities by examining the groups of airframe manufacturers, the research community, and the aircraft users. The aircraft manufacturers are restricted by cost and time constraints in their ability to use new design tools, and the user-pilots present factors which the manufacturers and researchers find difficult to address, such as provision of sensory cues or the pilots' discomfort with flight control computers. It is concluded that, taken together, the three points of perspective suggest methods of using design practices and standards to enhance the high-angle-of-attack flying qualities. A.T.

A80-26641 **HLH and beyond.** G. H. Fries and J. J. Schneider (Boeing Vertol Co., Philadelphia, Pa.). *Society of Automotive Engineers, Aerospace Meeting, Los Angeles, Calif., Dec. 3-6, 1979, Paper 791086.* 15 p. 26 refs.

Design, fabrication, and test of large high powered helicopter components in the U.S. Army Heavy Lift Helicopter Advanced Technology Component development program demonstrated the feasibility of efficient, large helicopter components and reduced the risk and cost of future heavy lift helicopter development. The components included a 92-foot diameter rotor system, an 18,000 horsepower drive system, a fly-by-wire flight control system, a 35 ton cargo handling system, and 8,000 horsepower turbo-shaft engines. Bench testing of the large, high power transmissions was not completed and is required to verify the adequacy of the design modifications resulting from the ATC technology development program. Moreover, current design methods were found to be inadequate for large flight weight gears, and new analytical design methods employing finite element techniques will be required for future large aircraft gear design applications. Extrapolation of the design and manufacturing technologies developed in the ATC program to larger but similar tandem rotor heavy lift configurations indicates that there are no formidable reasons why shaft driven helicopters cannot continue to grow in size. A study comparing shaft driven tandem helicopter configurations with hybrid airship configurations shows the helicopter to be competitive in the logging and containership off-loading applications for which the hybrid airship is being proposed. (Author)

A80-26642 **Single rotor options for heavy lift and potential of multi lift.** E. S. Carter, D. E. Cooper, and L. G. Knapp (United Technologies Corp., Sikorsky Aircraft Div., Stratford, Conn.). *Society of Automotive Engineers, Aerospace Meeting, Los Angeles, Calif., Dec. 3-6, 1979, Paper 791087.* 16 p.

The paper reviews the current state-of-the-art rotorcraft payload capacity growth, to show that the root of the problem is not any unsurmountable technical barrier, and briefly discusses the single rotor options for heavier lift. The economic factors which appear to have militated, up to this point, against development of larger helicopters for civil or military requirements are examined. C.F.W.

A80-26643 **Multi rotor options for heavy lift.** J. DeTore and S. Martin, Jr. (Bell Helicopter Textron, Fort Worth, Tex.). *Society of Automotive Engineers, Aerospace Meeting, Los Angeles, Calif., Dec. 3-6, 1979, Paper 791089.* 17 p. 23 refs.

The paper reviews the three and four rotor, tilt rotor V/STOL aircraft with an advanced tandem helicopter. The multirotor dynamic systems are projected to weight less than twin rotor systems and should avoid rapid design disk loading increases; design considerations are discussed, including safety, aeroelastic stability, external noise, and downwash effects. It is shown that the multirotor option can service four times the revenue-producing territory per day than an advanced tandem helicopter. It is recommended to pursue design studies and conduct scale model tests of aerodynamic interference, aeroelastic effects, and dynamic load distributions. A.T.

A80-26644 **The KC-135 - A successful multirole transport aircraft.** S. Starch (Boeing Military Airplane Co., Seattle, Wash.). *Society of Automotive Engineers, Aerospace Meeting, Los Angeles, Calif., Dec. 3-6, 1979, Paper 791093.* 13 p.

The paper examines the origin of the requirements for the KC-135 aircraft, its growth in missions, present status, and future prospects. Various photographs showing the development stages are presented together with graphs examining airlift statistics. It is concluded that the aircraft will use appreciably less fuel and meet civil standards for noise and atmospheric pollution because of its modern engine. C.F.W.

A80-26645 * **Multirole cargo aircraft options and configurations.** D. W. Conner and J. C. Vaughan, III (NASA, Langley Research Center, Hampton, Va.). *Society of Automotive Engineers, Aerospace Meeting, Los Angeles, Calif., Dec. 3-6, 1979, Paper 791096.* 16 p. 9 refs.

The paper discusses multirole cargo aircraft options and configurations. It was shown that derivatives of current wide-body aircraft would be economically attractive through 2008, but new dedicated airfreighters incorporating 1990 technology would offer little or no economic incentive. Option studies indicate that Mach 0.7 propfans would be economically attractive in trip cost, aircraft price, and airline ROI; spanloaders would be lower priced with higher ROI, but would have a relatively higher trip cost because of aerodynamic inefficiencies. Finally, air cushion landing gear configurations are identified as an option for avoiding runway constraints on airport accommodation of very large airfreighters. A.T.

A80-26646 **Future multi-mission transport aircraft - Requirements and design possibilities.** R. H. Lange and W. T. Mikolowsky (Lockheed-Georgia Co., Marietta, Ga.). *Society of Automotive Engineers, Aerospace Meeting, Los Angeles, Calif., Dec. 3-6, 1979, Paper 791097.* 14 p. 19 refs.

An assessment of future requirements for possible civil and/or military multimission aircraft is presented. A multirole strategic aircraft (the LX-MRSA) configuration with flexibility for a variety of missions such as a strategic missile carrier, ICBM carrier/launcher, and aerial tanker is discussed; a 1995 IOC advanced technology large aircraft is presented along with an assessment of desirable design features for a common military/commercial transport. Finally, a new aircraft concept known as Flatbed, configured for multirole operations with a novel backbone fuselage capable of carrying a passenger module or intermodal containers, is described. A.T.

A80-26647 **Opportunistic maintenance policies for economic replacement of internal life-limited components in modular aircraft engines.** J. L. Madden (USAF, Directorate of Management Sciences, Wright-Patterson AFB, Ohio). *Society of Automotive Engineers, Aerospace Meeting, Los Angeles, Calif., Dec. 3-6, 1979, Paper 791101.* 13 p. 7 refs.

New USAF aircraft engines have modules, each with internal life-limited components. Engines are repaired by replacing modules. Modules are repaired at either base or depot. An opportunistic maintenance policy specifies how early life-limited components may be replaced provided that the engine (or module) is already in repair. A repair level policy specifies when to repair a whole engine at depot instead of at base. Expected long term costs are calculated using computer simulation. Costs are maintenance manhours, pipeline requirements, shipping, and component replacement. Costs are graphed and the least cost policy choices are identified. (Author)

A80-26648 **On-condition maintenance - Review of military engines.** D. H. Story (USAF, Propulsion Management Div., Kelly

AFB, Tex.). *Society of Automotive Engineers, Aerospace Meeting, Los Angeles, Calif., Dec. 3-6, 1979, Paper 791102.* 6 p.

The Air Force has adopted the commercial airline's concept of on-condition maintenance. Application to transport aircraft type engines parallels the airline's experience. New generation, modular design, fighter engines have different manpower, facilities and equipment requirements. Engine diagnostics and automated trending and analysis have the potential to enhance maintenance under the on-condition concept. Long term impact of the concept will require continued monitoring and evaluation. (Author)

A80-26649 An approach to the runway denial problem. H. H. Ostroff (McDonnell Aircraft Co., St. Louis, Mo.). *Society of Automotive Engineers, Aerospace Meeting, Los Angeles, Calif., Dec. 3-6, 1979, Paper 791107.* 5 p.

Short runway operational aircraft are proposed as a more timely solution to the concern over runway denial weapons for the Air Force. Means for obtaining the required aircraft characteristics in the near and long term are discussed, as well as a possible role for Air Force VTOL aircraft. A tool for airbase vulnerability analysis is described. C.F.W.

A80-26650 Fighter options for tactical air defense, G. R. Kutz (Grumman Aerospace Corp., Bethpage, N.Y.). *Society of Automotive Engineers, Aerospace Meeting, Los Angeles, Calif., Dec. 3-6, 1979, Paper 791108.* 16 p.

A recent Grumman/Raytheon study sponsored by the AFFDL examined technology needs for future defensive counterair aircraft. The arena for that examination was theater air defense of NATO in the 1990's. This paper presents results of that effort with emphasis on the characteristics and technology complements of alternative concepts examined during the study. Five distinctly different weapon system designs emerged as competitive alternatives. These ranged from a small, low cost, transonic fighter armed with short range, IR guided missiles and deployed in quantity, to a large, sophisticated, and relatively expensive supersonic fighter/interceptor employing long range radar directed missiles. (Author)

A80-26651 Reliability and maintainability design standards from readiness-related goals. L. Rogin and J. Gold (Information Spectrum, Inc., Warminster, Pa.). *Society of Automotive Engineers, Aerospace Meeting, Los Angeles, Calif., Dec. 3-6, 1979, Paper 791109.* 10 p.

The paper considers the reliability and maintainability design standards for a Naval aircraft weapon system in terms of readiness-related goals. Generalized relationships and specific logic tracks are identified for the principal readiness-related parameters; the procedures assume that the systems will be consistent with the Naval operational methods. The anticipated ranges of variation for the principal parameters are established by evaluating the Fleet-wide averages over a wide range of current Naval aircraft systems. A.T.

A80-26730 Fatigue and microstructure; Proceedings of the Materials Science Seminar, St. Louis, Mo., October 14, 15, 1978. Seminar sponsored by the American Society for Metals. Metals Park, Ohio, American Society for Metals, 1979. 543 p. $60.

The Seminar focused on fatigue in machines and structures, in power generation, aircraft, and ground vehicles, new techniques for detection and monitoring of machine damage, mechanisms and theories of fatigue, cyclic plastic deformation and microstructure, fatigue-crack initiation and crack growth theories, high temperature fatigue, environmental effects of fatigue, fatigue crack propagation theories, and control of fatigue resistance through microstructure of ferrous alloys and high strength aluminum. A.T.

A80-26731 Fatigue in machines and structures - Aircraft. T. D. Cooper and C. A. Kelto (USAF, Materials Laboratory, Wright-Patterson AFB, Ohio). In: Fatigue and microstructure; Proceedings of the Materials Science Seminar, St. Louis, Mo., October 14, 15, 1978. Metals Park, Ohio, American Society for Metals, 1979, p. 29-56. 6 refs.

The paper examines fatigue in aircraft machines and structures. Analyses of aircraft failures shows that the engine failures are the single most important cause of aircraft accidents; premature fatigue cracking has resulted from improper part design or choice of materials, illustrated by failures in airframes and airframe/wing spar attachments. The former Air Force approach emphasizing the initial static strength of the structure and the 'safe-life' concept to achieve the desired fatigue life was replaced by the new Aircraft Structural Integrity Program which is based on the 'fail-safe' and the 'safe-crack-growth' design approaches. It is concluded that the new method will provide a better understanding of the metallurgical factors that control fatigue behavior and a better ability to achieve desired equipment life. A.T.

A80-26791 A time-shared monopulse approach to air/surface radar ranging. R. E. Wilcox (Emerson Electric Co., Electronics and Space Div., St. Louis, Mo.). In: EASCON '79; Electronics and Aerospace Systems Conference, Arlington, Va., October 9-11, 1979, Conference Record. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 249-255.

The paper discusses the relative merits and deficiencies of con-scan and COSRO systems for A/S ranging, after which a time-shared monopulse system TSMP is defined which is an autonomous and adaptive processing method to obtain ranging information over a large class of surface cross sections and topologies. The TSMP processor would time-share all three M.P. channels and perform the following sequence of operations. First, an angular section of the main beam is located, followed by finding that point in this main beam section at which the product of the azimuth and elevation difference channels achieve a minimum with respect to the attendant sum channel. This final range gate corresponds to the reflection delay along the desired ranging vector. (Author)

A80-26797 Application of Nd:YAG optical communications technology for aircraft to satellite links. J. D. Wolf, J. N. Windham, and J. A. Pautler (McDonnell Douglas Astronautics Co., St. Louis, Mo.). In: EASCON '79; Electronics and Aerospace Systems Conference, Arlington, Va., October 9-11, 1979, Conference Record. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 286-294. Contract No. F33615-76-C-1002.

A functional description is given for a general purpose satellite laser receiver. Low data rate multiple access, as well as single-user high data rate communications, are applied to airborne-satellite linking. Presented are advancements in solid state GaAs diode laser pump technology, which can provide a very long life. Nd:YAG is used for a low power laser beacon for precision pointing and tracking and for 20 Kbps communication. Geographic coverage advantages of small optical antennas in flush-mounted aircraft installations are shown for typical satellite orbits. (Author)

A80-26802 # Radiometric measurements of targets and clutter. J. P. Hollinger, B. E. Troy, and B. S. Yaplee (U.S. Navy, Naval Research Laboratory, Washington, D.C.). In: EASCON '79; Electronics and Aerospace Systems Conference, Arlington, Va., October 9-11, 1979, Conference Record. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 348-352.

Optimum passive detection of an object in a clutter background requires a knowledge of the detailed properties of the object and of the background. Airborne measurements at 90 GHz of the millimeter wavelength characteristics of selected targets and backgrounds are described and target detection enhancement is discussed. (Author)

A80-26810 # **Advanced computer program.** N. A. Blake (FAA, Washington, D.C.). In: EASCON '79; Electronics and Aerospace Systems Conference, Arlington, Va., October 9-11, 1979, Conference Record. Volume 3. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 502-506.

The paper examines the FAA's advanced engineering and development program, consisting of the development activities needed to define the automation and computer system improvements for the late 1980 and 1990 time period. The introduction of electronic tabular displays of flight data and computer assistance in the planning function is discussed. Attention is given to an outlined program that is both feasible and offers benefits in improved safety, productivity, and system performance. C.F.W.

A80-26811 **Theoretical limitations on collision avoidance systems.** I. W. Kay (Institute for Defense Analyses, Arlington, Va.). In: EASCON '79; Electronics and Aerospace Systems Conference, Arlington, Va., October 9-11, 1979, Conference Record. Volume 3. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 507-512. 7 refs. FAA-supported research.

General limitations on the performance of collision avoidance systems in dense air traffic result from the trade-off between the amount of protection afforded by a system and the frequency of the warnings that it will generate. In this context the protection referred to is meant to allow for unforeseen turns by encountering aircraft and some minimum aircraft separation requirement. The effectiveness and efficiency of a collision avoidance system's threat criterion can be illustrated qualitatively, for purposes of comparison, by means of a geometrical construct due to Holt et al. This kind of analysis indicates that at altitudes below 10,000 ft the use of bearing data will not greatly enhance the efficiency of a threat criterion that otherwise depends upon the use of separation data alone. A quantitative analysis of alarm rates shows that for the traffic distribution that has been projected for the Los Angeles Basin in 1982 it is likely that alarm rates will be a problem. Conceivably, by the use of adaptive collision avoidance techniques or through the agency of air traffic control procedures it may be possible to alleviate the problem. (Author)

A80-26819 # **The Federal Aviation Administration navigation program.** N. A. Blake (FAA, Washington, D.C.). In: EASCON '79; Electronics and Aerospace Systems Conference, Arlington, Va., October 9-11, 1979, Conference Record. Volume 3.

New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 666-672.

The Federal Aviation Administration's navigation program for the next two decades is outlined, which includes the following areas: those associated with certification of navigation systems to meet current requirements and those associated with building a data base to define future system improvements. Attention is given to Loran-C, Omega, and the Helicopter IFR Program, as well as to the cost factors involved in the Global Positioning System. C.F.W.

A80-26867 **Hybrid optical/digital processing for target identification.** R. Wood (USAF, Rome Air Development Center, Griffiss AFB, N.Y.). In: Optical signal processing for CCCI; Proceedings of the Seminar, Boston, Mass., October 29, 30, 1979. Bellingham, Wash., Society of Photo-Optical Instrumentation Engineers, 1980, p. 74-80. 6 refs.

Real-time processing techniques for aircraft identification of friend, foe, or neutral (IFFN) in a noncooperative target recognition (NCTR) environment are reviewed. Attention is given to motion compensation, image generation-scaling, and translation identification. V.T.

A80-26878 **Advanced composites - Special topics; Proceedings of the Conference, El Segundo, Calif., December 4-6, 1979.** Conference sponsored by Technology Conferences. El Segundo, Calif., Technology Conferences, 1979. 403 p. $48.

The conference focused on materials development, environmental effects, dimensional stability, defects and their effects, repair technology, and nondestructive evaluation of composite structures. Papers were presented on the development of a new dimensionally and thermally stable composite, failure mechanisms for advanced composite sandwich construction in hostile environments, the effects of high humidity environments on the behavior of aerospace grade graphite/epoxy composites, ultrasonic monitoring of flaw growth in graphite/epoxy laminates under fatigue loading, and influence of the interface on composite failure. V.L.

A80-26884 **Failure mechanisms for advanced composite sandwich construction in hostile environments.** G. Waring, K. E. Hofer, Jr. (IIT Research Institute, Chicago, Ill.), E. Vadala, and R. Trabocco (U.S. Naval Material Command, Naval Air Development Center, Warminster, Pa.). In: Advanced composites - Special topics; Proceedings of the Conference, El Segundo, Calif., December 4-6, 1979. El Segundo, Calif., Technology Conferences, 1979, p. 83-122. 25 refs. Navy-supported research.

The effect of environmental degradation was studied with reference to composite sandwich components of naval aircraft. The investigated environmental conditions included high humidity, elevated temperature, stress cycling, and stack gases and sea water. The 672-hour test program consisted of 336 hours of constant temperature (165 F)/constant humidity (95% RH) together with stress cycling representative of 1000 flight hours followed by 336-hour exposure to synthetic sea water and stack gases at ambient temperature. Strength loss and failure modes are detailed for various samples. Failure modes include compressive rupture of the composite skin and failure due to disbond of the adhesive. V.L.

A80-26888 **Repair of advanced composite structure.** J. D. Labor (Northrop Corp., Hawthorne, Calif.). In: Advanced composites - Special topics; Proceedings of the Conference, El Segundo, Calif., December 4-6, 1979. El Segundo, Calif., Technology Conferences, 1979, p. 161-170. 5 refs. Contract No. F33615-79-C-3217.

Developments in the repair technology of advanced composite aerospace structures are reviewed. Several programs over the last decade have yielded a number of repair procedures, e.g., flush and tapered external patches, injection of delaminations, and flush repair using a scarf joint. A new program is underway which will result in the publication of the Repair Guide scheduled for March 1982. V.L.

A80-26890 **Advanced composites serviceability program - Status review.** J. M. Altman (Rockwell International Corp., Los Angeles, Calif.). In: Advanced composites - Special topics; Proceedings of the Conference, El Segundo, Calif., December 4-6, 1979. El Segundo, Calif., Technology Conferences, 1979, p. 183-204. 5 refs. USAF-sponsored research.

A three-phase serviceability program sponsored by the Air Force will determine the effect of defects on the performance and serviceability of advanced composite primary structures and develop acceptance/rejection criteria for various zones of the structures. Phase I includes characterization of structural defects, development of empirical/analytical design tools, and coupon testing. Under phases II and III the damage mechanism models and acceptance/rejection criteria generated in phase I are to be validated by testing element-size specimens of primary composite structures and correlating these data with the coupon test results. Summaries of test results are presented. V.L.

A80-26891 **Nondestructive evaluation of graphite composite aircraft structures.** W. H. Sheldon (Northrop Corp., Aircraft Div., Hawthorne, Calif.). In: Advanced composites - Special topics; Proceedings of the Conference, El Segundo, Calif., December 4-6,

1979. El Segundo, Calif., Technology Conferences, 1979, p. 205-227.

Various nondestructive evaluation techniques were tested for detection of flaws in graphite composite aircraft structures. These techniques included ultrasonic inspection, laser holography, radiography, and inspection by Fokker Bond Tester and a Sondicator. Visibility of defects was optimized using B-scan (section views) and 3-D imaging techniques. It was found that B-scans/3-D scans enhance flaw geometry and depth, and provide information on the distribution of impact damage through the laminate thickness. Laser holography was successful in detecting skin/core defects; radiography was useful for detecting core damage and core tolerances; and the Fokker Bond Tester was more successful than the Sondicator for detecting flaws. V.L.

A80-26895 * Influence of interface on composite failure. G. C. Sih and E. T. Moyer, Jr. (Lehigh University, Bethlehem, Pa.). In: Advanced composites - Special topics; Proceedings of the Conference, El Segundo, Calif., December 4-6, 1979. El Segundo, Calif., Technology Conferences, 1979, p. 283-312. 6 refs. Grant No. NsG-3179.

The influence of the interface on the composite system behavior is investigated by analytical modeling. The stress analysis is based on the two-dimensional finite element procedure in which twelve-node isoparametric elements with cubic shape functions are used. The location of possible failure sites is predicted by the strain energy density (SED) failure theory which assumes failure to coincide with locations of minimum SED while the locations of maximum SED correspond to regions of excessive distortion or yielding. The results of the analysis show that the way in which the modulus of elasticity varies within the interface is as important in modeling as the average interface modulus. V.L.

A80-26929 Aerodynamic Testing Conference, 11th, Colorado Springs, Colo., March 18-20, 1980, Technical Papers. Conference sponsored by the American Institute of Aeronautics and Astronautics. New York, American Institute of Aeronautics and Astronautics, Inc., 1980. 386 p. $40.

Topics discussed include the automatic control of Langley's 0.3-meter cryogenic test facility, the Ascent Air Data System for the Space Shuttle, the measurement of local skin friction and static pressure on a swept wing in flight, the simulation of jet plumes in wind tunnels, supersonic flow development in slotted wind tunnels, and the high-fidelity flight simulation of commercial transports. Also considered are ground and flight test studies of reentry vehicle heatshield roll torque, aircraft store separation motion prediction via grid data trajectories, and high-resolution LDA measurements of Reynolds stress in boundary layers. B.J.

A80-26930 * # The National Transonic Facility - Status and operational planning. R. R. Howell (NASA, Langley Research Center, Hampton, Va.). In: Aerodynamic Testing Conference, 11th, Colorado Springs, Colo., March 18-20, 1980, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 1-9. (AIAA 80-0415)

The National Transonic Facility is scheduled to be completed in 1982. Several technical concerns remain, including thermal stress constraints which may limit the rate at which temperatures can be changed, seal performance in the cryogenic environment, and the tunnel process controls which could affect data acquisition rate. The current design affords the capability of dealing with all these concerns if they become problems. The outstanding instrument need is a real-time model surface deformation measurement system. Finally, an examination of the occupancy cost and the cost of liquid nitrogen for high Reynolds number tests indicates that operating costs should not be an inhibiting factor in the use of the facility. B.J.

A80-26931 * # Automatic control of NASA Langley's 0.3-meter cryogenic test facility. J. J. Thibodeaux (NASA, Langley Research Center, Hampton, Va.) and S. Balakrishna (NASA, Langley Research Center, Hampton; Old Dominion University, Norfolk, Va.). In: Aerodynamic Testing Conference, 11th, Colorado Springs, Colo., March 18-20, 1980, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 10-15. (AIAA 80-0416)

Experience during the past 6 years of operation of the 0.3-meter transonic cryogenic tunnel at the NASA Langley Research Center has shown that there are problems associated with efficient operation and control of cryogenic tunnels using manual control schemes. This is due to the high degree of process crosscoupling between the independent control variables (temperature, pressure, and fan drive speed) and the desired test condition (Mach number and Reynolds number). One problem has been the inability to maintain long-term accurate control of the test parameters. Additionally, the time required to change from one test condition to another has proven to be excessively long and much less efficient than desirable in terms of liquid nitrogen and electrical power usage. For these reasons, studies have been undertaken to: (1) develop and validate a mathematical model of the 0.3-meter cryogenic tunnel process, (2) utilize this model in a hybrid computer simulation to design temperature and pressure feedback control laws, and (3) evaluate the adequacy of these control schemes by analysis of closed-loop experimental data. This paper will present the results of these studies. (Author)

A80-26932 * # A study of nonadiabatic boundary-layer stabilization time in a cryogenic tunnel for typical wing and fuselage models. C. B. Johnson (NASA, Langley Research Center, Subsonic-Transonic Aerodynamics Div., Hampton, Va.). In: Aerodynamic Testing Conference, 11th, Colorado Springs, Colo., March 18-20, 1980, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 16-23. 10 refs. (AIAA 80-0417)

A theoretical study has been made of the time varying effect of nonadiabatic wall conditions on boundary layer properties for a two-dimensional wing section and an axisymmetric body of revolution typical of a fuselage. The wing section and body of revolution are representative of the root chord and fuselage of what is considered to be a typical size transport model for the National Transonic Facility. The transient analysis was made at a Mach number of 0.85, for stagnation pressures of 2, 6, and 9 atmospheres at several cryogenic values of total temperature for a solid wing and for three different fuselage skin thickness configurations. The analysis considered wing and fuselage sections made from stainless steel, beryllium copper, and aluminum. Examples are presented that may be used to determine the time required to reach an adiabatic condition after a change in total temperature. (Author)

A80-26933 # Numerical simulation of the wind tunnel environment by a panel method. K. D. Lee (Boeing Commercial Airplane Co., Seattle, Wash.). In: Aerodynamic Testing Conference, 11th, Colorado Springs, Colo., March 18-20, 1980, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 24-30. 13 refs. (AIAA 80-0419)

A simulation technique has been developed to analyze the testing environment of practical three-dimensional subsonic wind tunnels. A higher-order panel method was used to model complex wind tunnel environments including the effects of slot openness, finite test section length, and model mounting system. The homogeneous wall boundary condition represented the slotted test section. Results on a subsonic lifting wing are presented to demonstrate the interference effects due to various features in a rectangular tunnel. The present technique provides a diagnostic tool for the interpretation of experimental data and an effective means for designing a test environment with minimum interference. (Author)

A80-26934 # On the historical development of apparatus and techniques for smoke visualization of subsonic and supersonic flows. T. J. Mueller (Notre Dame, University, Notre Dame, Ind.). In:

Aerodynamic Testing Conference, 11th, Colorado Springs, Colo., March 18-20, 1980, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 31-44. 60 refs. Research sponsored by the University of Notre Dame; Grant No. AF-AFOSR-77-3412. (AIAA 80-0420)

The history of smoke visualization in wind tunnels is traced from 1893 to the present. The requirements necessary to produce a wind tunnel capable of being used for smoke visualization are discussed along with the development of smoke generating equipment. The apparatus and techniques used for the visualization of subsonic and supersonic flows are described, and some results on practical aerodynamic problems are presented. B.J.

A80-26935 * # Visualization of the laminar-turbulent transition in the flow over an airfoil using the smoke-wire technique. S. M. Batill and T. J. Mueller (Notre Dame, University, Notre Dame, Ind.). In: Aerodynamic Testing Conference, 11th, Colorado Springs, Colo., March 18-20, 1980, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 45-53. 16 refs. Grant No. NsG-1419. (AIAA 80-0421)

A flow visualization technique, referred to as the smoke-wire, was used for visualization of the transition of the free shear layer associated with the laminar separation bubble of a NACA 66 sub 3-018 airfoil section at low Reynolds number (50,000-130,000). The smoke-wire technique allows the introduction of fine smoke streaklines into the flow field through the electrical resistive heating of a very fine wire which has been coated with oil and which is located upstream from the leading edge of the airfoil section. Streakline data were collected using both high speed still and motion picture photography. (Author)

A80-26937 # Local skin friction and static pressure on a swept wing in flight. A. Bertelrud (Flygtekniska Forsoksanstalten, Bromma, Sweden). In: Aerodynamic Testing Conference, 11th, Colorado Springs, Colo., March 18-20, 1980, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 61-73. 14 refs. Air Materiel Department of Sweden Contracts No. INK-82223-76-001-21-001; No. INK-82223-77-001-21-001; No. INK-82223-77-116-21-001; No. INK-82223-78-003-21-001. (AIAA 80-0423)

A series of flight tests were performed to explore the possibility of using multiple total head/static probes (modified Preston tubes) for the measurement of local skin friction and static pressure distributions on a swept wing with moderate crossflow. The accuracy and repeatibility of the experiments were found to be acceptable. Calculations were performed (assuming infinite swept wing flow) with a three-dimensional Navier-Stokes code. The pressure coefficient prediction was good, but the level of skin friction was overpredicted for the case of moderate viscous effects. B.J.

A80-26939 * # Development of test methods for scale model simulation of aerial applications in the NASA Langley Vortex Facility. F. L. Jordan, Jr. (NASA, Langley Research Center, Hampton, Va.). In: Aerodynamic Testing Conference, 11th, Colorado Springs, Colo., March 18-20, 1980, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 79-93. 12 refs. (AIAA 80-0427)

Methods have been developed at the Langley Vortex Research Facility to simulate and measure the deposition patterns of aerially applied sprays and granular materials by means of tests with small-scale models of agricultural and dynamically scaled test particles. Interactions between the aircraft wake and the dispersed particles are studied with the aim of modifying wake characteristics and dispersal techniques in order to increase swath width, improve deposition pattern uniformity, and minimize drift. This paper examines the particle sizing analysis, test methods for particle dispersal from the model aircraft, and measurement and computer analysis of test deposition patterns. Results that indicate improved control of chemical drift by winglets are presented to demonstrate test methods. B.J.

A80-26941 # The simulation and modeling of jet plumes in wind tunnel facilities. H. H. Korst, R. A. White (Illinois, University, Urbana, Ill.), S.-E. Nyberg, and J. Agrell (Flygtekniska Forsoksanstalten, Bromma, Sweden). In: Aerodynamic Testing Conference, 11th, Colorado Springs, Colo., March 18-20, 1980, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 104-116. 20 refs. Research supported by the European Research Office, Flygtekniska Forsoksanstalten and U.S. Army; Grants No. DA-ERO-78-G-028; No. DAAG29-76-G-0209. (AIAA 80-0430)

A high pressure hot gas supply system has been developed for the FFA 0.5 x 0.5 m supersonic wind tunnel to allow the study of aerodynamic interference effects caused by plume induced flow separation from propulsive afterbodies. Experimental programs carried out with air and Freon-22 confirmed the correctness of the plume simulation method with the accuracy of modeling extending over wide ranges of jet-to-ambient pressure ratios straddling the design points. (Author)

A80-26942 * # Evaluation of a new concept for reducing free-stream turbulence in wind tunnels. R. A. Wigeland, J. Tan-atichat, and H. M. Nagib (Illinois Institute of Technology, Chicago, Ill.). In: Aerodynamic Testing Conference, 11th, Colorado Springs, Colo., March 18-20, 1980, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 117-128. 7 refs. Grant No. NsG-1451. (AIAA 80-0432)

A 45 deg-honeycomb flow manipulator, mounted parallel to the corner turning vanes, was investigated for improving the flow quality in wind tunnels with little or no settling chamber length. This manipulator permits increased turbulence decay distance in comparison to a conventional honeycomb arrangement. The resulting turbulence levels in a wind tunnel using the 45 deg-honeycomb are comparable to those obtained using a conventional honeycomb, but only when a 45 deg-screen is mounted immediately downstream of the honeycomb and when some separation distance between the turning vanes and the 45 deg-honeycomb is provided for adequate decay of the turning vane wakes (at least twice the spacing between the turning vanes). (Author)

A80-26943 * # A comparison of experimental and theoretical turbulence reduction from screens, honeycomb and honeycomb-screen combinations. J. Scheiman and J. D. Brooks (NASA, Langley Research Center, Hampton, Va.). In: Aerodynamic Testing Conference, 11th, Colorado Springs, Colo., March 18-20, 1980, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 129-137. 11 refs. (AIAA 80-0433)

A 1/2-scale model of a portion of the NASA Langley 8-foot transonic pressure tunnel was used to conduct some turbulence reduction research. The experimental results are correlated with various theories. Screens alone reduce axial turbulence more than the lateral turbulence; whereas, honeycomb alone reduce lateral turbulence more than axial turbulence. Because of this difference, the physical mechanism for decreasing turbulence for screens and honeycomb must be completely different. Honeycomb with a downstream screen is an excellent combination for reducing turbulence. (Author)

A80-26944 * # Additional flow quality measurements in the Langley Research Center 8-Foot Transonic Pressure Tunnel. J. D. Brooks, P. C. Stainback, and C. W. Brooks, Jr. (NASA, Langley Research Center, Hampton, Va.). In: Aerodynamic Testing Conference, 11th, Colorado Springs, Colo., March 18-20, 1980, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 138-145. 6 refs. (AIAA 80-0434)

Additional tests were conducted to further define the disturbance characteristics of the Langley 8-Foot Transonic Pressure Tunnel. Measurements were made in the settling chamber with hot

wire probes and in the test section with pressure transducers when various methods were used to choke the flow. In addition to presenting rms values measured at various locations and tunnel condition, autocorrelations and cross correlation data are also presented. (Author)

A80-26948 # **Experimental investigation of the interference-free flow field around a lifting wing-body model to establish cross flow characteristics for ventilated wind tunnel walls at low supersonic Mach numbers.** S.-E. Nyberg and H. Sorensen (Flygtekniska Forsoksanstalten, Bromma, Sweden). In: Aerodynamic Testing Conference, 11th, Colorado Springs, Colo., March 18-20, 1980, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 172-182. 9 refs. (AIAA 80-0444)

The interference-free flow field around a lifting delta-wing-body configuration has been measured with a probe in wind tunnel tests. Pressure and flow deflection were determined at Mach numbers 1.15, 1.20 and 1.30, at nominal incidences of 0, 5, 15 and 25 deg and at radial locations in relation to the model, where in wind tunnel tests the walls are normally situated. Some comparisons with theoretical calculations are made. The results indicate that the required relationship between pressure drop and cross flow for a minimum interference wind tunnel wall is quite different from hitherto widely used criteria based on the flow field around a cone-cylinder at zero angle of attack. (Author)

A80-26949 # **New requirements, test techniques, and development methods for high fidelity flight simulation of commercial transports.** E. F. Carlson, T. J. Galbraith, and P. C. Rumsey (Boeing Commercial Airplane Co., Seattle, Wash.). In: Aerodynamic Testing Conference, 11th, Colorado Springs, Colo., March 18-20, 1980, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 183-189. (AIAA 80-0445)

In order to improve the fidelity of flight simulation, a number of departures from past practices have been implemented in the modeling techniques at Boeing. A fully nonlinear aerodynamic model is used to avoid the approximations associated with linear derivatives. More comprehensive corrections are made to the aerodynamic data base for scale effects due to the Reynolds number. Significant changes have been made in the methods used to adjust the aerodynamic data for the effects of aeroelasticity. In the present paper the use of modern wind tunnel test techniques and flight test methods to generate and validate an improved aerodynamic data base for the simulator is described, and specific illustrations of wind tunnel testing on the Boeing 767 are given. The importance of a computerized data handling system to organize the increased size and complexity of the aerodynamic data base is stressed, and examples of the use of modern minicomputers in an interactive graphics mode to accomplish this task are presented. B.J.

A80-26950 # **Control and data acquisition aircraft for ALCM flight tests.** J. D. Lang and R. A. Pitzer (USAF, Directorate of Flight Test Engineering, Wright-Patterson AFB, Ohio). In: Aerodynamic Testing Conference, 11th, Colorado Springs, Colo., March 18-20, 1980, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 190-197. 6 refs. (AIAA 80-0446)

Ten aircraft were modified for control of the Air Launched Cruise Missile (ALCM) and for data acquisition during flight testing. Instrumentation systems were designed and installed by the 4950th Test Wing on two of the Wing's EC-135N Advanced Range Instrumentation Aircraft (ARIA) and on eight Air Force Flight Test Center F-4E 'chase' aircraft. These airborne facilities, which are used for reception, recording and relay of all flight test data as well as for fail-safe control of the unmanned test vehicles, are described in detail. Test results indicate advantages over use of ground-based facilities, and indicate potential expanded use of these test aircraft. (Author)

A80-26952 # **Description of a new high-alpha, high-load, pitch-yaw dynamic stability test mechanism at AEDC.** S. M. Coulter and T. D. Buchanan (ARO, Inc., Arnold Engineering Development Center, Arnold Air Force Station, Tenn.). In: Aerodynamic Testing Conference, 11th, Colorado Springs, Colo., March 18-20, 1980, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 211-220. 8 refs. (AIAA 80-0451)

A description of a forced-oscillation test mechanism and associated instrumentation for measuring pitch- and yaw-damping derivatives on aircraft configurations is presented. The mechanism is designed for 10-percent-scale models and can support 4000 lb normal force and 1000 lb axial force. Results of laboratory tests and a wind tunnel verification test of a typical fighter configuration indicate that the system can accurately measure dynamic moments; preliminary results from cross and cross-coupling measurements are discussed. (Author)

A80-26955 * # **The influence of wing, fuselage and tail design on rotational flow aerodynamics data obtained beyond maximum lift with general aviation configurations.** W. Bihrle, Jr. (Bihrle Applied Research, Inc., Jericho, N.Y.) and J. S. Bowman, Jr. (NASA, Langley Research Center, Hampton, Va.). In: Aerodynamic Testing Conference, 11th, Colorado Springs, Colo., March 18-20, 1980, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 237-246. 18 refs. (AIAA 80-0455)

The NASA Langley Research Center has initiated a broad general aviation stall/spin research program. A rotary balance system was developed to support this effort. Located in the Langley spin tunnel, this system makes it possible to identify an airplane's aerodynamic characteristics in a rotational flow environment, and thereby permits prediction of spins. This paper presents a brief description of the experimental set-up, testing technique, five model programs conducted to date, and an overview of the rotary balance results and their correlation with spin tunnel free-spinning model results. It is shown, for example, that there is a large, nonlinear dependency of the aerodynamic moments on rotational rate and that these moments are pronouncedly configuration-dependent. Fuselage shape, horizontal tail and, in some instances, wing location are shown to appreciably influence the yawing moment characteristics above an angle of attack of 45 deg. (Author)

A80-26956 # **Measurements of the dynamic performance of the main drive fan of the RAE 5 metre pressurised low speed wind tunnel.** R. W. Jeffery (Royal Aircraft Establishment, Aerodynamics Dept., Farnborough, Hants., England). In: Aerodynamic Testing Conference, 11th, Colorado Springs, Colo., March 18-20, 1980, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 247-255. 9 refs. (AIAA 80-0456)

Tests were carried out to monitor and evaluate the performance of the blades in the main drive fan of the 5 meter pressurized low speed wind tunnel. A technique was developed for in situ maintenance checking to detect the onset of internal cracking or delaminarization in the glass reinforced plastic blades. Three of the ten fan blades were instrumented with strain gauges to monitor the dynamic performance of the fan under different loadings resulting from combinations of fan speed and tunnel pressurization. The effect of a model was also investigated, with the model both stalled and unstalled. (Author)

A80-26957 * # **Measurements of control stability characteristics of a wind-tunnel model using a transfer function method.** I. Chopra (NASA, Ames Research Center, Moffett Field; NASA/

Stanford, Joint Institute for Aeronautics and Acoustics, Stanford, Calif.) and J. D. Ballard (NASA, Ames Research Center, Moffett Field, Calif.). In: Aerodynamic Testing Conference, 11th, Colorado Springs, Colo., March 18-20, 1980, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 256-261. (AIAA 80-0457)

Recent state-of-the-art techniques in rotor systems include the use of active feedback to augment the dynamic control characteristics of an aircraft system. A recent test of a stoppable rotor with blade circulation blowing was conducted in the Ames Research Center's 40- by 80-ft wind tunnel. A major part of the test schedule was dedicated to the acquisition of data to determine the stability of a closed-loop hub-moment feedback control system. Therefore, the open-loop control response was measured at several flight conditions to ascertain the stability of the system prior to the final closed-loop feedback control test. Measurements were made during both the stopped and rotating rotor modes, and open-loop Bode plots were obtained for the control loops associated with the moments about the longitudinal and lateral axis. (Author)

A80-26958 # **Selected wind tunnel testing developments at the Boeing Aerodynamics Laboratory.** J. P. Crowder, E. G. Hill, and C. R. Pond (Boeing Co., Seattle, Wash.). In: Aerodynamic Testing Conference, 11th, Colorado Springs, Colo., March 18-20, 1980, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 262-272. (AIAA 80-0458)

Three unique testing techniques that recently have been introduced at the Boeing Aerodynamic Laboratory are described; the laser angle meter, fluorescent mini-tufts for surface flow visualization, and the photo-graphical flow field survey technique. The laser angle meter, installed in the Boeing Transonic Wind Tunnel, is a highly precise and responsive fringe counting interferometer that directly measures model angle of attack at working distances of 4 to 5m. Use of the sophisticated angle meter is warranted when accurate drag data levels are required for internal balance mounted models or when rapid acquisition of model angular attitude data is essential. Fluorescent mini-tufts, extremely small nylon monofilaments, are sufficiently nonintrusive to be used concurrently with conventional data acquisition on subsonic and transonic models. This capability is particularly useful for wind tunnels where model access is limited. The photo-graphical flow field survey technique permits acquisition and online presentation of complete graphical records of total pressure isobars, or other isoparameter contour plots, with a greatly simplified traversing mechanism and without any computer analysis. Information obtained with this technique provides valuable insight into the structure of model flow fields. (Author)

A80-26959 # **Aircraft store separation motion prediction via grid data trajectories.** J. P. Billingsley (ARO, Inc., Arnold Engineering Development Center, Arnold Air Force Station, Tenn.; TRW Defense and Space Systems Group, Redondo Beach, Calif.), J. T. Best, and R. H. Burt (ARO, Inc., Arnold Engineering Development Center, Arnold Air Force Station, Tenn.). In: Aerodynamic Testing Conference, 11th, Colorado Springs, Colo., March 18-20, 1980, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 273-281. 16 refs. (AIAA 80-0462)

The grid data trajectory (GDT) technique of computing store separation trajectories is established as an accurate method by comparisons with the captive trajectory technique. This was done by obtaining an extensive and systematic grid of static aerodynamic forces and moments on a store model in the flow field beneath an aircraft model. The data were employed to predict trajectories using the GDT technique; the GDT predictions were compared directly with captive trajectories generated by the AEDC-VKF Captive Trajectory System. (Author)

A80-26960 * # **Exploratory investigation of the effects of vortex bursting on the high angle-of-attack lateral-directional stability characteristics of highly-swept wings.** J. L. Johnson, Jr., S. B. Grafton, and L. P. Yip (NASA, Langley Research Center, Hampton, Va.). In: Aerodynamic Testing Conference, 11th, Colorado Springs, Colo., March 18-20, 1980, Technical Papers.
New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 282-297. 6 refs. (AIAA 80-0463)

A recent low-speed wind-tunnel investigation of highly-swept wings has shown that vortex breakdown at high angles of attack can cause large destabilizing effects on static lateral-directional stability characteristics, and that the destabilizing effects of vortex breakdown can be greatly aggravated by model support strut interference effects. The present paper discusses these effects based on the results of static force tests of several highly-swept wing configurations for different wind-tunnel strut setup arrangements. Also included in the paper are photographs obtained during tuft-, smoke-, and helium-bubble flow visualization studies to indicate wing flow behavior patterns. (Author)

A80-26961 # **A new rig for flight mechanics studies in the ONERA Aerothermodynamic Test Center of Modane.** J. Christophe (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). In: Aerodynamic Testing Conference, 11th, Colorado Springs, Colo., March 18-20, 1980, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 298-305. (AIAA 80-0464)

The new rig of the large S1 Modane wind tunnel is designed for the study of the low-speed handling qualities of large models. These models, powered or not, will be studied under various environmental effects: ground effect, side wind on runways, atmospheric gusts, and large angle of attack excursion. The system has four degrees of freedom: pitch, yaw, and roll inside the model for steady position and oscillation; and steady position and oscillation of the supporting strut. Device requirements are summarized, and preliminary tunnel acceptance testing is discussed. B.J.

A80-26962 # **A system for the measurement of the attitude of wind tunnel models.** R. W. Jeffery, A. N. Tuck, and R. D. Law (Royal Aircraft Establishment, Aerodynamics Dept., Farnborough, Hants., England). In: Aerodynamic Testing Conference, 11th, Colorado Springs, Colo., March 18-20, 1980, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 306-315. 6 refs. (AIAA 80-0465)

Due to very large aerodynamic loads, deflections in the support systems of models tested in the RAE 5 meter pressurized low speed wind tunnel can be significant. For the continual measurement of the achieved model attitude a system, which includes a laser yaw-meter for the measurement of attitude in the horizontal plane, has been developed. From simple geometry the yaw angle can be calculated and, for a model mounted on the mechanical balance, the equipment can also measure displacements from the balance calibration center. Attitude in pitch and roll is measured by an orthogonal set of accelerometers. (Author)

A80-26963 # **The experimental modeling of unstalled supersonic turbofan flutter.** R. E. Riffel (General Motors Corp., Detroit Diesel Allison Div., Indianapolis, Ind.) and S. Fleeter (Purdue University, West Lafayette, Ind.). In: Aerodynamic Testing Conference, 11th, Colorado Springs, Colo., March 18-20, 1980, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 316-324. 8 refs. (AIAA 80-0454)

The paper examines experimental techniques necessary to extend current experimental unsteady rectilinear cascade modeling capability to include the relatively low supersonic inlet Mach number, high pressure ratios, and high reduced frequency values characteristic of the unstalled supersonic flutter of fan stages. Particular consideration is given to the cascade modeling concepts,

the steady and time-invariant experimental techniques, fabrication and instrumentation considerations, data acquisition and reduction procedures, and the correlation of steady, high-frequency time-invariant translation mode oscillating cascade data with corresponding state-of-the-art predictions. B.J.

A80-26964 * # The development of a self-streamlining flexible walled transonic test section. M. J. Goodyer and S. W. D. Wolf (Southampton University, Southampton, England). In: Aerodynamic Testing Conference, 11th, Colorado Springs, Colo., March 18-20, 1980, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 325-335. 9 refs. Research supported by the Science Research Council of England; Grant No. NsG-7172. (AIAA 80-0440)

This design eliminates the uncertainties in data from conventional transonic test sections. Sidewalls are rigid, and the flexible floor and ceiling are positioned by motorized jacks controlled by on-line computer to minimize run times. The tunnel-computer combination is self-streamlining without reference to the model. Data is taken from the model only when the walls are good streamlines, and is corrected for the small, known but inevitable residual interferences. Two-dimensional validation testing in the Mach range up to about 0.85 where the walls are just supercritical shows good agreement with reference data using a height:chord ratio of 1.5. Techniques are under development to extend Mach number above 1. This work has demonstrated the feasibility of almost eliminating wall interferences, improving flow quality, and reducing power requirements or increasing Reynolds number. Extensions to three-dimensional testing are outlined. (Author)

A80-26967 * # High-resolution LDA measurements of Reynolds stress in boundary layers and wakes. K. L. Orloff and L. E. Olson (NASA, Ames Research Center, Moffett Field, Calif.). In: Aerodynamic Testing Conference, 11th, Colorado Springs, Colo., March 18-20, 1980, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 363-374. 11 refs. (AIAA 80-0436)

The turbulent character of the boundary layer and wake associated with an airfoil has been studied at a Reynolds number of 1,000,000 and a Mach number of 0.1. To accomplish these measurements, a unique laser Doppler anemometer (LDA) has been developed that is capable of sensing two velocity components from a remote distance of 2.13 m. Using special simultaneity logic and counter-type signal processors, the geometrical features of the LDA have been exploited to provide variable spatial resolution as low as 0.2 mm. By combining the LDA with an on-line computerized data acquisition and display system, it has been possible to measure mean velocity and Reynolds stress tensor distribution at several locations along the upper surface of a 0.9-m-chord, flapped airfoil installed in the Ames 7- by 10-Foot Wind Tunnel. (Author)

A80-26968 # Wind tunnel and flight test drag comparisons for a guided projectile with cruciform tails. W. H. Appich, Jr. (Martin Marietta Aerospace, Orlando, Fla.), R. L. McCoy (U.S. Army, Ballistics Research Laboratories, Aberdeen Proving Ground, Md.), and W. D. Washington (U.S. Army, Missile Command, Redstone Arsenal, Ala.). In: Aerodynamic Testing Conference, 11th, Colorado Springs, Colo., March 18-20, 1980, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 375-382. 11 refs. Grant No. DAAA09-76-2001. (AIAA 80-0426)

Drag measurements from full-scale wind tunnel tests and ballistic range firings of a cannon-launched guided projectile are compared at Mach numbers between 0.8 and 1.5. The projectile has internally-housed cruciform wings and tails which deploy through longitudinal body slots. Within the control section, air can flow longitudinally and transversely between slots during flight; however, no flow passes through the projectile base, which is sealed to prevent damage during the gun launch. These internal flow characteristics were preserved in the wind tunnel model which was designed to facilitate measurement of internal drag and adjustment to free-flight values. Excellent agreement is obtained between the adjusted wind tunnel results and the ballistic range data. Limited pressure measurements within the control section indicate that the flow field is complex, with the internal drag resulting from combined effects of wake and stagnation pressures. Qualitative agreement is obtained between internal force and pressure data. (Author)

A80-27021 Lightning protection for aircraft. P. Little (Atomic Energy Research Establishment, Culham Laboratory, Abingdon, Oxon, England). *Atom*, vol. 281, Mar. 1980, p. 63-67.

The problems of protecting aircraft against lightning are discussed. The structure of electric fields existing due to electric charge in a cloud base is analyzed. Relative motions of a lightning channel with respect to an aircraft are described along with typical zones on an aircraft. Laboratory simulation and testing are also outlined. V.T.

A80-27127 # Analysis of the nonuniqueness of solutions to the problem of flow separation for small-aspect delta wings (Issledovanie needinstvennosti resheniia zadachi ob otryvnom obtekanii sistemy krylo-fiuzeliazh malogo udlineniia). A. V. Voevodin. *TsAGI, Uchenye Zapiski*, vol. 10, no. 1, 1979, p. 10-18. 10 refs. In Russian.

A method is proposed for analyzing the nonuniqueness of solutions for leading-edge separation from slender delta wings. The method is essentially a modification of Pullin's (1973) iterative method for calculating inviscid separation from conical slender bodies, which, however, does not require the use of a fairly exact solution to the problem with a fully developed vortex sheet as the initial approximation, and makes it possible to obtain solutions based on such simple flow schemes as Brown and Michael's (1954) model. Flow patterns, lift coefficients, and pressure distributions are obtained for a range of angles of attack and aspect ratios. The calculations confirm the nonuniqueness of solutions for wing-body configurations. V.P.

A80-27132 # Analytical determination of the influence of elasticity and mass distribution on the aerodynamic characteristics of an aircraft in quasi-steady motion (Teoreticheskoe opedelenie vliianiia uprugosti i raspredeleniia mass konstruktsii na nekotorye aerodinamicheskie kharakteristiki samoleta v kvaziustanovivshemsia dvizhenii). G. A. Amir'iants. *TsAGI, Uchenye Zapiski*, vol. 10, no. 1, 1979, p. 55-63. 6 refs. In Russian.

A procedure, based on the method of polynomials, is proposed for calculating the characteristics of static aeroelasticity. The calculations show that the mass distribution in elastic design has a substantial influence on the major aerodynamic characteristics of an aircraft in quasi-steady flight. Some possible means of achieving mass redistributions to improve the aerodynamic behavior of an aircraft are examined. V.P.

A80-27134 # Singularities of the numerical solution of the algebraic Riccati equation in matrix form by a modification of the Lax-Wendroff method (Osobennosti chislennogo resheniia matrichnogo algebraicheskogo uravneniia Rikkati metodom ustanovleniia). V. M. Kuvshinov. *TsAGI, Uchenye Zapiski*, vol. 10, no. 1, 1979, p. 69-76. 6 refs. In Russian.

The conditions and rate of convergence of an iterative process for solving the algebraic Riccati equation by a modification of the Lax-Wendroff method are examined, and the singularities of the numerical solution, caused by poor convergence are analyzed. The effectiveness of applying the Euler method and the Runge-Kutta method to the numerical integration of first-order differential Ricatti equations is compared. V.P.

A80-27135 # A single-step method of optimizing statically indeterminate minimum-volume systems (Odnoshagovyi metod

optimizatsii staticheski neopredelimykh sistem minimal'nogo ob'ema). E. K. Lipin. *TsAGI, Uchenye Zapiski,* vol. 10, no. 1, 1979, p. 77-89. In Russian.

A single-step method is proposed for calculating the design parameters for statically indeterminate minimum-volume systems. The method is based on determining 'parasitic' constraints, the presence of which in the system does not permit simultaneous realization of optimality conditions and strain compatibility. It is shown that in a system that is free of parasitic constraints, the stresses are independent of the mass distribution in the system elements, so that the optimal parameters can be determined in a single step. The idea of the method is illustrated by examples involving trusses. Three theorems for the optimal design of elastic systems are formulated and are used to construct a single-step optimization process. V.P.

A80-27136 # Minimum-weight wing in the presence of lift constraints (Krylo minimal'nogo vesa pri ogranichenii po nesushchei sposobnosti). N. V. Banichuk, V. I. Biriuk, I. I. Koande, A. A. Mironov, and A. P. Seiranian. *TsAGI, Uchenye Zapiski,* vol. 10, no. 1, 1979, p. 90-98. 7 refs. In Russian.

The necessary conditions for minimizing the weight functional of the wing are identified and are used as a basis to calculate numerically the optimal rigidity distribution over the wing by a gradient method. Results obtained for various values of the problem's parameters are examined, along with the influence of the angle of sweep and the ratio of torsional to flexural rigidity on the optimal solution. The dependence of the solution on the permissible lift losses due to aeroelastic strains is analyzed. V.P.

A80-27137 # Application of geometrical programming to problems of optimal design (Primenenie geometricheskogo programmirovaniia k zadacham optimal'nogo proektirovaniia konstruktsii). V. A. Pavlov and V. A. Shiriniants. *TsAGI, Uchenye Zapiski,* vol. 10, no. 1, 1979, p. 99-105. In Russian.

The analysis deals with the problem of optimizing an axially compressed reinforced panel. The strength conditions and the design and technological constraints are written in the form of inequalities, using the panel weight as the objective function. The effectiveness of applying geometrical programming methods to the solution of the optimization problem is demonstrated. V.P.

A80-27138 # Influence of the angle of attack on the thermal flux at the stagnation point at supersonic speeds (Vliianie ugla ataki na teplovoi potok v kriticheskoi tochke pri sverkhzvukovykh skorostiakh). G. I. Maikapar. *TsAGI, Uchenye Zapiski,* vol. 10, no. 1, 1979, p. 106-111. In Russian.

In the present paper, the variation of heat flux at the stagnation point of a blunt-nosed body of continuously varying curvature with the angle of attack is analyzed under the assumption that the heat flux is proportional to the square root of the mean curvature. It is shown that for large angles of attack, the optimal configuration is not an oblate ellipsoid or elliptical cylinder, as is the case at zero angle of attack, but rather configurations close to a circular cylinder or a sphere. V.P.

A80-27139 # Influence of the empennage on the effective thrust of jet engine exhaust nozzles (Vliianie operenila na effektivnuiu tiagu reaktivnykh sopl VRD). B. N. Mikhailov and E. V. Pavliukov. *TsAGI, Uchenye Zapiski,* vol. 10, no. 1, 1979, p. 116-121. 7 refs. In Russian.

The paper deals with an experimental study of the interference of tail surfaces with a jet nozzle at freestream Mach numbers between 0.6 and 1.14. A parameter used by Glasgow and Santman (1972) to generalize experimental data on the drag of isolated engine nacelles is modified for tail units. The critical value of this parameter, which separates the region where interference increases the effective drag from the region where the effective drag is reduced by interference is determined. V.P.

A80-27143 # Distribution of forces and stresses along rows of bolted connections (Raspredelenie usilii i napriazhenii po riadam boltovykh soedinenii). V. F. Kozhevnikov. *TsAGI, Uchenye Zapiski,* vol. 10, no. 1, 1979, p. 134-139. In Russian.

The paper presents a method of determining forces transmitted by multiple row bolted connections operating in shear by plane models of optically sensitive material. Distribution of forces and stresses is investigated in three-, four-, and five-row models of a double shear bolt connection; it is shown that increasing the number of bolt rows above three does not produce appreciable reduction of forces and maximum stresses in the outer, highly loaded rows of connections. A.T.

A80-27147 # Numerical modeling of supersonic flow near a thin delta wing with discontinuous edge (Chislennoe modelirovanie sverkhzvukovogo techeniia okolo tonkogo treugol'nogo kryla s izlomom kromki). A. N. Minailos. *TsAGI, Uchenye Zapiski,* vol. 10, no. 2, 1979, p. 22-29. 9 refs. In Russian.

The method of Kosykh and Minailos (1977) is used to study the supersonic flow (at freestream Mach of 2-8) past a delta wing with discontinuous edges at angles of attack of 12, 15, 18, 23, and 27 deg. Two different conditions of flow near the upper surface of the wing are examined: with and without developed vortex bundles. It is found that these vortices are formed by tangential discontinuities at the leading edges of the wing. B.J.

A80-27148 # Numerical method for calculating supersonic flow past a plane air intake with detached shock wave (Chislennyi metod rascheta obtekaniia ploskogo vozdukhozabornika sverkhzvukovym potokom na rezhimakh s vybitoi udarnoi volnoi). N. I. Tilliaeva. *TsAGI, Uchenye Zapiski,* vol. 10, no. 2, 1979, p. 30-40. 11 refs. In Russian.

An ideal gas model is used to develop an algorithm for calculating supersonic flow past an intake with detached shock wave. A difference scheme for calculating the flow is described, and some numerical results for different freestream Mach numbers are presented. Finally, approximate methods for determining the integral characteristics of the intake are discussed. B.J.

A80-27152 # The use of the spectral summation of fatigue damages in order to examine the combined stress state of structures (Primenenie spektral'nogo summirovaniia ustalostnykh povrezhdenii pri slozhno-napriazhennom sostoianii konstruktsii). V. D. Il'ichev. *TsAGI, Uchenye Zapiski,* vol. 10, no. 2, 1979, p. 65-75. 8 refs. In Russian.

The spectral summation method is used to obtain estimates of the fatigue damage of aircraft structures in the case of a random dynamic combined stress state. The finite element method and the obtained estimates are used to develop an algorithm for calculating the fatigue zones of the structure. A method for calculating the static component of the combined stress state is described. B.J.

A80-27157 # Pressure distribution in rectangular wing /blade/ sections during curvilinear motion in an incompressible medium (Raspredelenie davleniia v secheniiakh priamougol'nogo kryla /lopasti/ pri krivolineinom dvizhenii v neszhimaemoi srede). L. S. Pavlov. *TsAGI, Uchenye Zapiski,* vol. 10, no. 2, 1979, p. 104-108. In Russian.

Results of an experimental investigation of the effects of a time-varying velocity vector on the pressure distribution on a section of a rectangular wing moving along a trajectory corresponding to the plane projection of the rotational trajectory of a moving propeller blade section are discussed. A flat, rectangular wing with a NACA-0012 profile was attached at its end to a rotating shaft in the open section of a wind tunnel, and changes of pressure were measured around ten wing sections at various air speeds with a constant zero angle of attack. It is found that for a wing moving against the direction of air flow, for which total speed and slip angle vary slowly, wing pressure distribution does not differ significantly

from that of a wing moving in a straight line, while on the return section, the direction and magnitude of the velocity change abruptly and the elementary air mass experiences a greater increase in pressure, leading to flow reversal. The direct interaction between the wing and its vortex bundle, which occurs only in curvilinear motion, is also discussed. A.L.W.

A80-27165 # Calculation of minimum-weight and maximum-rigidity structures in the presence of design constraints (Raschet silovykh konstruktsii minimal'nogo vesa i maksimal'noi zhestkosti pri nalichii konstruktivnykh ogranichenii). T. G. Zuraev. *TsAGI, Uchenye Zapiski,* vol. 10, no. 2, 1979, p. 149-155. 8 refs. In Russian.

The analysis deals with the problem of designing for minimum weight or maximum rigidity in the presence of constraints placed, in the form of equalities or inequalities, on the parameters of the load-carrying members. A procedure for solving the problem is proposed and is applied to a mass-minimization problem in the presence of design and strength constraints. V.P.

A80-27167 # Hysteresis of aerodynamic characteristics (O gisterezise aerodinamicheskikh kharakteristik). A. I. Kur'ianov, G. I. Stoliarov, and R. I. Shteinberg. *TsAGI, Uchenye Zapiski,* vol. 10, no. 3, 1979, p. 12-15. In Russian.

The paper deals with an experimental investigation of the integral aerodynamic characteristics and the pressure distribution over wing models and segmented conical bodies of revolution at subsonic and supersonic speeds. The results reveal a hysteresis nature of the behavior of the aerodynamic characteristics of forces and moments and of the pressure distribution with decreasing or increasing angle of attack. A distinct dependence of the hysteresis on the Reynolds number is noted. V.P.

A80-27168 # Similarity of the aerodynamic characteristics of delta wings at supersonic speeds (Podobie aerodinamicheskikh kharakteristik treugol'nykh kryl'ev pri sverkhzvukovykh skorostiakh). A. N. Minailos. *TsAGI, Uchenye Zapiski,* vol. 10, no. 3, 1979, p. 16-26. 13 refs. In Russian.

In the present paper, the errors in the aerodynamic characteristics calculated within the framework of shock layer theory, or Brown and Michael's (1955) formula in slender body theory, are determined on the basis of the supersonic flow past infinitely thin triangular plates. It is shown that the similarity parameters of linear theory, as well as Messiter's (1963) parameters of hypersonic theory, are valid over a wide range of variation of the determining quantities. V.P.

A80-27173 # Method of determining steady-state aerodynamic characteristics for an elastic aircraft in free longitudinal motion (Metodika opredeleniia statsionarnykh aerodinamicheskikh kharakteristik prodol'nogo dvizhenia uprugogo svobodnogo samoleta). D. D. Evseev and Iu. F. Iaremchuk. *TsAGI, Uchenye Zapiski,* vol. 10, no. 3, 1979, p. 71-77. In Russian.

The paper deals with the problem of determining experimentally the steady-state aerodynamic characteristics of an elastic aircraft in free directional flight. An approximate procedure is proposed for determining the influence on the aerodynamic characteristics of the aircraft's elastic deformations produced by inertial mass forces. The procedure is based on comparing wind-tunnel deformation data for rigid and elastic models. The potentialities of the procedure are demonstrated by examples. V.P.

A80-27175 # Induced drag and lift-drag ratio of swept wings at supersonic speeds (Induktivnoe soprotivlenie i aerodinamicheskoe kachestvo strelovidnykh kryl'ev pri sverkhzvukovykh skorostiakh). R. A. Breusova, N. P. Vedeneeva, and R. I. Shteinberg. *TsAGI, Uchenye Zapiski,* vol. 10, no. 3, 1979, p. 87-90. In Russian.

The paper deals with a theoretical and experimental study of the induced drag and lift-drag ratio of wings of various sweep with subsonic leading edges at supersonic speeds. The effectiveness of suction for wings with rounded leading edges is demonstrated. V.P.

A80-27183 # Improvement of the convergence of the method of polynomials in designing small-aspect-ratio wings (Uluchshenie skhodimosti metoda mnogochlenov v raschetakh kryl'ev malogo udlineniia). E. I. Kriuchkov. *TsAGI, Uchenye Zapiski,* vol. 10, no. 3, 1979, p. 130-135. In Russian.

In the practical application of the method of polynomials there arises an error in the calculation of the stiffness matrix, which is magnified when determining the inverse stiffness matrix. The error involved in the solution then depends on the accuracy of the calculations. To reduce the effect of the poor formulation of the stiffness matrix, it is proposed to minimize the total energy functional under certain additional static equilibrium conditions. S.D.

A80-27202 Value analysis and the optimum cost concept applied to aerospace (L'analyse de la valeur et le principe conception pour un coût optimum /C.C.O./ appliqué à l'aérospatiale). R. Tassinari (Société Nationale Industrielle Aérospatiale; Association Française pour l'Analyse de la Valeur, Paris, France). *L'Aéronautique et l'Astronautique,* no. 80, 1980, p. 29-37. In French.

The concept of optimum cost considered as part of the design stage for new aircraft is discussed. Attention is given to the economics concerning costs of production and maintenance, known as life-cycle-cost, as well as to economics and performance criteria. In addition, the design-to-cost method of program administration is considered, taking U.S. Defense Department experience into account. J.P.B.

A80-27203 Laminar separation bubble with transition /theory and experiment/ (Bulbe de décollement laminaire avec transition /théorie et expérience/). C. Gleyzes, J. Cousteix, and J.-L. Bonnet (ONERA, Centre d'Etudes et de Recherches de Toulouse, Toulouse, France). *(Colloque d'Aérodynamique Appliquée, 16th, Lille, France, Nov. 12-16, 1979.) L'Aéronautique et l'Astronautique,* no. 80, 1980, p. 41-57. 14 refs. In French.

The leading edge bubble on a Peaky airfoil was studied experimentally using a 200 mm chord profile. Boundary layer measurements regarding mean velocity and longitudinal intensity of turbulence were carried out at Reynolds numbers for R sub c (c is the chord length) between 100,000 and 1,000,000. A study of the transition process is also presented by means of flow visualizations and a spectral analysis of the velocity. J.P.B.

A80-27221 Simulation defines alternatives for Copenhagen terminal expansion. E. Bastiansen, J. Hviid, and P. Matthiesen (Peter Matthiesen A/S, Herlev, Denmark). *Airport Forum,* vol. 10, Feb. 1980, p. 21-24.

The paper deals with an analysis of alternate designs of an apron/terminal system within a planning horizon of 1980 to 2000. The study takes into account forecasts for such factors as: air traffic and passenger volumes, transfer passenger patterns, aircraft mix, operations, and the number and size of aircraft stands. V.T.

A80-27222 Aeropuerto de Caracas - An unusual new general aviation facility near the city. A. Calzadilla. *Airport Forum,* vol. 10, Feb. 1980, p. 35-40.

Design problems of the Aeropuerto de Caracas are described. Consideration is given to the airport planning, engineering and architectural features, hangar design studies, and environmental aspects. Emphasis is placed on the large amount of earth moving required to obtain graded surfaces for the airport complex. V.T.

A80-27223 The use of computer systems in air traffic control. H. Ebert (Telefunken AG, Ulm, West Germany). *Airport Forum,* vol. 10, Feb. 1980, p. 47, 48, 50-52, 54.

The use of computer systems for air traffic control (ATC) is reviewed. Consideration is given to the main areas that can be taken over by computers: processing flight plan data, processing radar data, display of the air traffic situation on screens, communication of data from and to other control centers, and furnishing of decision aids. Electronic computers, display units, data transmission systems, and other peripheral systems used in ATC are outlined. V.T.

A80-27227 Achieving effective Radar Cross Section flight profiles on the B-1 aircraft. J. W. Walkington and L. W. Huster (USAF, Flight Test Center, Edwards AFB, Calif.). In: Society of Flight Test Engineers, Annual Symposium, 10th, Las Vegas, Nev., September 4-6, 1979, Proceedings. Lancaster, Calif., Society of Flight Test Engineers, 1979. 16 p.

This paper analyzes the flight profiles of the B-1 Radar Cross Section (RCS) missions to ascertain whether they produce sufficient data to correlate with previously acquired data from a quarter-scale model. Analysis of the time-expended versus benefits-derived is also presented. Finally, alternate flight profiles are investigated to determine whether they will provide part of the required data with less time expended. (Author)

A80-27228 First experience with telemetry and real time data reduction at Gates Learjet. J. P. Dwyer and E. Tooley (Gates Learjet Corp., Wichita, Kan.). In: Society of Flight Test Engineers, Annual Symposium, 10th, Las Vegas, Nev., September 4-6, 1979, Proceedings. Lancaster, Calif., Society of Flight Test Engineers, 1979. 17 p.

The paper considers a telemetry and real time data reduction system. The choice of a ground based system including cost, the front end, computer, and special peripherals are discussed, noting its limitations which reduce the number of parameters that can be processed simultaneously. Applications of the telemetry system to the Model 28/29 Longhorn aircraft with NASA designed winglets and store separation tests in a 'Special Missions' aircraft are described. It is concluded that the telemetry system reduced flight and data turnaround time, increased safety, and decreased data errors. A.T.

A80-27229 Are we spending too much on flight test instrumentation. C. M. Miller (USAF, Flight Test Center, Edwards AFB, Calif.). In: Society of Flight Test Engineers, Annual Symposium, 10th, Las Vegas, Nev., September 4-6, 1979, Proceedings. Lancaster, Calif., Society of Flight Test Engineers, 1979. 7 p.

The paper considers the problem of expenditures on flight test instrumentation. The reasons for these expenditures including instrumentation users' inadequate time for participation in the design process, ignorance of instrumentation and of data reduction costs, and a lack of shelf hardware to provide a cheaper method are discussed; alternatives to digital data instrumentation systems including photo panel, gun camera, tape recorder, and analog strip recorder are considered. Finally, involvement in cost analysis by the flight test engineer is examined, concluding that the solution of the problem of overspending on flight test instrumentation lies in the involvement of the instrumentation engineer at the start of the instrumentation process. A.T.

A80-27230 MIDS - The right tool for small test jobs. W. G. Densford and D. L. Jones (McDonnell Aircraft Co., St. Louis, Mo.). In: Society of Flight Test Engineers, Annual Symposium, 10th, Las Vegas, Nev., September 4-6, 1979, Proceedings. Lancaster, Calif., Society of Flight Test Engineers, 1979. 7 p.

The paper considers Minature Integrated Data Systems (MIDS). This system features onboard recording and telemetry, and consists of a set of palletized units which replace production hardware without structural changes and use production wiring to gain access to basic aircraft and avionic systems information. Installation time is required only for program-peculiar, hard-wired measurands. The airborne system is totally compatible with existing full-scale ground preflight-maintenance and data processing display facilities. A.T.

A80-27231 A low cost airborne data acquisition system. R. N. Webb (USAF, Airborne Instrumentation Div., Eglin AFB, Fla.). In: Society of Flight Test Engineers, Annual Symposium, 10th, Las Vegas, Nev., September 4-6, 1979, Proceedings. Lancaster, Calif., Society of Flight Test Engineers, 1979. 6 p.

The paper presents a Pulse Code Modulation (PCM) data acquisition system which is accurate and easy to calibrate and maintain. This airborne system is modular and software programmable, and would be interfaced with the aircraft central computer data bus to gather general airframe and avionics data, and utilize remote signal conditioning units for other unique parameters. An off-the-shelf system capable of growth to over 1000 channels was chosen; PCM data is recorded on board and telemetered for real time assessment, and a cockpit video system composed of multiple cameras and a cassette video tape recorder provides HUD, radar, and E-O weapons recording capability. A.T.

A80-27232 Airborne video instrumentation/data reduction. J. E. Soller (McDonnell Aircraft Co., St. Louis, Mo.). In: Society of Flight Test Engineers, Annual Symposium, 10th, Las Vegas, Nev., September 4-6, 1979, Proceedings. Lancaster, Calif., Society of Flight Test Engineers, 1979. 14 p.

The paper examines the development of airborne video instrumentation systems and ground-based video reduction stations. The airborne system consisting of a HUD video camera system, video interface unit, and long range electro-optical TV sensor tracker system is described; the video data reduction station which will generate a copy of the HUD camera video tape, provide for simultaneous playback of the tapes for rapid examination, and will produce digitized coordinate data of a target relative to some point in the field-of-view is discussed. It is concluded that airborne video instrumentation is cost-effective in evaluating aircraft performance, its avionics equipment, and its pilot. A.T.

A80-27233 Investigation of engine performance degradation of TF33-P-7 engines. R. E. Hart (USAF, Flight Test Center, Edwards AFB, Calif.). In: Society of Flight Test Engineers, Annual Symposium, 10th, Las Vegas, Nev., September 4-6, 1979. Lancaster, Calif., Society of Flight Test Engineers, 1979. 13 p.

As a result of the actual C-141A cruise performance being less than that in the Flight Manual, the Air Force initiated a test program to attempt to correlate engine performance degradation with time since overhaul. Analysis of test cell data from more than 40 TF33-P-7 engines showed no apparent correlation. In addition, there was no noticeable correlation between performance degradation and engine cycles. These results were unexpected. Test cell calibrations conducted on engines used on the stretch YC-141B flight test program showed no fuel flow or thrust deterioration; however, an increase in turbine exhaust temperature was noted. With the current emphasis on fuel economy, further investigation in the area of fuel flow and engine operation time is warranted. (Author)

A80-27234 VSTOL test techniques utilizing laser tracking. M. B. Deitchman (U.S. Naval Air Systems Command, Naval Air Test Center, Patuxent River, Md.). In: Society of Flight Test Engineers, Annual Symposium, 10th, Las Vegas, Nev., September 4-6, 1979, Proceedings. Lancaster, Calif., Society of Flight Test Engineers, 1979. 9 p.

The paper presents various test methods used in the evaluation of VSTOL aircraft utilizing automatic laser tracking. The extensive manual labor and long turnaround time required by photo-theodolite tracking has been virtually eliminated by the near real-time capability

of the Automatic Laser Tracking System (ALTS) which does not rely on a surveyed runway centerline for the test aircraft to track, but determines three-dimensional aircraft space-positioning with a range well in excess of airfield operations. The laser tracking system, the YAV-8B flight demonstration program, and the girder bridge ski jump evaluation programs are discussed, concluding that the ALTS system provides improved safety and efficiency in VSTOL aircraft testing. A.T.

A80-27235 Experience from testing the Viggen electronic systems utilizing existing computer capacity. J. G. Uhlin (Saab-Scania AB, Linkoping, Sweden). In: Society of Flight Test Engineers, Annual Symposium, 10th, Las Vegas, Nev., September 4-6, 1979, Proceedings. Lancaster, Calif., Society of Flight Test Engineers, 1979. 11 p.

The paper examines the testing of the Viggen electronic systems utilizing existing computer capacity. In the testing of JA37 Viggen studies were made of decreasing the pilot workload by presenting errors from the required test flight condition on the HUD to enable the pilot to maintain the correct condition during landing tests and of methods to optimize test runs by using syncpulses for start of target maneuvers. The sync is originated by a computer and transmitted to the target, signalling to start the maneuvers. To implement these objectives, available core-memory areas in the Central Data Computer of the aircraft were used to optimize the usage of currently available hardware without additional expenditures. A.T.

A80-27236 Firebrand anti-ship missile target - Flight test program objectives and vehicle instrumentation requirements. L. O. Lehman (U.S. Naval Material Command, Naval Air Development Center, Warminster, Pa.). In: Society of Flight Test Engineers, Annual Symposium, 10th, Las Vegas, Nev., September 4-6, 1979, Proceedings. Lancaster, Calif., Society of Flight Test Engineers, 1979. 19 p.

The paper examines the Firebrand supersonic anti-ship missile target system which will provide realistic threat simulation for test and evaluation of ship defense weapons systems. The flight test plans including the vehicle configuration requirements and objectives for the evaluation phase of the Contractor Test and Evaluation and Navy Technical Evaluation are discussed; demonstration flights which will collect mission profile data and reliability data are described. Instrumentation requirements for each vehicle configuration are defined, and a summary of the planned flight test schedules is presented. A.T.

A80-27237 Tactical navigation system testing. D. M. Carlson and J. C. Dunn (USAF, Armament Development and Test Center, Eglin AFB, Fla.). In: Society of Flight Test Engineers, Annual Symposium, 10th, Las Vegas, Nev., September 4-6, 1979, Proceedings. Lancaster, Calif., Society of Flight Test Engineers, 1979. 17 p.

The paper examines tactical navigation system testing. The major avionics systems including the AN/ARN-101 Digital Modular Avionics System of F-4 aircraft with its software and the Pave Tack electro-optical target acquisition, laser designation, and weapon delivery system are discussed. The 'hardware-in-the-loop' ground simulation facility is described noting that new and existing systems should be integrated; the integration of the Pave Tack System on the F-4 and F-111 aircraft exemplified the advantages and disadvantages of testing described here. It is concluded that simulation, integration, and test environment must be considered in a complete simulation facility which can test navigation systems, perform target acquisition/identification, and test delivery of guided and unguided missiles. A.T.

A80-27239 Testing the F-18 at the U.S. Naval Air Test Center. J. L. Dunn (U.S. Naval Air Systems Command, Naval Air Test Center, Patuxent River, Md.). In: Society of Flight Test Engineers, Annual Symposium, 10th, Las Vegas, Nev., September 4-6, 1979, Proceedings. Lancaster, Calif., Society of Flight Test Engineers, 1979. 9 p.

The paper describes the testing of F-18 aircraft at the U.S. Naval Air Test Center. The F/A-18 replaces the F-4 and A-7 models, and it is a fighter/attack common, single-seat, twin-engine, high performance strike fighter with high reliability and low maintenance. The Naval Air Test Center was used as the test site to optimize cross-utilization of test aircraft, minimize personnel and hardware support cost, and establish a common data base. Five of the first flight test aircraft have completed 155 flights for a total of 220 flight hours; simulators were used extensively to predict the F/A-18 characteristics, and Navy preliminary assessments were made of the APG-65 radar system, initial arrested landings, and catapult shots. A.T.

A80-27240 Helicopter crash position indicator flight trials. K. D. Nelson (Aerospace Engineering Test Establishment, CFB Cold Lake, Alberta, Canada). In: Society of Flight Test Engineers, Annual Symposium, 10th, Las Vegas, Nev., September 4-6, 1979, Proceedings. Lancaster, Calif., Society of Flight Test Engineers, 1979. 12 p.

The paper examines the Canadian Forces (CF) helicopter crash position indicator flight trials. These tests were conducted to clear the selected Crash Position Indicator (CPI) systems on fixed and rotary wing aircraft; for the rotary wing systems, a test method was developed using a combination of surface and stand-off tufting to define the flow-field characteristics in the vicinity of the CPI. Results were used to predict the separation characteristics and the trajectory of the CPI airfoil, concluding that this tufting prediction method in conjunction with a computer model will reduce the large test matrix on the CH-135 Twin Huey CPI installation to manageable size. A.T.

A80-27241 * Aircraft motion analysis using limited flight and radar data. R. C. Wingrove, R. E. Bach, Jr. (NASA, Ames Research Center, Aircraft Guidance and Navigation Branch, Moffett Field, Calif.), and E. K. Parks (Arizona, University, Tucson, Ariz.). In: Society of Flight Test Engineers, Annual Symposium, 10th, Las Vegas, Nev., September 4-6, 1979, Proceedings.
Lancaster, Calif., Society of Flight Test Engineers, 1979. 18 p. 11 refs.

The development and application of methods for reconstructing, from a limited set of recorded data, a comprehensive scenario of aircraft motions before and during an accident are described. The accuracy of these analytical methods is investigated using data recorded onboard the Ames CV-990 research aircraft. In these experiments, the expanded set of data, derived from either foil or ATC records, is compared with corresponding values measured by the research instrumentation system onboard the aircraft. The results indicate that many of the derived quantities are in good agreement with the corresponding onboard measurements. A recent application of this procedure using actual accident records is presented and potential applications are briefly reviewed. (Author)

A80-27242 Factorial design of experiments in the test and evaluation of a complex control system. B. L. Hildret (U.S. Naval Air Systems Command, Naval Air Test Center, Patuxent River, Md.). In: Society of Flight Test Engineers, Annual Symposium, 10th, Las Vegas, Nev., September 4-6, 1979, Proceedings.
Lancaster, Calif., Society of Flight Test Engineers, 1979. 20 p.

Factorial design is applied to the testing and optimization of the U.S. Navy's Automatic Carrier Landing System (ACLS). Two, three, and four factorial design test matrices are developed to examine the effect of proportional, derivative, integral, and acceleration feedbacks on ACLS control. The vertical glideslope deviation is found to decrease with increasing proportional and derivative feedbacks, while an increase in the integral gain results in increased deviation. The changing of the acceleration feedback has little effect on the vertical glideslope deviation. Factorial design is shown to be an effective technique in the design and analysis of complex structures. V.L.

A80-27243 **From tape measure to computer tape.** K. J. Bicker (Pilatus Aircraft, Ltd., Stans, Switzerland). In: Society of Flight Test Engineers, Annual Symposium, 10th, Las Vegas, Nev., September 4-6, 1979, Proceedings. Lancaster, Calif., Society of Flight Test Engineers, 1979. 15 p.

The data acquisition system of a PC-7 Turbo Trainer, utilizing PCM is described. The system includes a desktop computer with a printer, plotter, and flexible disk driver. Consideration is given to flight tests, system specifications, and software. V.T.

A80-27257 **Applying pressure . . . Relieving stress.** H. K. Lew. *Aviation Engineering and Maintenance,* vol. 4, Feb. 1980, p. 27-29.

The article describes the process of stress coining which it is believed can reduce fatigue failure, and extend the useful life of equipment subject to high cyclic loading. It is shown that stress coining is a cold work technique in which pressure is exerted to compress metal in or around a hole or slot beyond its elastic limit into a plastic state. After the material recovers, residual compressive stresses remain. It is concluded that since these stresses are located around the hole, they subsequently reduce service induced fatigue-type stresses. M.E.P.

A80-27269 **Future large cargo aircraft technology.** R. H. Lange (Lockheed-Georgia Co., Advanced Concepts Dept., Marietta, Ga.). *Lockheed Horizons,* Spring 1980, p. 16-24.

Some innovative design concepts are surveyed which show potential for significant improvements in aerodynamic efficiency, operating economics, and operational efficiency. Topics examined include military/civil commonality issues, and cargo capacity. Attention is given to the environmental impact of future cargo aircraft covering advanced composite materials, advanced aircraft propulsion, aircraft drag reduction, alternate fuels, and innovative design concepts. M.E.P.

A80-27270 **The changing horizons for technical progress. II.** R. H. Hopps (Lockheed-California Co., Burbank, Calif.). *Lockheed Horizons,* Spring 1980, p. 32-39.

Some new technologies are surveyed that offer the possibility of obsoleting the present concept of a jet transport. Attention is given to such areas as laminar flow control, all-wing concepts, superlarge aircraft, advanced turboprops, air cargo, avionics, hydrogen, VTOL and V/STOL. Also covered are a nuclear-powered airplane and a supersonic transport. It is concluded that new developments will be of an evolutionary manner rather than a sudden jump to a new generation of aircraft, as in the past. M.E.P.

A80-27306 **Experimental measurement of fields excited inside the fuselage of an aircraft.** J. Perini (Syracuse University, Syracuse, N.Y.). *IEEE Transactions on Electromagnetic Compatibility,* vol. EMC-22, Feb. 1980, p. 72-75. 5 refs.

The results of Piatkowski et al., 1975 and A. T. Adams et al., 1975 have been used in computing the fields excited inside the fuselage of an aircraft when subjected to external electromagnetic radiation. In addition, the fields were assumed to propagate in free space instead of inside a cavity. The present measurement program shows that it is improper to make this assumption, since the presence of metallic structures and the cavity resonances may account for deviations over 20 dB in relation to the free space field. M.E.P.

A80-27347 **Methodology for target discrimination.** F. McNolty (Lockheed Research Laboratories, Palo Alto, Calif.) and R. Clow. *Applied Optics,* vol. 19, Mar. 15, 1980, p. 984-999. 21 refs.

The objective is to distinguish the true target from point-target imitators and from extended-target clutter in the exoatmospheric regime. Matched filters are carefully studied from the viewpoint of SNR enhancement and pulse recognition. The matched filter structure takes into account photon noise, modulation noise, generation-recombination (GR) noise, contact noise, and various thermal noise sources. A multicolor radiant-intensity structure for target discrimination is developed by analyzing the uncertainties in such target irradiance parameters as range, temperature, projected area, and emissivity. Bias terms, variances, and other statistical descriptors are derived. Certain statistical discrimination techniques are discussed that exploit the radiant-intensity format. Helstrom's method for processing radar signals is adapted to a four-channel pulse-recognition system for which degradation due to arrival time delays and mismatched filters is discussed. (Author)

A80-27377 **F/A-18 status report.** J. E. Krings (McDonnell Douglas Corp., St. Louis, Mo.). *(Society of Experimental Test Pilots, Symposium, 23rd, Beverly Hills, Calif., Sept. 26-29, 1979.) Society of Experimental Test Pilots, Technical Review,* vol. 14, no. 4, 1979, p. 1-9.

F/A-18 aircraft performance during flight tests is discussed in terms of flying qualities, propulsion, carrier suitability, structural tests, avionics development, and high angle-of-attack studies. Attention is given to range-while-scan, track-while-scan, and velocity search radar modes, as well as to problems with regard to lateral sensitivity, a leaky environmental control system, and nose wheel liftoff. J.P.B.

A80-27378 **Night/adverse weather A-10 evaluator program /A-10B/.** W. H. Shawler (Fairchild Republic Co., Farmingdale, N.Y.). *(Society of Experimental Test Pilots, Symposium, 23rd, Beverly Hills, Calif., Sept. 26-29, 1979.) Society of Experimental Test Pilots, Technical Review,* vol. 14, no. 4, 1979, p. 10-21.

The A-10B fighter aircraft, which is designed for low-level flying and night/adverse weather (N/AW) conditions, is described. Attention is given to avionics, including the head-up display which is the key display for the complete system, the forward-looking infrared receiver, radar, the inertial navigation system, radar altimeter, laser ranger, and low light level TV. It is concluded that two crewmembers are required to significantly increase the probability of mission success, and N/AW mission capability has been demonstrated for the A-10. J.P.B.

A80-27379 **The Tornado all-weather high-speed low-level system.** L. Obermeier (Messerschmitt-Bölkow-Blohm GmbH, Munich, West Germany). *(Society of Experimental Test Pilots, Symposium, 23rd, Beverly Hills, Calif., Sept. 26-29, 1979.) Society of Experimental Test Pilots, Technical Review,* vol. 14, no. 4, 1979, p. 22-36.

The Interdictor/Strike version of the Tornado, an all-weather, low-level aircraft useful in high-threat environments, is described. Particular attention is given to the terrain-following (TF) system, including radar, computer, and inertial navigator, as well as to TF cockpit displays and controls, and safety and warning logics. Also considered are ride comfort, weapon aiming system, and the (two man) crew workload. J.P.B.

A80-27380 **F-16 European test and evaluation.** T. P. McAtee and L. Timm (USAF, Flight Test Center, Edwards AFB, Calif.). *(Society of Experimental Test Pilots, Symposium, 23rd, Beverly Hills, Calif., Sept. 26-29, 1979.) Society of Experimental Test Pilots, Technical Review,* vol. 14, no. 4, 1979, p. 37-51.

Four F-16's were tested in Europe in order to qualify for operations in adverse weather and to complete operational test and evaluation. Areas surveyed included routine operations, air-to-air and air-to-surface effectiveness, and operational suitability, and overall, the performance of the F-16 was highly satisfactory. It was found that the reclined seat significantly improves the pilot's ability to perform under high g loads. In addition, 64 deficiencies were noted, mostly of a minor nature, but some significant problems with the radar and the air-to-air refueling system were reported for the first time. J.P.B.

A80-27381 **YAV-8B status report.** C. A. Plummer, Jr. (McDonnell Douglas Corp., St. Louis, Mo.). *(Society of Experimental Test Pilots, Symposium, 23rd, Beverly Hills, Calif., Sept. 26-29, 1979.) Society of Experimental Test Pilots, Technical Review,* vol. 14, no. 4, 1979, p. 52-58.

The YAV-8B aircraft was modified from the AV-8A, containing these major changes: wing with a supercritical airfoil constructed almost entirely of graphite epoxy materials, a second row of auxiliary inlet air doors and a changed inlet lip shape, positive circulation generated by large flaps interconnected with the nozzles such that full flap (62 degrees) is obtained with approximately 50 degrees of nozzle angle, and lift improvement devices including strakes fitted to the 30-mm gun pods under the aircraft and a retractable door which connects them at the forward end. Flight test performance is discussed, where the goal was to demonstrate a tropical-day vertical takeoff and transition to wing-borne flight at a takeoff weight/hover weight ratio of 0.99. J.P.B.

A80-27382 **Have Bounce.** R. A. Borowski (USAF, Flight Test Center, Edwards AFB, Calif.). *(Society of Experimental Test Pilots, Symposium, 23rd, Beverly Hills, Calif., Sept. 26-29, 1979.) Society of Experimental Test Pilots, Technical Review,* vol. 14, no. 4, 1979, p. 61-67.

The validation of computer simulations of F-4 dynamic response to multiple runway repairs was carried out utilizing the AM-2 mat, made up of extruded aluminum sections 2 ft wide which interlock to form a mat 54 ft wide and of any desired length. Testing to date has shown that for a 55,000 pound F-4E, reinforcement occurs at about 32, 55, and 155 knots, where the 55-knot point leads to the highest loads. In addition, the rigid body response of the F-4, characterized by bouncing up and down on the main gear struts, seems to be consistent at a frequency of about 2 hertz. J.P.B.

A80-27383 **General aviation icing flight test.** W. H. Lawton (Piper Aircraft Corp., Lock Haven, Pa.). *(Society of Experimental Test Pilots, Symposium, 23rd, Beverly Hills, Calif., Sept. 26-29, 1979.) Society of Experimental Test Pilots, Technical Review,* vol. 14, no. 4, 1979, p. 68-76.

FAA certification of the Navajo, a light, twin reciprocating engined commuter aircraft, for flight into known icing is discussed. Attention is given to the simulated fiberglass ice shapes installed on parts of the wing, on horizontal and vertical tail surfaces that were not deiced by the pneumatic boots, and on the unheated radome/nose cone, in order to confirm the handling qualities, stability, and stall characteristics of the aircraft during or following an icing encounter. The development and flight tests of the icing tanker are also considered. J.P.B.

A80-27384 * **The Quiet Short-Haul Research Aircraft /QSRA/.** J. L. Martin (NASA, Ames Research Center, Moffett Field, Calif.). *(Society of Experimental Test Pilots, Symposium, 23rd, Beverly Hills, Calif., Sept. 26-29, 1979.) Society of Experimental Test Pilots, Technical Review,* vol. 14, no. 4, 1979, p. 77-93. 10 refs.

The Quiet Short-Haul Research Aircraft (QSRA), designed to expand the technology base of the upper-surface blowing propulsive-lift principle in order to establish criteria for the U.S. aircraft industry and for advanced STOL aircraft, is considered. The aircraft, which includes a three-axis, single channel, limited authority series type stability augmentation system, and a high-speed data system is described. Also discussed are STOL and acoustic performance, and handling qualities, particularly thrust effects. The QSRA has demonstrated its ability, even with the critical engine inoperative, to approach at 66 knots (wing loading of 83 lb/sq ft) and on a 9 degree glidepath; to maneuver in a 700-ft radius turn, and to land in an FAA field length of 1450 ft (over a 35-ft obstacle). J.P.B.

A80-27386 **The development of the world's first triengine business jet, the Mystere Falcon 50.** J. A. Resal (Avions Marcel Dassault-Brequet Aviation, Vaucresson, Hauts-de-Seine, France). *(Society of Experimental Test Pilots, Symposium, 23rd, Beverly Hills, Calif., Sept. 26-29, 1979.) Society of Experimental Test Pilots, Technical Review,* vol. 14, no. 4, 1979, p. 123-137.

The development and performance of the Mystere Falcon 50 (F-50) triengine business jet is discussed. The F-50 is basically composed of F-10 engines on the F-20 fuselage, but having a wing optimized for supercritical flow with less curvature on its upper side, thus providing a wide zone of moderate supersonic flow terminated by a mild shock wave. The F-50 can climb directly to 41,000 ft and fly 3500 nautical miles in still air; maximum cruise is Mach 0.81 to 0.84, depending on weight. J.P.B.

A80-27387 **CL-600 Challenger.** F. D. Adkins (Canadair, Ltd., Montreal, Canada). *(Society of Experimental Test Pilots, Symposium, 23rd, Beverly Hills, Calif., Sept. 26-29, 1979.) Society of Experimental Test Pilots, Technical Review,* vol. 14, no. 4, 1979, p. 138-144.

The CL-600 Challenger flight test program is described, in which the aircraft is averaging 25 to 30 hours per month; nearly 400 stalls have been done. The flight flutter program, which utilizes a flutter vane system powered from the aircraft hydraulic system with the vanes mounted on the wingtips, the aft fuselage, and the top of the vertical stabilizer, is discussed; Mach 0.94 and 460 KCAS have been achieved. J.P.B.

A80-27388 **Review of five years of flight testing the B-1.** J. S. Smith, III and F. A. Fiedler (USAF, Flight Test Center, Edwards AFB, Calif.). *(Society of Experimental Test Pilots, Symposium, 23rd, Beverly Hills, Calif., Sept. 26-29, 1979.) Society of Experimental Test Pilots, Technical Review,* vol. 14, no. 4, 1979, p. 209-231.

Five years of B-1 testing are reviewed, considering flutter, flying qualities, airloads, and performance testing. In addition, tests of the weapons delivery system are discussed, as well as a hinge moment problem, and capsule versus ejection seats. Furthermore, terrain following (TF) testing was made, and the most successful aspect of the B-1 TF flight tests was the response of the airplane to the TF commands; the most serious anomalies in the flight test program were electrical system malfunctions. J.P.B.

A80-27389 **Crossing the Channel in the Gossamer Albatross.** P. MacCready (Aerovironment, Inc., Pasadena, Calif.). *(Society of Experimental Test Pilots, Symposium, 23rd, Beverly Hills, Calif., Sept. 26-29, 1979.) Society of Experimental Test Pilots, Technical Review,* vol. 14, no. 4, 1979, p. 232-243.

The design and performance history of the Gossamer Albatross (GA), the first human-powered aircraft to cross the English Channel, and its predecessor the Gossamer Condor, the first human-powered aircraft to sustain controlled flight, are discussed. Emphasis was placed on having a simple, large, light, slow flying, wire-braced craft; therefore, carbon filament tubing was used, along with ribs constructed from expanded polystyrene foam and a mylar covering. Also discussed are the apparent mass effect, and the relevance of the GA flight for possible applications of low power. J.P.B.

A80-27415 * **Computational aerodynamics on large computers.** W. F. Ballhaus and F. R. Bailey (NASA, Ames Research Center, Moffett Field, Calif.). *(Symposium on Computers in Aerodynamics, Farmingdale, N.Y., June 4, 5, 1979.) Computers and Fluids,* vol. 8, Mar. 1980, p. 133-144. 22 refs.

Three examples of advances in computational aerodynamics; (1) three-dimensional inviscid transonic analysis, (2) design calculations for wings, and (3) the computation of viscous-induced aileron buzz, are reviewed. Attention is given to wing surface pressures, design optimization, computer memory, speed and advanced solution methods on parallel computer architecture. It is determined that many implicit approximate-factorization schemes, that have been

developed for Navier-Stokes equations, can be coded to run efficiently on microprocessors. C.F.W.

A80-27479 Acceleration of multicycle fatigue testing on aluminum structural alloys. M. N. Stepnov and S. P. Evstratova (Moskovskii Aviatsionnyi Tekhnologicheskii Institut, Moscow, USSR). *(Zavodskaia Laboratoriia,* vol. 45, July 1979, p. 649-653.) *Industrial Laboratory,* vol. 45, no. 7, Jan. 1980, p. 805-809. 8 refs. Translation.

A forced testing method for specimens and parts of aluminum alloys is presented which makes it possible to evaluate fatigue properties and their scattering for a large life range. Tests were performed on smooth and notched specimens 8 to 10 mm in diameter. In order to plot fatigue curves with an equal probability of failure, the invariance of the variability coefficient was utilized for the endurance limit to the life base. It is shown that by using the proposed forced testing technique to determine the endurance limit of specimens and structural elements of deformable aluminum alloys for bases of 100 to 1000 million cycles the testing times can be shortened by a factor of 20 to 200 respectively, with satisfactory accuracy. V.L.

A80-27596 * # The potential for damage from the accidental release of conductive carbon fibers from aircraft composites. V. L. Bell (NASA, Langley Research Center, Hampton, Va.). *NATO, AGARD, Specialists Meeting on the Effect of Service Environment on Composite Materials, Athens, Greece, Apr. 16, 1980, Paper.* 22 p. 37 refs.

The paper considers the potential for damage from the accidental release of conductive carbon fibers from aircraft composites. The electrical conductivity of carbon and graphite fibers has led to electrical equipment damage from the inadvertent release of virgin fibers into the atmosphere; an accidental release of carbon fibers from filamentary composites from the burning of crashed commercial airliners could damage electrical and electronic equipment. The experimental and analytical results by NASA of the methods of assessing the extent of potential damage in terms of costs is presented; the NASA materials research program to provide alternate or modified composites to overcome electrical hazards of carbon composites in aircraft structures is described. A.T.

A80-27597 * # Composite components on commercial aircraft. H. B. Dexter (NASA, Langley Research Center, Hampton, Va.). *NATO, AGARD, Specialists Meeting on the Effect of Service Environment on Composite Materials, Athens, Greece, Apr. 13-18, 1980, Paper.* 23 p. 16 refs.

The paper considers the use of composite components in commercial aircraft. NASA has been active in sponsoring flight service programs with advanced composites for the last 10 years, with 2.5 million total composite component hours accumulated since 1970 on commercial transports and helicopters with no significant degradation in residual strength of composite components. Design, inspection, and maintenance procedures have been developed; a major NASA/US industry technology program has been developed to reduce fuel consumption of commercial transport aircraft through the use of advanced composites. A.T.

A80-27598 * # Graphite-epoxy panel compression strength reduction due to local impact. M. P. Card and M. D. Rhodes (NASA, Langley Research Center, Hampton, Va.). *NATO, AGARD, Specialists Meeting on the Effect of Service Environment on Composite Materials, Athens, Greece, Apr. 13-18, 1980, Paper.* 14 p. 10 refs.

A review of results from on-going research to investigate the effects of low-velocity impact on the compressive strength of graphite-epoxy structures is presented. Extensive tests have been conducted on sandwich beams, laminated plates and stiffened panels. Conditions for failures were investigated by impact tests on statically loaded test specimens. The effects of compression load intensity were such that lightly loaded graphite structures (such as aircraft secondary structure) were insensitive to impact damage. In more heavily loaded structures, (such as wing panels), however, appreciable reductions in compressive strength occurred. The implications of the tests for structural design are discussed by comparing panel masses for designs where ultimate strains have been reduced due to impact considerations with the masses of designs with higher ultimate strains. Finally, preliminary test data is presented to show the possibility of improvements in damage tolerance achievable by using an alternate matrix material. (Author)

A80-27599 * # Operational implications of some NACA/NASA rotary wing induced velocity studies. H. H. Heyson (NASA, Langley Research Center, Hampton, Va.). *Illinois Department of Transportation, Annual Midwest Helicopter Safety Seminar, 3rd, Joliet, Ill., Feb. 26, 27, 1980, Paper.* 53 p. 60 refs.

The purpose of the paper is to present some highlights of the broad NACA/NASA efforts throughout the years, with particular emphasis given to those results having special importance to aircraft users. Subjects covered include the rotor wake and vortex hazards, partial power descent and minimum speed for autorotation. Several aspects of ground effect are covered, including nonuniform wakes, nonlinear power and control effects in forward flight, and yaw control at near-hovering speeds. C.F.W.

A80-27612 Reliability growth testing of avionic equipment. E. B. Gamble (RCA, Avionics Systems Div., Van Nuys, Calif.). *RCA Engineer,* vol. 25, Dec. 1979-Jan. 1980, p. 52-56. 5 refs.

The article examines the features of a reliability growth program used to achieve cost effective reliability for new systems produced for the aviation market. The origin of reliability growth is reviewed and illustrative data are presented from results obtained with the PriMUS-20/30 X-band digital weather radar. M.E.P.

A80-27622 Source book on materials for elevated-temperature applications: A comprehensive collection of outstanding articles from the periodical and reference literature. Edited by E. F. Bradley. Metals Park, Ohio, American Society for Metals, 1979. 408 p. $35.

The book focuses on industrial turbine applications, super 12% Cr steels, stainless steels, heat-resistant alloy castings, iron-base and iron-containing superalloys, nickel-base superalloys, cobalt-base superalloys, directional solidification, protective coatings, and welding. Papers were presented on high-temperature oxidation and corrosion of superalloys in the gas turbine, environment-dependence of the mechanical properties of metals at high temperature, the super 12% Cr steels, strength of stainless steels at elevated temperatures, and welding of the nickel alloys and dissimilar metals for high-temperature service. A.T.

A80-27716 # Airport radio navigation systems (Radionavigatsionnye sistemy aeroportov). K. V. Makarov, V. V. Chervetsov, I. F. Sheshin, and V. A. Volynets. Moscow, Izdatel'stvo Transport, 1978. 336 p. 60 refs. In Russian.

The book deals with radio navigation systems used at airports for landing aircraft and for navigation. Principles of organizing air traffic are discussed, along with the interaction between navigation and landing aids during all stages of flight. The principle of operation and the block diagrams of homing stations, radio marker beacons, radio direction finders, glide-path beacons, and radio-range beacons are examined. V.P.

A80-27723 # Stationary movement of wings in the transonic regime (Movimiento estacionario de alas en régimen transónico). F. J. S. Calero. Madrid, Universidad Politécnica, Doctor Ingeniero Aeronáutico Thesis, 1978. 155 p. 245 refs. In Spanish.

The exact transonic small perturbation equation of order delta (squared) is derived; avoidance of the explicit determination of the far field singularities of a wing is accomplished by using appropriate transformations. The three-dimensional boundary value problem is split into a series of simplified problems corresponding to its two limits: in the outer flow the wing shrinks to a line of singularities; in the inner region the problem becomes a local investigation of two-dimensional airfoil sections. The local non-uniform region at wing tips of large curvature is also investigated. J.P.B.

A80-27725 Fundamentals of design. V - Fin design for combat aircraft. B. R. A. Burns. *Air International,* vol. 18, Jan. 1980, p. 21-25.

The basic principles of fin design are discussed and the pros and cons of various alternative layouts are presented. Attention is given to rudder designs, twin-fins, all-moving fins and ventral fins, as well as to dihedral and anhedral tailplanes, dorsal fins, and wing-tip fins. C.F.W.

A80-27726 767 - A Boeing for the 'eighties. *Air International,* vol. 18, Feb. 1980, p. 59-66, 99.

The article surveys the development of the 767 into its present twin engine, low tail configuration. Attention is given to the 7X7 wide body studies and the 7N7 narrow body using the 727/737 fuselage cross section. Discussion also covers the various twin and three engines proposals, low and T-tails, and upper surface blowing configurations which have the engines forward of and above the wing leading edge. Finally, complete specifications for 767-200 are given. M.E.P.

A80-27727 The light fighter market . . . and a European proposal. *Air International,* vol. 18, Feb. 1980, p. 77-81.

It is noted that the market for light fighters is of a similar size to that for heavier fighters, and that the export market is considerably larger than that for heavier models. Attention is given to the Piranha concept, designed by a Swiss-based organization, which is shown to be comparable with the F-5E in terms of weight and capability. Discussion covers armament such as Oerlikon KCA or Mauser Bk-27 cannon, and avionics. Also covered are various engine options, including twin engines, as well as performance, political and economic considerations. M.E.P.

A80-27728 Fundamentals of design. VI - Tailplanes, tailless and canard design. B. R. A. Burns (British Aerospace, Warton Div., Preston, Lancs., England). *Air International,* vol. 18, Mar. 1980, p. 126-129.

It is noted that in contrast to fins the design of tailplanes has evolved progressively with the extending speed range of combat aircraft. The article discusses the design of longitudinal stabilizing and control surfaces, and examines the pros and cons of alternative configurations. Topics covered include control power, tailless aircraft, canard configurations, and artificial stability. M.E.P.

A80-27732 Flow in primary, non-rotating passages in turbomachines; Proceedings of the Winter Annual Meeting, New York, N.Y., December 2-7, 1979. Meeting sponsored by the American Society of Mechanical Engineers. Edited by H. J. Herring (Dynalysis, Princeton, N.J.), A. Soler (Pennsylvania, University, Philadelphia, Pa.), and W. G. Steltz (Westinghouse Electric Corp., Lester, Pa.). New York, American Society of Mechanical Engineers, 1979. 193 p. Members, $15.; nonmembers, $30.

The symposium discusses turbomachine performance including the effects of inlet guide vane on performance characteristics of a high specific speed propeller pump, and rotating stall in a vaneless diffuser of a centrifugal fan. Attention is also given to experimental techniques including loss coefficient determination by water tank test and application to turbomachine development, and laser anemometer measurements at the exit of a T63 combustor. Computational techniques are covered including a calculation procedure for three-dimensional, viscous, compressible duct flow, numerical prediction of three-dimensional subsonic diffuser flows, and analysis of the three-dimensional flow in a turbine scroll. Finally, the characteristics of ducts and diffusers are examined. M.E.P.

A80-27733 # Effect of non-rotating passages on performance of centrifugal pumps and subsonic compressors. A. Kovats. In: Flow in primary, non-rotating passages in turbomachines; Proceedings of the Winter Annual Meeting, New York, N.Y., December 2-7, 1979. New York, American Society of Mechanical Engineers, 1979, p. 1-14. 31 refs.

It is noted that in the past studies of flow conditions in pumps and compressors, as well as design recommendation, were concentrated on the impeller. It is only in the last decades that researchers have directed more attention to the importance of inlet conditions and diffusers or volutes. The paper evaluates and surveys test results and calculations which can be of use to designers. Attention is given to the problem of turbulence, noting that at this time the appropriate physical laws can not be expressed in exact mathematical formulas. M.E.P.

A80-27734 # Rotating stall in a vaneless diffuser of a centrifugal fan. K. Imaichi and H. Tsurusaki (Osaka University, Toyonaka, Japan). In: Flow in primary, non-rotating passages in turbomachines; Proceedings of the Winter Annual Meeting, New York, N.Y., December 2-7, 1979. New York, American Society of Mechanical Engineers, 1979, p. 23-31.

In a centrifugal fan which had an axisymmetric vaneless diffuser, circumferentially uniform discharge at the exit of the diffuser suddenly changed into a periodic circumferentially fluctuating flow state. Detailed measurements were carried out on this fluctuating flow state, and it was proved to be a rotating stall in the diffuser. Properties of the rotating stall in the diffuser are made clear, and it is pointed out that a measured rotating stall is different from the previously studied rotating stall in a diffuser proper. Moreover, a causal relation between back flow in the diffuser and the rotating stall is actually proved, and numerical values on a radial extent of the back flow are presented. These data can be used to predict the initiation of the rotating stall. (Author)

A80-27735 # Aerodynamic performance of a centrifugal compressor with vaned diffusers. Y. Yoshinaga, H. Mishina, F. Koseki, N. Nishida (Hitachi, Ltd., Tokyo, Japan), and I. Gyobu (Hitachi, Ltd., Tsuchiura, Japan). In: Flow in primary, non-rotating passages in turbomachines; Proceedings of the Winter Annual Meeting, New York, N.Y., December 2-7, 1979.
New York, American Society of Mechanical Engineers, 1979, p. 33-40. 9 refs.

An experimental investigation to improve the stage efficiency through the use of vaned diffusers is presented. Sixteen different vaned diffusers were tested on a model compressor rig. The results showed that the pressure recovery of the vaned diffuser increased up to the critical diffusion ratio, which was shown to be approximately 0.5. The measured pressure distribution around vanes of the well-designed diffusers which had the fair diffusion ratios, were found to agree well with the potential flow solutions. Finally, the importance of the diffuser inlet configuration to the improvement of the stage efficiency is discussed. (Author)

A80-27737 * # Laser anemometer measurements at the exit of a T63 combustor. D. R. Zimmerman (General Motors Corp., Detroit Diesel Allison Div., Indianapolis, Ind.). In: Flow in primary, non-rotating passages in turbomachines; Proceedings of the Winter Annual Meeting, New York, N.Y., December 2-7, 1979.
New York, American Society of Mechanical Engineers, 1979, p. 57-62. 9 refs. Research supported by the General Motors Corp.; Contract No. NAS3-21267.

In the first practical application of laser anemometry to an actual gas turbine engine combustor, the mean velocity and turbulent intensity profiles were measured in a steady-flow combustion rig across an annulus simulating a turbine inlet; to establish a basis for comparison with similar measurements to be made in an operating engine and to confirm current turbine aerodynamics and heat transfer design assumptions. It was necessary to develop a new experimental technique for traversing the annulus due to differential thermal expansion of the cantilevered combustion rig and a new computer-graphics analysis technique for analyzing the velocity histograms due to the high background light intensity. The axial mean velocity and turbulent intensity were uniform across the annulus under all operating conditions and the flow had little or no swirl component. The isothermal mean velocity was doubled by the burning of fuel, however, the isothermal turbulent intensity was relatively unaffected. (Author)

A80-27738 * # **Flow measurements in a turbine scroll.** W. Tabakoff, Y. Sheoran, and K. Kroll (Cincinnati, University, Cincinnati, Ohio). In: Flow in primary, non-rotating passages in turbomachines; Proceedings of the Winter Annual Meeting, New York, N.Y., December 2-7, 1979. New York, American Society of Mechanical Engineers, 1979, p. 63-73. 9 refs. Grant No. NsG-3066.

The paper presents a study conducted to determine experimentally the flow behavior in the combined scroll nozzle assembly of a radial inflow turbine. It is shown that hot film anemometry was used to measure the flow velocity in the scroll. M.E.P.

A80-27742 # **Evaluation of an analysis for axisymmetric internal flows in turbomachinery ducts.** T. J. Barber, P. Raghuraman (United Technologies Corp., Commercial Products Div., East Hartford, Conn.), and O. L. Anderson (United Technologies Research Center, East Hartford, Conn.). In: Flow in primary, non-rotating passages in turbomachines; Proceedings of the Winter Annual Meeting, New York, N.Y., December 2-7, 1979.
New York, American Society of Mechanical Engineers, 1979, p. 107-114. 26 refs.

The paper demonstrates that the Anderson analysis is sufficiently versatile and reliable to be used as a design tool. The analytical basis of the method is examined in order to review the necessary assumptions and the solution algorithm. Attention is given to a series of comparisons which demonstrate the applicability of the method to practical duct problems having either moderate flow skew, moderate cross-sectional area variations or stator cascades. M.E.P.

A80-27743 # **Numerical prediction of compressible potential flow for arbitrary geometries.** C. K. Forester (Boeing Aerospace Co., Seattle, Wash.). In: Flow in primary, non-rotating passages in turbomachines; Proceedings of the Winter Annual Meeting, New York, N.Y., December 2-7, 1979. New York, American Society of Mechanical Engineers, 1979, p. 115-124. 36 refs.

A method for calculating compressible potential flow through and about arbitrary geometries is being developed for applications in the subsonic, transonic, and supersonic flow speed range. Discussion of the technique focuses on the mathematical and computer coding considerations which impact the algorithm efficiency, accuracy and applicability to generally shaped physical domains. An example of flow computed and compared with experimental data for an S-duct like that of a Boeing 727 center engine is highlighted. Highly compressible flow in an S-duct is also shown. (Author)

A80-27744 # **Transonic inlet flow calculations using a general grid-generation scheme.** L. T. Chen (McDonnell Douglas Research Laboratories, St. Louis, Mo.) and D. A. Caughey (Cornell University, Ithaca, N.Y.). In: Flow in primary, non-rotating passages in turbomachines; Proceedings of the Winter Annual Meeting, New York, N.Y., December 2-7, 1979. New York, American Society of Mechanical Engineers, 1979, p. 125-132. 19 refs. Research supported by the McDonnell Douglas Independent Research and Development Program.

Finite difference solutions for transonic flowfields about engine inlet nacelles are obtained by combining a general grid-generation scheme with a previously developed general solver for transonic potential flowfields. An extrapolated relaxation procedure is used to obtain improved convergence of the transonic solution to small residuals. Results obtained for flowfields with embedded supersonic regions both outside and inside the inlets compare well with experimental results. (Author)

A80-27745 # **Three-dimensional inviscid compressible rotational flows - Numerical results and comparison with analytical solutions.** M. Pandolfi and G. Colasurdo (Torino, Politecnico, Turin, Italy). In: Flow in primary, non-rotating passages in turbomachines; Proceedings of the Winter Annual Meeting, New York, N.Y., December 2-7, 1979. New York, American Society of Mechanical Engineers, 1979, p. 141-149. 9 refs. Consiglio Nazionale delle Ricerche Contract No. 78,02427,07.

The paper presents a numerical method for predicting 3D inviscid compressible rotational flows. The approach is shown to be based on a time dependent technique, and the equations, boundary conditions, and features of the algorithm are discussed. The accuracy of the results is checked by means of computations which have been performed on four flow fields where analytical solutions are available. Finally, numerical results are compared with analytical results. M.E.P.

A80-27746 # **Straight-walled, two-dimensional diffusers - Transitory stall and peak pressure recovery.** J. Ashjaee and J. P. Johnston (Stanford University, Stanford, Calif.). In: Flow in primary, non-rotating passages in turbomachines; Proceedings of the Winter Annual Meeting, New York, N.Y., December 2-7, 1979. New York, American Society of Mechanical Engineers, 1979, p. 151-158. 15 refs. Project SQUID.

An investigation of straight-walled, two-dimensional diffusers of large aspect ratio for the purpose of studying the regime of incipient transitory stall, is presented. Twelve symmetric diffusers of constant nondimensional length with total included angles ranging from 4 to 24 deg, covering attached, intermittently detaching, and unsteady detached flows were examined. It is reported that pressure recovery and flow direction intermittency were obtained along the diffuser walls. Finally, conclusions are drawn concerning the nature of the flow in the vicinity of peak pressure recovery. M.E.P.

A80-27747 # **Effect of wake-type nonuniform inlet velocity profiles on first appreciable stall in plane-wall diffusers.** K. F. Kaiser (Wallace Murray Corp., Indianapolis, Ind.) and A. T. McDonald (Purdue University, West Lafayette, Ind.). In: Flow in primary, non-rotating passages in turbomachines; Proceedings of the Winter Annual Meeting, New York, N.Y., December 2-7, 1979. New York, American Society of Mechanical Engineers, 1979, p. 159-168. 16 refs.

The combustor diffuser in a gas turbine engine must accept a high-speed, unsteady, distorted flow from the engine compressor. It must deliver flow to the combustor with minimum loss in total pressure and minimum velocity profile distortion. Both pressure recovery and outlet flow distortion characteristics of diffusers must be considered in design tradeoffs. The purpose of this investigation was to study the effects of nonuniform inlet velocity profiles on the inception of stall in two-dimensional plane-wall diffusers. Centrally-located 'wake-type' inlet velocity profiles were chosen to simulate the flow conditions at the inlet of a combustor diffuser. The inlet distortion was characterized by dimensionless wake strength and wake width parameters. The experiments were performed on an open surface water table to make flow visualization possible. A centerline or pocket-type stall, such as previously reported in swirling flows, was observed for sufficiently severe inlet profile distortion. A new

definition of first appreciable stall, based on a fraction of the exit area stalled, was introduced to characterize stalls which did not occur on a solid surface. (Author)

A80-27751 # Flight recording in the UK. I - Evolution. T. E. Ford. *Aircraft Engineering,* vol. 52, Mar. 1980, p. 6-8.

The evolution of flight recording in the UK from the 1960's to the present is reviewed. Relevant flight parameters, and crash protection requirements for both the flight data and cockpit voice recorders are outlined, as are the various recording requirements for subsonic aircraft, depending on size. Areas of present study are considered, including flight operations, structures, systems, and engine condition monitoring. J.P.B.

A80-27752 # The energy problem: Its effect on aircraft design. I - Supply and demand. W. Tye. *Aircraft Engineering,* vol. 52, Mar. 1980, p. 9-11.

Energy demands for aircraft by the year 2000 are discussed, considering fuel supply shortages that are expected to result in a 7% cut in the availability of aviation fuel. Attention is given to the use of kerosine with higher aromatic content and an expected trend toward fuels more like diesel oil, as well as consequent engine and aircraft modifications. J.P.B.

A80-27760 Experimental procedure to determine limits of ISM interference affecting navigational ILS equipment. P. Corona and E. Paolini (Istituto Universitario Navale, Naples, Italy). In: Electromagnetic compatibility 1979; Proceedings of the Third Symposium and Technical Exhibition, Rotterdam, Netherlands, May 1-3, 1979. Zurich, Eidgenössische Technische Hochschule Zürich, 1979, p. 141-146.

A method for determining acceptable ISM (industrial, scientific, medical) interference field limits for instrument landing systems is described. The method involves the definition of the useful field of the ILS localizer and the measurement of the receiving patterns of the localizer antennas. A laboratory evaluation of the limits for interference voltage is presented. B.J.

A80-27766 Swedish EMP research. G. Dahlen, L. Hoglund, T. Karlsson, H. Persson (Forsvarets Forskningsanstalt, Linköping, Sweden), and B. Sjoholm (Forsvarets Forskningsanstalt, Stockholm, Sweden). In: Electromagnetic compatibility 1979; Proceedings of the Third Symposium and Technical Exhibition, Rotterdam, Netherlands, May 1-3, 1979. Zurich, Eidgenössische Technische Hochschule Zürich, 1979, p. 197-201. 5 refs.

The electromagnetic pulse from nuclear explosions (EMP or NEMP) has been studied since 1965 at the Swedish National Defense Research Institute (the FOA). This paper reviews recent research at the FOA on EMP environments, coupling, simulators, measurements, and shielded cables. B.J.

A80-27773 EMC in lightweight helicopters - Special problems and experience in design and control. K. H. Rippl (Messerschmitt-Bölkow-Blohm GmbH, Munich, West Germany). In: Electromagnetic compatibility 1979; Proceedings of the Third Symposium and Technical Exhibition, Rotterdam, Netherlands, May 1-3, 1979. Zurich, Eidgenössische Technische Hochschule Zürich, 1979, p. 247-250.

The study deals with EMC problems of lightweight helicopter design. In order to ensure the compatible operation of various units of electronic and electrical equipment, all technical and economical possibilities must be exploited in the course of planning and development with the aim of verifying the appropriate EMC principles. Consideration is given to the EMC problems due to the existing design and operation. V.T.

A80-27777 Computational techniques for EMP interaction. F. M. Tesche (LuTech, Inc., Berkeley, Calif.) and J. P. Castillo (USAF, Weapons Laboratory, Kirtland AFB, N. Mex.). In: Electromagnetic compatibility 1979; Proceedings of the Third Symposium and Technical Exhibition, Rotterdam, Netherlands, May 1-3, 1979. Zurich, Eidgenössische Technische Hochschule Zürich, 1979, p. 287-292. 19 refs.

Various computational techniques for EMP interaction are reviewed, including the eigenvalue method, integral equation approaches, and the finite difference method. It is shown that the most accurate solution to a particular interaction problem is not always the best, because of errors inherent in the process of decomposing a system into its topological pieces. The methods are illustrated by examples and comparisons between the computations and the experimental data. V.L.

A80-27778 Modelling of aircraft responses to EMP. T. W. Armour (Atomic Weapons Research Establishment, Aldermaston, Berks., England). In: Electromagnetic compatibility 1979; Proceedings of the Third Symposium and Technical Exhibition, Rotterdam, Netherlands, May 1-3, 1979. Zurich, Eidgenössische Technische Hochschule Zürich, 1979, p. 293-295.

The F111 fighter-bomber is studied using a wire-grid model, in which the length of the fuselage is 22.4 m and the wing-span 19.2 m. The time-domain response of surface current is obtained by computing current over the range of frequencies from 1 to 40 MHz in 1 MHz steps. Predictions made by a modelling code CHAOS-3 are compared with the finite-difference calculations and experimental published data. It is concluded that the wire-grid model predictions are in good agreement with the experimental data. The wire-grid and finite difference calculations are also very similar; however, it is stressed that comparisons are only possible for points on the aircraft fuselage. L.M.

A80-27783 Induced effects of lightning on an all composite aircraft. R. A. Perala, R. Cook (Electro Magnetic Applications, Inc., Golden, Colo.), and K. Lee (Mission Research Corp., Albuquerque, N. Mex.). In: Electromagnetic compatibility 1979; Proceedings of the Third Symposium and Technical Exhibition, Rotterdam, Netherlands, May 1-3, 1979. Zurich, Eidgenössische Technische Hochschule Zürich, 1979, p. 421-424. 8 refs. Contract No. F33615-77-C-5169.

The paper presents results for lightning induced cable currents and voltages on typical cable runs inside an all composite aircraft. Consideration is given to both a direct stroke and a nearby stroke. Attention is also given to results for the case in which the aircraft is coated with 6-mil aluminum flame spray. Finally, it is shown that, as expected, the direct stroke induces the largest voltages, but that the effects of the nearby strike are not negligible. M.E.P.

A80-27784 System EMC - Tendencies of a worldwide standardization and cooperation. R. Rode (Messerschmitt-Bölkow-Blohm GmbH, Munich, West Germany). In: Electromagnetic compatibility 1979; Proceedings of the Third Symposium and Technical Exhibition, Rotterdam, Netherlands, May 1-3, 1979.

Zurich, Eidgenössische Technische Hochschule Zürich, 1979, p. 485-490.

The paper deals with the tendencies in worldwide EMC standardization and cooperation. Emphasis is placed on standardization of test methods including system analyses, system integration, prototype and production systems. EMC problems in an international airport and military aircraft are outlined. V.T.

A80-27789 The fatigue performance of service aircraft and the relevance of laboratory data. P. J. E. Forsyth (Royal Aircraft Establishment, Farnborough, Hants., England). *(Society of Environmental Engineers, Symposium on Environmental Engineering Today,*

London, England, May 9-11, 1979.) Society of Environmental Engineers, Journal, vol. 19-1, Mar. 1980, p. 3-10. 14 refs.

Corrosion factors reducing the fatigue life of aircraft parts are discussed along with other factors similarly reducing fatigue life and causing differences between laboratory data and service experience. The aircraft structural environment is reviewed, and consideration is given to the possible breakdown of corrosion-protective coatings in fatigue-sensitive areas, leading to the development of a corrosion pit, the initiation of fatigue cracks in corrosion pits, and the effects of corrosion on fatigue crack propagation. The effects of anodize pits on fatigue crack initiation, and of pits in general on fatigue life are considered, and the reliability of simple coupon, simplified joint and major structural fatigue life are considered, and the reliability of simple coupon, simplified joint and major structural fatigue tests is discussed in relation to the environmental factors considered. It is concluded that the damage tolerance approach in structural design should eliminate most of the uncertainty in fatigue life prediction. A.L.W.

A80-27790 Simulating the shock protection performance of large transit packs by means of small scale laboratory models. I. P. Layne (Rolls-Royce, Ltd., Aero Div., Bristol, England). *(Society of Environmental Engineers, Symposium on Environmental Engineering Today, London, England, May 9-11, 1979.) Society of Environmental Engineers, Journal*, vol. 19-1, Mar. 1980, p. 13-16.

The simulation of the performance of the shock protection of large packages for the transport of such items as aircraft engine power plants using small-scale laboratory models is discussed. The development of transit pack model testing techniques in the aircraft industry is reviewed, and the scaling and construction of models is considered. The testing and interpretation methods used with model tests are indicated, and the practical applications and benefits of the procedure are presented. Advantages of the testing of the shock protection performance of models of transit packs include the ability to represent a large variety of test parameters at a considerable reduction in time and cost compared to full-scale testing, the ability to select the optimum shock protection system, and accurate performance prediction at an early stage in development. A.L.W.

A80-27797 Optimal twisting of blades in axial turbomachines. Y. A. Lesokhin (Technion - Israel Institute of Technology, Haifa, Israel). *Journal of Mechanical Engineering Science*, vol. 21, Oct. 1979, p. 367-369. 11 refs.

One possible way to improve the aerodynamic performance of turbomachines is to analyse and generalize existing results obtained from design and testing. These can be applied to develop a quantitative relationship between the geometry of various regions of the flow path and turbomachine performance. An optimal correlation between various geometric parameters can be established in this manner. By studying blade geometry of various kinds of axial turbomachine (compressors, gas turbines, hydraulic turbines and pumps), the author has found some regularities in their geometry which enable the design of highly efficient blades. Regularities in the twisting of impeller blades of axial compressors working over a wide range of Mach numbers are represented in this work. Information is presented showing that analogous regularities exist also for axial hydraulic turbine and pump blades. (Author)

A80-27875 # Cast aluminum primary aircraft structure. C. K. Gunther (Boeing Aerospace Co., Seattle, Wash.). In: Cast metals for structural and pressure containment applications; Proceedings of the Winter Annual Meeting, New York, N.Y., December 2-7, 1979. Meeting sponsored by the American Society of Mechanical Engineers. New York, N.Y., American Society of Mechanical Engineers (MPC Publications, No. 11), 1979, p. 315-329. 6 refs.

The paper describes the efforts required to demonstrate the structural integrity of cast primary structure by using the demonstration component of the Cast Aluminum Structures Technology (CAST) program as an example. The component selected for the demonstration of the technology emerging from the CAST program is the forward fuselage bulkhead of the Boeing YC-14 aircraft. This structure meets all the requirements for a successful demonstration of the technology. The discussion covers material data on fatigue and fracture behavior, effects of defects, equivalent initial flaw approach and fatigue rating approach to effects of defects, structural analysis, and full-scale testing. The CAST program has demonstrated that castings can be used in primary aircraft structure. S.D.

A80-27898 # Structural design of transport airplanes for transient environments. J. E. Wignot (Lockheed-California Co., Burbank, Calif.). In: Survival of mechanical systems in transient environments; Proceedings of the Winter Annual Meeting, New York, N.Y., December 2-7, 1979. Meeting sponsored by the American Society of Mechanical Engineers. New York, American Society of Mechanical Engineers (Applied Mechanics Symposia Series. AMD Volume 36), 1979, p. 33-59. 10 refs.

A survey of some of the analytical techniques used at Lockheed to design transport airplanes to survive the transient environments experienced during their service life is presented. Transient loads in flight are due to gusts, steady maneuvers and abrupt maneuvers. On the ground transient loads result from landing, taxiing, braking and turning. Transient impulses will be experienced under such emergency conditions as gear deranged landings, rapid decompression and hail or bird impact while high frequency transients are associated with sonic fatigue and equipment vibration requirements. The use of multidiscipline inputs together with a matrix algebra approach is highlighted by summarizing the analytical methods used. References are given to sources for use in further study. (Author)

A80-27902 The duration of false alarms in surveillance radar. J. M. Smith and G. Duckworth (Marconi Radar Systems, Ltd., Leicester, England). *Marconi Review*, vol. 42, 4th Quarter, 1979, p. 219-234. 7 refs.

The generation of false alarms by noise in a scanning pulsed radar is examined with emphasis placed on the size of corresponding plots in range and bearing coordinates. Results are derived for noncoherently detected video signals with ideal analog integration of 'M out of N' binary processing. V.T.

A80-27992 * # Minimum-mass designs of stiffened graphite/polyimide compression panels. G. G. Weaver, II (Hercules, Inc., Wilmington, Del.) and J. R. Vinson (Delaware, University, Newark, Del.). In: Modern developments in composite materials and structures; Proceedings of the Winter Annual Meeting, New York, N.Y., December 2-7, 1979. New York, American Society of Mechanical Engineers, 1979, p. 215-233. 16 refs. NSF-supported research; Grant No. NsG-1488.

This study presents results from an analytic investigation to determine minimum-mass designs of stiffened Gr/Pi compression panels for a wide range of uniaxial compression loads. Four panel configurations are considered: (1) hat stiffened-laminated skin, (2) hat stiffened-honeycomb core sandwich skin, (3) blade stiffened-laminated skin and (4) blade stiffened-honeycomb core sandwich skin panels. Designs are generated by an automatic optimization computer code entitled PASCO (Panel Analysis and Sizing COde). The analysis portion of PASCO contains a generalized buckling analysis which calculates all critical modes without assuming any of them a priori. Mass-strength curves are presented for the four configurations along with specific designs generated for low, moderate and high values of compression load. A mass-strength curve for a titanium hat stiffened panel is provided for comparison. A 30% to 50% mass savings over titanium panels is shown for moderately and heavily loaded Gr/Pi panels. (Author)

A80-28010 * Wear of seal materials used in aircraft propulsion systems. R. C. Bill (U.S. Army, Army Aviation Research and Development Center, Cleveland, Ohio) and L. P. Ludwig (NASA,

Lewis Research Center, Cleveland, Ohio). *(U.S. Navy, Workshop on Thermal Deformation, Annapolis, Md., June 19, 20, 1979.) Wear,* vol. 59, Mar. 1, 1980, p. 165-189. 23 refs.

A review of various types of seal locations in a gas turbine engine and the significance of wear for each type are presented. Material selection guidelines and the PV (contact pressure times sliding velocity) criteria for seal materials are discussed, and examples of wear mechanisms in positive contact seals are given. It is suggested that improved wear, erosion, and oxidation resistant materials will be required for improved seal durability; finally, a correlation is proposed between wear characteristics and a factor that includes material strength, ductility, specific heat and hot-working temperature to attain low porosity metallic gas path seal materials. A.T.

A80-28018 # **Flight control design based on nonlinear model with uncertain parameters.** I. Horowitz (Weizmann Institute of Science, Rehovot, Israel), B. Golubev, and T. Kopelman. *Journal of Guidance and Control,* vol. 3, Mar.-Apr. 1980, p. 113-118. 9 refs. Grant No. AF-AFOSR-77-3355.

A nonlinear model used for a short-period longitudinal flight problem is described. An approach discussed is based on a synthesis technique for feedback around a nonlinear uncertain plant. The nonlinear plant set is replaced by a linear time-invariant plant set. Design execution then involves frequency response concepts. V.T.

A80-28019 * # **Implicit model following and parameter identification of unstable aircraft.** J. V. Lebacqz (NASA, Ames Research Center, Moffett Field, Calif.; Calspan Advanced Technology Center, Buffalo, N.Y.) and K. S. Govindaraj (Calspan Advanced Technology Center, Buffalo, N.Y.). *Journal of Guidance and Control,* vol. 3, Mar.-Apr. 1980, p. 119-123. 11 refs.

A transformation in the s-plane is described which has utility in implicit model-following optimal control design application and in estimation or parameter identification problems. The objective of the transformation is, for the control problem, to achieve an unstable closed-loop system, and, for the estimation problem, to alleviate algorithm convergence problems that may arise in identifying unstable systems. For the control problem, the transformation is a shift along the real (sigma) axis of the plant and model poles and zeros. This transformation is shown to be equivalent to a modified performance index but offers the advantage of compatibility with existing optimal control solution algorithms. For the estimation problem, the data are multiplied by an exponential function and the assumed measurement and process noise covariances are appropriately modified. Examples of both control and estimation applications are presented. (Author)

A80-28050 # **The role of research applied to the air traffic control system (Il ruolo della ricerca applicata nel sistema di controllo del traffico aereo).** F. Valdoni (Fondazione Ugo Bordoni; CNR, Rome, Italy). *Istituto Italiano di Navigazione, Atti,* July-Dec. 1979, p. 25-35. In Italian.

This paper reviews the role of research in the air traffic control system from various points of view, including the economic, social, administrative, and operative. The role of industry and universities in research programs is discussed, as is the airport system and territorial concerns. In addition, research is considered in terms of short term experimentation, medium term innovation, and long term acquisition of knowlege. The scope of the Finalized Project for air traffic navigation and control is also reviewed, considering its subprojects in administrative improvement, primary and secondary radar, and takeoff and landing safety. J.P.B.

A80-28212 # **Experience based upon experimental dry tuned gyros.** H. Karnick (Anschütz und Co., GmbH, Kiel, West Germany). In: Symposium on Gyro Technology, Stuttgart, West Germany, September 25, 26, 1979, Proceedings.
Düsseldorf, Deutsche Gesellschaft für Ortung und Navigation, 1979, p. 2.0-2.28.

Tests have been conducted on numerous modifications of dynamically tuned gyros designed especially for experimental use. Following a brief review of the characteristics of experimental gyros of particular importance to the test program, the paper discusses some of the results of and experience gained from the tests, along with their consequences for the design of dry tuned gyros. The discussion focuses primarily on shaft bearing assembly, spin motor, pickoff, suspension, rotor balancing, and gas torques. S.D.

A80-28218 # **The experimental strapdown system of DFVLR.** D. Rahlfs (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Flugführunge, Braunschweig, West Germany). In: Symposium on Gyro Technology, Stuttgart, West Germany, September 25, 26, 1979, Proceedings.
Düsseldorf, Deutsche Gesellschaft für Ortung und Navigation, 1979, p. 8.0-8.40. 9 refs.

Strapdown inertial systems presently play an increasingly important role in guidance and navigational applications. The paper shows that the experimental modular strapdown system constructed by DFVLR offers many possibilities for future research in the area of inertial strapdown techniques. The system is based on a nearly self-contained sensor unit with a digital BPWM rebalance readout of high accuracy and a high-quality temperature control of sensor and electronics. The strapdown computer consists of multiple microcomputers interconnected by dual memories. The sensor and the computer are controlled by intelligent units for flexible control of system operation. Sensor module test is discussed relative to test procedures and first results. A low drift rate of the digital output signal is identified. S.D.

A80-28221 # **The laser gyro and its application to an helicopter navigation system.** B. de Salaberry (Société Française d'Equipements pour la Navigation Aérienne, Boulogne-Billancourt, Hauts-de-Seine, France). In: Symposium on Gyro Technology, Stuttgart, West Germany, September 25, 26, 1979, Proceedings. Düsseldorf, Deutsche Gesellschaft für Ortung und Navigation, 1979, p. 11.0-11.25.

The challenge for the avionics industry is to propose high-performance yet cost-effective systems consistent with the economy of European military helicopter projects. The SEXTAN system is proposed which offers an attractive new solution to the difficult problem of helicopter navigation. This system, presently under development, continuously combines redundant and complementary data provided by a suitable strapdown laser gyro inertial unit, a doppler radar and a magnetometer. The discussion covers the SEXTAN system architecture; merits and performance of such a system; heading, attitude and velocity unit (CAV); laser rate gyro; pendulous force balancing accelerometer; CAV computer and algorithm; NADIR MkII computer; mechanization algorithm; and self-compensated magnetometer. S.D.

A80-28254 **Buoyant module VHF antenna design for submerged systems/aircraft communications.** R. J. Decesari (Hydro Products, Inc., San Diego, Calif.). In: OCEANS '79; Proceedings of the Fifth Annual Combined Conference, San Diego, Calif., September 17-19, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 366-372. Navy-supported research.

The paper presents a description of a prototype communications system designed to provide VHF communications from a stationary or moving body or submarine at depth. The design approach revolves around the existing submarine buoyant cable antenna and the utilization of existing low frequency buoyant coaxial cable. Attention is given to the three distinct subsystems of the electrical design: the submarine control station, the existing buoyant cable, and the buoyant module antenna and electronics. C.F.W.

A80-28269 # **Airships - Basis for a new oceanic capability.** J. G. Vaeth (NOAA, National Environmental Satellite Service, Suitland, Md.). In: OCEANS '79; Proceedings of the Fifth Annual Combined Conference, San Diego, Calif., September 17-19, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 700-703.

Blimps, modernized versions of the U.S. Navy's antisubmarine and early warning airships of the 1940's and 50's, offer an untapped potential for ocean science and engineering. As buoyant aircraft, they are not only energy-conserving but could engage uniquely in protracted airborne operations for remote and in-situ sensing. Their range, endurance, and ability to use sound equipment could be useful in detecting, following, observing, and protecting marine life. By combining a 'view from above' with an ability to 'work from above', airships could add a valuable new dimension to scientific and engineering activities in the sea. (Author)

A80-28284 * # **Evaluation of finite element formulations for transient conduction forced-convection analysis.** E. A. Thornton (Old Dominion University, Norfolk, Va.) and A. R. Wieting (NASA, Langley Research Center, Hampton, Va.). In: National Conference on Numerical Methods in Heat Transfer, 1st, College Park, Md., September 24-26, 1979, Proceedings. College Park, Md., University of Maryland, 1979, p. 250-267. 13 refs. Grant No. NsG-1321.

Conventional versus upwind convective finite elements, and lumped versus consistent formulations for practical conduction/forced convection analysis are evaluated on the basis of numerical studies, with finite element and finite difference lumped-parameter temperatures compared to closed-form analytical solutions for convection problems. Attention is given to two practical combined conduction and forced convection applications, stressing that the finite element method, showing superior accuracy, is competitive with the finite difference lumped-parameter method. Also considered are the computational time savings offered by the zero capacitance nodes procedure and comparative finite element and finite difference lumped-parameter computer times. The present study has reference to the design of actively cooled engine and airframe structures for hypersonic flight. L.M.

A80-28380 # **Capacity payoffs at large hub airports from ATC initiatives.** J. C. Orman and S. L. M. Hockaday (Peat, Marwick, Mitchell and Co., San Francisco, Calif.). In: Radio Technical Commission for Aeronautics, Technical Symposium and Annual Assembly Meeting, Washington, D.C., November 15, 16, 1979, Proceedings. Washington, D.C., Radio Technical Commission for Aeronautics, 1979, p. 21-38.

The paper reviews the current status of system capacity and delay analysis with particular reference to ongoing FAA efforts in the E&D field. The main emphasis of the capacity element of existing E&D programs is on increasing system capacity through reductions in minimum IFR radar longitudinal separations between arrival aircraft. The biggest problem associated with achieving reduced longitudinal separation of any type is the ability to deal effectively with wake turbulence. Analysis at high-activity airports indicates that gains in system capacity and reductions in aircraft travel time may be achieved by methods other than reduction in minimum longitudinal separations. A summary of 14 of the more promising methods is presented, including examples of potential site-specific applications and benefits. B.J.

A80-28381 # **Primary radar in ATC.** D. D. Thomas. In: Radio Technical Commission for Aeronautics, Technical Symposium and Annual Assembly Meeting, Washington, D.C., November 15, 16, 1979, Proceedings. Washington, D.C., Radio Technical Commission for Aeronautics, 1979, p. 43-48.

A basic question concerning air traffic control in the United States is addressed: whether all existing primary long-range enroute radars should be replaced with more modern equipment for tracking of nonbeacon-equipped aircraft or whether they should be permitted to fade out of the system and only secondary radar be used for enroute aircraft tracking. The industry viewpoint is discussed, which holds that primary radar should be directed toward the detection of hazardous weather rather than aircraft tracking. B.J.

A80-28382 # **Electronic flight rules /EFR/ - A concept for enhanced freedom of airspace.** P. R. Drouilhet, Jr. (MIT, Lexington, Mass.). In: Radio Technical Commission for Aeronautics, Technical Symposium and Annual Assembly Meeting, Washington, D.C., November 15, 16, 1979, Proceedings. Washington, D.C., Radio Technical Commission for Aeronautics, 1979, p. 49-56.

This paper reviews the EFR concept, ground rules, control procedures, and mechanizations. It is concluded that EFR offers an interesting approach to reducing both the direct and indirect cost of aviation by extending the efficiency and flexibility of VFR to operation in instrument meteorological conditions. There appear to be ground-based (centralized) and aircraft-based (distributed) approaches which can adequately provide EFR service. B.J.

A80-28383 # **The introduction of new systems in international civil aviation.** O. Carel (Direction Générale de l'Aviation Civile, Service Technique de la Navigation Aérienne, Paris, France). In: Radio Technical Commission for Aeronautics, Technical Symposium and Annual Assembly Meeting, Washington, D.C., November 15, 16, 1979, Proceedings. Washington, D.C., Radio Technical Commission for Aeronautics, 1979, p. 71-77.

The international coordination of civil aviation is discussed with particular reference to the European situation. Particular attention is given to the standardization of new navigation systems; such systems as VOR/Decca and MLS are discussed. B.J.

A80-28384 # **Adding more automation to the air traffic control system.** B. M. Horowitz (Mitre Corp., Bedford, Mass.). In: Radio Technical Commission for Aeronautics, Technical Symposium and Annual Assembly Meeting, Washington, D.C., November 15, 16, 1979, Proceedings. Washington, D.C., Radio Technical Commission for Aeronautics, 1979, p. 97-106.

The paper summarizes the recommendations of an FAA-sponsored automation/productivity group that dealt with problems of air traffic control. The group's recommendations are discussed with respect to required resources, ATC concept development, field tests, NAFEC tests, computer hardware, display hardware tests, software costs, costs to achieve needed levels of confidence, and overall costs. B.J.

A80-28418 * # **Strouhal number influence on flight effects on jet noise radiated from convecting quadrupoles.** R. Dash (NASA, Ames Research Center, Moffett Field; Stanford University, Stanford, Calif.). *AIAA Journal*, vol. 18, Mar. 1980, p. 337-339.

The paper reports a complementary extension of previous work to include the high-frequency features reflected in the discussion of the higher Strouhal number influence on flight effects. It is found that, in addition to the usual features of flight effects on noise from ordinary flows, the high Strouhal number flows exhibit some more interesting features which are uniquely characteristic to them. The additional features are as follows: (1) Flight effects are more favorable to hot jets than to cold jets; (2) the higher the Strouhal number of the jet flow, the lesser the forward arc amplification due to flight; (3) as the Strouhal number increases, the peak amplification angle in the forward quadrant and the peak suppression angle in the aft quadrant move toward 90 deg and get closer, thus reducing the amplification exposure to a constricted angular region; (4) the silence zone is disturbed and displaced from its normal position parallel to the jet flow to give rise to multiple crossings of flight curves with the static line; and (5) the occurrence of multiple crossings is a strange phenomenon solely characteristic of high Strouhal number with high subcritical jet flows in flight. S.D.

A80-28419 * # **Effect of temperature on surface noise.** W. Olsen and C. Wasserbauer (NASA, Lewis Research Center, Cleveland, Ohio). *AIAA Journal*, vol. 18, Mar. 1980, p. 339, 340. 8 refs.

An experimental work is discussed whose objective was to obtain data that show the effect of temperature and temperature fluctuations on surface noise. This was accomplished experimentally by immersing a small chord airfoil in the turbulent airstream of a hot jet. The theory and experiment reported by Olsen (1976) provided a guide for designing and validating the hot jet experiment and for interpreting the data. It is shown that increased temperature causes a small decrease in the sound levels; at the same time it causes a shift in the spectra that is smaller but similar to the shift observed with subsonic hot jet noise. S.D.

A80-28487 # **The future development of air traffic as seen by airline companies.** M. Wernet (Deutsche Lufthansa AG, Cologne, West Germany). In: International Symposium on Traffic and Transportation Technologies, Hamburg, West Germany, June 18-20, 1979, Proceedings. Volume E. Bonn, Bundesministerium für Forschung und Technologie, 1979, p. 1-24.

The development of traffic volume handled by scheduled air services is examined. Particular consideration is given to regulation and market organization constraints; the shortcomings of the 'old' system based on the 1944 Chicago Convention are emphasized. Some recommendations on improving the old system are made, and predictions on the development of air traffic in the 1980s are given. B.J.

A80-28488 # **Influence of air traffic on the concept of air traffic control.** K. Platz (Bundesanstalt für Flugsicherung, Frankfurt am Main, West Germany). In: International Symposium on Traffic and Transportation Technologies, Hamburg, West Germany, June 18-20, 1979, Proceedings. Volume E. Bonn, Bundesministerium für Forschung und Technologie, 1979, p. 25-48.

The paper describes methods for determining and deciding on the control capacity of ATC systems. The concept of a future ATC system is briefly discussed; some generalities concerning investment and personnel needs are presented. B.J.

A80-28489 # **Airbus family concept for the 1990s.** C. Schubert (Deutsche Airbus GmbH, Munich, West Germany). In: International Symposium on Traffic and Transportation Technologies, Hamburg, West Germany, June 18-20, 1979, Proceedings. Volume E. Bonn, Bundesministerium für Forschung und Technologie, 1979, p. 66-84.

The A310, a smaller version of the A300, will be available for delivery to airlines in 1983; there will be three basic versions. The introduction of further members of Airbus family is planned for the second half of the 1980s and for the 1990s. The new members will be the B9, a stretched version of the 300 B2 with a greater seating capacity; the B11, a long-range aircraft developed from the A310; and a version of the A300 constructed specifically for cargo purposes. The introduction of JET I and JET II will be a further expansion in the range of aircraft covered by the Airbus family. B.J.

A80-28490 # **Technological aspects of future very large airplanes.** J. Spintzyk (Dornier GmbH, Friedrichshafen, West Germany). In: International Symposium on Traffic and Transportation Technologies, Hamburg, West Germany, June 18-20, 1979, Proceedings. Volume E. Bonn, Bundesministerium für Forschung und Technologie, 1979, p. 85-107. 9 refs.

The design of very large transport aircraft is discussed with reference to Dornier proposals concerning a future international cargo transport system. It is found that very large cargo aircraft can be realized in a conventional fixed wing configuration, in seaplane as well as in landplane version. Structural weight increases, especially of the wings, can be limited by such measures as reduced load assumptions and maneuver load control. Modern active control techniques can be used to solve the control and flight mechanics problems associated with the large mass and moments of inertia. B.J.

A80-28491 # **Major areas of research in aeronautics and air traffic at the German Aerospace Research Establishment /DFVLR/.** F. Thomas (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Braunschweig, West Germany). In: International Symposium on Traffic and Transportation Technologies, Hamburg, West Germany, June 18-20, 1979, Proceedings. Volume E. Bonn, Bundesministerium für Forschung und Technologie, 1979, p. 108-136.

The paper examines the large experimental facilities and some significant research achievements of the DFVLR; medium-term and long-term planning of DFVLR research activities is also described. It is shown that requirements of high cost efficiency, good energy conversion, improved ATC, and far-reaching integration of air traffic into the overall transport system will significantly determine the technological development of aviation for decades to come. Attention is given to the utilization of such new technologies as cryogenics in wind tunnel design, digital control concepts, automated ATC procedures, and advanced composites and ceramics. B.J.

A80-28492 # **Avionics - The leading technology in flight guidance and air traffic control.** J. Filz (Deutsche Lufthansa AG, Hamburg, West Germany). In: International Symposium on Traffic and Transportation Technologies, Hamburg, West Germany, June 18-20, 1979, Proceedings. Volume E. Bonn, Bundesministerium für Forschung und Technologie, 1979, p. 137-159. 10 refs.

Some possible future trends in avionics are examined. The impacts of avionics technology on flight guidance and control systems are described with particular attention given to the evolution of automatic flight control systems; the evolution of the guidance, navigation, and communication function; and the evolution of displays, controls, and warning systems. Cost and productivity are also examined with emphasis on trends influencing future ATC systems and envisaged automation levels. B.J.

A80-28493 # **Coming civil transport aircraft with 'active' control elements.** D. Volk (Messerschmitt-Bölkow-Blohm GmbH, Hamburg, West Germany). In: International Symposium on Traffic and Transportation Technologies, Hamburg, West Germany, June 18-20, 1979, Proceedings. Volume E. Bonn, Bundesministerium für Forschung und Technologie, 1979, p. 160-182. 14 refs.

Different active control applications in the area of civil transport aircraft are reviewed with emphasis on risks, technical problems, and possible improvements in cost effectiveness. Maneuver load alleviation, gust load alleviation, yaw damping, the adaptive wing concept, and direct lift control are considered. The maximum amount of static stability reduction is discussed for the A300. Particular consideration is given to the Advanced Control Transonic Transport Aircraft program. B.J.

A80-28494 # **The aerodynamics of future transport aircraft and the role of the wind tunnel during development.** G. Krenz (Vereinigte Flugtechnische Werke-Fokker GmbH, Bremen, West Germany). In: International Symposium on Traffic and Transportation Technologies, Hamburg, West Germany, June 18-20, 1979, Proceedings. Volume E. Bonn, Bundesministerium für Forschung und Technologie, 1979, p. 183-201.

The aerodynamics of medium and large civil transports in the narrow-body and wide-body classes is examined; specifically attention is given to such narrow-body aircraft as A300 and A310 and the Boeing 767, and to such wide-body aircraft as JET I, JET II, and the Boeing 757. Aerodynamic standards achieved in comparison with past designs are described, and consideration is given to changes in

geometry and corresponding gains in wing lift capacity, which can be used for weight reduction and performance improvement. The role of the wind tunnel in aircraft development is described, and some test results representing the aerodynamics for the next generation of aircraft are presented. B.J.

A80-28495 # **New materials and methods for airframe construction.** H. W. Bergmann (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Strukturmechanik, Braunschweig, West Germany). In: International Symposium on Traffic and Transportation Technologies, Hamburg, West Germany, June 18-20, 1979, Proceedings. Volume E. Bonn, Bundesministerium für Forschung und Technologie, 1979, p. 202-220. 6 refs.

It is predicted that future airframe construction will receive a great impetus from the combined use of new metal alloys and advanced composites. Current trends indicate the possibility of significant savings in the production of metal components by computerized matching operations, the more extended use of castings and forgings, and the use of such innovations as PM processes, superplastic forming, and diffusion bonding. Advanced composites are also attractive from a manufacturing viewpoint. They can be produced in near-final shapes with relatively low expenditure of energy and lend themselves to integral-type construction. B.J.

A80-28500 **Legal liability of the controller.** I. E. McCluskey. *The Controller,* vol. 19, 1st Quarter, 1980, p. 23-25.

Criminal liability of a controller is discussed with regard to Roman law states, socialist systems, and Anglo-Saxon systems. The unique position of the controller is considered, since several legal systems may be involved even though he never leaves his place of work. Furthermore, the additional stress due to the possibility of criminal as well as civil liability is discussed, as well as the various interpretations of the controller's possible negligence in the event of an air accident in socialist systems (criminal responsibility for rule violation), Roman law states (guilty, if there is reasonable certainty), and Anglo-Saxon law states (criminal guilt only if there was criminal intent). J.P.B.

A80-28819 # **Wind-turbine power improvement with modern airfoil sections and multiple-speed generators.** B. F. Habron (Westinghouse Research and Development Center, Pittsburgh, Pa.), F. R. Goldschmied, and H. S. Kirschbaum. In: Wind Energy Conference, Boulder, Colo., April 9-11, 1980, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 130-147. 11 refs. (AIAA 80-0633)

A brief study was conducted on the power improvement of horizontal-axis wind turbines with modern airfoil sections and multiple-speed PAM generators. On the basis of a reference single-speed variable-pitch wind turbine with NACA 23018 blades, the following improvements can be made with a three-speed PAM generator and NASA LS(1)-0417 blades: (1) 15% gain of plant factor, i.e., average annual energy generation, (2) 17% gain of power output at a rated wind speed of 25 mph, and (3) 70% gain of power output at a higher wind speed of 32 mph. (Author)

A80-28851 # **Flutter analysis of a NACA 64A006 airfoil in small disturbance transonic flow.** T. Y. Yang, P. Guruswamy, A. G. Striz (Purdue University, West Lafayette, Ind.), and J. J. Olsen (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). *Journal of Aircraft,* vol. 17, Apr. 1980, p. 225-232. 16 refs. Grant No. AF-AFOSR-78-3523.

Flutter analyses are performed for a NACA 64A006 airfoil pitching and plunging in small-disturbance, unsteady transonic flow. Flutter results are presented as plots of flutter speed and corresponding reduced frequency vs one of the four parameters: airfoil/air mass density ratio, position of mass center, position of elastic axis, and freestream Mach number. In each figure, several sets of curves for different values of plunge/pitch frequency ratios are shown. The examples demonstrate the dip phenomenon of the curves for flutter speed in the transonic regime. Flutter results of transonic codes are compared with those obtained by linear flat plate theory. (Author)

A80-28852 # **Prandtl's biplane theory applied to canard and tandem aircraft.** E. V. Laitone (California, University, Berkeley, Calif.). *Journal of Aircraft,* vol. 17, Apr. 1980, p. 233-237. 5 refs.

Prandtl's biplane theory for elliptic loadings is generalized to apply to nonelliptic spanwise load distributions. The induced drag is calculated by assuming an infinite stagger distance so all of the mutually induced drag acts upon the rear surface which has no effect upon the front surface. Consequently, the mutually induced drag is calculated by integrating the Trefftz-plane downwash of the front surface over the independent load distribution on the rear surface. This procedure is verified by explicit solutions that give the same mutually induced drag irrespective of the fore and aft location of the larger span when carrying either an elliptic or a uniform load distribution. It was found that the mutually induced drag was less when the larger span had a uniform load distribution, but the total induced drag was not decreased because of the additional self-induced drag produced by the change from the ideal elliptic loading to a uniform loading. However, when the larger span carried a uniform loading it allowed the smaller span, when either fore or aft, to support more of the aircraft's weight at the minimum induced drag condition. (Author)

A80-28853 * # **Measurements of cabin and ambient ozone on B747 airplanes.** G. D. Nastrom (Control Data Corp., Minneapolis, Minn.), J. D. Holdeman, and P. J. Perkins (NASA, Lewis Research Center, Combustion and Pollution Research Branch, Cleveland, Ohio). *Journal of Aircraft,* vol. 17, Apr. 1980, p. 246-249. 14 refs. FAA-supported research.

In response to recent concerns over possibly high ozone levels in the cabins of aircraft flying in the stratosphere, simultaneous measurements of the cabin and ambient ozone levels have been made as part of the NASA Global Atmospheric Sampling Program. Examples of the data taken on commercially operated Boeing 747-100 and 747SP airplanes are given for selected flights, together with summary statistics of over 5600 observations. Cabin ozone levels vary with the ambient level and, for unmodified aircraft, are higher on the 747SP than on the 747-100. Modifications to the ventilation system of the 747SP reduced cabin ozone levels by varying amounts up to a factor of 14. (Author)

A80-28854 # **Avoiding divergent stall in control configured aircraft by using a canard arrangement.** C. W. McCutchen (National Institutes of Health, Laboratory of Experimental Pathology, Bethesda, Md.). *Journal of Aircraft,* vol. 17, Apr. 1980, p. 283, 284.

The use of an unstable canard configuration for pitch control in aircraft with automatically controlled stability is investigated. Automatic, as opposed to inherent, stability permits the center of gravity of an aircraft to be shifted aft, thus improving the lift/drag ratio and maneuverability. However, increased loading on the rear surface makes this surface prone to stall and can lead to pitching moments which may be difficult or impossible to control. By using a canard layout, a pitching divergence can be checked or a stall recovery can be made by reducing the lift of the canard surface, which is always possible, rather than by increasing the lift of a tail surface, which may be impossible. V.L.

A80-28856 # **Application of unsteady airfoil theory to rotary wings.** W. Johnson (U.S. Army, Research and Technology Laboratories, Moffett Field, Calif.). *Journal of Aircraft,* vol. 17, Apr. 1980, p. 285, 286.

The correct application of unsteady airfoil theory to helicopter rotor load analysis is explained. It is shown that airfoil motion only enters the problem through the boundary condition, which involves

normal velocity. The equations of Theodorsen theory specifying lift and pitch moment from a thin, two-dimensional airfoil undergoing unsteady motion in an incompressible flow are rewritten to emphasize that the mean and linear normal velocity distribution components over the airfoil chord must be identified, rather than the airfoil section pitch and heave motions. The incorrect identification of these terms is shown to lead to serious errors in moment calculation, and the nonequivalence of flapping and feathering motion for an articulated rotor blade. The calculation is then illustrated for the case of the rigid flap and rigid pitch motion of an articulated rotor blade in forward flight. A.L.W.

A80-28857 # Class of shockfree airfoils producing the same surface pressure. W. C. Chin (Boeing Co., Aerodynamics Research Group, Seattle, Wash.). *Journal of Aircraft,* vol. 17, Apr. 1980, p. 286-288. 7 refs.

The feasibility of shockfree airfoils producing the same surface pressure over a wide range of operating Mach numbers is investigated. Numerical results are presented for a series of airfoils corresponding to a known base-line shockfree pressure; it is shown that physically acceptable airfoils can be found. The results are significant in the engineering of adaptive wings aimed at fixing, throughout a range of Mach numbers, pressure distributions with desirable loading and boundary layer separation characteristics. V.L.

A80-28862 The freight forwarder as an air carrier. D. Schoner. *(International Bar Association, Seminar, Zurich, Switzerland, Sept. 19, 20, 1979.) Air Law,* vol. 5, no. 1, 1980, p. 2-15. 94 refs.

The purpose of the paper is to describe the differences between the freight forwarder and the air carrier, in order to determine when the freight forwarder is to be considered an air carrier. Attention is given to the national laws of Switzerland, Belgium, Italy, and France as well as to the U.S. The question regarding the classification differences is discussed with respect to the Guadalajara Convention of 1961. C.F.W.

A80-28947 Experimental study of electrostatic dischargers for helicopters (Etude expérimentale d'un déchargeur électrostatique pour hélicoptère). S. Lagrigaldie (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France) and N. Félici (CNRS, Laboratoire d'Electrostatique, Grenoble, France). *(Revue de Physique Appliquée,* vol. 15, Jan. 1980, p. 81-91.) ONERA, TP no. 1980-5, 1980. (p. 81-91) 12 p. 12 refs. In French.

An electric discharge system which operates on the principle of atmospheric water vapor condensation and charged aerosol formation has been developed. It is experimentally shown that it is possible to remove a current of 60 microamperes from a helicopter surface. Radio frequency interference associated with the operation of the discharger should be negligible. B.J.

STAR ENTRIES

N80-17982# Loughborough Univ. of Technology (England). Dept. of Transport Technology.

A CONSIDERATION OF GENERAL AVIATION IN THE UNITED KINGDOM

R. E. Caves May 1979 73 p refs

(TT-7902; ISSN-0140-9751) Avail: NTIS HC A04/MF A01

A semistructural analysis of the operational and economic viability on 1978 data, is presented. Models of contemporary fare structures, block times, and costs are developed in order to determine break even values for third level scheduled operations. Two potentially attractive routes from a theoretical stand point are examined to demonstrate the marginal nature of third level operations. Some attention is given to airport access, to nonscheduled general aviation, and to the relevance of the results within present U.K. transport planning choices. Author (ESA)

N80-17983 Illinois Inst. of Tech., Chicago.

DYNAMIC STALL ON OSCILLATING AIRFOILS IN OSCILLATING FREE-STREAMS Ph.D. Thesis

Bang-Ji Hsieh 1979 278 p

Avail: Univ. Microfilms Order No. 8003648

The dynamic stall phenomenon on an oscillating airfoil in the presence of the free stream oscillations was studied. The study was conducted on a NACA 0012 profile airfoil which was oscillating in pitch around a mean angle of attack of 15 degrees with an amplitude of 10 degrees. The corresponding range of angles extending from 5 to 25 degrees includes the angle of stall of a stationary airfoil in steady flow which was about 12 degrees under present conditions. Tests were made in both steady and oscillating free streams and at the two reduced frequencies of 0.15 and 0.25. Education, i.e., periodic sampling and averaging was used to remove the nonphase related noise from the pressure signals providing an instantaneous ensemble average which was phase related to the oscillation of the airfoil, of the free stream, or both. The instantaneous distributions of pressure coefficient, normal force coefficient and moment coefficient were computed from the instantaneous educted pressure signals in terms of the instantaneous dynamic pressure of the free stream. Comparisons between tripped and untripped flows and between the flows at the two reduced frequencies are discussed. Dissert. Abstr.

N80-17984*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

AN EXPERIMENTAL INVESTIGATION OF TWO LARGE ANNULAR DIFFUSERS WITH SWIRLING AND DISTORTED INFLOW

William T. Eckert, James P. Johnston (Stanford Univ., Calif.), Tad D. Simons (Stanford Univ., Calif.), Kenneth W. Mort, and V. Robert Page Feb. 1980 106 p refs

(NASA-TP-1628; AVRADCOM-TR-79-40; A-7436) Avail: NTIS HC A06/MF A01 CSCL 01A

Two annular diffusers downstream of a nacelle-mounted fan were tested for aerodynamic performance, measured in terms of two static pressure recovery parameters (one near the diffuser exit plane and one about three diameters downstream in the settling duct) in the presence of several inflow conditions. The two diffusers each had an inlet diameter of 1.84 m, an area ratio of 2.3, and an equivalent cone angle of 11.5, but were distinguished by centerbodies of different lengths. The dependence of diffuser performance on various combinations of swirling, radially distorted, and/or azimuthally distorted inflow was examined. Swirling flow and distortions in the axial velocity profile in the annulus upstream of the diffuser inlet were caused by the intrinsic flow patterns downstream of a fan in a duct and by artificial intensification of the distortions. Azimuthal distortions or defects were generated by the addition of four artificial devices (screens and fences). Pressure recovery data indicated beneficial effects of both radial distortion (for a limited range of distortion levels) and inflow swirl. Small amounts of azimuthal distortion created by the artificial devices produced only small effects on diffuser performance. A large artificial distortion device was required to produce enough azimuthal flow distortion to significantly degrade the diffuser static pressure recovery. Author

N80-17985# Toronto Univ., Downsview (Ontario). Inst. for Aerospace Studies.

RESEARCH ON THE STABILITY OF AIR CUSHION SYSTEMS

P. A. Sullivan, M. Hinchey, I. Murra, and G. J. Parravano Nov. 1979 166 p refs

(UTIAS-238; ISSN-0082-5255) Avail: NTIS HC A08/MF A01

Certain specified problems encountered in the development of flexible multicell type skirted air cushions for overland use are described. The hysteresis mechanisms in static roll stiffness are included. A preliminary examination of the dynamics of a skirt developed for low speed operation is reported and the progress made on the analysis and prediction of self excited oscillations in heave is summarized. R.C.T.

N80-17986*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.

WIND-TUNNEL/FLIGHT CORRELATION STUDY OF AERODYNAMIC CHARACTERISTICS OF A LARGE FLEXIBLE SUPERSONIC CRUISE AIRPLANE (XB-70-1). 3: A COMPARISON BETWEEN CHARACTERISTICS PREDICTED FROM WIND-TUNNEL MEASUREMENTS AND THOSE MEASURED IN FLIGHT

Henry H. Arnaiz, John B. Peterson, Jr. (NASA. Langley Research Center), and James C. Daugherty (NASA. Ames Research Center) Mar. 1980 59 p refs

(NASA-TP-1516; H-1079) Avail: NTIS HC A04/MF A01 CSCL 01A

A program was undertaken by NASA to evaluate the accuracy of a method for predicting the aerodynamic characteristics of large supersonic cruise airplanes. This program compared predicted and flight-measured lift, drag, angle of attack, and control surface deflection for the XB-70-1 airplane for 14 flight conditions with a Mach number range from 0.76 to 2.56. The predictions were derived from the wind-tunnel test data of a 0.03-scale model of the XB-70-1 airplane fabricated to represent the aeroelastically deformed shape at a 2.5 Mach number cruise condition. Corrections for shape variations at the other Mach numbers were included in the prediction. For most cases, differences between predicted and measured values were within the accuracy of the comparison. However, there were significant differences at transonic Mach numbers. At a Mach number of 1.06 differences were as large as 27 percent in the drag coefficients and 20 deg in the elevator deflections. A brief analysis indicated that a significant part of the difference between drag coefficients was due to the incorrect prediction of the control surface deflection required to trim the airplane. Author

N80-17987*# National Aeronautics and Space Administration, Washington, D. C.

BOUNDARY LAYER CONTROL BY MEANS OF SUCTION

G. Maillart Jan. 1980 45 p refs Transl. into ENGLISH from Bull. des Services Techniques 106, Apr. 1947 35 p Original language document was announced as N79-71086 Transl. by Kanner (Leo) Associates, Redwood City, Calif.

(Contract NASw-3199)

(NASA-TM-75502) Avail: NTIS HC A03/MF A01 CSCL 01A

The process of boundary layer control by means of suction is described. Its historical development is briefly traced, and its application to airfoils and diffusers is discussed. Author

N80-17988*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
INTERACTION OF A TWO-DIMENSIONAL STRIP BOUNDARY LAYER WITH A THREE-DIMENSIONAL TRANSONIC SWEPT-WING CODE
Perry A. Newman, James E. Carter, and Ruby M. Davis Mar. 1978 35 p refs
(NASA-TM-78640) Avail: NTIS HC A03/MF A01 CSCL 01A

A 3D inviscid transonic analysis code was combined with a 2D strip integral boundary layer technique to form an approximate interaction procedure for analyzing the flow over a high aspect ratio wing near cruise conditions. Converged results obtained using the procedure for an aspect ratio 10.3 supercritical wing are discussed. Angle of attack adjustments were made during the iterative procedure in order to compensate for the viscous lift loss. A comparison of the calculations with experimental data is presented. A.W.H.

N80-17989*# Lockheed-Georgia Co., Marietta.
THE AERODYNAMIC DESIGN OF AN ADVANCED ROTOR AIRFOIL
James A. Blackwell, Jr. and Bobby L. Hinson Mar. 1978 112 p
(Contract NAS1-14597)
(NASA-CR-2961; LG77ER0208) Avail: NTIS HC A06/MF A01 CSCL 01A

An advanced rotor airfoil, designed utilizing supercritical airfoil technology and advanced design and analysis methodology is described. The airfoil was designed subject to stringent aerodynamic design criteria for improving the performance over the entire rotor operating regime. The design criteria are discussed. The design was accomplished using a physical plane, viscous, transonic inverse design procedure, and a constrained function minimization technique for optimizing the airfoil leading edge shape. The aerodynamic performance objectives of the airfoil are discussed. A.W.H.

N80-17991*# National Aeronautics and Space Administration, Washington, D. C.
COMPARISON OF AERODYNAMIC COEFFICIENTS OBTAINED FROM THEORETICAL CALCULATIONS WIND TUNNEL TESTS AND FLIGHT TESTS DATA REDUCTION FOR THE ALPHA JET AIRCRAFT
R. Guiot and H. Wunnenberg Feb. 1980 31 p refs Transl. into ENGLISH of "Comparison des Coefficients Aerodynamiques Issues des Calculs Theoretiques, Essais en Soufflerie et Depouillements d'Essais en vol Effectues sur l'Alpha Jet", Rept. AGARD-CP-187 AGARD Presented at the 46th Meeting of the Flight Mech. Panel, Valloire, France, 9-13 Jun. 1975 p 19-1 - 19-15 Original language document was announced as N76-25295 Transl. by Kanner (Leo) Associates Redwood City, Calif. Original language document prepared by Avions Marcel Dassault-Breguet Aviation, Saint-Cloud, France and Dornier-Werke G.m.b.H., Friedrichshafen, West Germany
(Contract NASw-3199)
(NASA-TM-75237; AGARD-CP-187) Avail: NTIS HC A03/MF A01 CSCL 01A

The methods by which aerodynamic coefficients are determined and discussed. These include: calculations, wind tunnel experiments and experiments in flight for various prototypes of the Alpha Jet. A comparison of obtained results shows good correlation between expectations and in-flight test results. J.M.S.

N80-17992*# Mississippi State Univ., State College. Dept. of Aerospace Engineering.
FULL SCALE VISUALIZATION OF THE WING TIP VORTICES GENERATED BY A TYPICAL AGRICULTURAL AIRCRAFT
Final Report
Ernest J. Cross, Jr., Phillip D. Bridges, Joe A. Brownlee, W. Wayne Livingston et al Jan. 1980 102 p refs
(Contract NsG-1511)
(NASA-CR-162796; MSSU-EIRS-ASE-80-2) Avail: NTIS HC A06/MF A01 CSCL 01A

The trajectories of the wing tip vortices of a typical agricultural aircraft were experimentally determined by flight test. A flow visualization method, similar to the vapor screen method used in wind tunnels, was used to obtain trajectory data for a range of flight speeds, airplane configurations, and wing loadings. Detailed measurements of the spanwise surface pressure distribution were made for all test points. Further, a powered 1/8 scale model of the aircraft was designed, built, and used to obtain tip vortex trajectory data under conditions similar to that of the full scale test. The effects of light wind on the vortices were demonstrated, and the interaction of the flap vortex and the tip vortex was clearly shown in photographs and plotted trajectory data. Author

N80-17993*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECT OF SWEEP AND ASPECT RATIO ON THE LONGITUDINAL AERODYNAMICS OF A SPANLOADER WING IN- AND OUT-OF-GROUND EFFECT
Scott O. Kjelgaard and John W. Paulson, Jr. Jan. 1980 166 p refs
(NASA-TM-80199) Avail: NTIS HC A08/MF A01 CSCL 01A

A wind tunnel investigation was conducted to determine the effects of leading edge sweep, aspect ratio, flap deflection, and eleven deflection on the longitudinal aerodynamic characteristics of a span distributed load advanced cargo aircraft (spanloader). Model configurations consisted of leading edge sweeps of 0, 15, 30, and 45 deg and aspect ratios of approximately 2, 4, 6, and 8. Data were obtained for angles of attack of -8 to 18 deg out of ground effect and at angles of attack of -2, 0, and 2 deg in ground effect at Mach number equal 0.14. Flap and elevon deflections ranged from -20 to 20 deg. The data presented in tabulated form are intended for reference purposes and are presented without analysis. A.W.H.

N80-17994*# Pennsylvania State Univ., University Park. Dept. of Aerospace Engineering.
COMPUTER PREDICTION OF THREE-DIMENSIONAL POTENTIAL FLOW FIELDS IN WHICH AIRCRAFT PROPELLERS OPERATE: COMPUTER PROGRAM DESCRIPTION AND USERS MANUAL
Stephen J. Jumper Aug. 1979 258 p refs
(Grant NsG-1308)
(NASA-CR-162816; PSU-Aero-R-79/80-5) Avail: NTIS HC A12/MF A01 CSCL 01A

A method was developed for predicting the potential flow velocity field at the plane of a propeller operating under the influence of a wing-fuselage-cowl or nacelle combination. A computer program was written which predicts the three dimensional potential flow field. The contents of the program, its input data, and its output results are described. R.E.S.

N80-17996# Naval Surface Weapons Center, White Oak, Md.
AN EXPERIMENTAL STUDY OF TWO-DIMENSIONAL SUPERSONIC JET IMPINGEMENT ON A FLAT PLATE
T. F. Zien and R. T. Driftmyer Aug. 1979 95 p refs
(AD-A076536; NSWC/TR-79-289) Avail: NTIS HC A05/MF A01 CSCL 20/4

An experimental study of the flow field associated with a two-dimensional, supersonic jet impinging normally on a flat plate is reported. Two wedge nozzles manufactured at the design Mach numbers of 1.75 and 2.75, respectively, were used to provide the jet. Extensive pitot surveys of the free jet were first conducted to determine the quality of the free jet. Results indicate that the simple wedge nozzles were adequate in providing the desired two-dimensional jet in the free expansion configuration. Results of surface pressure measurements and schlieren photographs of the impingement flow indicating the shock patterns are then presented and discussed. Although the results are principally reported for the case of the jet at isentropic exit conditions, some results of underexpanded and overexpanded jets are also included. Some discrepancies between the experiment and the simple theory based in the method of integral relations and the inviscid flow model are noted and discussed. An 'effective' jet Mach number is introduced which accounts largely for the discrepancy between experiments and theory, and its determination is based on the measured stagnation point pressure on the plate surface. GRA

N80-18001# Neilsen Engineering and Research, Inc., Mountain View, Calif.

DATA REPORT FOR A TEST PROGRAM TO STUDY TRANSONIC FLOW FIELDS ABOUT WING-BODY/PYLON/STORE COMBINATIONS. VOLUME 1: TUNNEL EMPTY FLOW SURVEY DATA, WING BODY FORCE/MOMENT/SURFACE PRESSURE DATA, AND PRESSURE STORE FORCE/MOMENT/SURFACE PRESSURE DATA Interim Summary Report, 14-22 Feb. 1978

S. S. Stahara and A. J. Crisalli May 1978 256 p
(Contract F44620-75-C-0047; AF Proj. 2307)
(AD-A077182; AFOSR-79-1070TR; NEAR-TR-163-Vol-1) Avail: NTIS HC A12/MF A01 CSCL 20/4

Results are presented for transonic wind tunnel tests conducted in the 4T Wind Tunnel at Arnold Engineering and Development Center for various wing-body/pylon store model combinations. Experimental data were obtained at 0.2, and 5 degrees angle of attack of the model combinations and at Mach numbers of 0.925, 0.950, 1.05, and 1.10 in the transonic range. Pylon and store models were attached to a wing-body combination in two separate, systematic model build-up sequences. At each stage of the first sequence, flow velocities and static pressures were obtained in the vicinity of the store or those regions normally occupied by a store while force, moment, and surface pressure measurements were taken on the wing-body model. Also, flow velocities and static pressure were recorded on a cylindrical control surface far from the tunnel centerline to provide outer flow field conditions. The second model build-up sequence involved a special pressure-instrumented store that was mounted on the captive trajectory system for simulating a separating store. Detailed pressure distributions and loading were obtained on the store. GRA

N80-18002# Neilsen Engineering and Research, Inc., Mountain View, Calif.

DATA REPORT FOR A TEST PROGRAM TO STUDY TRANSONIC FLOW FIELDS ABOUT WING-BODY/PYLON/STORE COMBINATIONS. VOLUME 2: FLOW FIELD SURVEY DATA FOR CONFIGURATIONS 21 AND 22 Interim Report, 14-23 Feb. 1978

S. S. Stahara and A. J. Crisalli May 1978 247 p
(Contract F44620-75-C-0047; AF Proj. 2307)
(AD-A077183; AFOSR-79-1071TR; NEAR-TR-163-Vol-2) Avail: NTIS HC A11/MF A01 CSCL 20/4

This volume of the data report presentes the flow-field survey data for configurations 21 and 22 at Mach numbers M1 = 0.925, M2 - 0.950, and M3 = 1.05 and angles of attack alpha = 0. 2, and 5 degrees. The data were obtained in the 4T Wind Tunnel at Arnold Engineering and Development Center. These tests, performed at a nominal Reynolds number per foot of 3.0 x 10 to the 6th power are indexed and outlined. GRA

N80-18003# Institut de Mecanique des Fluides de Marseille (France).

TRANSIENT EFFECTS ON A STALLED AIRFOIL IN A PULSATING FLOW: COMPARISON WITH RESULTS FROM A SIMILAR AIRFOIL UNDERGOING HORIZONTAL SHAKING [EFFETS INSTATIONNAIRES SUR UN PROFIL EN DECROCHAGE DANS UN ECOULEMENT PULSE; COMPARISON AVEC LE MOUVEMENT DE TAMIS]

C. Maresca, D. Favier, and J. Rebont Paris Assoc. Aeron. et Astronautique de Paris 1979 66 p refs In FRENCH; ENGLISH summary Presented at 15th Colloq. d'Aerodyn. Appl., Marseille, 7-9 Nov. 1978
(Contract STTA-77/98/313/00/481/75/86)
(AAAF-NT-79-13; ISBN-2-7170-0540-4) Avail: NTIS HC A04/MF A01; CEDOCAR, Paris FF 29 (France and EEC) FF 33 (others)

The unsteady effects encountered by a symmetrical airfoil NACA 0012 set at fixed indicence (20 deg) in an oscillating flow (delta V/V = 0.74; C sub omega/2V = 0.65; Re = 70,000) were studied. The results were obtained through measurements of aerodynamic components (lift, drag, moment) evidenced by distributions of the static pressure and skin friction along the chord of the airfoil and through visualizations around the airfoil at different phases of the period. The results are discussed and compared with those already obtained on the same airfoil moving forward-backwards in a uniform flow under the same conditions. As far as the mean effects on the lift, drag, pressure distribution, and vortex shedding mechanism on the upper side of the airfoil are concerned, the reciprocity of the two kinds of flow is demonstrated. Author (ESA)

N80-18008# Lockheed-California Co., Burbank.

GENERAL AVIATION AIRPLANE STRUCTURAL CRASHWORTHINESS PROGRAMMER'S MANUAL Final Report, Nov. 1977 - Dec. 1978

W. L. Labarge Jun. 1979 210 p Revised
(Contract DOT-FA75WA-3707)
(AD-A075737; FAA-RD-78-120-Rev; LR-23683) Avail: NTIS HC A10/MF A01 CSCL 13/12

A programming manual is presented to describe the program KRASH. Included are: systems requirements, input data deck, and demonstration problems. M.M.M.

N80-18010*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

NASA AVIATION SAFETY REPORTING SYSTEM Quarterly Report, 1 Apr. - 30 Jun. 1978

Jun. 1979 54 p refs Prepared in cooperation with Battelle Columbus Labs., Mountain View, Calif.
(NASA-TM-78608; A-7904; QR-9) Avail: NTIS HC A04/MF A01 CSCL 01C

The human factors frequency considered a cause of or contributor to hazardous events onboard air carriers are examined with emphasis on distractions. Safety reports that have been analyzed, processed, and entered into the aviation safety reporting system data base are discussed. A sampling of alert bulletins and responses to them is also presented. J.M.S.

N80-18011*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

THE AERIAL RELAY SYSTEM: AN ENERGY-EFFICIENT SOLUTION TO THE AIRPORT CONGESTION PROBLEM

Albert C. Kyser Jan. 1980 24 p refs Presented at the AIAA Aircraft Systems and Technol. Meeting, New York, 22 Aug. 1979
(NASA-TM-80208) Avail: NTIS HC A02/MF A01 CSCL 17B

The ability to transfer airline passengers between aircraft in flight, if adequately developed and integrated into the national air transportation system, could provide significant improvements in transportation-system performance, in terms of airport congestion, fuel consumption, and passenger service. The proposed Aerial Relay System concept, which was developed as a means of exploiting inflight transfer, makes use of large 'cruise liner' aircraft which fly continuously along their routes, docking periodically with short-haul feeder aircraft for exchange of payloads. Preliminary vehicle designs for a representative system are described and the operational feasibility of the concept for the United States in the 1990's is discussed. R.E.S.

N80-18012# Defence and Civil Inst. of Environmental Medicine, Downsview (Ontario).

HUMAN FACTORS IN HIGH SPEED LOW LEVEL ACCIDENTS: A 15 YEAR REVIEW

R. C. Rud and D. F. Leben Jul. 1979 13 p refs
(AD-A076221; DCIEM-79-R35) Avail: NTIS HC A02/MF A01 CSCL 01/2

The Canadian Forces introduced the gf 104G into Squadron Operation in 1963 and since that time these aircraft have operated in the high-speed, low-level environment in both the strike/reconnaissance and tactical support roles. Fifty-seven accidents involving these aircraft are reviewed with regard to cause factors. Marginal weather appears to be the one most significant factor contribution to low-level, high-speed accidents however, several human factors such as visual contrast problems, fatigue, stress, reaction time, 'mission completion' syndrome, inattention and task overload were identified. Aspects of accidents which typify human factors problems are described. Suggested possible preventive measures are outlined. Author (GRA)

N80-18013# Naval Air Development Center, Warminster, Pa. Aircraft and Crew Systems Technology Directorate.
FEASIBILITY TESTING OF A BODY INFLATABLE BLADDER (BIB) RESTRAINT DEVICE Phase Report
Marcus Schwartz Apr. 1979 46 p
(WF41400000)
(AD-A078681; NADC-79241-60) Avail: NTIS HC A03/MF A01 CSCL 06/17

A feasibility model of an inflatable type restraint system was designed and developed for use with existing operational restraint hardware to improve crewman safety during ejection. The vest type inflatable system is worn over the flight suit and under the MA-2 integrated torso harness. Upon inflation, the crewman is forced back into the suit while slack is removed from the harness. Subsequent ejection tower testing has demonstrated significant reductions in horizontal head and torso response during the catapult phase of the ejection.Author (GRA)

N80-18014# Technische Hogeschool, Delft (Netherlands). Afdel. der Luchtvaart- en Ruimtevaarttechniek.
AVIATION SAFETY AND ITS IMPROVEMENT [DE VEILIGHEID IN DE LUCHTVAART EN HAAR BEWAKING]
H. Wittenberg Jan. 1978 55 p refs In DUTCH Presented at Symp. Veiligheid van de Vervoerssystemen, Delft, 17 Mar. 1978
(VTH-LR-260) Avail: NTIS HC A04/MF A01

A synopsis of 75 years of air transportation data was compiled in relation to aircraft accidents and aviation safety. Regulations covering aircraft construction, maintenance, aircraft control and navigation, training, and accident investigation are reviewed.
Author (ESA)

N80-18017# Federal Aviation Administration, Washington, D. C. Office of Systems Engineering Management.
REPORT ON THE TASK FORCE ON AIRCRAFT SEPARATION ASSURANCE, APPENDICES
D. J. Bryant, D. G. Hamrick, W. D. Love, A. L. McFarland, A. D. Mundra, H. C. Strunz, and C. F. Swett Jan. 1979 334 p ref
(AD-A077713; FAA-EM-78-19-Vol-3-App; AEM-2) Avail: NTIS HC A15/MF A01 CSCL 17/7

An integrated aircraft separation assurance (ASA) system for the national airspace system is examined. The system element requirements which are defined to provide two levels of backup to the ATC system, a separation violation warning and a final fail safe collision advisory and resolution function, are defined. Current ASA development programs are discussed and the changes required to make the transition to an integrated ASA system are reported. This volume includes appendices for two previous volumes and defines in detail the specific interfaces and designs required for system integration. A.W.H.

N80-18020*# Research Triangle Inst., Durham, N. C.
CONTINUED STUDY OF NAVSTAR/GPS FOR GENERAL AVIATION Final Report
R. D. Alberts and W. H. Ruedger Dec. 1979 214 p refs
(Contract NAS1-14719)
(NASA-CR-159145; RTI-1404-00-01F) Avail: NTIS HC A10/MF A01 CSCL 17G

A conceptual approach for examining the full potential of Global Positioning Systems (GPS) for the general aviation community is presented. Aspects of an experimental program to demonstrate these concepts are discussed. The report concludes with the observation that the true potential of GPS can only be exploited by utilization in concert with a data link. The capability afforded by the combination of position location and reporting stimulates the concept of GPS providing the auxiliary functions of collision avoidance, and approach and landing guidance. A series of general recommendations for future NASA and civil community efforts in order to continue to support GPS for general aviation are included. R.E.S.

N80-18021*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FLIGHT PERFORMANCE OF THE TCV B-737 AIRPLANE AT JORGE NEWBERRY AIRPORT, BUENOS AIRES, ARGENTINA USING TRSB/MLS GUIDANCE
William F. White and Leonard Clark Jan. 1980 41 p refs
(NASA-TM-80223) Avail: NTIS HC A03/MF A01 CSCL 17G

The flight performance of the Terminal Configured Vehicle airplane is summarized. Demonstration automatic approaches and landings utilizing time reference scanning beam microwave landing system (TRSB/MLS) guidance are presented. The TRSB/MLS was shown to provide the terminal area guidance necessary for flying curved automatic approaches with final legs as short as 2 km. R.E.S.

N80-18024# Atmospheric Sciences Lab., White Sands Missile Range, N. Mex.
HELICOPTER REMOTE WIND SENSOR SYSTEM DESCRIPTION
D. H. Dickson and Charles M. Sonnenschein Sep. 1979 57 p
(DA Proj. 1L1-62111-AH-71)
(AD-A076153; ERADCOM/ASL-TR-0040) Avail: NTIS HC A04/MF A01 CSCL 14/2

The helicopter remote wind sensor (HRWS) is an application of a laser Doppler velocimeter. This system description describes the HRWS fabricated by Raytheon Company for the US Army Atmospheric Sciences Laboratory. The HRWS was designed to measure wind fields in an aircraft turbulent environment. The operational emphasis is to augment an attack helicopter's fire control system. This CO2 laser heterodyne system remotely measures three dimensional winds from 1 to 33 meters in front of the sensor. The HRWS was mounted in an external pod compatible with AH-1, AAH and UH-1 wing stores or a fixed wing aircraft equipped with standard wing shackles. The HRWS theory, functions, and subsystem are discussed. Data from flight and ground testing will be presented in a later report. GRA

N80-18028*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
TERMINAL CONFIGURED VEHICLE PROGRAM: TEST FACILITIES GUIDE
Washington 1980 67 p refs
(NASA-SP-435) Avail: NTIS HC A04/MF A01 CSCL 01C

The terminal configured vehicle (TCV) program was established to conduct research and to develop and evaluate aircraft and flight management system technology concepts that will benefit conventional take off and landing operations in the terminal area. Emphasis is placed on the development of operating methods for the highly automated environment anticipated in the future. The program involves analyses, simulation, and flight experiments. Flight experiments are conducted using a modified Boeing 737 airplane equipped with highly flexible display and control equipment and an aft flight deck for research purposes. The experimental systems of the Boeing 737 are described including the flight control computer systems, the navigation/guidance system, the control and command panel, and the electronic display system. The ground based facilities used in the program are described including the visual motion simulator, the fixed base simulator, the verification and validation laboratory, and the radio frequency anechoic facility. A.W.H.

N80-18029*# Boeing Vertol Co., Philadelphia, Pa.
SYNTHESIS OF ROTOR TEST DATA FOR REAL-TIME SIMULATION
M. A. McVeigh Mar. 1979 232 p refs
(Contract NAS2-9015)
(NASA-CR-152311; D210-11505-1) Avail: NTIS HC A11/MF A01 CSCL 01C

A mathematical model of a hingeless tilting rotor is presented. The model was obtained by a systematic curve fit procedure applied to an extensive set of model scale wind tunnel data. The math model equations were used in a real time flight simulation model of a hingeless tilt rotor XV-15 to assess changes in flying qualities compared to those obtained using a previous rotor model. Extensive plots of the rotor derivatives are given. Discussions of attempts to apply multivariable linear regression techniques to the data and the use of an analytical rotor representation are included. Author

N80-18030*# Boeing Vertol Co., Philadelphia, Pa.
A HINGELESS ROTOR XV-15 DESIGN INTEGRATION FEASIBILITY STUDY. VOLUME 1: ENGINEERING DESIGN STUDIES Final Report
J. P. Magee and H. R. Alexander Mar. 1978 473 p
(Contract NAS2-9015)
(NASA-CR-152310; D210-11360-1-Vol-1) Avail: NTIS HC A20/MF A01 CSCL 01C

A design integration feasibility study was carried out to investigate what modifications to the basic XV-15 were necessary to accomplish a flight demonstration of the XV-15 with a Boeing hingeless rotor. Also investigated were additional modifications which would exploit the full capability provided by the combination of the new rotor and the existing T53 engine. An evaluation of the aircraft is presented and the data indicate improved air vehicle performance, acceptable aeroeleastic margins, lower noise levels and improved flying qualities compared with the XV-15 aircraft. Inspection of the rotor system data provided shows an essentially unlimited life rotor for the flight spectrum anticipated for the XV-15. R.E.S.

N80-18031*# Analytical Mechanics Associates, Inc., Mountain View, Calif.
CONCEPTS FOR GENERATING OPTIMUM VERTICAL FLIGHT PROFILES
John A. Sorensen Sep. 1979 107 p refs
(Contract NAS1-15497)
(NASA-CR-159181) Avail: NTIS HC A06/MF A01 CSCL 01C

Algorithms for generating optimum vertical profiles are derived and examined. These algorithms form the basis for the design of onboard flight management concepts. The variations in the optimum vertical profiles (resulting from these concepts) due to variations in wind, takeoff weight, and range-to-destination are presented. Further considerations for mechanizing two different onboard methods of computing near-optimum flight profiles are then outlined. Finally, the results are summarized, and recommendations are made for further work. Technical details of optimum trajectory design, steering requirements for following these trajectories, and off-line computer programs for testing the concepts are included. J.M.S.

N80-18032*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
PERFORMANCE ESTIMATES OF A BOEING 747-100 TRANSPORT MATED WITH AN OUTSIZE CARGO POD
Lloyd S. Jernell Feb. 1980 20 p refs
(NASA-TM-80227) Avail: NTIS HC A02/MF A01 CSCL 01C

The design mission performance of a Boeing 747-100 aircraft mated with an outsize cargo pod was studied. The basic design requirement was the rapid deployment of a combat loaded mobile bridge launcher from a United States east coast staging base to Europe. Weight was minimized by stripping the aircraft of unneeded, quick removal items and by utilizing graphite-epoxy composite materials for most pod components. The mission analysis was based on wind tunnel data and full scale carrier aircraft and engine data. The results are presented in tabular and graphic form. A.W.H.

N80-18033# North American Rockwell Corp., El Segundo, Calif.
AIRCRAFT TRANSPARENCY FAILURE AND LOGISTICAL COST ANALYSIS: SUPPLEMENTAL STUDY Final Report, Feb. - Jun. 1979
S. S. Brown Wright-Patterson AFB, Ohio AFFDL Jun. 1979 250 p refs
(Contract F33615-77-C-3060; AF Proj. 2402)
(AD-A075500; NA-79-237; AFFDL-TR-79-3083) Avail: NTIS HC A11/MF A01 CSCL 01/3

Concern for increasing costs in maintenance of transparency systems has prompted the Air Force Flight Dynamics Laboratory to sponsor this study contract. The object of this study is to identify the high-cost, high maintenance transparency components; identify cause of failures; and recommend corrective programs to reduce cost of ownership to the Air Force Logistics Command. The study involved the review of 20 selected aircraft in current inventory to establish an extensive data base relating transparency maintenance activity and associated logistical support costs. An important adjunct to this study was to research design characteristics, perform a failure analysis, and identify associated logistical support cost for each study aircraft. By using a selective process of correlating the transparency failure modes and maintenance costs with the relative stature of aircraft in current inventory, corrective programs were established and verified by life-cycle cost trades. These corrective programs entailed a comprehensive search for various design improvement that could be innovated to negate the reported failures. The study results contained herein are an extension of objectives of the original program and are directed at supplementing the corrective programs for six additional aircraft. GRA

N80-18034# Naval Air Development Center, Warminster, Pa.
DESIGN AND TEST OF A BORON - ALUMINUM HIGH TEMPERATURE WING Final Report
R. J. Richey and T. E. Hess May 1979 106 p refs
(AD-A075814; NADC-79145-60) Avail: NTIS HC A06/MF A01 CSCL 01/3

The feasibility of utilizing the high buckling stability characteristics of boron - aluminum advanced composite material in a simple, low-cost spar-rib-skin construction for a thin airfoil structure was investigated for high temperature application up to 589 K. The design concept developed consists of boron-aluminum skins, to carry the primary bending and torsion loads, mechanically fastened to a light gage steel sub-structure, which resists transverse shear and stabilizes the skins. The viability of the concept depends on whether this stabilization of the skin material can be accomplished with a practical number and spacing of substructure elements. A weight saving of one third in comparison to the production article is projected in this boron-aluminum version of the BYM-34E wing. A major wing subcomponent was fabricated and static tested to validate the structural adequacy of the overall design. GRA

N80-18035# Boeing Aerospace Co., Seattle, Wash.
NEW REMOTELY PILOTED VEHICLE LAUNCH AND RECOVERY CONCEPTS: COMPUTER PROGRAM LISTINGS Final Report, Mar. 1978 - Mar. 1979
Steven J. Baumgartner, Roger F. Yurczyk, James G. Brister, and Vinod K. Rajpaul Jun. 1979 173 p
(Contract F33615-78-C-3404; AF Proj. 2402)
(AD-A076611; AFFDL-TR-79-3069-Vol-2) Avail: NTIS HC A08/MF A01 CSCL 01/3

Dynamic analysis, preliminary design, and performance/cost trade studies of air bag skid and air cushion concepts for launch and recovery of Boeing and Rockwell advanced RPV concepts have been conducted. Dynamic analysis was performed using the six degree-of-freedom computer program EASY. Dynamic simulations included perturbations to steady state flight, landing, and takeoff simulations. Launch and recovery concepts investigated were air bag skid system, air cushion recovery system, integrated air cushion system, and air cushion launch platform. Performance/cost trade study factors investigated were complexity, fuel requirements, adverse weather capability, ground equipment and facility requirements, survivability, reliability and maintainability, and system acquisition and life cycle costs. Results of the study indicated that an air cushion system is a feasible means of recovery of an RPV such as the Boeing and Rockwell ARPV concepts. An air bag skid with an arrestor system is a feasible approach when minimum field length is a major design factor. Integrated air cushion system for launch and recovery are greatly affected by engine characteristics. In each case, the launch and recovery systems are shown to be an integral part of the total vehicle design and strongly influences the airframe design. GRA

N80-18036* National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.
AIR SPEED AND ATTITUDE PROBE Patent
Gerald J. Baker and Merle A. Economu, inventors (to NASA) Issued 15 Jan. 1980 6 p Filed 30 May 1978 Supersedes N78-25088 (16 - 16, p 2077)
(NASA-Case-FRC-11009-1; US-Patent-4,184,149; US-Patent-Appl-SN-910708; US-Patent-Class-340-177VA;

US-Patent-Class-73-188; US-Patent-Class-73-189; US-Patent-Class-73-212) Avail: US Patent and Trademark Office CSCL 01D

An air speed and attitude probe characterized by a pivot shaft normally projected from a data boom and supported thereby for rotation about an axis of rotation coincident with the longitudinal axis of the shaft is described. The probe is a tubular body supported for angular displacement about the axis of rotation and has a fin mounted on the body for maintaining one end of the body in facing relation with relative wind and has a pair of transducers mounted in the body for providing intelligence indicative of total pressure and static pressure for use in determining air speed. A stack of potentiometers coupled with the shaft to provide intelligence indicative of aircraft attitude, and circuitry connecting the transducers and potentiometers to suitable telemetry circuits are described.

Official Gazette of the U.S. Patent and Trademark Office

N80-18037*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

EARLY FLIGHT TEST EXPERIENCE WITH COCKPIT DISPLAYED TRAFFIC INFORMATION (CDTI)

Terence S. Abbott, Gene C. Moen (Army Res. and Technol. Labs., Hampton, Va.), Lee H. Person, Jr., Gerald L. Keyser, Jr., Kenneth R. Yenni, and John F. Garren Feb. 1980 31 p refs

(DA Proj. 1L2-62209-AH-76)

(NASA-TM-80221; AVRADCOM-TR-80-B-2) Avail: NTIS HC A03/MF A01 CSCL 01D

Coded symbology, based on the results of early human factors studies, was displayed on the electronic horizontal situation indicator and flight tested on an advanced research aircraft in order to subject the coded traffic symbology to a realistic flight environment and to assess its value by means of a direct comparison with simple, uncoded traffic symbology. The tests consisted of 28 curved, decelerating approaches, flown by research-pilot flight crews. The traffic scenarios involved both conflict-free and blunder situations. Subjective pilot commentary was obtained through the use of a questionnaire and extensive pilot debriefing sessions. The results of these debriefing sessions group conveniently under either of two categories: display factors or task performance. A major item under the display factor category was the problem of display clutter. The primary contributors to clutter were the use of large map-scale factors, the use of traffic data blocks, and the presentation of more than a few aircraft. In terms of task performance, the cockpit displayed traffic information was found to provide excellent overall situation awareness. R.E.S.

N80-18038*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

THE EFFECT OF VIEWING TIME, TIME TO ENCOUNTER, AND PRACTICE ON PERCEPTION OF AIRCRAFT SEPARATION ON A COCKPIT DISPLAY OF TRAFFIC INFORMATION

Sharon OConnor, Everett Palmer, Daniel Baty, and Sharon Jago Feb. 1980 17 p refs Prepared in cooperation with San Jose State Univ., Calif.

(Grant NsG-2269)

(NASA-TM-81173; A-8072) Avail: NTIS HC A02/MF A01 CSCL 01D

The concept of a cockpit display of traffic information (CDTI) includes the integration of air traffic, navigation, and other pertinent information in a single electronic display in the cockpit. Two studies were conducted to develop a clear and concise display format for use in later full-mission simulator evaluations of the CDTI concept. Subjects were required to monitor a CDTI for specified periods of time and to make perceptual judgments concerning the future position of a single intruder aircraft in relationship to their own aircraft. Experimental variables included: type of predictor information displayed on the two aircraft symbols; time to encounter point; length of time subjects viewed the display; amount of practice; and type of encounter (straight or turning). Results show that length of viewing time had little or no effect on performance; time to encounter influenced performance with the straight predictor but did not with the curved predictor; and that learning occurred under all conditions. R.E.S.

N80-18039* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

METHOD AND APPARATUS FOR RAPID THRUST INCREASES IN A TURBOFAN ENGINE Patent

Jack E. Cornett (GE, Cincinnati, Ohio), Ralph C. Corley (GE, Cincinnati, Ohio), Thomas O. Fraley (GE, Cincinnati, Ohio), and Andrew A. Saunders, Jr., inventors (to NASA) (GE, Cincinnati, Ohio) Issued 22 Jan. 1980 9 p Filed 9 Dec. 1977 Sponsored by NASA

(NASA-Case-LEW-12971-1; US-Patent-4,184,327 ; US-Patent-Appl-SN-858936; US-Patent-Class-60-240; US-Patent-Class-60-39.03; US-Patent-Class-60-39.27) Avail: US Patent and Trademark Office CSCL 21E

Upon a landing approach, the normal compressor stator schedule of a fan speed controlled turbofan engine is temporarily varied to substantially close the stators to thereby increase the fuel flow and compressor speed in order to maintain fan speed and thrust. This running of the compressor at an off-design speed substantially reduces the time required to subsequently advance the engine speed to the takeoff thrust level by advancing the throttle and opening the compressor stators.

Official Gazette of the U.S. Patent and Trademark Office

N80-18040*# Little (Arthur D.), Inc., Cambridge, Mass.

STUDY OF RESEARCH AND DEVELOPMENT REQUIREMENTS OF SMALL GAS-TURBINE COMBUSTORS

E. P. Demetri, R. F. Topping, and R. P. Wilson, Jr. Jan. 1980 69 p refs

(Contract NAS3-21980)

(NASA-CR-159796; ADL-83381-2) Avail: NTIS HC A04/MF A01 CSCL 21E

A survey is presented of the major small-engine manufacturers and governmental users. A consensus was undertaken regarding small-combustor requirements. The results presented are based on an evaluation of the information obtained in the course of the study. The current status of small-combustor technology is reviewed. The principal problems lie in liner cooling, fuel injection, part-power performance, and ignition. Projections of future engine requirements and their effect on the combustor are discussed. The major changes anticipated are significant increases in operating pressure and temperature levels and greater capability of using heavier alternative fuels. All aspects of combustor design are affected, but the principal impact is on liner durability. An R&D plan which addresses the critical combustor needs is described. The plan consists of 15 recommended programs for achieving necessary advances in the areas of liner thermal design, primary-zone performance, fuel injection, dilution, analytical modeling, and alternative-fuel utilization. M.M.M.

N80-18042*# Vought Corp., Dallas, Tex.

LOW SPEED TEST OF THE AFT INLET DESIGNED FOR A TANDEM FAN V/STOL NACELLE

W. W. Rhoades and A. H. Ybarra Feb. 1980 79 p refs

(Contract NAS3-21468)

(NASA-CR-159752; TR-2-30320/OR-52360) Avail: NTIS HC A05/MF A01 CSCL 21E

An approximately .25 scale model of a Tandem Fan nacelle designed for a Type A V/STOL aircraft configuration was tested in a 10-by-10 foot wind tunnel. A 12 inch, tip driven, turbofan simulator was used to provide the suction source for the aft fan inlet. The front fan inlet was faired over for this test entry. Model variables consisted of a long aft inlet cowl, a short aft inlet cowl, a shaft simulator, blow-in door passages and diffuser vortex generators. Inlet pressure recovery, distortion, inlet angle of attack separation limits were evaluated at tunnel velocities from 0 to 240 knots, angles of attack from -10 to 40 degrees and inlet flow rates representative of throat Mach numbers of 0.1 to 0.6. High inlet performance and stable operation was verified at all design forward speed and angle of attack conditions. The short aft inlet configuration provided exceptionally high pressure recovery except at the highest combination of angle of attack and forward speed. The flow quality at the fan face was somewhat degraded by the addition of blow-in door passages to the long aft inlet configuration due to the pressure disturbances generated by the flow entering the diffuser through the auxiliary air passages. M.M.M.

N80-18043*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AEROPROPULSION IN YEAR 2000
Richard J. Weber 1980 18 p refs Proposed for presentation at Global Technol. 2000, the 1980 Intern. Meeting of the Am. Inst. of Aeron. and Astronautics, Baltimore, 5-11 May 1980
21A

A sampling of probable future engine types, such as convertible engines for helicopters, turboprops for fuel-conservative airliners, and variable-cycle engines for supersonic transports are presented. Related technology improvements in propellers, materials, noise suppression, etc. are reviewed. R.E.S.

N80-18044# Ohio State Univ. Research Foundation, Columbus.
INVESTIGATION OF THE BOUNDARY LAYER BEHAVIOR ON TURBINE AIRFOILS Final Report, 16 Jun. 1975 - 15 Dec. 1978
Lit S. Han, Wesley R. Cox, and Arnon Chait Aug. 1979 273 p refs
(Contract F33615-75-C-2052; AF Proj. 3066)
(AD-A075501; OSURF/760256/784174; AFAPL-TR-79-2011) Avail: NTIS HC A12/MF A01 CSCL 20/4

Smoke flow visualization, hot-wire anemometer, and pressure distribution studies were conducted to determine some of the wake and pressure surface boundary layer transition region characteristics along an enlarged two-dimensional turbine airfoil model in cascade. Smooth surface as well as rough surface airfoils were used in the study, which utilized a continuous, subsonic, specially built wind-tunnel. The flow provided a range of blade chord Reynolds numbers from 7.9E - 5 1.5E - 6 at turbulence levels of 0.6 to 0.8%. A pressure surface transition region was found to exist from about S/C = 0.43 to the trailing edge for the smooth surface airfoil, and up to S/C = 0.1 for a rough surface airfoil. The transition region for a smooth surface was initiated through the formation of Goertler vortices which were found to break down through the action of traveling Tollmein-Schlichting waves. Other phenomena observed include various trailing edge vortex formations which may be linked to the intermittency of the boundary layer near the trailing edge, and a low frequency traveling wave formed in conjunction with the appearance of traveling waves. An empirical relationship was developed for the traveling wave frequency. Comparison was made with stability theory and empirical methods of predicting transition. Linear stability theory was found to predict the Goertler wavelength, but not that of the traveling waves. GRA

N80-18045# Aeronautical Systems Div., Wright-Patterson AFB, Ohio.
PROCEEDINGS OF THE 7TH ANN. TRI-SERVICE MEETING FOR AIRCRAFT ENGINE MONITORING AND DIAGNOSTICS Final Report, 5-7 Dec. 1979
James L. Pettigrew and Keith Hamilton Jul. 1979 284 p Meeting held at Arnold Air Force Station, Tenn., 5-7 Dec. 1978
(AD-A076126; ASD-TR-79-5040) Avail: NTIS HC A13/MF A01 CSCL 21/5

These proceedings contain an edited compilation of the presentations of government agencies at the Seventh Tri-Service Diagnostic Conference held at Arnold Engineering Development Center, Arnold Air Force Station Tennessee 5-7 Dec 1978. The program themes were current experience service needs and technology thrusts in aircraft turbine engine monitoring and diagnostics. Working level representatives from the maintenance organization of operating and support commands gave their views on the requirements for specific diagnostic and maintenance decision information. GRA

N80-18046# ARO, Inc., Arnold Air Force Station, Tenn.
AN INVESTIGATION OF F-16 NOZZLE-AFTERBODY FORCES AT TRANSONIC MACH NUMBERS WITH EMPHASIS ON SUPPORT SYSTEM INTERFERENCE Final Report, Jan. - Jul. 1978
Earl A. Price, Jr. AEDC Dec. 1979 207 p refs Sponsored by the Air Force
(AD-A078693; AEDC-TR-79-56; AFAPL-TR-79-2099) Avail: NTIS HC A10/MF A01 CSCL 20/4

A comprehensive experimental program was conducted to provide nozzle-afterbody data with a minimum interference support system on a 1/9-scale F-16 model and to determine the interference induced on the afterbody-nozzle region by a sting, a wingtip, and a strut model support system. The investigation was conducted over the Mach number range from 0.6 to 1.5 and at angles of attack from 0 to 9 deg. Interference was evaluated by comparison of nozzle-afterbody axial and normal forces obtained from integrating pressure data. The results include parametric studies of the effects of various components of the wingtip support system (i.e., the support blade axial position, wingtip boom diameter, boom spacing, and boom-tip axial location). High-pressure air at ambient temperature was utilized for exhaust plume simulation. The results indicate that a sting support passing through the nozzle with the jet effects simulated by an annular jet appears to offer a minimum interference support system for the type of nozzle-afterbody test described in this report. GRA

N80-18047*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
V/STOLAND AVIONICS SYSTEM FLIGHT-TEST DATA ON A UH-1H HELICOPTER
Fredric A. Baker, Dean N. Jaynes, Lloyd D. Corliss, Sam Liden (Sperry Rand Corp., Phoenix, Ariz.), Robert B. Merrick, and Daniel C. Dugan Feb. 1980 68 p refs
(NASA-TM-78591; A-7831) Avail: NTIS HC A04/MF A01 CSCL 01C

The flight-acceptance test results obtained during the acceptance tests of the V/STOLAND (versatile simplex digital avionics system) digital avionics system on a Bell UH-1H helicopter in 1977 at Ames Research Center are presented. The system provides navigation, guidance, control, and display functions for NASA terminal area VTOL research programs and for the Army handling qualities research programs at Ames Research Center. The acceptance test verified system performance and contractual acceptability. The V/STOLAND hardware navigation, guidance, and control laws resident in the digital computers are described. Typical flight-test data are shown and discussed as documentation of the system performance at acceptance from the contractor. M.M.M.

N80-18048*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THRUST AUGMENTED SPIN RECOVERY DEVICE Patent Application
Bobby L. Berrier, inventor (to NASA) Filed 27 Apr. 1979 15 p
(NASA-Case-LAR-11970-2; US-Patent-Appl-SN-034104) Avail: NTIS HC A02/MF A01 CSCL 01C

A lightweight and drag-free yaw control system developed for a jet propelled aircraft is described. Emphasis is placed on providing aircraft attitude control at low flight speeds, at high angles of attack, and during spin. The control system is comprised of a vertical tail with a thrust augmented rudder and a thrust rudder tab. The jet exhaust stream is deflected by the thrust vectoring rudder tab in a sideward direction to the aircraft, producing a thrust vectored yawing moment and creating supercirculation about the vertical tail and thrust augmented rudder. Supercirculation, a thrust-induced aerodynamic phenomenon, generates lift without increasing drag, enabling the rudder to provide additional yawing force for attitude control. J.M.S.

N80-18049# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
UNSTEADY EFFECTS WITH CONTROL SURFACES [EFFETS INSTATIONNAIRES DES GOUVERNES]
Richard Grenon and Andre Desopper Assoc. Aeron. et Astronautique de France 1979 14 p refs In FRENCH Presented at 15th Colloq. d'Aerodyn. Appl., Marseille, 7-9 Nov. 1978
(AAAF-NT-79-01; ISBN-2-7170-0528-5) Avail: NTIS HC A02/MF A01; CEDOCAR; Paris FF 17 (France and EEC) FF 21 (others)

The unsteady phenomena observable around control surfaces in subsonic and transonic flow is discussed. Results obtained with an airfoil profile equipped with a trailing edge flap moving sinusoidally in a two dimensional subsonic or transonic flow regime are reported. Steady and unsteady pressure measurements made during wind tunnel tests are given. A comparison is

made between these measurements and results for the steady and unsteady flow field of a perfect fluid. An attempt is made to take into consideration viscous effects. Results show that theory does not satisfactorily describe coupling phenomena, notably flow separation and the interaction between the shock front and the boundary layer. Author (ESA)

N80-18050# Aerospatiale Usines de Toulouse (France). Helicopters Div.
ROTORS IN FORWARD FLIGHT AND DYNAMIC STALL [PALE RECULANTE ET DECROCHAGE DYNAMIQUE]
J. Renaud Paris Assoc. Aeron. et Astronique de France 1979 26 p refs In FRENCH Presented at 15th Colloq. d'Aerodyn. Appl., Marseille, 7-9 Nov. 1978
(AAAF-NT-79-20; ISBN-2-7170-0547-1) Avail: NTIS HC A03/MF A01; CEDOCAR, Paris FF 17 (France and EEC) FF 21 (others)

Dynamic stall of rotors in forward flight is studied in terms of the limiting on helicopter performance. Manifestations of the phenomena depend on the characteristics of the rotors and on operating conditions. The lift of the rotor, forward velocity, engine speed, and the interaction of vortices with the blade surface all contribute to the development of stall. Experiments demonstrating the unsteady nature of the phenomena are reported. Simulation of dynamic stall phenomena on an oscillating model shows that the delay in unsteady stalling is associated with the development of a system of vortices along the leading edge. A two dimensional analysis is used in modeling dynamic stall. Author (ESA)

N80-18051# Yang (Nai C.) and Associates, New York, N.Y.
NONDESTRUCTIVE EVALUATION OF AIRPORT PAVEMENTS. VOLUME 1: PROGRAM REFERENCES
Nai C. Yang Sep. 1979 173 p
(Contract DOT-FA77WA-3964)
(AD-A078835; FAA-RD-78-154-1) Avail: NTIS HC A08/MF A01 CSCL 13/2

The concept of nondestructive evaluation and functional pavement design was integrated into a computer program which is described. The program logic and operational procedures used in the computer program are outlined as follows. The nondestructive test (NDT) is used as a substitute for the plate load test without interference to airport operation. The evaluation and design segment evaluates the strength by cumulative stress damage and progressive surface deformation. The final program output is the cost information for ten design alternatives of equal functional performance. The validation program makes the correlations between the NDT data and subgrage geology, regional climate, airport operation, existing pavements, and response of airport bridges. A.W.H.

N80-18052# Permali, Inc., Mount Pleasant, Pa.
DEVELOPMENT AND TEST OF LOW-IMPACT RESISTANT TOWERS Final Report
Eugene T. Rogers, Jonathan A. Ross, and Kenneth M. Snyder Aug. 1979 76 p
(Contract DOT-FA78WA-4152)
(AD-A077160; W79005; FAA-AF-79-1) Avail: NTIS HC A05/MF A01 CSCL 01/5

A break-away fiberglass mast for use in low impact resistant (LIR) structures to support airport approach lighting systems was developed. This design will withstand 100 mph winds (including gusts) without ice and 75 mph winds (including gusts) with a 1/2 inch radial ice load. Yet, when struck by a light airplane wind, it breaks into pieces without catastrophic damage to the wing. It was observed that impact energy needed to break the mast was in the order of 679 foot-pounds and that peak forces were in the order of 5,656 lbs. J.M.S.

N80-18053# Aeronautical Research Labs., Melbourne (Australia).
COMPUTER SYNTHESIS OF FLIGHT SIMULATION VISUALS
John Sandor Feb. 1979 36 p refs
(ARL/SYS-Note-61; AR-001-593) Avail: NTIS HC A03/MF A01

The principles of computer synthesis of external world visuals for faster display are reviewed. The areas of environment description, edge and polygon clipping, hidden surface removal, shading, and image aberrations are discussed. Particular attention is given to hierarchical environment structure, image coherence, shading functions, and area averaging edge smoothing techniques. A.W.H.

N80-18054# Aeronautical Research Labs., Melbourne (Australia).
PROGRAMS FOR THE TRANSONIC WIND TUNNEL DATA PROCESSING INSTALLATION. PART 7: EXTENDED FOCAL
N. Pollock Mar. 1979 44 p refs
(AD-A073414; ARL/Aero-TM-314) Avail: NTIS HC A03/MF A01 CSCL 09/2

Since the transonic wind tunnel data processing installation, which is based on a PDP 8-I computer, was installed in 1968 a considerable library of standard programs have been produced. This program library covers all types of testing commonly carried out in the wind tunnel. However there remains the possibility of unusual tests being required which are not covered by existing programs. This memorandum describes modifications to the Digital Equipment Corporation FOCAL language (FOCAL is a keyboard oriented interpretive language similar to BASIC) which permit the tunnel instrumentation, display and plotter to be operated by FOCAL programs. Using this extended FOCAL language it should be possible to rapidly write and de-bug programs to meet unusual requirements not covered by the standard program library. GRA

N80-18103*# Lockheed-California Co., Burbank.
ADVANCED COMPOSITE AILERON FOR L-1011 TRANSPORT AIRCRAFT Quarterly Technical Report, 22 Dec. 1973 - 24 Mar. 1978
14 Apr. 1978 54 p ref
(Contract NAS1-15069)
(NASA-CR-162863; LR-28559; DLR-003; QTR-2) Avail: NTIS HC A04/MF A01 CSCL 11D

Design and evaluation of alternate concepts for the major subcomponents of the advanced composite aileron (ACA) was completed. From this array of subcomponents, aileron assemblies were formulated and evaluated. Based on these analyses a multirib assembly with graphite tape/syntactic core covers, a graphite tape front spar, and a graphite fabric rib was selected for development. A weight savings of 29.1 percent (40.8 pounds per aileron) is predicted. Engineering cost analyses indicate that the production cost of the ACA will be 7.3 percent less than the current aluminum aileron. Fabrication, machining, and testing of the material evaluation specimens for the resin screening program was completed. The test results lead to the selection of Narmco 5208 resin for the ACA. Other activities completed include: the detailed design of the ACA, construction of a three dimensional finite element model for structural analysis, and formulation of detail plans for material verification and process development. R.E.S.

N80-18104*# Lockheed-California Co., Burbank.
ADVANCED MANUFACTURING DEVELOPMENT OF A COMPOSITE EMPENNAGE COMPONENT FOR L-1011 AIRCRAFT Quarterly Technical Report, 1 Jan. 1978 - 31 Mar. 1978
14 Apr. 1978 130 p
(Contract NAS1-14000)
(NASA-CR-162862; LR-28573; DLR-003; QTR-9) Avail: NTIS HC A07/MF A01 CSCL 11D

Tooling concepts were developed which would permit co-couring of the hat stiffeners to the skin to form the cover assembly in a single autoclave cycle. These tooling concepts include the use of solid rubber mandrels, foam mandrels, and formed elastometric bladders. A simplification of the root end design of the cover hat stiffeners was accomplished in order to facilitate fabrication. The conversion of the 3D NASTRAN model from level 15 to level 16 was completed and a successful check run accomplished. A detailed analysis of the thermal load requirement for the environmental chambers was carried out. Based on the thermal analysis, best function requirements, load inputs and ease of access, a system involving four chambers, two for the covers containing 6 and 4 specimens, respectively, and two for the spares containing 6 and 4 specimens, respectively, evolved. R.E.S.

N80-18106*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
APPLICATION OF COMPOSITE MATERIALS TO TURBOFAN ENGINE FAN EXIT GUIDE VANES
G. T. Smith 1980 19 p refs Presented at 35th Ann. Conf. of the Reinforced Plastics/Composite Inst., New Orleans, 4-8 Feb. 1980; sponsored by Soc. of Plastics Industries
(NASA-TM-81432; E-356) Avail: NTIS HC A02/MF A01 CSCL 11D

A program was conducted by NASA with the JT9D engine manufacturer to develop a lightweight, cost effective, composite material fan exit guide vane design having satisfactory structural durability for commerical engine use. Based on the results of a previous company supported program, eight graphite/epoxy and graphite-glass/epoxy guide vane designs were evaluated and four were selected for fabrication and testing. Two commercial fabricators each fabricated 13 vanes. Fatigue tests were used to qualify the selected design configurations under nominally dry, 38 C (100 F) and fully wet and 60 C (140 F) environmental conditions. Cost estimates for a production rate of 1000 vanes per month ranged from 1.7 to 2.6 times the cost of an all aluminum vane. This cost is 50 to 80 percent less than the initial program target cost ratio which was 3 times the cost of an aluminum vane. Application to the JT9D commercial engine is projected to provide a weight savings of 236 N (53 lb) per engine. Author

N80-18108*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THE POTENTIAL FOR DAMAGE FROM THE ACCIDENTAL RELEASE OF CONDUCTIVE CARBON FIBERS FROM BURNING COMPOSITES
Vernon L. Bell Apr. 1980 23 p refs Proposed for presentation at the AGARD Structures and Materials Panel Specialist's Meeting of Effect of Service Environment on Composite Materials, Athens, Greece, 16 Apr. 1980
(NASA-TM-80213) Avail: NTIS HC A02/MF A01 CSCL 11D

The potential damage to electrical equipment caused by the release of carbon fibers from burning commercial airliners is assessed in terms of annual expected costs and maximum losses at low probabilities of occurrence. A materials research program to provide alternate or modified composite materials for aircraft structures is reviewed. K.L.

N80-18109*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
COMPOSITE COMPONENTS ON COMMERCIAL AIRCRAFT
H. Benson Dexter Mar. 1980 24 p refs To be presented at the AGARD Specialist Meeting on Effect of Service Environ. on Composite Mater., Athens, 13-18 Apr. 1980
(NASA-TM-80231) Avail: NTIS HC A02/MF A01 CSCL 11D

Commercial aircraft manufacturers are making production commitments to composite structure for future aircraft and modifications to current production aircraft. Flight service programs with advanced composites sponsored by NASA during the past 10 years are described. Approximately 2.5 million total composite component flight hours have been accumulated since 1970 on both commercial transports and helicopters. Design concepts with significant mass savings were developed, appropriate inspection and maintenance procedures were established, and satisfactory service was achieved for the various composite components. A major NASA/U.S. industry technology program to reduce fuel consumption of commercial transport aircraft through the use of advanced composites was undertaken. Ground and flight environmental effects on the composite materials used in the flight service programs supplement the flight service evaluation. A.R.H.

N80-18144# National Technical Information Service, Springfield, Va.
CARBON AND GRAPHITE. PART 2. CARBON AND GRAPHITE COMPOSITES - EXCLUDING CARBON FIBER COMPOSITES. A BIBLIOGRAPHY WITH ABSTRACTS Progress Report, 1964 - Oct. 1979
William E. Reed Dec. 1979 262 p Supersedes NTIS/PS-78/1051; NTIS/PS-77/0845; NTIS/PS-76/0686; NTIS/PS-75/614; COM-74-11527
(PB80-802374; NTIS/PS-78/1051; NTIS/PS-77/0845; NTIS/PS-76/0686; NTIS/PS-75/614; COM-74-11527) Avail: NTIS HC $30.00/MF $30.00 CSCL 11B

Carbon and graphite composites are studied. Topics include nonfiber carbon reinforcement, carbon or graphite matrix composites, applications, properties, fabrication, and structural analysis. The majority of research concerns aircraft components and ablative materials for rockets. This updated bibliography contains 262 abstracts, 48 of which are new entries to the previous edition. GRA

N80-18145# National Technical Information Service, Springfield, Va.
CARBON AND GRAPHITE. PART 1: CARBON AND GRAPHITE FIBERS AND FIBER COMPOSITES, VOLUME 4. A BIBLIOGRAPHY WITH ABSTRACTS Progress Report, Sep. 1977 - Oct. 1979
William E. Reed Dec. 1979 249 p Supersedes NTIS/PS-78/1050; NTIS/PS-77/0844; NTIS/PS-76/0685; NTIS/PS-75/613; COM-74-11527
(PB80-802366; NTIS/PS-78/1050; NTIS/PS-77/0844; NTIS/PS-76/0685; NTIS/PS-75/613; COM-74-11527) Avail: NTIS HC $30.00/MF $30.00 CSCL 11B

Citations cover reinforcement of numerous polymers and metals by carbon and graphite fibers. Topics include processing, design, properties, stress analysis, and performance of the composite structures or parts. Composites from polyimide, epoxy, and aluminum matrices are among the types cited. Fabrication and testing of materials for rocket nozzles, reentry vehicles, aircraft components, automobiles, and ships are included. This updated bibliography contains 241 abstracts, 100 of which are new entries to the previous edition. GRA

N80-18161# Lockheed Missiles and Space Co., Palo Alto, Calif.
ADVANCED ALUMINUM ALLOYS FROM RAPIDLY SOLIDIFIED POWERS Research and Development Status Report, 5 Mar. - 4 Jun. 1979
R. E. Lewis Jun. 1979 23 p refs
(Contract F33615-78-C-5203; DARPA Order 3575)
(AD-A077197; LMSC-D677934) Avail: NTIS HC A02/MF A01 CSCL 11/6

Advanced aluminum alloys are to be developed that will provide major payoffs for important new aircraft, spacecraft, and missile systems in the next decade. Payoffs will result from weight savings of structural components which, in turn, lead to increased range, payload, service life, and decreased life-cycle cost. Recently conducted feasibility and design tradeoff studies provide a basis for selecting certain property goals for improved aluminum alloys that will result in significant weight savings. GRA

N80-18162# Lockheed Missiles and Space Co., Palo Alto, Calif. Research Lab.
DEVELOPMENT OF ADVANCED ALUMINUM ALLOYS FROM RAPIDLY SOLIDIFIED POWDERS FOR AEROSPACE STRUCTURAL APPLICATIONS Interim Technical Report, 5 Mar. - 4 Sep. 1979
R. E. Lewis Sep. 1979 137 p refs
(Contract F33615-78-C-5203; ARPA Order 3575)
(AD-A077800; LMSC-D678772) Avail: NTIS HC A07/MF A01 CSCL 11/6

Advanced aluminum alloys are being developed that will provide major payoffs in terms of weight savings for new aerospace structures. The two property goals are: (1) a 30-percent increase in modulus of elasticity-to-density ratio, and (2) a 20-percent increase in modulus of elasticity-to-density ratio plus a 20-percent increase in strength-to-density ratio, when compared to Al 7075-T76 and without a significant loss in other properties important for structural applications. The program is organized into three phases: (1) a fundamental alloy and process development study; (2) scale-up of two best alloys and evaluation of mill product forms; (3) design evaluation involving selected

redesign of aerospace components, analysis of payoffs, and recommendations for manufacturing technology development. Phase 1 activity, to be completed in the first two years, is organized into four Tasks: (1) development of advanced aluminum alloys containing lithium; (2) development of advanced aluminum alloys that do not contain lithium; (3) quantitative microstructural analyses and mechanical property correlations; (4) study of aerospace structural applications for advanced aluminum alloys including development and application of a method for predicting weight savings. Phase 1 activity is described below; Phases 2 and 3 have not been initiated. GRA

N80-18205*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INITIAL CHARACTERIZATION OF AN EXPERIMENTAL REFEREE BROADENED-SPECIFICATION (ERBS) AVIATION TURBINE FUEL
George M. Prok and Gary T. Seng Jan. 1980 10 p refs
(NASA-TM-81440; E-206) Avail: NTIS HC A02/MF A01 CSCL 21D

Characterization data and a hydrocarbon compositional analysis are presented for a research test fuel designated as an experimental referee broadened-specification aviation turbine fuel. This research fuel, which is a special blend of kerosene and hydrotreated catalytic gas oil, is a hypothetical representation of a future fuel should it become necessary to broaden current kerojet specifications. It is used as a reference fuel in research investigations into the effects of fuel property variations on the performance and durability of jet aircraft components, including combustors and fuel systems. J.M.S.

N80-18206# Southwest Research Inst., San Antonio, Tex. Army Fuels and Lubricants Research Labs.
EVALUATION OF JP-5 TURBINE FUEL IN THE SINGLE CYLINDER CUE 1790 DIESEL ENGINE Final Report, Jun. - Nov. 1979
Richard B. Moon Nov. 1979 42 p refs
(Contract DAAK70-79-C-0060)
(AD-A078666; AFLRL-119) Avail: NTIS HC A03/MF A01 CSCL 21/4

The performance test compared fuel consumption and horsepower of the CUE 1970 when operating on JP-5 turbine fuel in place of diesel fuel while the endurance test compared engine wear and deposits when operating the CUE 1790 on JP-5 instead of diesel fuel. The performance test indicated no change in power and a 3 + or - 1 percent increase in fuel consumption. The endurance test indicated no change to slightly less wear, less deposits, no change in the oil consumption rate, and nothing unusual or excessive in the used oil analyses. Analysis of the JP-5 indicated a cetane number within diesel fuel specifications. Although further tests are necessary to define the effect of random variables on the test results, from this test it can be concluded that the use of JP-5 in the CUE 1790 resulted in no appreciable loss in performance or service life. As a result, JP-5 is considered to be a satisfactory alternative fuel for use in the AVDS 1790-2C diesel engine. GRA

N80-18221 Boeing Aerospace Co., Seattle, Wash.
INCANDESCENT LAMP LIFE UNDER RANDOM VIBRATION
Clark J. Beck, Jr. *In* Shock and Vibration Inform. Center The Shock and Vibration Bull., Pt. 4 Sep. 1978 p 71-81 refs
Avail: NRL, Tech. Inform. Div., Washington, D.C.

Several sets of incandescent lamps were subjected to random vibration in order to generate a curve of lamp life versus vibration level. The vibration levels were varied from 0.02 G sq/Hz to 1.6 G sq/Hz. Each set of lamps was vibrated until all lamps failed or for a maximum time of 2-1/2 hours. The tests were conducted with lamps energized and not energized. The test results show that average operational life of a lamp under random vibration differs significantly from lamp rated life. M.M.M.

N80-18222 Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
ANGULAR VIBRATION MEASUREMENT TECHNIQUES
P. Wayne Whaley and Michael W. Obal *In* Shock and Vibration Inform. Center The Shock and Vibration Bull., Pt. 4 Sep. 1978 p 83-93 refs
Avail: NRL, Tech. Inform. Div., Washington, D.C.

Six angular vibration sensors are evaluated in light of the requirements for measuring angular vibrations of aircraft structures in order to describe optical package disturbances. In addition, experience with differential angular vibration measurement using conventional accelerometers is presented and evaluated. These results indicate a strong need to develop a good, reliable, miniature angular vibration sensor for airborne measurements. K.L.

N80-18229 McDonnell-Douglas Astronautics Co., St. Louis, Mo.
TURBULENT-BOUNDARY-LAYER EXCITATION AND RESPONSE THERETO FOR A HIGH-PERFORMANCE CONICAL VEHICLE
C. M. Ailman *In* Shock and Vibration Inform. Center The Shock and Vibration Bull., Pt. 4 Sep. 1978 p 159-169 refs
Avail: NRL, Tech. Inform. Div., Washington, D.C.

A compiled data bank for describing the fluctuating pressures that force the shell of a non-maneuvering reentry vehicle to vibrate during reentry is presented, the use of local aerodynamic parameter values for the cone when predicting these pressures is discussed, and the characteristics of shell-mode vibration peculiar to a conical structure with a multilayered skin are described. Flight data are reported for such a structure maneuvering as a result of flow disturbance at the aft end. The data suggest some angle of attack dependencies not previously detected, and indicate low frequency response of the vehicle as a beam. The beam response is analytically examined as to its probable cause. K.L.

N80-18259# Institute for Telecommunication Sciences, Boulder, Colo.
COMPARISON OF MEASURED DATA WITH IF-77 PROPAGATION MODEL PREDICTIONS Final Report
M. E. Johnson and G. D. Gierhart Aug. 1979 443 p refs
(Contracts DOT-FA78WAI-840; DOT-FA68WAI-145)
(AD-A076508; FAA-RD-79-9) Avail: NTIS HC A19/MF A01 CSCL 20/14

Measured propagation data were compared with predictions made by the IF-77 (ITS-FAA-77) and other propagation models. Although IF-77 was developed for aeronautical applications, it can be used for some point-to-point propagation paths, and the measured data selected for comparison includes point-to-point as well as aeronautical paths. Approximately 870,000 hours of data are associated with the 242 paths used. Predictions made with IF-77 were always best or second best and were substantially better than those made for free space conditions. The IF-77 model has a wide range of application and provides predictions compatible with the more specialized models tested. The aeronautical propagation data pool from which the data were selected is an appendix. A.R.H.

N80-18300*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LIQUID METAL SLIP RING Patent Application
Frank D. Berkopec, Robert R. Lovell, and David H. Culp, inventors (to NASA) Filed 21 Dec. 1979 11 p
(NASA-Case-LEW-12277-3; US-Patent-Appl-SN-106190) Avail: NTIS HC A02/MF A01 CSCL 09A

The liquid metal slip ring described comprises a rotor in the form of a range about an axis and a stator, the rotor being rotatable relative to the stator. The rotor has a channel in which the liquid metal is retained during operation by surface tension. The stator comprises a brush or probe which is partially immersed in the metal in the channel and is bidirectionally symmmetrical so that whichever direction the rotor turns the probe presents the same physical resistance and affords the same electrical conductivity as a connection between the probe and the rotor. Author

N80-18311# Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio.

PERMANENT MAGNET AND SUPERCONDUCTING GENERATORS IN AIRBORNE, HIGH POWER SYSTEMS Interim Report, 1 Feb. 1978 - 31 Mar. 1979
Hugh L. Southall and Frederick C. Brockhurst Aug. 1979 99 p refs
(AF Proj. 3145)
(AD-A078424; AFAPL-TR-79-2073) Avail: NTIS HC A05/MF A01 CSCL 10/2

This report presents results of a study performed to compare airborne, high power supplies at power levels of 10 and 20 MW utilizing permanent magnet and superconducting generators. Algorithms for the weight and volume of these electrical generators are presented and algorithms for the other power supply components are used to predict total system weights for seven point designs at the two power levels. GRA

N80-18327 Illinois Inst. of Tech., Chicago.
HEAT, MASS AND MOMENTUM TRANSFER THROUGH SPRAYS Ph.D. Thesis
Mohan L. Jain 1979 293 p
Avail: Univ. Microfilms Order No. 8003649

An experimental facility consisting of a subsonic wind tunnel, a spray generation system and instrumentation was designed and constructed. A numerical-photographic procedure was developed for analyzing drop trajectories to imply drop drag coefficients. Experiments were conducted over a Reynolds number range of 1000-3500, and it was found that the drops in the sprays of the present type experience up to 18% higher drag than single drops. Thermal experiments to determine average heat and mass transfer through sprays were conducted over a Reynolds number range of 1000-2500 for three different spray configurations involving two volume fractions. It is shown that the widely used Ranz-Marshall correlations for single drops give too high a prediction for heat and mass transfer in the present system. Only 36-67% of the calculated transport actually occurred over the Reynolds number range studied. Dissert. Abstr.

N80-18343# McDonnell-Douglas Research Labs., St. Louis, Mo.
VISCOUS FLOWFIELDS INDUCED BY TWO- AND THREE-DIMENSIONAL LIFT JETS IN GROUND EFFECT Final Technical Report, 1 Feb. 1976 - 28 Feb. 1979
W. W. Bower, R. K. Agarwal, G. R. Peters, and D. R. Kotansky 1 Mar. 1979 38 p refs
(Contract N00014-76-C-0494; NR Proj. 215-246; RR0141184)
(AD-A078782; ONR-CR-215-246-3F) Avail: NTIS HC A03/MF A01 CSCL 20/4

An important consideration for VTOL aircraft design is the aerodynamic interaction between airframe undersurfaces and the ground. In an effort to predict this phenomenon, a second-order-accurate, finite-difference scheme for solution of the two- and three-dimensional conservation equations of fluid mechanics, in combination with a turbulence model, is described. The solution technique is applied to a planar lift jet in ground effect for both incompressible and compressible flow and to two interacting incompressible jets with fountain formation. Fluid properties that characterize the jet impingement flowfields are given for a range of Reynolds numbers, and comparisons with measured data are presented. GRA

N80-18358* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
STATIC PRESSURE ORIFICE SYSTEM TESTING METHOD AND APPARATUS Patent
Randolph F. Culotta and Donald L. Posey, inventors (to NASA) Issued 8 Jan. 1980 7 p Filed 17 Aug. 1978 Supersedes N78-33123 (16 - 24, 3179)
(NASA-Case-LAR-12269-1; US-Patent-4,182,158; US-Patent-Appl-SN-934576; US-Patent-Class-73-40; US-Patent-Class-73-4R) Avail: U.S. Patent and Trademark Office CSCL 14B

A method and apparatus are presented for pressure testing the static pressure orifices and associated connections used in wind tunnels. A cylindrical module, having in one end an open hemispherical calibration pressure chamber separated from and surrounded by an annular vacuum chamber is placed over the orifice of the system to be tested. O-rings ensure seating and a vacuum seal between the chambered end of the module and the surface around the orifice: one O-ring separates the outer chamber from the outside environment. Ports lead from each of the chambers out the other end of the module to tubes connected to a control box consisting of calibration pressure and vacuum supply lines, bleeder valves, and gauges.
Official Gazette of the U.S. Patent and Trademark Office

N80-18364*# National Aeronautics and Space Administration. Pasadena Office, Calif.
FREQUENCY-SCANNING PARTICLE SIZE SPECTROMETER Patent Application
Alain L. Fymat, inventor (to NASA) (JPL) Filed 10 Aug. 1979 21 p
(Contract NAS7-100)
(NASA-Case-NPO-13606-2; US-Patent-Appl-SN-065676) Avail: NTIS HC A02/MF A01 CSCL 14B

A particle size spectrometer having a fixed field of view within the forward light scattering cone at an angle theta sub s between approximately 100 and 200 minutes of arc (preferably at 150 minutes), a spectral range extending approximately from 0.2 to 4.0 inverse micrometers, and a spectral resolution between about 0.1 and 0.2 inverse micrometers (preferably toward the lower end of this range of spectral resolution), is employed to determine the distribution of particle sizes, independently of the chemical composition of the particles, from measurements of incident light, at each frequency, sigma (= 1/lambda), and scattered light, I(sigma). NASA

N80-18368*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FIBER OPTIC SENSORS FOR MEASURING ANGULAR POSITION AND ROTATIONAL SPEED
Robert J. Baumbick Mar. 1980 13 p
(NASA-TM-81454; E-381) Avail: NTIS HC A02/MF A01 CSCL 20F

Two optical sensors, a 360 deg rotary encoder and a tachometer, were built for operation with the light source and detectors located remotely from the sensors. The source and detectors were coupled to the passive sensing heads through 3.65 meter fiber optic cables. The rotary encoder and tachometer were subjected to limited environmental testing. They were installed on an air breathing engine during recent altitude tests. Over 100 hours of engine operation were accumulated without any failure of either device. K.L.

N80-18369# Aeronautical Research Labs., Melbourne (Australia).
SPECIFICATION FOR THE INSTALLATION OF ELECTRICAL RESISTANCE STRAIN GAUGES ON STRAIN PAIRS COUNTER AIRCRAFT
S. W. Gee Mar. 1979 13 p
(AD-A071363; ARL/Struc-TM-301) Avail: NTIS HC A02/MF A01 CSCL 14/2

A number of RAAF aircraft are to be strain gauged as part of a program designed to monitor the in-flight fatigue damage accumulated by service aircraft during normal squadron usage. Flight strains are to be measured by gauges, strategically placed on the structure and monitored by strain pairs counters. The materials and methods of application recommended in this memo, have been successfully used for flight trials over several years and have proved very reliable. Any deviations from the suggested methods should be thoroughly checked before use on the aircraft. GRA

N80-18395 Tennessee Technological Univ., Cookeville.
IDENTIFICATION OF NOISE SOURCES IN FC CENTRIFUGAL FAN ROTORS Ph.D. Thesis
David Raj 1978 263 p
Avail: Univ. Microfilms Order No. 8004108

The sources of broad band noise in forward curved centrifugal fan rotors were studied using a 10.6 inch diameter fan. The flow field inside the fan was observed using flow visualization techniques. The velocity and velocity fluctuations of the rotor

exit flows were measured using a hot-wire anemometer. The blade-to-blade variation of the absolute velocity, both magnitude and direction, and the high level of velocity fluctuations made it necessary to develop a special sampling system for the velocity measurements. This system was successfully used to measure the rotor exit velocity levels. The separated flow over the blade suction surface was the major broad band noise source. The presence of circumferential and axial gradients in the mean flow also contributed to the problem. The rotor blades must be redesigned to eliminate the flow separation over the suction surfaces. Dissert. Abstr.

N80-18400*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
GAS PATH SEAL Patent Application
Robert C. Bill and Robert D. Johnson, inventors (to NASA) Filed 20 Nov. 1979 8 p
(NASA-Case-NPO-12131-3; US-Patent-Appl-SN-096255) Avail: NTIS HC A02/MF A01 CSCL 20A

A gas path seal suitable for use with a turbine engine or compressor is described. A shroud wearable or abradable by the abrasion of the rotor blades of the turbine or compressor shrouds the rotor bades. A compliant backing surrounds the shroud. The backing is a yieldingly deformable porous material covered with a thin ductile layer. A mounting fixture surrounds the backing. NASA

N80-18402*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
IMPROVED TIRE/WHEEL CONCEPT Patent Application
Philip M. Harper, Sr., inventor (to NASA) (Boeing Commercial Airplane Co., Seattle, Wash.) Filed 12 Dec. 1979 12 p Sponsored by NASA
(NASA-Case-LAR-11695-2; US-Patent-Appl-SN-103836) Avail: NTIS HC A02/MF A01 CSCL 01C

A tire and wheel assembly is described which consists of a low profile pneumatic tire with sidewalls that deflect inwardly under a load and a wheel having a narrow central channel and extended rim flanges. The extended rim flanges support the tire sidewalls under static and dynamic loading conditions to produce a combination particularly suited to aircraft applications. NASA

N80-18404*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EVALUATION OF A HIGH PERFORMANCE FIXED-RATIO TRACTION DRIVE
Stuart H. Loewenthal, Neil E. Anderson, and Douglas A. Rohn 1980 32 p refs Proposed for presentation at 3d Intern. Power Transmission and Gearing Conf., San Francisco, Calif., 18-22 Aug. 1980; sponsored by Am. Soc. of Mech. Engr.
(NASA-TM-81425; E-349) Avail: NTIS HC A03/MF A01 CSCL 13I

The results of a test program to evaluate a compact, high performance, fixed ratio traction drive are presented. This transmission, the Nasvytis Multiroller Traction Drive, is a fixed ratio, single stage planetary with two rows of stepped planet rollers. Two versions of the drive were parametrically tested back-to-back at speeds to 73,000 rpm and power levels to 180 kW (240 hp). Parametric tests were also conducted with the Nasvytis drive retrofitted to an automotive gas turbine engine. The drives exhibited good performance, with a nominal peak efficiency of 94 to 96 percent and a maximum speed loss due to creep of approximately 3.5 percent. Author

N80-18417# National Technical Information Service, Springfield, Va.
SEALS AND GASKETS. A BIBLIOGRAPHY WITH ABSTRACTS Progress Report, Nov. 1976 - Nov. 1979
William E. Reed Dec. 1979 125 p Supersedes NTIS/PS-78/1251; NTIS/PS-77/1093; NTIS/PS-76/0938; NTIS/PS-75/838; NTIS/PS-75/140
(PB80-802010; NTIS/PS-78/1251; NTIS/PS-77/1093; NTIS/PS-76/0938; NTIS/PS-75/838; NTIS/PS-75/140) Avail: NTIS HC $30.00/MF $30.00 CSCL 11A

Both gas and liquid seals are considered. Areas studied include polymers, physical properties, glass metal seals, configurations, test methods, and design. Applications involve such areas as gas turbines, water pumps, shaft seals, spacecraft seals, and other specialized seals and gaskets. Highway joint seals are excluded. This updated bibliography contains 213 abstracts, 74 of which are new entries to the previous edition. GRA

N80-18419# Arinc Research Corp., Annapolis, Md.
THE APPLICATION OF RELIABILITY IMPROVEMENT WARRANTY TO DYNAMIC SYSTEMS Final Report, 26 Sep. 1978 - 4 Sep. 1979
A. A. Bilodeau, F. B. Crum, W. A. Dunphy, and R. A. Kowalski 4 Sep. 1979 162 p
(Contract DAAK70-78-C-0200)
(AD-A075520; Rept-1736-01-1-2025; MERADCOM-TQ-1) Avail: NTIS HC A08/MF A01 CSCL 14/4

The Reliability Improvement Warranty (RIW) is currently used within the Department of Defense to provide an incentive to contractors to design and produce equipment that will have a low failure rate, as well as low costs of repair following failure in field or operational use. Current applications of RIW have generally been restricted to initial production procurements of relatively small, transportable avionics equipment. The RIW concept has potential applications for dynamic systems (e.g., transmissions, gearboxes, engines, etc.) procured by the U.S. Army Mobility Equipment Research and Development Command (MERADCOM). However, dynamic systems may differ from avionics in design and maintenance concepts, transportability features, and deployment and utilization philosophy. Therefore, current criteria for using RIW and current guidelines for developing RIW terms and conditions should be reviewed and adapted for this new class of systems. This effort identified several differences between the characteristics of dynamic systems and those of RIW avionics equipment that are not emphasized in current RIW guidelines. RIW application criteria for dynamic systems were also developed. An existing life-cycle cost (LCC) model was modified to address quantitative features of dynamic systems that should be considered in an economic analysis of RIW versus organic maintenance. Case studies were developed to demonstrate the use of the RIW selection criteria and the LCC model. GRA

N80-18438# Laboratorium fuer Betriebsfestigkeit, Darmstadt (West Germany).
MINITWIST: A SHORTENED VERSION OF TWIST
H. Lowak, J. B. DeJonge, J. Franz, and D. Schuetz 1979 25 p refs In GREEK
(LBF-TB-146) Avail: NTIS HC A02/MF A01

A description of the shortened version of the transport wing standard load program (TWIST), called MINITWIST, is presented. In all cases where testing time is a prohibitive factor to use TWIST, it is proposed to use this shortened program. The user of this shortened program should be aware though that in most cases the load cycles with high frequency and low amplitude omitted in MINITWIST would contribute to damage; thus the results will overestimate the fatigue life. R.E.S.

N80-18449# Aeronautical Research Labs., Melbourne (Australia).
A REVIEW OF AUSTRALIAN INVESTIGATIONS ON AERONAUTICAL FATIGUE DURING THE PERIOD APRIL 1977 TO MARCH 1979
G. S. Jost Apr. 1979 68 p refs
(AD-A071641; ARL/Struc-TM-303) Avail: NTIS HC A04/MF A01 CSCL 01/3

A summary is presented of the aircraft fatigue research and associated activities which form part of the programs of the Aeronautical Research Laboratories, Commonwealth Aircraft Corporation Pty. Ltd., Department of Transport (Airworthiness Branch), Royal Australian Air Force and the Government Aircraft Factories. The major topics discussed include the fatigue of both civil and military aircraft structures, fatigue of materials and components and fatigue life monitoring and assessment. GRA

N80-18450# Army Research and Technology Labs., Fort Eustis, Va.
HLH ROTOR BOX BEAM FATIQUE TEST

M. Hanson Sep. 1979 21 p refs
(DA Proj. 1L1-62209-AH-76)
(AD-A076931; USARTL-TN-35) Avail: NTIS HC A02/MF A01 CSCL 20/11

The purpose of this program was to evaluate the fatigue properties of a fiberglass/epoxy box beam specimen which was similar in design to the Heavy Lift Helicopters (HLH) rotor blade spar. The fiberglass/epoxy box beam was designed and fabricated by Boeing Vertol using a ply layup scheme similar to the rotor HLH blade spar but with a different preimpregnated fiberglass tape. The box beam was tested at a fatigue load level sufficient to cause failure within a reasonable number of fatigue cycles (5 x 1000,000) to determine fatigue strength and observe failure modes and rates. Premature fatigue failure occurred in the box beam as the result of chordwise wrinkles occurring during fabrication. The Integral Spar Inspection System (ISIS), which depends on a pressure differential between the sealed spar and outside ambient pressure to detect leaks resulting from cracks or flaws, indicated that a leakage had occurred at approximately the same time the failure was observed. It was concluded that the ISIS appeared to be a viable technique for signaling a structural failure of fiberglass spars. The presence of the wrinkles in the spar which resulted in premature failure, however, precluded any conclusions with regard to the fatigue strength of the preimpregnated fiberglass tape used. GRA

N80-18587# Air Force Engineering and Services Center, Tyndall AFB, Fla. Engineering and Services Lab.
CONTROL OF PARTICULATE EMISSIONS FROM TURBINE ENGINE TEST CELLS BY COOLING WATER INJECTION Final Report, Feb. - May 1979
Michael G. MacNaughton, James J. Tarquinio, and Joseph A. Martone Jul. 1979 77 p
(AF Proj. 1900)
(AD-A075947; AFESC/ESL/TR-79-19) Avail: NTIS HC A05/MF A01 CSCL 13/2

The operation of DOD turbine engine test cells in California has been criticized by the State environmental regulatory agencies because smoke generated by some engines results in excessive opacity (visibility) of the test cell exhaust plume. Since the plume exceeds visibility standards for only a relatively small proportion of engines tested a low cost control technique which brings the test cell into compliance with opacity standards is required. This study was initiated to verify that, in addition to forming a steam plume, water used to cool the test cell walls also removes engine generated particulates and substantiates this procedure as a legitimate pollution control technique. It can be concluded from this study that water injection as practiced at McClellan AFB test cell results in significant (approx. 50% by weight) control of turbine engine particulate emissions. It is postulated that the process could be made more efficient by the use of better designed spray nozzles which would increase water droplet particle contact and inclusion of a demister to increase water removal from the exhaust. GRA

N80-18624# Photometrics, Inc., Lexington, Mass.
AIRCRAFT PROGRAM FOR TARGET BACKGROUND, AND SKY RADIANCE MEASUREMENTS
Randall B. Sluder, W. Scott Andrus, and Irving L. Kofsky 15 Jun. 1979 28 p refs
(Contract F19629-77-C-0168; ARPA Order 2656)
(AD-A076959; PHM-01-79; SCIENTIFIC-2; AFGL-TR-79-0139) Avail: NTIS HC A03/MF A01 CSCL 17/8

A review of PhotoMetrics: field and data reduction work for the Air Force Geophysics Laboratory in the DNA-sponsored nuclear effects simulations program and the ARPA-sponsored targets and backgrounds measurements program during the period April 1978-April 1979 is presented. Data flights of USAF NKC-135 53120 on which PhotoMetrics operated radiometric instruments, the design, fabrication and application of an optical co-aligner for very narrow-angle aircraft instruments are documented, and modifications to an ISIT vidicon camera for auroral imaging are reviewed. GRA

N80-18884*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
PUBLICATIONS IN ACOUSTIC AND NOISE CONTROL FROM NASA LANGLEY RESEARCH CENTER DURING 1940-1979
Barbara A. Fryer, comp. Jan. 1980 104 p refs Update
(NASA-TM-80211) Avail: NTIS HC A06/MF A01 CSCL 20A

Reference lists of approximately 900 published Langley Research Center reports in various areas of acoustics and noise control for the period 1940-1979 are presented. Specific topic areas covered include: duct acoustics; propagation and operations; rotating blade noise; jet noise; sonic boom; flow surface interaction noise; structural response/interior noise; human response; and noise prediction. J.M.S.

N80-18985*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AMES RESEARCH CENTER PUBLICATIONS: A CONTINUING BIBLIOGRAPHY, 1978
Feb. 1980 139 p
(NASA-TM-81175; A-8079) Avail: NTIS HC A07 CSCL 05B

This bibliography lists formal NASA publications, journal articles, books, chapters of books, patents and contractor reports issued by Ames Research Center which were indexed by Scientific and Technical Aerospace Abstracts, Limited Scientific and Technical Aerospace Abstracts, and International Aerospace Abstracts in 1978. Citations are arranged by directorate, type of publication and NASA accession numbers. Subject, personal author, corporate source, contract number, and report/accession number indexes are provided. Author

N80-18988*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
COMPUTER PROGRAMS FOR ESTIMATING CIVIL AIRCRAFT ECONOMICS
Dal V. Maddalon, John K. Molloy, and Milton J. Neubawer Jan. 1980 51 p refs
(NASA-TM-80196) Avail: NTIS HC A04/MF A01 CSCL 05C

Computer programs for calculating airline direct operating cost, indirect operating cost, and return on investment were developed to provide a means for determining commercial aircraft life cycle cost and economic performance. A representative wide body subsonic jet aircraft was evaluated to illustrate use of the programs. K.L.

N80-19022*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ANALYSIS OF FUEL-CONSERVATIVE CURVED DECELERATING APPROACH TRAJECTORIES FOR POWERED-LIFT AND CTOL JET AIRCRAFT
Frank Neuman Apr. 1980 38 p refs
(NASA-TP-1650; A-7986) Avail: NTIS HC A03/MF A01 CSCL 02A

A method for determining fuel conservative terminal approaches that include changes in altitude, speed, and heading are described. Three different guidance system concepts for STOL aircraft were evaluated in flight: (1) a fixed trajectory system; (2) a system that included a fixed path and a real time synthesized capture flight path; and (3) a trajectory synthesizing system. Simulation results for the augmentor wing jet STOL research aircraft and for the Boeing 727 aircraft are discussed. The results indicate that for minimum fuel consumption, two guidance deceleration segments are required. A.W.H.

N80-19023*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AEROACOUSTIC WIND-TUNNEL TESTS OF A LIGHT TWIN-BOOM GENERAL-AVIATION AIRPLANE WITH FREE OR SHROUDED-PUSHER PROPELLERS
H. Clyde McLemore and Robert J. Pegg Apr. 1980 88 p refs
(NASA-TM-80203; L-13371) Avail: NTIS HC A05/MF A01 CSCL 01B

Tests were conducted in the Langley full-scale tunnel to determine the aerodynamic performance and acoustic characteristics of four different pusher-propeller configurations on a twin boom, general aviation airplane. The propellers included a 2-blade free propeller, two 3-blade shrouded propellers, and a 5-blade shrouded propeller. The tests were conducted for a range of airplane angles of attack from about 0 deg to 16 deg for test speeds from 0 to about 36 m/sec and for a range of propeller blade angles and rotation speeds. The free propeller provided the best aerodynamic propulsive performance. For forward flight conditions, the free propeller noise levels were lower than those of the shrouded propellers. In the static conditions the free propeller noise levels were as low as those for the shrouded propellers, except for the propeller in-plane noise where the shrouded propeller noise levels were lower. J.M.S.

N80-19024*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
MILITARY AIRCRAFT AND MISSILE TECHNOLOGY AT THE LANGLEY RESEARCH CENTER: A SELECTED BIBLIOGRAPHY
Dal V. Maddalon Jan. 1980 43 p
(NASA-TM-80204) Avail: NTIS HC A03/MF A01 CSCL 02A

A compilation of reference material is presented on the Langley Research Center's efforts in developing advanced military aircraft and missile technology over the past twenty years. Reference material includes research made in aerodynamics, performance, stability, control, stall-spin, propulsion integration, flutter, materials, and structures. Author

N80-19025*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
WORKSHOP ON AIRCRAFT SURFACE REPRESENTATION FOR AERODYNAMIC COMPUTATION
T. J. Gregory, ed. and John Ashbaugh, ed. Feb. 1980 560 p Workshop held at Ames Research Center, Moffett Field, Calif., 1-2 Mar. 1978
(NASA-TM-81170; A-8075) Avail: NTIS HC A24/MF A01 CSCL 02A

Papers and discussions on surface representation and its integration with aerodynamics, computers, graphics, wind tunnel model fabrication, and flow field grid generation are presented. Surface definition is emphasized. R.E.S.

N80-19026*# Michigan Univ., Ann Arbor.
TRAJECTORIES OPTIMIZATION IN HYPERSONIC FLIGHT Final Report
Nguyen X. Vinh Mar. 1980 5 p refs
(Grant NsG-1448)
(NASA-CR-162846) Avail: NTIS HC A02/MF A01 CSCL 02A

Equations of motion were derived for the three dimensional flight of a lifting vehicles, taking into consideration all the main effects of different forces acting on a vehicle at orbital speeds. A set of equations was formulated which are valid for both the flight with lift modulation inside a planetary atmosphere and the Keplerian motion in the vacuum. The equations are independent of the physical characteristics of the vehicle. The only parameters involved are the maximum lift to drag ratio of the vehicle and a constant characterizing the atmosphere. The results obtained can be applied without modifications to any future reentry vehicle, regardless of its size, shape, and mass. A.R.H.

N80-19027# RAND Corp., Santa Monica, Calif.
ESTIMATING THE TIME REQUIRED TO TRANSITION AIRCRAFT FLEETS TO NEW SCHEDULED MAINTENANCE INTERVALS Interim Report
I. K. Cohen and Eugene Poggio Oct. 1979 37 p
(Contract F49620-77-C-0023)
(AD-A078606; RAND/N-1247-AF) Avail: NTIS HC A03/MF A01 CSCL 15/5

Typically, decisionmakers are called upon to make decisions on aircraft inspection intervals on the basis of very limited analytic information. Under such circumstances, decisionmakers are understandably concerned about the risks incurred in extending inspection intervals. This note presents in some detail a discussion of the phenomenon that although an immediate change is made in inspection intervals, it takes a considerable period of time for the fleet to transition to the changed interval. The slow fleet maturation may provide considerable opportunity to monitor and control the condition of the fleet during the transition period. Thus, in the case of extending inspection intervals, risk is reduced and spread over time while the payoff for the change is immediate. GRA

N80-19028 Engineering Sciences Data Unit, London (England).
UNDERCARRIAGE DRAG PREDICTION METHODS
1979 31 p
(ESDU-79015; ISBN-0-85679-260-8; ISSN-0141-391-397X) For information on availability of series, sub-series, and other individual data items, write NTIS, Attn: ESDU, Springfield, Va. 22161. HC $770.50

A method for estimating the drag of an aircraft undercarriage is presented. The research is applied to the calculation of the drag of an aircraft in the landing approach. The results can be applied to virtually any type of fixed or retractable undercarriage at low speeds. ESDU (GRA)

N80-19030*# Bihrle Applied Research, Inc., Jericho, N. Y.
ROTARY BALANCE DATA FOR A TYPICAL SINGLE-ENGINE GENERAL AVIATION DESIGN FOR AN ANGLE-OF-ATTACK RANGE OF 8 DEG TO 90 DEG. 1: LOW-WING MODEL A
Randy S. Hultberg and William Mulcay Feb. 1980 400 p refs
(Contract NAS1-14849)
(NASA-CR-3100) Avail: NTIS HC A17/MF A01 CSCL 01A

Aerodynamic characteristics obtained in a rotational flow environment utilizing a rotary balance are presented in plotted form for a 1/5 scale, single engine, low-wing, general aviation airplane model. The configuration tested included the basic airplane, various control deflections, tail designs, fuselage shapes, and wing leading edges. Data are presented without analysis for an angle of attack range of 8 to 90 deg and clockwise and counterclockwise rotations covering a range from 0 to 0.85. A.W.H.

N80-19033*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A FLIGHT INVESTIGATION OF BLADE SECTION AERODYNAMICS FOR A HELICOPTER MAIN ROTOR HAVING NLR-1T AIRFOIL SECTIONS
Charles E. K. Morris, Jr., Dariene D. Stevens, and Robert L. Tomaine Jan. 1980 194 p refs Sponsored in part by AVRADCOM, St. Louis, Mo.
(DA Proj. TL2-62209-A-76)
(NASA-TM-80166; AVRADCOM-TR-80-B-2) Avail: NTIS HC A09/MF A01 CSCL 01A

A flight investigation was conducted using a teetering-rotor AH-1G helicopter to obtain data on the aerodynamic behavior of main-rotor blades with the NLR-1T blade section. The data system recorded blade-section aerodynamic pressures at 90 percent rotor radius as well as vehicle flight state, performance, and loads. The test envelope included hover, forward flight, and collective-fixed maneuvers. Data were obtained on apparent blade-vortex interactions, negative lift on the advancing blade in high-speed flight and wake interactions in hover. In many cases, good agreement was achieved between chordwise pressure distributions predicted by airfoil theory and flight data with no apparent indications of blade-vortex interactions. R.E.S.

N80-19040# ARO, Inc., Arnold Air Force Station, Tenn.
WIND TUNNEL TEST TO INVESTIGATE AERODYNAMIC HYSTERESIS PHENOMENA OF THE F-4 AND F-11 AIRCRAFT MODELS
Joseph F. Herman AEDC 15 May 1979 37 p
(AD-A077196; AEDC-TSR-79-P27) Avail: NTIS HC A03/MF A01 CSCL 01/3

Wind tunnel tests were conducted to investigate aerodynamic hysteresis phenomena found in other investigations of the F-4 and F-111 aircraft models. A 1/20-scale model of the F-4C aircraft was used to obtain static force, moment and wing pressure data in pitch and sideslip over a Mach number range from 0.7 to 0.95. A 1/24-scale model of the F-111 aircraft was used to obtain static force and moment data for a Mach number range of 0.7 to 1.3. Data on the F-111 were obtained for wing sweep angles of 26 and 54 deg. In addition, tuft and oil flow visualization data were obtained for selected configurations. GRA

N80-19041# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio. Recovery Crew Station Branch.
RECOVERY SYSTEM PRELIMIMINARY DESIGN. A SIMPLIFIED APPROACH TO DETERMINING STAGING, TIMING AND ALTITUDE REQUIREMENTS FOR FAST INFLATING PARACHUTES Final Report, 13 Feb. - 1 Jun. 1976
Michael W. Higgins Sep. 1979 74 p
(AF Proj. 6065)
(AD-A077548; AFFDL-TR-79-3007) Avail: NTIS HC A04/MF A01 CSCL 01/3

Determining a recovery system design that will take a specified act of initial conditions and will operate within a given set of constraints to provide a required final condition is a complex task. To perform this task, current design practices make extensive use of both person hours and computer time in an analytical 'cut and try' process. This report documents an analytical technique that takes a specified set of inputs (initial conditions, final conditions and operating constraints) and outputs a 'reasonable' recovery system preliminary design for fast inflating parachutes. The output includes the number of operating stages, the drag area of each operating stage, the reefing cutter times, and resulting altitude losses. The technique assumes a vertical trajectory, step function increases in parachute drag area, and that the recovery system is a point mass. The limitations of the analytical technique are discussed and recommendations are made with respect to reducing or removing the effects of these limitations. The analytical technique is applied to three different sets of conditions and constraints as example applications. Use of the analytical technique documented in this report will significantly reduce the assets required to arrive at a final recovery system design. GRA

N80-19042# Naval Postgraduate School, Monterey, Calif.
PROCEEDINGS OF A WORKSHOP ON V/STOL AIRCRAFT AERODYNAMICS, VOLUME 2
C. Henderson and M. F. Platzer 18 May 1979 474 p refs
Workshop held in Monterey, Calif., 16-18 May 1979
(AD-A078909) Avail: NTIS HC A20/MF A01 CSCL 20/4

Contents: Propulsion System/Airframe Interactions--Recent Applications of Theoretical Analysis to V/STOL Inlet Design, Inlet Operating Characteristics at High Angles of Attack, Low Speed Development of the Supersonic XFV-12A V/STOL Inlet, Subsonic VTOL Inlet Experimental Results, Inlet Ram Forces and Moments and V/STOL Aircraft, Theoretical Fan Velocity Distortions Due to Inlets and Nozzles, Aerodynamics of a Tilt-Nacelle V/STOL Propulsion System, Isolated Deflector Nozzle Static Tests for V/STOL Aircraft; V/STOL Aircraft Configurational Considerations and Developments--High Angle of Attack Aerodynamics at DTNSRDC, Development of High Lift Devices for Application to Advanced Navy Aircraft, YC-14 Low Speed Test Techniques, Vectored-Engine-Over-Wing Concept Development, Wind Tunnel Investigation of a Highly Maneuverable Supersonic V/STOL Fighter, Transition Characteristics of the External-Augmentor V/STOL Aircraft Concept, Calculation of Forces and Moments Acting on an Augmentor Wing for a VTOL Fighter in Hover or Transition Flight, Aerodynamics of an Advanced Jet Flap and an Ultra-STOL Application, and High Speed Aerodynamic Technology for V/STOL Fighter Attack Aircraft. GRA

N80-19044# Science Applications, Inc., Irvine, Calif.
HYPERSONIC INTERFERENCE FLOW FLIGHT EXPERIMENT DESIGN Final Report, 15 Jun. - 15 Apr. 1979
L. A. Cassel, T. C. Duncan, and E. H. Lahti Jun. 1979 244 p refs
(Contract F33615-77-C-3043; AF Proj. 2404)
(AD-A078861; SAI-175-80-008-R; AFFDL-TR-79-3065) Avail: NTIS HC A11/MF A01 CSCL 20/4

An experiment has been defined to measure the aeroheating and loads resulting from three-dimensional shock wave/boundary layer interference in hypersonic flight. This report describes the definition of this flight experiment, including the instrumentation and electronics required to measure the interference heating and loads and transmit those measurements by telemetry to ground stations. The measurements include quasi-steady heat transfer rates and pressures as well as fluctuating pressures. Additional measurements are specified for specific definition of the experiment environment. The experiment is configured to investigate the interference flow at the base of a stabilizer on a missile launched from an F-4 aircraft. The missile is to be propelled to hypersonic speed by a solid propellant motor and the measurements are to be made at altitudes between 50 KFT and ground impact. The mechanical, structural, and thermal protection system specifications for the experiment carrier missile are provided in this report. Missile design and fabrication drawings are available under separate cover from the sponsoring agency. GRA

N80-19045# Scientific Research Associates, Inc., Glastonbury, Conn.
VISCOUS FLOW IN THE REGION OF A ROUNDED TRAILING EDGE Final Report, 1 Jul. 1978 - 30 Jun. 1979
Ralph Levy, W. Roger Briley, and Henry McDonald 31 Jul. 1979 41 p refs
(Contract N00019-78-C-0470)
(AD-A078588; R79-920003-F) Avail: NTIS HC A03/MF A01 CSCL 20/4

The Interactive Zone Embedding concept is a generalization of concepts which have been used for some time with boundary layer analyses. This concept has been extended to more complex flows using a potential flow for the outer zone and the compressible Navier-Stokes equations for the inner zone. In this interactive manner the flow about a rounded trailing edge was computed for two locations of the outer boundary. The calculations were performed on a 5:1 elliptic cylinder at a Mach number of 0.2 and a Reynolds number based on chord of 1,000. A body fitted conformal coordinate system was used. In the first instance the outer boundary was located approximately one chord from the ellipse and in the second the outer boundary was brought to about one-half chord of the ellipse. The displacement body was chosen as the interactive streamline and the potential flow over this streamline was computed as the sum of the analytic potential flow over the elliptic cylinder plus the flow from a series of sources. The strengths of these sources were determined to make the interaction streamline also be a streamline in the potential flowfield. The resulting potential flow was used to evaluate the static pressure at the outflow boundary of the Navier-Stokes zone. The calculations were performed with the large Navier-Stokes domain and were repeated with a smaller Navier-Stokes domain. The flow properties in the vicinity of the body of the two calculations were in excellent agreement. GRA

N80-19046# Naval Ship Research and Development Center, Bethesda, Md. Aviation and Surface Effects Dept.
EXPERIMENTAL INVESTIGATION OF A CIRCULATION CONTROL AILERON Final Report, Oct. 1977 - Sep. 1978
Steven W. Prince Jul. 1979 29 p refs
(WF41421000)
(AD-A078825; DTNSRDC/ASED-79/08) Avail: NTIS HC A03/MF A01 CSCL 20/4

A Circulation Control (CC) aileron was tested on a semispan wing-fuselage model at a dynamic pressure equal to 20 lb/sq ft (957 N/sq m) and a Reynolds number of 0.8 million per ft (2.62 million per m). Three different trailing edge geometries were used on CC ailerons of 10 and 20 percent of the half span. Blowing was controlled to produce jet momentum

coefficients from 0.0017 to 0.0124. Rolling moment coefficients as high as 0.035 were recorded for the 20 percent CC aileron for angles of attack between 0 and 12 deg. The CC aileron was at least three times as effective as a pure reaction jet for the same amount of bleed air. Adverse yaw was large, on the order of one-half of the rolling moment. GRA

N80-19047# Advisory Group for Aerospace Research and Development, Paris (France).
PROPULSION AND ENERGETICS PANEL WORKING GROUP 11 ON AIRCRAFT FIRE SAFETY. VOLUME 2: MAIN REPORT
B. P. Botteri, ed., M. Gerstein, ed., T. Horeff, ed., and J. Parker, ed. Nov. 1979 167 p 2 Vol.
(AGARD-AR-132-Vol-2; ISBN-92-835-1344-4) Avail: NTIS HC A08/MF A01

Recent aircraft fire experience was analyzed and areas in which fire protection enhancement is needed were delineated. Technological opportunities that offer significant prospect for improvement of safety and personnel survivability were also identified. Because of the complexity of the overall problems, attention was focused upon turbine engine powered transport aircraft in a conventional (non-combat) operational environment. Conclusions and recommendations are summarized. R.E.S.

N80-19048*# TRW Defense and Space Systems Group, Redondo Beach, Calif.
DATA REDUCTION AND ANALYSIS OF GRAPHITE FIBER RELEASE EXPERIMENTS
Paul Lieberman, Albert R. Chovit, Benjamin Sussholz, and Howard F. Korman Jul. 1979 362 p refs
(Contract NAS1-15465)
(NASA-CR-159032; NASA/TRW-79-2) Avail: NTIS HC A16/MF A01 CSCL 01C

The burn and burn/explode effects on aircraft structures were examined in a series of fifteen outdoor tests conducted to verify the results obtained in previous burn and explode tests of carbon/graphite composite samples conducted in a closed chamber, and to simulate aircraft accident scenarios in which carbon/graphite fibers would be released. The primary effects that were to be investigaged in these tests were the amount and size distribution of the conductive fibers released from the composite structures, and how these various sizes of fibers transported downwind. The structures included plates, barrels, aircraft spoilers and a cockpit. The heat sources included a propane gas burner and 20 ft by 20 ft and 40 ft by 60 ft JP-5 pool fires. The larger pool fire was selected to simulate an aircraft accident incident. The passive instrumentation included sticky paper and sticky bridal veil over an area 6000 ft downwind and 3000 ft crosswind. The active instrumentation included instrumented meteorological towers, movies, infrared imaging cameras, LADAR, high voltage ball gages, light emitting diode gages, microwave gages and flame velocimeter. A.R.H.

N80-19049# Computer Sciences Corp., Huntington Valley, Pa.
MICROPROCESSOR CONTROLLED EJECTION SEAT Final Report
Kathleen M. Breakey 23 Oct. 1979 208 p refs
(Contract N66269-78-C-0191)
(AD-A077479; NADC-79240-60) Avail: NTIS HC A10/MF A01 CSCL 01/3

The operation of an ejection seat depends on a number of devices on the seat performing certain tasks at specific times. Traditionally, the timing and sequencing of these tasks have been controlled by fuses, gas lines and mechanical linkages, with marginal accuracy and limited logic. This effort was undertaken to demonstrate the feasibility of using a microprocessor to control these functions with increased accuracy and more sophisticated logic. The microprocessor provides timing by electronic clock, event sequencing via electrical signals, and sophisticated logic based on environmental inputs. In addition, the microprocessor, in conjunction with a gimballed rocket motor, provides the capability of performing a Vertical Seeking Maneuver in the event of an adverse attitude ejection. This report contains the software required to complement all these functions. GRA

N80-19051# Perceptronics, Inc., Woodland Hills, Calif.
AIRCRAFT EMERGENCY DECISIONS: COGNITIVE AND SITUATIONAL VARIABLES Annual Technical Report
Rosemarie Hopf-Weichel, Luigi Lucaccini, Joseph Saleh, and Amos Freedy Jul. 1979 171 p refs
(Contract F49620-78-C-0067; AF Proj. 2313)
(AD-A077413; PATR-1065-79-7; AFOSR-79-1175TR) Avail: NTIS HC A08/MF A01 CSCL 01/2

Military aircraft accidents are important not only to the individuals directly involved, but also to those responsible for preparing and maintaining combat-ready forces for the nation's defense. This report addresses problems underlying aircraft emergency situations. A literature review provided background information, and an analysis of selected accident reports. A workshop was convened to review the state-of-the-art of aircrew emergency decision training, safety research, and behavioral decision theory. A selected set of emergency situations was the basis of a preliminary classification of aircraft emergency situations in terms of several situational and decision making attributes. The classification is based on data derived from interviews with experienced military flying personnel. A taxonomy of emergency situation types was developed, incorporating both situational and task specific elements as cognitive attributes of the decision tasks performed under emergency conditions. On the basis of the taxonomy, three classes of emergency situations were found to be of interest: Situation 1 (predictable) Situation 2 (partly predictable), and Situation 3 (unpredictable). Initial training guidelines are suggested in light of the cognitive requirements of each class. GRA

N80-19052# RAND Corp., Santa Monica, Calif.
AIRCRAFT ICING DURING LOW-LEVEL FLIGHTS Interim Report
Robert R. Rapp Nov. 1979 19 p refs
(Contract F49620-77-C-0023)
(AD-A078843; RAND/N-1311-AF) Avail: NTIS HC A02/MF A01 CSCL 91/2

The reasons why icing may hinder low and slow flights are presented. A crude measure of the potential of icing near the ground is presented and it is shown that, by this measure, icing may be a serious problem when flying over the higher terrain of central Europe. Some suggestions for improving the measure of icing potential are given. GRA

N80-19053# Stencel Aero Engineering Corp., Asheville, N. C.
PROTOTYPE DEVELOPMENT PASSIVE, SEAT-MOUNTED LIMB RETENTION SYSTEM Final Report, Sep. 1977 - May 1979
May 1979 94 p refs
(Contracts N62269-77-C-0251; WF140000)
(AD-A076331; NADC-79201-60) Avail: NTIS HC A05/MF A01 CSCL 01/3

It has been well documented that the predominant cause of injury (both major and minor) occurring from combat ejections during the Southeast Asia conflict was due to flailing of the extremities as a result of increased ejection speed. A prototype passive seat mounted limb retention system was developed and manufactured which does not require the aircrewman to wear any additional devices or fasten additional restraint connections. It will not, in any way, compromise his movement in the cockpit or his control of the aircraft. This functional prototype device will undergo feasibility testing to determine acceptability for further development. GRA

N80-19054# Federal Aviation Administration, Washington, D. C.
AIRBORNE RADAR APPROACH SYSTEM FLIGHT TEST EXPERIMENT Final Report
L. D. King and R. J. Adams Oct. 1979 127 p refs
(Contract DOT-FA79WA-4293)
(AD-A077900; FAA-RD-79-99) Avail: NTIS HC A07/MF A01 CSCL 17/7

The performance of airborne radar as an approach aid is analyzed using data from the airborne radar approach (ARA) system flight tests experiment. The experiment design, equipment used, and test objectives are reviewed. The ARA tests were performed utilizing the Bendix RDR-1400a airborne radar system.

The test vehicle was a CH-53A helicopter. Test airspace environments included airport, remote sites, and offshore areas. Flight tests for ARA accuracy and procedures development were performed in both skin paint and single beacon radar operating modes. The technical and operating performance, in flight considerations, the development of pilot procedures, and detailed accuracy data for each area of testing are discussed. A.W.H.

N80-19055*# Analytical Mechanics Associates, Inc., Mountain View, Calif.
NAVIGATION SYSTEMS FOR APPROACH AND LANDING OF VTOL AIRCRAFT
Stanley F. Schmidt and Richard L. Mohr Oct. 1979 63 p refs
(Contract NAS2-9430)
(NASA-CR-152335; AMA-79-15) Avail: NTIS HC A04/MF A01 CSCL 17G

The formulation and implementation of navigation systems used for research investigations in the V/STOLAND avionics system are described. The navigation systems prove position and velocity in a cartestian reference frame aligned with the runway. They use filtering techniques to combine the raw position data from navaids (e.g., TACAN, MLS) with data from onboard inertial sensors. The filtering techniques which use both complementary and Kalman filters, are described. The software for the navigation systems is also described. R.E.S.

N80-19059# Army Communications-Electronics Engineering Installation Agency, Fort Huachuca, Ariz.
STANDARD ENGINEERING INSTALLATION PACKAGE. AIR TRAFFIC RADIO CHANNEL CONTROL (ATRCC) EQUIPMENT Final Report
Nov. 1979 90 p refs
(AD-A077648; USACEEIA-SEIP-036) Avail: NTIS HC A05/MF A01 CSCL 17/7

This Standard Engineering Installation Package SEIP provides information for the engineering and installation of ATRCC facilities worldwide. Information provided consists of site survey data, siting criteria, installation specifications and instructions, a bill of materials, quality assurance procedures and completion certification format. Information provided must be adapted to the specific ATRCC facility/location by the project engineer.
Author (GRA)

N80-19060 Engineering Sciences Data Unit, London (England).
ESTIMATION OF THE ENDURANCE OF CIVIL AIRCRAFT WING STRUCTURES
1979 14 p
(ESDU-79024; ISBN-0-85679-272-1; ISSN-0141-3996) For information on availability of series, sub-series, and other individual data items, write NTIS, Attn: ESDU, Springfield, Va. 22161. HC $386.50

A method of analyzing the cumulative frequency spectrum for an aircraft wing station into discrete loading cycles in preparation for a fatique damage calculation is described. The calculations derive the mean life estimation of a wing structure. The results apply to civil or transport aircraft in which maneuver loadings are small. ESDU

N80-19061# Dynamics Research Corp., Wilmington, Mass. Systems Div.
APPLICATION OF THE ESTIMATION-BEFORE-MODELING (EBM) SYSTEM IDENTIFICATION METHOD TO THE HIGH ANGLE OF ATTACK/SIDESLIP FLIGHT OF THE T-2C JET TRAINER AIRCRAFT. VOLUME 2: SIMULATION STUDY USING T-2C WIND TUNNEL MODEL DATA Final Report
Harold L. Stalford and S. Ramachandran 23 Jun. 1978 275 p refs 3 Vol.
(Contract N62269-76-C-0342)
(AD-A079923; R-254U-Vol-2; NADC-76097-30-Vol-2; Rept-1273-Vol-2) Avail: NTIS HC A12/MF A01 CSCL 20/4

This report presents the results of a feasibility study of the Estimation-Before-Modeling (EBM) method for aerodynamic parameter identification in the stall/post stall flight regimes. The feasibility study is conducted by processing synthetic flight data generated by exciting a wind tunnel model of the Navy's T-2C, a light jet trainer aircraft. It is carried out under realistic conditions by using the controls and the initial conditions of sixteen actual T-2C flight test data records to generate the sixteen synthetic maneuvers used in the study. The synthetic data are corrupted by realistic measurement noise levels representative of the actual. The EBM method is a two stage process. In the first stage, the corrupted data are processed one maneuver at a time using an extended Kalman-Bucy filter/Bryson-Frazier smoother to obtain estimated values of the states and of the forces and moments acting on the aircraft. In the second stage, subspace modeling together with a step-wise multiple linear regression technique is used to process the estimated values from all sixteen maneuvers together in parallel to identify a global state/control dependent model of the three force coefficients and the three moment coefficients. The identified global model compares well with the true values of the T-2C wind tunnel model. The EBM method is demonstrated to accurately identify the high nonlinearities of the T-2C wind tunnel model. The prediction accuracy of the identified global model is shown to be excellent by a comparison of the responses for a new maneuver and for the original sixteen maneuvers. GRA

N80-19062# Drexel Univ., Philadelphia, Pa.
SIGNIFICANCE OF LARGE SCATTER OF COMPOSITE PROPERTIES TO AIRCRAFT RELIABILITY Final Report
Pei Chi Chou and Robert Croman Sep. 1979 48 p refs
(Contract N62269-78-C-0267)
(AD-A077804; NADC-78094-60) Avail: NTIS HC A03/MF A01 CSCL 01/3

Statistical calculations have been made for the static load reliability of an aircraft fleet assuming typical metallic and composite strength distributions. A factor of safety is defined as the element strength divided by the 'weakest of the fleet' strength. Element strength is typical 'A' or 'B' basis material allowables. 'Weakest of the fleet' strength is calculated statistically assuming each aircraft to be made up of a realistic arrangement (in-series or in-parallel) of critical elements. Similar calculations are also made for fatigue life. It is shown that the reliability of the current damage tolerant design, such as multiple load path and crack stoppers, can be specified in quantitative terms. GRA

N80-19063*# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
CLOSED LOOP MODELS FOR ANALYZING ENGINEERING REQUIREMENTS FOR SIMULATORS Final Report
Sheldon Baron, Ramal Muralidharan, and David Kleinman Feb. 1980 232 p refs
(Contract NAS1-14449)
(NASA-CR-2965) Avail: NTIS HC A11/MF A01 CSCL 14B

A closed loop analytic model, incorporating a model for the human pilot, (namely, the optimal control model) that would allow certain simulation design tradeoffs to be evaluated quantitatively was developed. This model was applied to a realistic flight control problem. The resulting model is used to analyze both overall simulation effects and the effects of individual elements. The results show that, as compared to an ideal continuous simulation, the discrete simulation can result in significant performance and/or workload penalties. J.M.S.

N80-19064# Grumman Aerospace Corp., Bethpage, N.Y.
CREW STATION DESIGN FACILITY FEASIBILITY STUDY Final Technical Report, Sep. 1977 - Dec. 1978
S. LaCarrubba May 1979 189 p
(Contract F33615-77-C-3067; AF Proj. 2403; AF Proj. 6190)
(AD-A078134; AFFDL-TR-79-3037) Avail: NTIS HC A09/MF A01 CSCL 01/3

This report addresses the feasibility of a new and unique facility capable of simulating the total range of lighting conditions experienced in military aircraft crew stations during operational flight. The facility would provide a means for evaluating the impact of extreme illumination levels on the legibility of displays and instruments/panel lighting systems to be incorporated in advanced crew stations. This facility would interface with the flight simulation test facilities already established at the Flight Control Development Laboratory at WPAFB. At the beginning of this effort, two baseline lighting simulation systems were

selected for development. One configuration uses an opaque dome shaped lighting enclosure with internal sky illumination sources. The other configuration uses a translucent enclosure with external sky illumination sources. Techniques for simulating air-to-air and air-to-ground visual effects, terrain, and motion simulation were investigated for each baseline configuration. The principal conclusion of this study is that real levels of sky and sun luminance, colors and color shading can be simulated and controlled (with some limitations) utilizing the translucent dome lighting enclosure with external sky illumination sources. GRA

N80-19065# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.

USAF DAMAGE TOLERANT DESIGN HANDBOOK: GUIDELINES FOR THE ANALYSIS AND DESIGN OF DAMAGE TOLERANT AIRCRAFT STRUCTURES, REVISION A Interim Report, Jan. 1977 - Nov. 1978

Howard A. Wood and Robert M. Engle, Jr. Mar. 1979 447 p Revised
(AF Proj. 2401)
(AD-A078216; AFFDL-TR-79-3021-Rev-A) Avail: NTIS HC A19/MF A01 CSCL 01/3

This is the first edition of a handbook to support the USAF Airplane Damage Tolerance Requirements contained in MIL-A-83444. It provides specific background data and justification for the detailed requirements of MIL-A-83444 and provides guidelines and state-of-the-art analysis methods to assist contractor and USAF personnel in complying with the intent of the specification and in solving cracking problems in general, for metallic aircraft structures. The material in this document is general enough to be useful in the evaluation of the damage tolerance of in-service aircraft designed and qualified prior to the issuance of MIL-A-83444. The handbook was structured to provide a clear and concise summary of the specification, MIL-A-83444, as well as supporting analysis methods, test techniques, and nondestructive inspection (NDI). Methods are provided as state-of-the-art along with suggested and/or recommended practices, limitations, etc. Copies of appropriate USAF structural specifications are contained as an appendix. GRA

N80-19066# Boeing Aerospace Co., Seattle, Wash.

NEW REMOTELY PILOTED VEHICLE LAUNCH AND RECOVERY CONCEPTS. VOLUME 1: ANALYSIS, PRELIMINARY DESIGN AND PERFORMANCE/COST TRADE STUDIES Final Report, Mar. 1978 - Mar. 1979

Steven J. Baumgartner, James G. Brister, Vinod K. Rajpaul, and Roger F. Yurczyk Jun. 1979 259 p refs
(Contract F33615-78-C-3404; AF Proj. 2402)
(AD-A077475; AFFDL-TR-79-3069-Vol-1) Avail: NTIS HC A12/MF A01 CSCL 01/3

Dynamic analysis, preliminary design, and performance/cost trade studies of air bag skid and air cushion concepts for launch and recovery of Boeing and Rockwell advanced RPV concepts have been conducted. Dynamic analysis was performed using the six degree-of-freedom computer program EASY. Dynamic simulations included perturbations to steady state flight, landing, and takeoff simulations. Launch and recovery concepts investigated were air bag skid system, air cushion recovery systems, integrated air cushion system, and air cushion launch platform. Performance/cost trade study factors investigated were complexity, fuel requirements, adverse weather capability, ground equipment and facility requirements, survivability/vulnerability, reliability and maintainability, and system acquisition and life cycle costs. Results of the study indicated that an air cushion system is a feasible means of recovery of an RPV such as the Boeing and Rockwell ARPV concepts. An air bag skid with an arrestor system is a feasible approach when minimum field length is a major design factor. Integrated air cushion systems for launch and recovery are greatly affected by engine characteristics. In each case, the launch and recovery systems are shown to be an integral part of the total vehicle design and strongly influence the airframe design. GRA

N80-19067# Army Aviation Engineering Flight Activity, Edwards AFB, Calif.

PRELIMINARY AIRWORTHINESS EVALUATION UH-1H HELICOPTER EQUIPPED WITH MULTIPLE TARGET ELECTRONIC WARFARE SYSTEM (MULTEWS) Final Report, 13 Aug. - 2 Dec. 1977

Vernon L. Diekmann, Sherwood C. Spring, Mathews S. Mathews, III, John F. Hagen, and John S. Tulloch May 1978 187 p refs
(AD-A078476; USAAEFA-77-09) Avail: NTIS HC A09/MF A01 CSCL 01/3

The United States Army Aviation Engineering Flight Activity conducted a Preliminary Airworthiness Evaluation (PAE) of a UH-1H helicopter equipped with a Multiple Target Electronic Warfare System (MULTEWS) from 13 August through 2 December 1977. The evaluation was conducted at Edwards Air Force Base, California, and required 45 flights for a total productive flight time of 41 hours. The test program was terminated when the test aircraft sustained major damage during height-velocity testing. The addition of the MULTEWS equipment to the UH-1H airframe caused significant degradation in performance and handling qualities. Changes in the operator's manual should be made to reflect the changes in performance for MULTEWS configured aircraft. The MULTEWS installation also generally degraded the vibration characteristics of the UH-1H, increased structural loads, increased the maintenance workload, and degraded aircraft crashworthiness. The degradation in performance and handling qualities as well as the excessive vibrations and structural loads in the MULTEWS configured aircraft were attributed to the extremely high drag and turbulent wake of the externally mounted MULTEWS components. GRA

N80-19068# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.

DIGITAL COMPUTER SOLUTION OF AIRCRAFT LONGITUDINAL AND LATERAL DIRECTIONAL DYNAMIC CHARACTERISTICS Final Report

John M. Griffin, Robert B. Yeager, Larry B. Jordan, and David A. Ratino Jul. 1979 173 p refs Revised
(AD-A078672; AFFDL-TR-78-203) Avail: NTIS HC A08/MF A01 CSCL 01/3

Two FORTRAN IV computer programs are presented for the solution of aircraft longitudinal and lateral-directional transfer function factors and dynamic characteristics. The longitudinal program solves for the three-degree-of-freedom dynamic characteristics (phugoid damping ratio and natural frequency, short period damping ratio and natural frequency, etc.) and the numerator factors of the alpha, u, theta, h, and vertical acceleration transfer functions. The lateral-directional program solves for the three-degree-of-freedom characteristics (Dutch roll damping ratio and natural frequency, roll and spiral mode time constants, etc.) and the numerator factors of the beta, phi, y, and lateral acceleration transfer functions. In addition, some time histories and specialized handling qualities parameters can be computed and printed out. The equations and their underlying assumptions are discussed. The two complete computer programs are shown, and the input, output, and program functions are discussed.GRA

N80-19069# Human Engineering Labs., Aberdeen Proving Ground, Md.

A STUDY OF THE CANOPY DESIGN FOR THE ADVANCED ATTACK HELICOPTER BY USE OF COMPUTER GRAPHICS Final Report

Christopher C. Smith Aug. 1979 137 p refs
(AD-A078291; HEL-TM-13-79) Avail: NTIS HC A07/MF A01 CSCL 01/3

A package of computer programs has been developed for use in helicopter canopy design. The programs compute point-wise measures of three important design factors for the transparent surfaces of an attack helicopter canopy. These factors are: (1) the internal glare; (2) the external glint; and (3) the optical distortions exhibited by the canopy design. The programs have been applied to modifications in the present canopy design on the YAH-64 Advanced Attack Helicopter. The results suggest that reduced internal glare is possible with slight additional glint and distortion by displacing the side windows 4 inches from the plane of the frame vertices and rotating the axis of curvature of the top window by 90 degrees and displacing it 1.5 inches. GRA

N80-19070# Aeronautical Systems Div., Wright-Patterson AFB, Ohio. Flight Systems Engineering.
DEVELOPMENT OF A NORMALIZED PROBABILITY DISTRIBUTION FOR LATERAL LOAD FACTORS DUE TO AIRCRAFT GROUND TURNING Final Report
John W. Rustenburg Aug. 1979 41 p refs
(AF Proj. 139A)
(AD-A077047; ASD-TR-79-5037) Avail: NTIS HC A03/MF A01 CSCL 01/3

It was desirable to determine the expected frequency of occurrence of lateral load factors due to aircraft ground turning maneuvers for a specified airplane service life. In order to accomplish this determination, published and unpublished ground operations data measured on a C-141-A, DC-9-15, 727-100, KC-135, and F-105D aircraft was condensed and evaluated, and used in the development of a normalized side load factor probability distribution for ground turning. The normalized distribution can be used to predict the expected lateral load factor spectrum due to ground turns for any aircraft. A subordinate analysis of KC-135 and FB-111A data provided a normalized probability distribution of lateral load factor applicable to taxiing and landing. GRA

N80-19071# Army Command and General Staff Coll., Fort Leavenworth, Kansas.
THE F-16 WILD WEASEL: A FEASIBILITY STUDY M.S. Thesis. Final Report
Byron L. Huff 8 Jun. 1979 63 p refs
(AD-A077050) Avail: NTIS HC A04/MF A01 CSCL 17/4

This study attempts to determine the feasibility of the Wild Weasel proposal being made by General Dynamics Corporation. The investigation covers the NATO threat, a brief history of the Wild Weasel; the capabilities of the current Wild Weasel (F-4G Phantom); the capabilities of the F-16 Wild Weasel; and a cost comparison of the F-16 and F-4G Wild Weasel aircraft. The investigation reveals that an advanced Wild Weasel is necessary to contend with the Soviet air defense system and to be compatible with near-future Allied fighter aircraft. GRA

N80-19072# Dynamics Research Corp., Wilmington, Mass. Systems Div.
APPLICATION OF THE ESTIMATION-BEFORE-MODELING (EBM) SYSTEM IDENTIFICATION METHOD TO THE HIGH ANGLE OF ATTACK/SIDESLIP FLIGHT OF THE T-2C JET TRAINER AIRCRAFT. VOLUME 3: IDENTIFICATION OF T-2C AERODYNAMICS STABILITY AND CONTROL CHARACTERISTICS FROM ACTUAL FLIGHT TEST DATA Final Report
Harold L. Stalford 11 Apr. 1979 254 p refs 3 Vol.
(Contract N62269-76-C-0342)
(AD-A079924; R-287U-Vol-3; NADC-76097-30-Vol-3; Rept-1273-Vol-3) Avail: NTIS HC A12/MF A01 CSCL 20/4

This volume presents the results of the application of the Estimation-Before-Modeling (EBM) System Identification Method to high angle of attack/sideslip flight test data of the T-2C Jet Trainer aircraft. Eighteen maneuvers consisting of over 600 seconds of 20 hertz data are processed. An extended Kalman-Bucy filter/Bryson-Frazier smoother is used in the first step to provide state estimates and measurement biases and scale factors. In the second step of the EBM method, the step-wise multiple linear regression technique and subspace modeling are used to identify detailed models of C sub y, C sub l, C sub n and C sub m. Partial results are given for C sub x and C sub z. The state and control derivatives of the identified model agree well with the wind tunnel model. Most of the identified dynamic derivatives compare well with the theoretically predicted value at low alpha and some compare well at high alpha. GRA

N80-19073# Dynamics Research Corp., Wilmington, Mass. Systems Div.
APPLICATION OF THE ESTIMATION-BEFORE-MODELING (EBM) SYSTEM IDENTIFICATION METHOD TO THE HIGH ANGLE OF ATTACK/SIDESLIP FLIGHT OF THE T-2C JET TRAINER AIRCRAFT. VOLUME 1: EXECUTIVE SUMMARY Final Report
Harold L. Stalford 12 Nov. 1979 61 p refs 3 Vol.
(Contract N62269-76-C-0342)
(AD-A080025; R-303U-Vol-1; NADC-76097-30-Vol-1; Rept-1273-Vol-1) Avail: NTIS HC A04/MF A01 CSCL 20/4

This report (Volume 1) summarizes the development and application of the Estimation-Before-Modeling (EBM) method for aircraft parameter identification in the non-linear flight regime. The method utilizes a Two-step approach wherein model independent states, forces and moments are first estimated and then state and control dependent model parametes are obtained using a Stepwise Multiple Linear Regression (SLMR) approach. In the second step (SLMR) the angle of attack and sideslip and control input space for all available flight data is divided into small subspaces and force and moment coefficients are modeled within each subspace. The method is applied to both simulated and actual flight data for a T-2C jet trainer aircraft in the stall and post-stall flight regimes. Volumes 2 and 3 of this report present detailed description of the EBM method and its application. GRA

N80-19074# Naval Air Development Center, Warminster, Pa.
PROCEEDINGS OF A WORKSHOP ON V/STOL AIRCRAFT AERODYNAMICS, VOLUME 1
C. Henderson and M. F. Platzer May 1979 604 p refs Workshop held in Monterey, Calif., 16-18 May 1979
(AD-A079115) Avail: NTIS HC A99/MF A01 CSCL 01/3

This report contains the proceedings of the Workshop on V/STOL Aircraft Aerodynamics held at the Naval Postgraduate School on May 16 to 18, 1979. This workshop was sponsored by the Naval Air Development Center. The workshop participants included representatives from industry, government, universities and abroad. GRA

N80-19075# Foster-Miller Associates, Inc., Waltham, Mass.
ANALYSIS OF TRUNK FLUTTER IN AN AIR CUSHION LANDING SYSTEM Final Report
Ashok B. Boghani and Roger B. Fish Aug. 1979 114 p refs
(Contract F33615-78-C-3412; AF Proj. 2307)
(AD-A079008; WP-7819; AFFDL-TR-79-3102) Avail: NTIS HC A06/MF A01 CSCL 01/3

This report deals with explaining the occurrence of flutter in the Air Cushion Landing System (ACLS) trunks and suggesting means of suppressing it. Observations of flutter in several ACLS trunks indicate that the flutter is caused by the interaction between the trunk membrane and the flow at the trunk bottom. The flow creates a negative stiffness effect at the bottom which, if larger than the positive stiffness due to the tension of the trunk, induces flutter. A computer simulation based on this model succeeds in predicting the flutter observed in the XC-8A tests. Suggestions on solving the flutter problem are based on either modifying the trunk or modifying the flow. Computer simulations of several suggestions indicate that: (1) Providing a minimum gap; (2) Lowering the separation point; (3) chaning the operation conditions show good promise in suppressing the flutter. Two other suggestions, not simulated, which also have good potential for flutter suppression are: (1) Incorporating circular trunk, and (2) Incorporating hybrid trunk. GRA

N80-19076# Boeing Military Airplane Development, Seattle, Wash.
EASY ACLS DYNAMIC ANALYSIS, VOLUME 2. PART 2: COMPONENT COMPUTER PROGRAMS Final Report, Apr. 1977 - Jun. 1979
M. K. Wahi, G. S. Duleba, and P. R. Perkins Sep. 1979 296 p refs
(Contract F33615-77-C-3054; AF Proj. 2404)
(AD-A079803; AFFDL-TR-79-3105-Vol-2-Pt-2) Avail: NTIS HC A13/MF A01 CSCL 09/2

This volume contains a detailed description of the component subroutines and of other standard functions/subroutines which are used in the EASY dynamic analysis program. Macro-flow charts and some micro-flowcharts and listings are included. Sample output is included where appropriate. GRA

N80-19077# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

THRUST VECTORING TO ELIMINATE THE VERTICAL STABILIZER M.S. Thesis
Roy Edward LaFroth Dec. 1979 134 p refs
(AD-A079852; AFIT/GAE/AA/79D-9) Avail: NTIS HC A07/MF A01 CSCL 01/3

Root locus analysis techniques are used to design an active thrust vector control system to provide the directional stability for an F-111 without the vertical stabilizer. A linear analysis of the lateral-directional modes is performed for the aircraft both with and without the vertical stabilizer. The aircraft with the vertical stabilizer is used as a baseline. Computer histories for discrete atmospheric turbulence and a covariance analysis for random turbulence are used for the evaluation. It is found that the thrust vector control produces a response as good as or better than the baseline aircraft. Requirements for the thrust vector deflection and rate of deflection are generated. The lowest possible rate of deflection for acceptable flying qualities is shown to be 1 rad/sec. GRA

N80-19078# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
MINIMUM TIME TURNS WITH THRUST REVERSAL M.S. Thesis
Thomas L. Johnson Dec. 1979 77 p refs
(AD-A079851; AFIT/GAE/AA/79D-6) Avail: NTIS HC A05/MF A01 CSCL 01/2

The object of this study is to find the optimal trajectories and corresponding minimum turning times for a high performance aircraft with and without thrust reversal to perform a prescribed turn, and then to compare those trajectories and times to evaluate the benefit of thrust reversal. Optimal control theory is applied to solve the minimum time to turn optimal control problem, using a suboptimal control problem approach and a second-order parameter-optimization method. The results of the study found that the suboptimal control approach was effective in solving the problem, that thrust reversal is beneficial in reducing turning time if the aircraft's initial velocity is above the corner velocity, and that thrust reversal is not beneficial in performing a minimum time turn without losing energy. GRA

N80-19079# Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio. Aerospace Power Div.
AN ANALYTICAL AND EXPERIMENTAL STUDY OF AIRCRAFT HYDRAULIC LINES INCLUDING THE EFFECT OF MEAN FLOW Final Report, Jul. 1977 - Jul. 1979
John H. Pletcher, Jr. Nov. 1979 204 p refs
(AF Proj. 3145)
(AD-A079746; AFAPL-TR-79-2104) Avail: NTIS HC A11/MF A01 CSCL 01/3

A mathematical model of a fluid transmission line was developed which included the effect of mean flow coupling with oscillatory flow. The analysis centered on solving the nonhomogeneous confluent hypergeometric equation with complex parameters using an infinite series and evaluating the solution using Ward's method. Experiments were run using an aircraft hydraulic system. The frequency response, vibration displacement, and standing pressure half wave were measured in a straight line and a line with bends for flow rates up to 9.5 gpm. A clampon transducer, which did not disturb the flow and could be easily moved, was used for the pressure measurements. In the absence of vibration the clampon transducer measurements were within 5% of readings taken with a conventional Statham in-line transducer. A sensitivity analysis showed the effect of small changes in geometry, temperature, steady-state pressure, fluid properties, entrained air content, and element volume. Using the new mathematical model, the attenuation and phase constant were calculated for hydraulic and air lines. Results compared well with experiment and published data. The new analysis and line model provide a means for the fluid systems engineer to accurately account for mean flow effects. GRA

N80-19080# Goodyear Aerospace Corp., Litchfield Park, Ariz.
THE FABRICATION AND TESTING OF PROTOTYPE UH-1 AIRCRAFT WINDSHIELDS MANUFACTURED WITH A SHEET INTERLAYER Final Report, 29 Mar. 1978 - 29 Jan. 1979
James O. Coast Aug. 1979 65 p refs
(Contract DAAG46-78-C-0008)
(AD-A077711; GERA-2378; USAAVRADCOM-TR-79-32; AMMRC-TR-79-50) Avail: NTIS HC A04/MF A01 CSCL 01/3

This program was conducted to determine the feasibility of fabricating helicopter windshields with a designated urethane sheet interlayer. Four sets of full-size UH-1 windshields consisting of two each of two different constructions were fabricated and tested. GRA

N80-19081# Lockheed-Georgia Co., Marietta.
AERODYNAMIC INVESTIGATION OF C-141 LEADING EDGE MODIFICATION FOR CRUISE DRAG REDUCTION, VOLUME 2 Final Report, Jun. 1977 - Sep. 1978
W. T. Blackerby and P. R. Smith Jun. 1979 319 p refs
(Contract F09603-77-A-0204)
(AD-A077688; LG78ER0233-Vol-2; AFFDL-TR-79-3059-Vol-2) Avail: NTIS HC A14/MF A01 CSCL 01/3

A study of the aerodynamic design and high speed wind tunnel investigation of wing leading edge modifications for cruise drag reduction on the C-141 aircraft has been completed. Also investigated were the effects of a wing swept tip extension and trailing edge anti-drag bodies. These modifications were tested in the AEDC 16-Foot Transonic Facility, using a 0.044 scale C-141B model, to determine the effects on C-141 cruise aerodynamic characteristics and wing chordwise pressure distributions. Design of the leading edge modifications was based on the use of transonic wing theory, transonic airfoil theory and experience previously gained with a two-dimensional airfoil leading edge modification program. Force data results were analyzed to determine the effects on C-141 cruise drag, drag rise characteristics and cruise performance. Correlations were made with transonic theory using the measured chordwise pressure distributions. A fuel and cost savings evaluation was made of the selected leading edge configuration based on measured and predicted cruise performance improvements. GRA

N80-19082# Douglas Aircraft Co., Inc., Long Beach, Calif.
EVALUATION OF AIRCRAFT WINDSHIELD MATERIALS IN A SIMULATED SUPERSONIC FLIGHT ENVIRONMENT Final Report, May 1978 - Mar. 1979
J. B. Hoffman Jun. 1979 200 p refs
(Contract F33615-75-C-3105; AF Proj. 2202)
(AD-A078673; MDC-J7186; AFFDL-TR-79-3058) Avail: NTIS HC A09/MF A01 CSCL 01/3

A series of wind tunnel tests were conducted at Mach 2.4, 2.6 and 3.0 to determine material survivability and optical clarity for a variety of small, flat laminated and monolithic specimens of acrylic, urethane, glass, silicone and polycarbonate materials for potential use in the design of Mach 3.0 aircraft windshields. Twenty-seven specimens were tested to determine the material limitations and capabilities, which included an investigation of specific edge designs and the effect of edge structure on temperature distribution. The tests were conducted in a Mach 6 wind tunnel which utilized a shock generator to reduce the air stream to the desired flow across the outer surface of the specimens. The specimens were individually mounted in a pressurized box to provide a simulated cabin environment on their inner surface. Grid line photography was used to delineate inflight and permanent optical distortion. Material damage was evaluated and thermal gradients were documented. Prior to this test program, the aerodynamic effect of a Mach 2.4 through Mach 3.0 flight environment on transparent plastic and interlayer materials was unknown. The survival of these specimens demonstrated that laminated configurations consisting of acrylic/silicone/polycarbonate or urethane/urethane/polycarbonate, as well as glass/silicone/polycarbonate are viable candidates for aircraft windshields that would be exposed to a Mach 3.0 flight environment for short exposures. GRA

N80-19083# Sikorsky Aircraft, Stratford, Conn. Sikorsky Aircraft Div.
NADC ABC ROTOR MAPS Final Report
David T. Balsh 29 Jun. 1979 32 p refs
(Contract N62269-79-M-3221)

(AD-A078802; SER-69060) Avail: NTIS HC A03/MF A01 CSCL 01/3

This report is the formal documentation of the rotor performance maps and includes a description of the anticipated 1995 IOC rotor configuration on which the rotor maps are based and substantiation for the methodology used in the generation of the maps. The rotor maps themselves are presented in the appendix of this report in both HESCOMP transcript sheet form and in computer input code form, (the latter is a copy of the listing obtained from a set of punched computer cards which will have been presented to NAVAIRDEVCEN. GRA

N80-19084# RAND Corp., Santa Monica, Calif.
MEASURING TECHNOLOGICAL CHANGE IN JET FIGHTER AIRCRAFT Interim Report
William L. Stanley and Michael D. Miller Sep. 1979 124 p refs
(Contract F49620-77-C-0023)
(AD-A077393; RAND/R-2249-AF) Avail: NTIS HC A06/MF A01 CSCL 01/3

This report develops a technique to characterize the level of and change in jet fighter air vehicle technology. It complements other methods used to assess technological risks of new fighter concepts and to compare U.S. and foreign fighter technology. The technique uses multiple regression to relate time of appearance of an aircraft design to its level of technology. Resulting expressions measure performance consequences of technological advance in terms of such parameters as specific power, sustained load factor, Breguet range, and payload fraction. Measured in these terms, the rate of advance of U.S. fighter air vehicle technology is declining. The monetary cost of increasing the rate of advance could be very high. In the future, designers will have to balance increasingly difficult improvements in air vehicle technology against improvements in other technologies (such as avionics or armament) that also enhance combat effectiveness. GRA

N80-19085# Systems Technology, Inc., Hawthorne, Calif.
DEVELOPMENT OF VTOL FLYING QUALITIES CRITERIA FOR LOW SPEED AND HOVER Final Report
Roger H. Hoh and Irving L. Ashkenas Dec. 1979 150 p refs
(Contract N62269-77-C-0278)
(AD-A079911; STI-TR-1116-1; NADC-77052-30) Avail: NTIS HC A07/MF A01 CSCL 01/2

A classification scheme has been developed to account for outside visual cues and cockpit displays in determining the required equivalent system forms for low speed and hover. Tentative criteria are presented in terms of a visibility scale which quantifies environmental conditions for the intended mission in a more fine-grained manner than simply specifying IMC or VMC. There are indications that rate and attitude systems may be used for partial IMC conditions but that a translational rate command system is required for low speed and hover in zero visibility. In general, most experiments indicate that advanced displays are not a substitute for augmentation. Tentative limiting conditions are defined for rate and attitude systems, but more data are required to define handling qualities for translational rate command systems. Since the existing data base is primarily oriented toward command/response characteristics, definition of the limiting conditions for turbulence and large discrete wind shears also requires more data. GRA

N80-19086# Systems Research Labs., Inc., Dayton, Ohio. Electronic Warfare Center.
DEVELOPMENT OF A VISUAL INSPECTION TECHNIQUE (OPTICAL ASSESSMENT OF AIRCRAFT TRANSPARENCIES)
Frank E. Ward, Anthony J. DeFrances, and Robert G. Eggleston (AMRL) Wright-Patterson AFB, Ohio AMRL Oct. 1979 129 p refs
(Contract F33615-77-C-0535; AF Proj. 2313)
(AD-A079369; AMRL-TR-79-67) Avail: NTIS HC A07/MF A01 CSCL 01/3

This work assessed the utility of different types of targets and psychophysical procedures for evaluating optical distortions induced by aircraft windscreens. Targets, both static and dynamic, were viewed through windscreens and the amount of distortion was judged by a magnitude estimation procedure. Judgements were analyzed by discriminant analysis to identify the targets that best facilitated good discrimination among windscreens. A psychophysical matching procedure was also evaluated. In some conditions, photographic representations of the distortion patterns were evaluated using the magnitude estimation procedures. The results of the work show that windscreen-induced distortion is a multidimensional attribute and is best evaluated by multiple inspection procedures. Specific static and dynamic targets are recommended for use in evaluating distortion. Correlations between physical measures of distortion and psychophysical judgments are reported as well as reliabilities for selected experiments. Suggestions for improvements and further work are included. GRA

N80-19087# Kay and Associates, Inc., Mount Prospect, Ill.
[AVIONICS LOGISTICS SUPPORT INCLUDING V/STOL, LAMPS, AND INSTRUMENT REPAIR] Final Report, 5 Dec. 1977 - 28 Aug. 1979
2 Nov. 1979 30 p refs
(Contract N60921-78-C-0014)
(AD-A077460) Avail: NTIS HC A03/MF A01 CSCL 01/3

This unclassified report contains information on the contractual effort of Kay and Associates, Inc. in support of the Naval Surface Weapons Center and the Naval Air Systems Command. The efforts encompassed a study concerning VSTOL vs LAMPS, Sea Based Air requirements, composition and configuration of future ship weapons, and screening of Source, Maintenance and Recoverability code changes. Additionally, this effort included the research and analysis of candidate instrument repair facilities with a view toward selecting specific instruments for various weapons systems for increased repair capability at the Intermediate level of Maintenance. GRA

N80-19088# Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio.
A COMPUTER PROGRAM FOR ESTIMATING AIRCRAFT LANDING DISTANCE Interim Report, Aug. 1977 - Jul. 1979
Kervyn D. Mach Aug. 1979 39 p
(AF Proj. 3066)
(AD-A077169; AFAL-TR-79-2086) Avail: NTIS HC A03/MF A01 CSCL 01/2

This report describes a computer program which will estimate the runway length required to land a specified airplane. The program accepts inputs describing the aircraft gross weight, velocity, drag, and engine performance and computes the landing distance on specified runway surfaces. Sample results for a time-engine STOL transport are included. The computer program is described along with instructions for its use. GRA

N80-19089# National Technical Information Service, Springfield, Va.
REMOTELY PILOTED VEHICLES, VOLUME 2. A BIBLIOGRAPHY WITH ABSTRACTS Progress Report, Nov. 1975 - Nov. 1979
Guy E. Habercom, Jr. Dec. 1979 270 p Supersedes NTIS/PS-78/1246; NTIS/PS-77/1143; NTIS/PS-76/1034; NTIS/PS75-876
(PB80-802119; NTIS/PS-78/1246; NTIS/PS-77/1143; NTIS/PS-76/1034; NTIS/PS-75/876) Avail: NTIS HC $30.00/MF $30.00 CSCL 01C

Operation of vehicles under remote guidance and control is investigated. Aircraft, drones, and extraterrestrial explorers are among the areas researched. This updated bibliography contains 262 abstracts, 35 of which are new entries to the previous edition. GRA

N80-19090# Advisory Group for Aerospace Research and Development, Paris (France).
DYNAMIC ENVIRONMENTAL QUALIFICATION TECHNIQUES
Nov. 1979 40 p refs Meeting held in Williamsburg, Va., Apr. 1979

(AGARD-R-682; ISBN-92-835-1342-8) Avail: NTIS HC A03/MF A01

Dynamic qualification test procedures are discussed with emphasis on determining the resistance of equipment to the effects of environments peculiar to military operations and requirements.

N80-19091# Aeronautical Systems Div., Wright-Patterson AFB, Ohio.

APPLICATION OF MIL-STD-810C DYNAMIC REQUIREMENTS TO USAF AVIONICS PROCUREMENTS

J. H. Wafford *In* AGARD Dyn. Environ. Qualification Tech. Nov. 1979 11 p refs

Avail: NTIS HC A03/MF A01

The vibration requirements and the application of these requirements to the procurement of avionics equipment are discussed. Data obtained from external noise measurements and aerodynamically induced vibration are reported. R.C.T.

N80-19092# Messerschmidt-Boelkow G.m.b.H., Munich (West Germany). Unternehmensbereich Flugzeuge.

DYNAMIC ENVIRONMENTS AND TEST SIMULATION FOR QUALIFICATION OF AIRCRAFT EQUIPMENT AND EXTERNAL STORES

G. Haidl, C. Lodge (British Aerospace Aircraft Group, Warton, England), and H. Zimmermann (Vereinigte Flugtechnische Werke-Fokker G.m.b.H., Bremen, West Germany) *In* AGARD Dyn. Environ. Qualification Tech. Nov. 1979 13 p refs (For primary document see N80-19090 10-05)

Avail: NTIS HC A03/MF A01

Equipment within an aircraft was exposed to a wide variety of environments during ground and flight operations in order to determine its reliability and performance under conditions which will be encountered during its service life. Test specifications based upon real environments, but simplified for simulation, were established. Significant observations and results are reported. R.C.T.

N80-19093# British Aerospace Aircraft Group, Bristol (England).

CIVIL AIRCRAFT EQUIPMENT ENVIRONMENT QUALIFICATION TECHNIQUES

B. W. Payne and G. H. F. Nayler *In* AGARD Dyn. Environ. Qualification Tech. Nov. 1979 10 p refs

Avail: NTIS HC A03/MF A01

The vibration testing of civil aircraft equipment is discussed. The environmental test levels that are existing in international requirements for civil aircraft are presented. R.C.T.

N80-19094# Advisory Group for Aerospace Research and Development, Paris (France).

PARAMETER IDENTIFICATION

Nov. 1979 353 p refs Lecture held in Delft, Netherlands, 29-30 Oct. 1979 and in London, 1-2 Nov. 1979

(AGARD-LS-104; ISBN-92-835-1340-1) Avail: NTIS HC A16/MF A01

The present state of the art of aircraft parameter identification techniques is reviewed. A critical appraisal of current methods developed and applied to the problems of analysis of flight test data in a number of NATO countries is given. Particular emphasis is placed on the practical aspects of aircraft parameter estimation to generate information useful for the flight test engineer.

N80-19095# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugmechanik.

AIRCRAFT PARAMETER IDENTIFICATION METHODS AND THEIR APPLICATIONS: SURVEY AND FUTURE ASPECTS

P. G. Hamel *In* AGARD Parameter Identification Nov. 1979 26 p refs

Avail: NTIS HC A16/MF A01

An overall view of the methods for the determination of aircraft flight mechanic parameters from flight tests and the problems associated with them is given. Technologies in the field of instrumentation, data handling, and data processing as well as improved methodologies for optimum control input design are covered. The application spectrum for parameter identification including aircraft handling qualities investigations and acceptance testing is emphasized. J.M.S.

N80-19096*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

IDENTIFICATION EVALUATION METHODS

Vladislav Klein *In* AGARD Parameter Identification Nov. 1979 21 p refs

Avail: NTIS HC A16/MF A01 CSCL 01C

Methods for airplane parameter estimation, the equation error method, output error method, and two advanced methods are presented and their basic properties described. The advanced methods include the maximum likelihood and extended Kalman filter method. For a better understanding of the estimation techniques a first-order scalar differential equation is used as a model of the system under test. Application of the methods to a general multivariable linear system is briefly outlined. A note on the parameter estimation in the frequency domain is also presented. Numerical examples along with the comparison of results from various methods are given. J.M.S.

N80-19097# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugmechanik.

PRACTICAL INPUT SIGNAL DESIGN

E. Plaetschke and G. Schulz (DFVLR, Oberpfaffenhofen, West Germany) *In* AGARD Parameter identification Nov. 1979 19 p refs

Avail: NTIS HC A16/MF A01

The design of optimal inputs for identifying stability and control derivatives of the longitudinal and lateral motion of an aircraft is considered. First the purpose of input optimization, the constraints, and an overview of the literature is presented. Then two different procedures of input design are treated in more detail. Starting with investigations in the frequency domain the first method yields a multistep input signal, which fulfills specific spectral requirements. The second way of input design is based on the optimization of different measures of the Fisher information matrix, such as determinant or trace. Depending on the measure used, the designed signals differ with respect to their spectral composition. The discussed input signals, which were used in a flight test program, are compared with respect to the achieved accuracy of the identified stability and control derivatives. J.M.S.

N80-19098# National Aerospace Lab., Amsterdam (Netherlands).

ASPECTS OF FLIGHT TEST INSTRUMENTATION

J. H. Breeman, K. vanWoerkom, H. L. Jonkers, and J. A. Mulder *In* AGARD Parameter Identification Nov. 1979 22 p refs Prepared in cooperation with Technische Hogeschool, Delft, Netherlands

Avail: NTIS HC A16/MF A01

The design of the instrumentation system for parameter estimation tests is considered. Specifications of instrumentation for nonsteady flight testing are discussed along with general aspects and selection criteria of various transducer types. As practical examples parts of the high accuracy instrumentation systems developed for the determination of performance and stability and control characteristics for dynamic maneuvers are described. Problems of signal conditioning are discussed. J.M.S.

N80-19099# Technische Hogeschool, Delft (Netherlands). Dept. of Aerospace Engineering.

ANALYSIS OF AIRCRAFT PERFORMANCE STABILITY AND CONTROL MEASURES

J. A. MUlder, H. L. Jonkers, J. J. Horsten, J. H. Breeman, and J. L. Simons *In* AGARD Parameter Identification Nov. 1979 87 p refs Prepared in cooperation with National Aerospace Lab., Amsterdam

Avail: NTIS HC A16/MF A01

An overview is presented of the nonsteady flight test technique. Principal elements of this technique which is directed towards time efficient and accurate determination of performance characteristics as well as stability and control characteristics from measurements in nonsteady or quasi-steady flight, are: application of high quality flight test instrumentation systems; accurate reconstruction of the aircraft's motions; identification of nonlinear aerodynamic models; and calculation of performance, stability and control characteristics by correction of nonsteady or quasi-steady flight conditions towards prespecified nominal conditions. Main emphasis is on a tutorial exposition of the first three of these elements. In addition to the tutorial presentation some experimental results of various flight test programs are presented. J.M.S.

N80-19100*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.
AIRCRAFT IDENTIFICATION EXPERIENCE
Kenneth W. Iliff *In* AGARD Parameter Identification Nov. 1979 35 p refs
Avail: NTIS HC A16/MF A01 CSCL 01C

Important aspects of estimating the unknown coefficients of the aircraft equations of motion from dynamic flight data are presented. The primary topic is the application of the maximum likelihood estimation technique. Basic considerations that must be addressed in the estimation of stability and control derivatives from conventional flight maneuvers are discussed. Some complex areas of estimation (such as estimation in the presence of atmospheric turbulence, estimation of acceleration derivatives, and analysis of maneuvers where both kinematic and aerodynamic coupling are present) are also discussed. R.E.S.

N80-19101# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugmechanik.
ROTORCRAFT IDENTIFICATION EXPERIENCE
J. Kaletka *In* AGARD Parameter Identification Nov. 1979 32 p refs
Avail: NTIS HC A16/MF A01

An overview of the identification of stability and control derivatives of the rotorcraft with respect to practical aspects and applications is presented. First an introduction to the basic dynamics and control of helicopters is given. The helicopter characteristics causing difficulties in the identification are discussed. Measurement and sensor problems are also discussed. Approaches to overcome the difficulties are presented. Emphasis is placed on the following two key elements of the identification procedure: (1) the selection of adequate mathematical models and identifiable derivatives of the helicopter to isolate significant model effects; and (2) possibilities of increasing the information content of flight test data by appropriate system excitation and by multiple-run evaluations. Identification results obtained from simulated and flight test data of helicopters by applying different identification methods are presented. R.E.S.

N80-19102# Royal Aircraft Establishment, Farnborough (England). Flight Systems Dept.
IDENTIFICATION EXPERIENCE IN EXTREME FLIGHT REGIMES
A. Jean Ross *In* AGARD Parameter Identification Nov. 1979 15 p refs
Avail: NTIS HC A16/MF A01

A mathematical model for identifying stability and control derivatives of fighter aircraft is presented. The principles of the statistical approach are described. The treatment of the nonlinear terms is described and the tests which should be applied to assess the validity of the results are discussed. Selected results from investigations of manoeuvres at high angles of attack are presented to show the types of problems which can be solved, and to illustrate some effects of nonlinearities. R.E.S.

N80-19103# Institut de Mecanique des Fluides de Lille (France).
WIND TUNNEL AND FREE FLIGHT MODEL IDENTIFICATION EXPERIENCE
R. A. Verbrugge, W. Charon, and M. Marchand (DFVLR, Brunswick) *In* AGARD Parameter Identification Nov. 1979 33 p refs

Avail: NTIS HC A16/MF A01

An overview of different experimental techniques used for parameter identification based on dynamic model tests in wind tunnel or in free flight is presented. The specific domain of application is defined for each test technique. Particular aspects of semi-free and free model tests techniques in wind tunnel or laboratory experiences are described. Data processing from the collection until the application of identification procedure is discussed in terms of (1) the nature and quality of the information, (2) the data acquisition software, (3) the state vector elaboration, and (4) some specific filter aspects and evaluation methods. A set of results illustrate each particular point. A review of the present state of these techniques is given and future field of application is discussed. R.E.S.

N80-19104# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugmechanik.
CLOSED LOOP ASPECTS OF AIRCRAFT IDENTIFICATION
R. Koehler and K. Wilhelm *In* AGARD Parameter Identification Nov. 1979 24 p refs

Avail: NTIS HC A16/MF A01

Specific problems of system identification applied to highly augmented aircraft with respect to flying qualities assessment are discussed. An introduction to the influence of augmentation system on dynamic response and flying qualities is given. The application of parameter estimation techniques to control loop systems and problems of control loop identification and equivalent system modellization are discussed. R.E.S.

N80-19105# Arinc Research Corp., Annapolis, Md.
AVIONICS INTERFACE DATA SUMMARIES: A-10A, EF-111A, F-43, F-4G, F-15A, F-16A, F-111A, F-111E, F-111F, RF-4C
Oct. 1979 718 p refs
(Contract F33657-71-C-0567)
(AD-A077388; Rept-1750-01-2-2041) Avail: NTIS HC A99/MF A01 CSCL 01/3

This document is one of a series of reports that describe Avionics interfaces for various USAF aircraft. GRA

N80-19106# Naval Aerospace Medical Research Lab., Pensacola, Fla.
COMPARISON OF SPECIFICATIONS FOR HEAD-UP DISPLAYS IN THE NAVY A-4M, A-7E, AV-8A, AND F-14A AIRCRAFT
Lawrence H. Frank Nov. 1979 65 p refs
(ZF51524004; SF55525401)
(AD-A080047; NAMRL-SR-76-6) Avail: NTIS HC A04/MF A01 CSCL 01/4

This report provides, within a single document, a compendium of data on Head-Up Displays (HUDs) in U.S. Navy and U.S. Marine Corps aircraft that is germane to a Human Factors assessment of HUD design on pilot performance. The data in this report are compiled from current Naval Air Training and Operating Procedures Standardization (NATOPS) manuals and design specifications for each of the HUD units. Operational HUDs were found to vary dramatically from each other and the military specification for HUDs, MIL-D-81641(AS), with respect to symbology and formating. Furthermore, display clutter was reported by pilots to be a major problem. A comprehensive information processing evaluation of virtual image symbols and formating under dynamic conditions was recommended. Finally, none of the current Navy aircraft has a HUD control panel that complies to MIL-D-81641(AS), the military specification for HUDs. Pilots are required to bring their eyes back into the cockpit to ensure proper switch selection and, consequently, negate the primary purpose of maintaining a head-up mode. GRA

N80-19107# Bunker-Ramo Corp., Wright-Patterson AFB, Ohio.
FLIGHT PATH DISPLAYS Final Report, 15 Mar. - 1 Nov. 1978

Debra A. Warner Jun. 1979 106 p refs
(Contract F33615-78-C-3614; AF Proj. 2403)
(AD-A077181; AFFDL-TR-79-3075) Avail: NTIS HC A06/MF A01 CSCL 01/3

Aircraft display technology has advanced to the state where the flight path display--an integrated format on which both the vertical and horizontal path are graphically represented--is feasible. This report researches efforts made to design flight paths for use in both fixed wing and rotary wing aircraft. Results from comparison evaluations of flight path and non-flight path displays are discussed and conclusions drawn with respect to desirable display symbology. A hypothetical flight path display designed as a result of the findings in the referenced studies is proposed for future testing and evaluation. GRA

N80-19109# Calspan Advanced Technology Center, Buffalo, N.Y. Aerodynamic Research Dept.

TESTS OF AN IMPROVED ROTATING STALL CONTROL SYSTEM ON A J-85 TURBOJET ENGINE Final Technical Report, May 1976 - May 1979

Gary R. Ludwig Wright-Patterson AFB, Ohio AFAPL Aug. 1979 76 p refs
(Contract F33615-76-C-2092; AF Proj. 3066)
(AD-A077704; CALSPAN-XE-5933-A-104; AFAPL-TR-79-2060) Avail: NTIS HC A05/MF A01 CSCL 21/5

This report presents the results of testing a fast-acting rotating stall control system on a J-85 turbojet engine under sea level static conditions, both with and without inlet distortion. The control is an electronic feedback control system which uses unsteady pressure signals produced by pressure sensors within the compressor to detect incipient rotating stall and provide a correction signal when such a condition occurs. On the J-85 engine, the correction signal is used to drive a fast-response hydraulic actuator which operates intermediate stage compressor bleed doors and inlet guide vane flaps. The performance of the stall control was tested by closing the bleed doors until rotating stall occurred or until the control anticipated stall and held the bleed doors open. The tests showed that the control is capable of anticipating stall before it occurs and keeping the engine completely clear of stall at speeds up to 80 percent of design speed. No tests were performed above 80 percent of design because opening the bleed doors at such speeds might aggravate the stall rather than clear it. GRA

N80-19110*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

PRELIMINARY STUDY OF VTO THRUST REQUIREMENTS FOR A V/STOL AIRCRAFT WITH LIFT PLUS LIFT/CRUISE PROPULSION

George E. Turney and John L. Allen Feb. 1980 23 p refs
(NASA-TM-81429; E-351) Avail: NTIS HC A02/MF A01 CSCL 21E

A preliminary assessment was made of the VTO thrust requirements for a supersonic (Type B) aircraft with a Lift plus Lift/Cruise propulsion system. A baseline aircraft with a takeoff gross weight (TOGW) of 13 608 kg (30,000 lb) was assumed. Pitch, roll, and yaw control thrusts (i.e., the thrusts needed for aircraft attitude control in the flight hover mode) were estimated based on a specified set of maneuver acceleration requirements for V/STOL aircraft. Other effects (such as installation losses, suckdown, reingestion, etc.), which add to the thrust requirements for VTO were also estimated. For the baseline aircraft, the excess thrust required for attitude control of the aircraft during VTO and flight hover was estimated to range from 36.9 to 50.9 percent of the TOGW. It was concluded that the total thrust requirements for the aircraft/propulsion system are large and significant. In order to achieve the performance expected of this aircraft/propulsion system, reductions must be made in the excess thrust requirements. J.M.S.

N80-19111*# National Aeronautics and Space Administration, Washington, D. C.

STRUCTURAL ANALYSIS OF HOLLOW BLADES: TORSIONAL STRESS ANALYSIS OF HOLLOW FAN BLADES FOR AIRCRAFT JET ENGINES

A. Ogawa, Y. Sofue, and T. Isobe Oct. 1979 25 p refs Transl. into ENGLISH of "Chukuyoku no Kozokaiseki," Rept. NAL-TR-533 Natl. Aerospace Lab., Tokyo, May 1977, 15 p Transl. by Kanner (Leo) Associates, Redwood City, Calif.
(Contract NASw-3199)
(NASA-TM-75718; NAL-TR-533) Avail: NTIS HC A02/MF A01 CSCL 21E

A torsional stress analysis of hollow fans blades by the finite element method is presented. The fans are considered to be double circular arc blades, hollowed 30 percent, and twisted by a component of the centrifugal force by the rated revolution. The effects of blade hollowing on strength and rigidity are discussed. The effects of reinforcing webs, placed in the hollowed section in varying numbers and locations, on torsional rigidity and the convergence of stresses, are reported. A forecast of the 30 percent hollowing against torsional loadings is discussed. A.W.H.

N80-19112# Royal Aircraft Establishment, Farnborough (England).

CONTRIBUTION OF PHOTOELASTIC ANALYSIS TO THE STUDY OF TURBO-ENGINE COMPONENTS

J. L. Guillo Nov. 1979 34 p Transl. into ENGLISH from AGARD Conf. Proc. No. 248, Apr. 1979
(BR71985; RAE-Lib-Trans-2028) Avail: NTIS HC A03/MF A01

Photoelastic measurements which determine the local stress concentrations, and the method of stress freezing in the analysis of three dimensional stress states are discussed in relation to jet engine components. The means employed for the preparation and carrying out of freezing operations and the equipment used in the operation are described. Examples of applying photoelastic measurement and stress freezing operations are presented. Emphasis is placed on the determination of the stress intensity factor which governs crack propagation under cyclic stress application. A.W.H.

N80-19113*# Pratt and Whitney Aircraft Group, East Hartford, Conn. Commercial Products Div.

CORE COMPRESSOR EXIT STAGE STUDY. 1: AERODYNAMIC AND MECHANICAL DESIGN

E. A. Burdsall, E. Canal, Jr., and K. A. Lyons Sep. 1979 128 p ref
(Contract NAS3-20578)
(NASA-CR-159714; PWA-5561-55) Avail: NTIS HC A07/MF A01 CSCL 21E

The effect of aspect ratio on the performance of core compressor exit stages was demonstrated using two three stage, highly loaded, core compressors. Aspect ratio was identified as having a strong influence on compressors endwall loss. Both compressors simulated the last three stages of an advanced eight stage core compressor and were designed with the same 0.915 hub/tip ratio, 4.30 kg/sec (9.47 lbm/sec) inlet corrected flow, and 167 m/sec (547 ft/sec) corrected mean wheel speed. The first compressor had an aspect ratio of 0.81 and an overall pressure ratio of 1.357 at a design adiabatic efficiency of 88.3% with an average diffusion factor or 0.529. The aspect ratio of the second compressor was 1.22 with an overall pressure ratio of 1.324 at a design adiabatic efficiency of 88.7% with an average diffusion factor of 0.491. R.C.T.

N80-19114# American Inst. of Aeronautics and Astronautics, New York.

THE 4TH INTERNATIONAL SYMPOSIUM ON AIR BREATHING ENGINES

Apr. 1979 425 p refs Symp. held at Lake Buena Vista, Orlando, Fla., 1-6 Apr. 1979
(Grant N00014-77-G-0069)
(AD-A078956) Avail: NTIS HC A18/MF A01 CSCL 21/5

Partial Contents: Inlet Flow Distortion; Operations/Cost/Maintenance; Aeroelasticity/Vibrations; Systems Integration; Fuels and Combustion; 3 Dimensional Flow and Boundary Layer/Shock Separation; Component Developements Compressors; and Ramjets. GRA

N80-19115# Calspan Advanced Technology Center, Buffalo, N.Y. Aerodynamic Research Dept.
BASIC STUDIES OF ROTATING STALL IN AXIAL FLOW COMPRESSORS Final Report, Jun. 1976 - Apr. 1979
Gary R. Ludwig and Joseph P. Nenni Sep. 1979 150 p refs
(Contract F33615-76-C-2092; AF Proj. 3066)
(AD-A077690; CALSPAN-XE-5933-A-105;
AFAPL-TR-79-2083) Avail: NTIS HC A07/MF A01 CSCL 21/5

This report presents the results of a theoretical and experimental program aimed at obtaining a sufficient understanding of the rotating stall phenomena such that its onset and properties can be predicted under a wide set of circumstances. The theoretical research covers the development of two dimensional stability theories for compressible flows and the progress towards the development of a three dimensional theory for incompressible flow. The experimental work, performed in an annular cascade facility, studied the effects of rotorstator interference both on the steady-state performance of the blade rows and on rotating stall. The influence of circumferential distortion on the rotating stall boundary for the stage was also determined. Comparisons are made between the experimental results and the predictions of a two dimensional rotating stall stability theory which had been developed previously for incompressible flows. GRA

N80-19116# Calspan Advanced Technology Center, Buffalo, N.Y. Aerodynamic Research Dept.
AERODYNAMIC AND ACOUSTIC INVESTIGATIONS OF AXIAL FLOW FAN AND COMPRESSOR BLADE ROWS, INCLUDING THREE-DIMENSIONAL EFFECTS Final Report, 1 Jun. 1976 - 31 Mar. 1979
Gregory F. Homicz, John A. Lordi, and Gary R. Ludwig Aug. 1979 145 p refs
(Contract F33615-76-C-2092; AF Proj. 3066)
(AD-A077712; CALSPAN-XE-5933-A-103;
AFAPL-TR-79-2061) Avail: NTIS HC A07/MF A01 CSCL 21/5

This report presents the results of a program designed to study the influence of three-dimensional effects on the aerodynamics and acoustics of axial flow fans and compressors. To avoid numerical solutions of the full nonlinear three-dimensional equations, a linearized analysis is employed. This is first applied to the determination of the steady loading on a three-dimensional annular blade row with a prescribed chamber line in inviscid compressible flow. The blades are represented by pressure dipole singularities in a lifting-surface formulation, and a collection procedure is presented for inverting the resulting integral equation. Comparisons are presented between the present results and those of two-dimensional strip theory and an inverse three-dimensional theory. Next the analysis is extended to the case of unsteady flow through the rotor, such as might be caused by inflow distortion or blade flutter. The integral equation for this case is somewhat more complicated, but appears to be solvable by a suitable extension of the procedure developed in the steady problem. Finally, further comparisons are presented between a theoretical model of rotor-stator interaction noise developed under a previous program and a current series of measurements made in an annular cascade facility. GRA

N80-19117# Systems Control, Inc., Palo Alto, Calif.
VARIABLE CYCLE ENGINE MULTIVARIABLE CONTROL SYNTHESIS: CONTROL STRUCTURE DEFINITION Interim Report, 1 Sep. 1977 - 31 Aug. 1978
Stephen M. Rock and Ronald L. DeHoff Feb. 1979 174 p refs
(Contract F33615-77-C-2096; AF Proj. 3006)
(AD-A078670; AFAPL-TR-79-2043) Avail: NTIS HC A08/MF A01 CSCL 21/5

The variable cycle aircraft turbine engine, GE23-JTDE, represents a prototype of future multimode propulsion plants. It is a sophisticated design of highly variable geometry and multiple control inputs. To control this engine, a large number of engine variables must be sensed. These include engine pressures, temperatures, rotor speeds, and airframe and inlet commands. A controller for this engine must therefore be multivariable (i.e., manipulating large numbers of input and output variables) and multifunctional (i.e., perform, in addition to control logic, data conditioning and fault diagnosis). The development of such a full authority digital electronic controller must utilize demonstrated multivariable design techniques to integrate adequately these complex system functions. A preliminary design of a controller for this variable cycle engine is described. It is implementable on a small digital computer (less than 16K words of storage), and is modular in design (subroutine format). Specific controller functions of transient regulation, steady state regulation, trajectory generation, signal processing, and fault detection and accommodation are incorporated in a way which allows experimentation with different techniques for each function without affecting the overall structure. Promising techniques for implementing each function are discussed. GRA

N80-19118# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
NOVEL CERAMIC TURBINE ROTOR CONCEPTS Final Technical Report, 22 Sep. 1978 - 22 May 1979
L. J. Stoffer Wright-Patterson AFB, Ohio AFAPL Sep. 1979 93 p refs
(Contract F33615-78-C-2041; AF Proj. 3066)
(AD-A078669; R79AEG527; AFAPL-TR-79-2074) Avail: NTIS HC A05/MF A01 CSCL 21/5

A novel design concept for a ceramic turbine rotor has been studied in detail for a non-man-rated, limited-life gas turbine engine application. The feature of the design involves keeping the rotating ceramic components in a compression state at all turbine operating conditions. An air-cooled composite material containment hoop is utilized at the outer diameter of ceramic air-cooled fins which support ceramic turbine blades in compression against a radially compliant wheel. The design study of this Compression Structured Ceramic Turbine Rotor included detailed material, heat transfer, and 3-D stress analyses. The study effort also looked at the operational limits of the design and a performance and economic analysis comparison to a baseline metal design. Conclusions and recommendations for future development are also presented in this report. GRA

N80-19119# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
EVALUATION OF FUEL CHARACTER EFFECTS ON J79 ENGINE COMBUSTION SYSTEM Final Technical Report, 7 Jun. 1977 - 31 Aug. 1978
C. C. Gleason, T. L. Oller, M. W. Shayerson, and D. W. Bahr Jun. 1979 198 p refs
(Contract F33615-77-C-2042; AF Proj. 3048)
(AD-A078440; R79AEG321; AFAPL-TR-79-2015;
CEEDO-TR-79-06) Avail: NTIS HC A09/MF A01 CSCL 21/5

Results of a program to determine the effects of broad variations in fuel properties on the performance, emissions, and durability of the J79-17A turbojet engine combustion system are presented. Combustor tests conducted at engine idle, takeoff, subsonic cruise, supersonic dash, cold day ground start, and altitude relight operating conditions with 13 different fuels are described. The test fuels covered a range of hydrogen contents (12.0 to 14.5 percent), aromatic type (monocyclic and bicyclic), initial boiling point (285 to 393 K), final boiling point (552 to 679 K) and viscosity (0.83 to 3.25 mm2/s at 300 K). At high power operating conditions, fuel hydrogen content was found to be a very significant fuel property with respect to linear temperature, flame radiation, smoke, and NO sub x emission levels. Carbon monoxide and HC emissions were very low at these conditions with all of the fuels. At engine idle operating conditions, CO, HC, and NO sub x emission levels were found to be independent of fuel hydrogen content, but a small effect of fuel volatility and/or viscosity was found. At cold day ground start conditions (to 329 K) lightoff was obtained with all fuels, but the required fuel-air ratio increased with the more viscous fuels. At altitude conditions, the current engine relight limits with JP-4/JP-5 fuel were essentially met or exceeded with all of the JP-4 or JP-8 based fuel blends. However, a very significant reduction in altitude relight capability was found when a No. 2 diesel fuel was tested. GRA

N80-19120# Pratt and Whitney Aircraft Group, West Palm Beach, Fla. Government Products Div.
INVESTIGATION OF FAN BLADES SHROUD MECHANICAL DAMPING
Donald A. Rimkunas and H. Murray Frye Jun. 1979 79 p refs
(Contract F33615-77-C-2086; AF Proj. 2307)
(AD-A078439; PWA-FR-11065; AFAPL-TR-79-2054) Avail: NTIS HC A05/MF A01 CSCL 21/5

This program was conducted to investigate the effect of dry friction damping at the shroud interfaces on the structural dynamic characteristics of shrouded fan blades typical of current high performance jet engines. An analytical definition of the loads generated at the shroud faces for a general stick-slip condition was developed. The analytical load description includes the elastic case of a stuck or locked shroud as well as the case of a slipping shroud. These loads were used in a non-linear steady-state vibration analysis of the shrouded blade. Controlled vibration testing of the first-stage fan blade with a trailing edge shroud of a YF100 (prototype) turbofan engine was conducted. The blade was tested with variable shroud restraints to simulate the full range of boundary conditions from freely slipping to fully locked, including the intermediate condition of micro-slipping. The testing of the blade with a freely slipping shroud was inconclusive because of repeatability problems. Good agreement was found between the nonlinear analysis and test data for the stuck and micro-slip boundary conditions. GRA

N80-19122# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics.
AN ANALYSIS AND SYNTHESIS OF ENGINE CONDITION MONITORING SYSTEMS M.S. Thesis
Jack W. Chapman, Jr. and Charles L. Page, Jr. Sep. 1979 138 p refs
(AD-A077531; AFIT-LSSR-27-79B) Avail: NTIS HC A07/MF A01 CSCL 21/5

Engine condition monitoring systems have been developed to assist flight line maintenance activities and aid in the transition of aircraft engine maintenance philosophy from that of maximum operating time to reliability centered or on condition maintenance. This study includes a comprehensive review of past, current, and proposed Air Force applications of turbine engine monitoring systems to describe the major features of TEMS. Engine performance data output from TEMS to the various engine management functions are analyzed. The authors conclude that TEMS data and the existing or proposed engine management systems are not directly compatible. Moreover, the analysis indicates that implementation of TEMS and an on condition maintenance policy would require a greatly expanded data base to accomplish the required engine management record keeping, monitoring, and forecasting tasks. Several recommendations are offered for interfacing TEMS with the engine management systems. Areas for further research are suggested. GRA

N80-19123# AiResearch Mfg. Co., Phoenix, Ariz.
DEMONSTRATION PROGRAM FOR A FLEXIBLE DUCT VALVE FOR RAMJET ENGINE FUEL CONTROLS Final Report, 15 Nov. 1978 - 28 Feb. 1979
James S. Roundy 14 Sep. 1979 67 p refs
(Contract N62269-77-C-0352)
(AD-A078529; AiResearch-41-2226; NADC-77136-60) Avail: NTIS HC A04/MF A01 CSCL 21/5

A demonstration program was conducted to develop a flex duct-type metering valve for use in the fuel control of ramjet engines for Navy missiles. This type valve has inherent advantages of simplicity, low cost, and high reliability that make it particularly attractive for this application. This type valve functions best when the leakage flow from the metering gap is bypassed back upstream of the fuel pump. GRA

N80-19124# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group
ADVANCED INFRARED SIGNATURE PREDICTION PROGRAM. SPECTRAL CALCULATION OF RADIATION FROM A TURBINE PROPULSION SYSTEM AS INTERCEPTED BY AN OBSERVER (SCORPION). VOLUME 3: ANALYSIS
M. E. Wilton Nov. 1979 235 p refs
(Contract N00140-76-C-1072)
(AD-A078436; R78AEG314) Avail: NTIS HC A11/MF A01 CSCL 17/5

Current infrared-guided missiles can detect and destroy aircraft from relatively long distances. Future IR missiles will be even more sensitive and destructive. The engine designer must select cycles and engine configurations that present as small a target as possible to these missile threats. To accomplish this, he must know the IR emissions from the aircraft and be able to judge the success of schemes to suppress these emissions. Measurements are invaluable in determining the IR emissions for selected aircraft situations but cannot possibly be made for all aircraft and for all situations. This is obviously true in the engine design phase. In addition, understanding of the fundamental sources of these emissions is essential to the invention or evaluation of new suppression concepts. An accurate prediction pool, therefore, is vital to the process of reducing the vulnerability of an aircraft to IR-guided missiles. As a supplier of jet engines for military aircraft, the General Electric Company has developed a series of computer programs to predict the IR signatures and vulnerability of IR-guided missiles. The SCORPIO-N computer program presented in this report is the latest in the series. It is an outgrowth of the SCORPIO-IIIA program (Reference 1) and the SPRITE program (Reference 2) with improvements to the plume module which permit studies of truly three-dimensional flow fields. GRA

N80-19125# Vought Corp., Dallas, Tex.
POWER SYSTEM CONTROL STUDY. PHASE 1: INTEGRATED CONTROL TECHNIQUES Interim Report, 1 Jul. 1978 - 15 Jun. 1979
D. E. Lautner, A. J. Marek, and J. R. Perkins Wright-Patterson AFB, Ohio AFAPL Jun. 1979 240 p refs
(Contract F33615-78-C-2018; AF Proj. 3145)
(AD-A078629; AFAPL-TR-79-2084) Avail: NTIS HC A11/MF A01 CSCL 01/3

This report documents the Phase 1 results of a two phase study program which addresses the integration of advanced power system control technologies into a reliable and fault tolerant system. The advanced control technologies integrated include electric engine start, automatic load management, microprocessor control implementations, design techniques for providing 'no-gap' power and an all 'solid state' electric power distribution system. Electric system performance requirements are established and preliminary designs of an integrated 'baseline' control system for single and multiengine aircraft for the 1990 operational time period are presented. Finally, stability analysis requirements and procedures are established for each of the two designs. During Phase 2, detail design of the power control system will be completed and a stability analysis will be conducted. GRA

N80-19126*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
APPLICATION OF THE CONCEPT OF DYNAMIC TRIM CONTROL TO AUTOMATIC LANDING OF CARRIER AIRCRAFT
G. Allan Smith and George Meyer Apr. 1980 87 p refs
(NASA-TP-1512; A-7801) Avail: NTIS HC A05/MF A01 CSCL 01C

The results of a simulation study of an alternative design concept for an automatic landing control system are presented. The alternative design concept for an automatic landing control system is described. The design concept is the total aircraft flight control system (TAFCOS). TAFCOS is an open loop, feed forward system that commands the proper instantaneous thrust, angle of attack, and roll angle to achieve the forces required to follow the desired trajector. These dynamic trim conditions are determined by an inversion of the aircraft nonlinear force characteristics. The concept was applied to an A-7E aircraft approaching an aircraft carrier. The implementation details with an airborne digital computer are discussed. The automatic carrier landing situation is described. The simulation results are presented for a carrier approach with atmospheric disturbances, an approach with no disturbances, and for tailwind and headwind gusts. A.W.H.

N80-19127*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
FLIGHT EVALUATION OF CONFIGURATION MANAGEMENT SYSTEM CONCEPTS DURING TRANSITION TO THE LANDING APPROACH FOR A POWERED-LIFT STOL AIRCRAFT
James A. Franklin and Robert C. Innis Mar. 1980 32 p refs (NASA-TM-81146; A-7957) Avail: NTIS HC A03/MF A01 CSCL 01C

Flight experiments were conducted to evaluate two control concepts for configuration management during the transition to landing approach for a powered-lift STOL aircraft. NASA Ames' augmentor wing research aircraft was used in the program. Transitions from nominal level-flight configurations at terminal area pattern speeds were conducted along straight and curved descending flightpaths. Stabilization and command augmentation for attitude and airspeed control were used in conjunction with a three-cue flight director that presented commands for pitch, roll, and throttle controls. A prototype microwave system provided landing guidance. Results of these flight experiments indicate that these configuration management concepts permit the successful performance of transitions and approaches along curved paths by powered-lift STOL aircraft. Flight director guidance was essential to accomplish the task. Author

N80-19128# Systems Research Labs., Inc., Dayton, Ohio.
HANDLING QUALITY REQUIREMENTS FOR ADVANCED AIRCRAFT DESIGN LONGITUDINAL MODE Final Report, Feb. 1977 - Aug. 1978
Ralph H. Smith and Norman D. Geddes Aug. 1979 185 p refs
(Contract F33615-77-C-3011; AF Proj. 2090)
(AD-A077858; AFFDL-TR-78-154) Avail: NTIS HC A09/MF A01 CSCL 01/3

This report considers the problem of developing handling qualities specifications for aircraft with nonclassical dynamic response to control. These include closed loop flight control system effects on basic airframe dynamics, direct force control applications, digital flight control, integrated fire-flight control, and integrated display-flight control. Only the longitudinal mode is considered. Elements of classic pilot-vehicle analysis methodology are distilled against a theoretical framework for the prediction of pilot opinion rating to develop a simplified and practical approach to handling qualities prediction that is directly applicable to the development of specificatons for aircraft flight control system design. The most important effects of motion cues on handling qualities are included within this model. The methods proposed for the prediction and correlation of handling qualities are validated against the largest and most appropriate base of handling qualities data available; the agreement is nearly 100 percent. GRA

N80-19129# Naval Academy, Annapolis, Md.
MICROPROCESSOR CONTROL OF LOW SPEED V/STOL FLIGHT Final Report, 1978 - 1979
Robert V. Walters 8 Jun. 1979 203 p refs
(AD-A077661; USNA-TSPR-100) Avail: NTIS HC A10/MF A01 CSCL 01/4

This paper considers the design of an improved three-axis stability augmentation system (SAS) for the AV-8B Advanced Harrier V/STOL aircraft using microprocessor-based digital control. It focuses on improving the handling qualities of the airplane through SAS redesign in the low speed flight regime. Particular attention is paid to the so-called 'weather-cocking' instability encountered in transition (hover to/from conventional) flight. There was a dearth of information about the Harrier's flight characteristics until the development of MCAIR's X22A AV-8B mathematical model, which yielded a set of linearized stability derivatives for the aircraft. The first step toward improvement of the AV-8B SAS requires the use of these coefficients in the development of an analog/hybrid model of both the aircraft itself and of the unmodified SAS. The controller design uses digital state feedback control to relocate the system closed loop poles. It is concluded that this method of control represents a valid approach to the final solution of the Harrier's stability and control problems and that this controller design concept might be applied to future aerospace vehicles. GRA

N80-19130# Federal Aviation Administration, Washington, D. C.
NONDESTRUCTIVE EVALUATION OF AIRPORT PAVEMENTS. VOLUME 2: OPERATIONAL MANUAL FOR PAVBEN PROGRAM AT TCC Final Report
David Yang Sep. 1979 123 p
(Contract DOT-FA77WA-3964)
(AD-A079495; FAA-RD-78-154-Vol-2) Avail: NTIS HC A06/MF A01 CSCL 01/5

The operation of PAVBEN program is presented. The job inputs consist of: (1) field data; (2) types of existing pavements; (3) facility classifications; (4) demand forecast and (5) local cost values. The default system contains all design data for: (1) 15 air transports; (2) 9 FAA regional cost values; (3) 8 types of pavement design; (4) 22 layer components; (5) 20 types of existing pavement and (6) universal mechanistic design model. The major outputs will be: (1) NDT inventory file; (2) present functional life; (3) computed engineering data; (4) pavement thickness and cost data and (5) cost/benefit analysis for four new pavements, three overlays and three keel constructions. The program is written in a high level language FORTRAN IV. R.E.S.

N80-19131*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A THEORETICAL ANALYSIS OF SIMULATED TRANSONIC BOUNDARY LAYERS IN CRYOGENIC-NITROGEN WIND TUNNELS
Jerry B. Adcock and Charles B. Johnson Mar. 1980 40 p refs
(NASA-TP-1631; L-13364) Avail: NTIS HC A03/MF A01 CSCL 14B

A theoretical analysis was made to determine the real gas effects on simulation of transonic boundary layers in wind tunnels with cryogenic nitrogen as the test gas. The analysis included laminar and turbulent flat plate boundary layers and turbulent boundary layers on a two dimensional airfoil. The results indicate that boundary layers in such wind tunnels should not be substantially different from ideal gas boundary layers at standard conditions. At a pressure of 9.0 atm, two separate effects produce deviations of real gas values from ideal gas values which are in the opposite direction from deviations at 1.0 atm and are of the same insignificant order of magnitude. Results also show that nonadiabatic boundary layers should be adequately simulated if the enthalpy ratio is the correlating parameter rather than the temperature ratio. J.M.S.

N80-19132*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
DESIGN CONSIDERATIONS FOR ATTAINING 250-KNOT TEST VELOCITIES AT THE AIRCRAFT LANDING DYNAMICS FACILITY
C. E. Gray, Jr., R. E. Snyder, J. T. Taylor, A. Cires, A. L. Fitzgerald, and M. F. Armistead Feb. 1980 29 p refs
(NASA-TM-80222) Avail: NTIS HC A03/MF A01 CSCL 14B

Preliminary design studies are presented which consider the important parameters in providing 250 knot test velocities at the Aircraft Landing Dynamics Facility. Four major components of this facility are: the hydraulic jet catapult, the test carriage structure, the reaction turning bucket, and the wheels. Using the hydraulic-jet catapult characteristics, a target design point was selected and a carriage structure was sized to meet the required strength requirements. The preliminary design results indicate that to attain 250 knot test velocities for a given hydraulic jet catapult system, a carriage mass of 25,424 kg (56,000 lbm.) cannot be exceeded. R.E.S.

N80-19133*# National Aeronautics and Space Administration, Washington, D. C.
METHODS OF SOUND SIMULATION AND APPLICATIONS IN FLIGHT SIMULATORS
K.-P. Gaertner Jan. 1980 98 p refs Transl. into ENGLISH of "Methoden der Gerawuschsimulation und ihre Anwendung in Flugsimulatoren", Rept-22, Gesellschaft zur Foederund der Astrophysikalischen forschung E. V., Forschungsinstitut fuer Antropotechnik, Meckenheim, West Germany, Apr. 1975 105 p Translation was announced as N77-29179 Transl. by

Kanner (Leo) Associates, Redwood City, Calif.
(Contract NASw-3199)
(NASA-TM-75768; Rept-22) Avail: NTIS HC A05/MF A01 CSCL 14B

An overview of methods for electronically synthesizing sounds is presented. A given amount of hardware and computer capacity places an upper limit on the degree and fidelity of realism of sound simulation which is attainable. Good sound realism for aircraft simulators can be especially expensive because of the complexity of flight sounds and their changing patterns through time. Nevertheless, the flight simulator developed at the Research Institute for Human Engineering, West Germany, shows that it is possible to design an inexpensive sound simulator with the required acoustic properties using analog computer elements. The characteristics of the sub-sound elements produced by this sound simulator for take-off, cruise and approach are discussed. Author

N80-19135# ARO, Inc., Arnold Air Force Station, Tenn.
LASER-RAMAN FLOW-FIELD DIAGNOSTICS OF TWO LARGE HYPERSONIC TEST FACILITIES Final Report, 13 Apr. 1977 - 10 Jul. 1978
W. D. Williams, D. A. Wagner, H. M. Powell, and L. L. Price
AEDC Dec. 1979 41 p refs
(AD-A078289; AEDC-TR-7988) Avail: NTIS HC A03/MF A01 CSCL 14/2

Laser-Raman scattering has been utilized to discover nonequilibrium N2 vibrational levels in a continuous, resistance-heated wind tunnel (Tunnel C) and in an arc-heated wind tunnel (Tunnel F). Vibrational temperatures of up to two times the bulk reservoir temperature have been measured in the Tunnel F free stream. A double-diaphragm device for delay of the Tunnel F nozzle expansion was found to significantly reduce the vibrational temperature level. In tunnel C, the vibrational temperatures were found to be dependent upon the water vapor concentration in the flow. It is hypothesized that water vapor-induced de-excitation of the vibrationally excited nitrogen molecules results in a significant rise in local static temperature and corresponding reduction in Mach number. GRA

N80-19136# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
THE HISTORY OF STATIC TEST AND AIR FORCE STRUCTURES TESTING Final Technical Report
Bernard C. Boggs Jun. 1979 299 p refs
(AD-A077029; AFFDL-TR-79-3071) Avail: NTIS HC A13/MF A01 CSCL 14/2

This report traces the history of aircraft static testing from its early beginning and follows the development of structures testing in the United States Air Force from 1917 to 1979. Those technologies that are related to structures testing are included which were important to airplane structures strength. Test technology development which provided test facilities, tests systems and test methods are covered for the static, dynamic, fatigue, and environmental simulation of subsonic, sonic, supersonic, hypersonic and re-entry aircraft missions. GRA

N80-19137# Advisory Group for Aerospace Research and Development, Paris (France).
TOWARD NEW TRANSONIC WINDTUNNELS
J. P. Hartzuiker, ed. (National Aerospace Lab., Amsterdam) Nov. 1979 78 p refs
(AGARD-AG-240; ISBN-92-835-1343-6) Avail: NTIS HC A05/MF A01

Cryogenic concepts for transonic wind tunnels are examined including discussions of tunnel drive and support systems, tunnel performance, and cryogenic aerodynamics. Also presented is an investigation of the flow quality of three transonic tunnels with differing drive mechanisms. Factors effecting a more complete determination of tunnel flow quality are discussed.

N80-19138# Royal Aircraft Establishment, Bedford (England).
AN INVESTIGATION OF THE QUALITY OF THE FLOW GENERATED BY THREE TYPES OF WIND TUNNEL (LUDWIEG TUBE, EVANS CLEAN TUNNEL AND INJECTOR DRIVEN TUNNEL)
P. G. Pugh, H. Grauer-Carstensen (DFVLR, Goettingen, West Germany), and C. Quemard (CERT, Toulouse) *In* AGARD Towards New Transonic Windtunnels Nov. 1979 23 p refs

Avail: NTIS HC A05/MF A01

Flow quality in three wind tunnels with differing drive systems is examined. The investigation included measurements of (1) fluctuating static pressure on the sidewall of the test section; (2) turbulence immediately upstream of the contraction and in the test section; (3) fluctuations of flow angle (both pitch and yaw) in the test section; and (4) fluctuations of both pitot and static pressures in the test section flow. Factors important to the description of wind tunnel flow quality are also discussed. It is shown that the use of fluctuating static pressure as in index of flow quality in invalid when comparing wind tunnels having different forms of drive system or, possibly, even widely different types of test section. Fluctuations in flow angle are of much more direct consequence to the gathering of the usual types of data and can be measured using either appropriately designed yawmeters or with hot-film probes. M.H.

N80-19139*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
DEVELOPMENT OF THE CRYOGENIC TUNNEL CONCEPT AND APPLICATION TO THE US NATIONAL TRANSONIC FACILITY
Robert A. Kilgore *In* AGARD Towards New Transonic Windtunnels Nov. 1979 27 p refs

Avail: NTIS HC A05/MF A01 CSCL 14B

A fan-driven, high Reynolds number, transonic cryogenic wind tunnel is described. The tunnel has a 2.5- by 2.5 m test section and is capable of operating from ambient to cryogenic temperatures at stagnation pressures up to 8.8 atm. An overview of the cryogenic concept and discussions of drive power requirements, support systems, and operating characteristics and performance of the wind tunnel are included. M.G.

N80-19140# National Aerospace Lab., Amsterdam (Netherlands).
THE CRYOGENIC WIND TUNNEL: ANOTHER OPTION FOR THE EUROPEAN TRANSONIC FACILITY
J. P. Hartzuiker, J. Christophe (ONERA, Paris), W. Lorenz-Meter (DFVLR, Goettingen, West Germany), and P. G. Pugh (RAE, Bedford, England) *In* AGARD Towards New Transonic Wintunnels Nov. 1979 15 p refs

Avail: NTIS HC A05/MF A01

A cryogenic wind tunnel concept is discussed. The tunnel should have a maximum stagnation pressure of 6 bars, 10 seconds running time, and the Reynolds number (based on mean aerodynamic chord) should be variable between 25 and 40 million, to enable extrapolation of test results to full scale conditions. The advantages and drawbacks of cryogenic testing as well as fundamental aspects of cryogenic aerodynamics are discussed. Comparative estimates for capital and operating costs are finally presented. M.G.

N80-19193*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ASSESSMENT OF CARBON FIBER ELECTRICAL EFFECTS
Washington Mar. 1980 278 p refs Conf. held in Hampton, Va., 4-5 Dec. 1979
(NASA-CP-2119; L-13503) Avail: NTIS HC A13/MF A01 CSCL 11D

The risks associated with the use of carbon fiber composites in civil aircraft are discussed along with the need for protection of civil aircraft equipment from fire-released carbon fibers. The size and number of carbon fibers released in civil aircraft crash fires, the downwind dissemination of the fibers, their penetration into buildings and equipment, and the vulnerability of electrical/electronic equipment to damage by the fibers are assessed.

N80-19194*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
APPROACH TO THE ASSESSMENT OF THE HAZARD
Robert J. Huston *In its* Assessment of Carbon Fiber Elec. Effects Mar. 1980 p 11-27 refs

Avail: NTIS HC A13/MF A01 CSCL 11D
An overview of the carbon fiber hazard assessment is presented. The potential risk to the civil sector associated with the accidental release of carbon fibers from aircraft having composite structures was assessed along with the need for protection of civil aircraft from carbon fibers. K.L.

N80-19195*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
RELEASE OF CARBON FIBERS FROM BURNING COMPOSITES
Vernon L. Bell *In its* Assessment of Carbon Fiber Elec. Effects Mar. 1980 p 29-57

Avail: NTIS HC A13/MF A01 CSCL 11D
The results of a burn/explosion test program are presented. The amount of fiber released and the physical characteristics of the fibers are among the data reported. K.L.

N80-19196*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
DISSEMINATION, RESUSPENSION, AND FILTRATION OF CARBON FIBERS
Wolf Elber *In its* Assessment of Carbon Fiber Elec. Effects Mar. 1980 p 59-71

Avail: NTIS HC A13/MF A01 CSCL 11D
Carbon fiber transport was studied using mathematical models established for other pollution problems. It was demonstrated that resuspension is not a major factor contributing to the risk. Filtration and fragmentation tests revealed that fiber fragmentation shifts the fiber spectrum to shorter mean lengths in high velocity air handling systems. K.L.

N80-19197*# Bionetics Corp., Hampton, Va.
EVALUATION OF EQUIPMENT VULNERABILITY AND POTENTIAL SHOCK HAZARDS
Israel Taback *In* NASA. Langley Res. Center Assessment of Carbon Fiber Elec. Effects Mar. 1980 p 73-99

Avail: NTIS HC A13/MF A01 CSCL 11D
The vulnerability of electric equipment to carbon fibers released from aircraft accidents is investigated and the parameters affecting vulnerability are discussed. The shock hazard for a hypothetical set of accidents is computed. K.L.

N80-19198*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
LARGE-SCALE FIBER RELEASE AND EQUIPMENT EXPOSURE EXPERIMENTS
R. A. Pride *In its* Assessment of Carbon Fiber Elec. Effects Mar. 1980 p 101-136 refs

Avail: NTIS HC A13/MF A01 CSCL 11D
Outdoor tests were conducted to determine the amount of fiber released in a full scale fire and trace its dissemination away from the fire. Equipment vulnerability to fire released fibers was assessed through shock tests. The greatest fiber release was observed in the shock tube where the composite was burned with a continuous agitation to total consumption. The largest average fiber length obtained outdoors was 5 mm. K.L.

N80-19199*# Bionetics Corp., Hampton, Va.
SURVEYS OF FACILITIES FOR THE POTENTIAL EFFECTS FROM THE FALLOUT OF AIRBORNE GRAPHITE FIBERS
Ansel J. Butterfield *In* NASA. Langley Res. Center Assessment of Carbon Fiber Elec. Effects Mar. 1980 p 137-149

Avail: NTIS HC A13/MF A01 CSCL 11D

The impact of the entry of graphite fibers into workplaces in the United States is discussed. Areas where an electrical failure could cause major problems include process and production systems, hospitals, and police/fire emergency communication systems. K.L.

N80-19200*# Operations Research, Inc., Silver Spring, Md.
ASSESSMENT OF THE RISK DUE TO RELEASE OF CARBON FIBER IN CIVIL AIRCRAFT ACCIDENTS, PHASE 2
Leon S. Pocinki, Merrill E. Cornell, and Lawrence Kaplan *In* NASA. Langley Res. Center Assessment of Carbon Fiber Elec. Effects Mar. 1980 p 157-182 refs

(Contract NAS1-15379)
Avail: NTIS HC A13/MF A01 CSCL 11D
The risk associated with the potential use of carbon fiber composite material in commercial jet aircraft is investigated. A simulation model developed to generate risk profiles for several airports is described. The risk profiles show the probability that the cost due to accidents in any year exceeds a given amount. The computer model simulates aircraft accidents with fire, release of fibers, their downwind transport and infiltration of buildings, equipment failures, and resulting ecomomic impact. The individual airport results were combined to yield the national risk profile. A.W.H.

N80-19201*# Little (Arthur D.), Inc., Boston, Mass.
ASSESSMENT OF RISK DUE TO THE USE OF CARBON FIBER COMPOSITES IN COMMERCIAL AND GENERAL AVIATION
J. Fiksel, Donald Rosenfield, and A. Kalelkar *In* NASA. Langley Res. Center Assessment of Carbon Fiber Elec. Effects Mar. 1980 p 183-211 refs

Avail: NTIS HC A13/MF A01 CSCL 11D
The development of a national risk profile for the total annual aircraft losses due to carbon fiber composite (CFC) usage through 1993 is discussed. The profile was developed using separate simulation methods for commercial and general aviation aircraft. A Monte Carlo method which was used to assess the risk in commercial aircraft is described. The method projects the potential usage of CFC through 1993, investigates the incidence of commercial aircraft fires, models the potential release and dispersion of carbon fibers from a fire, and estimates potential economic losses due to CFC damaging electronic equipment. The simulation model for the general aviation aircraft is described. The model emphasizes variations in facility locations and release conditions, estimates distribution of CFC released in general aviation aircraft accidents, and tabulates the failure probabilities and aggregate economic losses in the accidents. A.W.H.

N80-19202*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
PERSPECTIVE ON THE RESULTS
Robert J. Huston *In its* Assessment of Carbon Fiber Elec. Effects Mar. 1980 p 213-223 refs

Avail: NTIS HC A13/MF A01 CSCL 11D
The results of studies on the risk due to the use of carbon fibers in aircraft are assessed. Assumptions such as additional fire protection in the aircraft, new structural concepts, and the development of unique carbon composites are evaluated. Some findings from the national risk profile including equipment vulnerability and economic impact are discussed. A.W.H.

N80-19239# Colt Industries, Inc., Pittsburgh, Pa. Crucible Materials Research Center.
CONSOLIDATION OF TITANIUM POWDER TO NEAR NET SHAPES Final Report, 1 Feb. 1974 - 1 Mar. 1978
J. H. Schwertz, V. K. Chandhok, V. C. Peterson, and V. R. Thompson May 1978 333 p refs
(Contract F33615-74-C-5114)
(AD-A078039; AFML-TR-78-41) Avail: NTIS HC A15/MF A01 CSCL 11/6

This program was conducted to develop the technology necessary to establish a cost effective approach to the production of titanium alloy parts for both aircraft engine and airframe applications. This approach was based on a PM near-net shape process utilizing ceramic mold techniques in conjunction with HIP (Hot Isostatic Pressing) to a minimum machining envelope. Program objectives included: (1) the optimization of an existing PM process for the HIP of near-net shapes of titanium using low-cost tooling; (2) the reduction of the process to an efficient, cost effective, manufacturing procedure; and (3) thorough characterization of the end product. In cooperation with General Electric (GE) and McDonnell-Douglas (MCAIR) as sub-contractors, representative components and alloys were selected for this program. These were a Ti-17 compressor stub shaft and a Ti-6-4 keel splice former. Hot Isostatic Pressing parameters were optimized for both the Ti-17 and Ti-6-4 alloy using the ceramic mold process. SiO_2 was chosen as the most promising mold material. The ability to produce near-net shapes of both engine and airframe components was successfully demonstrated. Both parts exhibited comparable properties to cast and wrought material with the exception of low cycle fatigue requirements on the engine stub shaft. The results indicate that a potential exists for the HIP process to reduce both input material and machining costs compared to current cast and wrought product. GRA

N80-19266# Naval Postgraduate School, Monterey, Calif.
ACCURACY AND REPEATABILITY INDICES FOR JOINT OIL ANALYSIS PROGRAM DATA M.S. Thesis
Douglas Carlton Hatcher Sep. 1979 49 p refs
(AD-A078156) Avail: NTIS HC A03/MF A01 CSCL 11/8

This thesis examines spectrometric oil analysis data in an attempt to construct tables of statistical estimates for use in evaluating a laboratory's performance individually and in comparison to control laboratory. Tables of estimates were obtained from data provided by twenty six laboratories. GRA

N80-19268# Douglas Aircraft Co., Inc., Long Beach, Calif.
PRIMARY ADHESIVELY BONDED STRUCTURE TECHNOLOGY (PABST). GENERAL MATERIAL PROPERTY DATA Final Report, Feb. 1975 - Sep. 1978
R. W. Shannon, P. Stifel, R. Beger, E. J. Hughes, and J. L. Rutherford Wright-Patterson AFB, Ohio AFFDL Sep. 1978 408 p
(Contract F33615-75-C-3016)
(AD-A077891; MDC-J6065A; AFFDL-TR-77-107) Avail: NTIS HC A18/MF A01 CSCL 11/1

This program investigated state-of-the-art adhesives, adhesive primers, surface treatments, and coatings to determine, through durability testing, a system that could be used to adhesively bond a primary aircraft structure. Test methods were also evaluated. Previous work indicated cyclic-stressed testing in hostile environments and, specifically, high moisture environments reduced the life and durability of a given adhesive system over the same system load to the same level at constant stress. Conclusions include: (1) stressed durability testing is required to determine if a given surface treatment is durable; (2) normal industry accepted processing tolerances on surface treatments are too wide to produce consistently durable bonded joints; (3) handling of surface treated details must be designed to prevent mechanical damage and contamination; (4) phosphoric acid anodize process was the surface treatment most tolerant to processing variations and inspectable; (5) adhesive primers from different suppliers demonstrated a large variation in environment resistance and corrosion protection capabilities; (6) the type of carrier used in adhesive films has a large effect on the moisture resistance of the adhesives; and (7) cyclic stressed testing in a hostile environment is necessary to determine the optimum adhesive durability. GRA

N80-19354# Norsk Marconi A.S., Oslo.
MULTIPATH ANALYSIS OF ILS GLIDE PATH
T. Breien *In* AGARD Terrain Profiles and Contours in Electromagnetic Wave Propagation Dec. 1979 10 p refs

Avail: NTIS HC A17/MF A01

A major problem with instrument landing system slide path is the dependence of the signal quality upon site conditions. Unwanted scattering from the surroundings causes error in the guidance signal. A new method to analyze the problem is described. For practical use, the surroundings are modeled as a set of plane wedges. The scattering from each wedge is analyzed using uniform theory of diffraction (UTD), which assumes smooth, sharp and perfectly conducting wedges. Theoretical and practical work was carried out to study the influence of finite conductivity, surface roughness and round edges on the scattered signal. The conclusion is that for most glide path surroundings, UTD gives adequate accuracy. An effective UTD computer program for analysis of glide path performance was developed. Comparisons between computed and measured results show good agreement. R.E.S.

N80-19373# Royal Aircraft Establishment, Farnborough (England).
THE ROLE OF HF IN AIR-GROUND COMMUNICATIONS: AN OVERVIEW
B. Burgess *In* AGARD Spec. Topics in HF Propagation Nov. 1979 6 p refs
Avail: NTIS HC A25/MF A01

High frequency radio is a prime means for beyond line-of-eight air-ground communications and will remain as such into the foreseeable future, complementing Satellite communications where this latter system is employed. Various aspects that make up an HF communciations system and the contribution that they make to the overall system performance are reviewed. The needs of the modern user in the use of HF communications are considered with emphasis on the changing requirements on the HF link that the use of digital communications brings. Error rate performance, avoidance of interference, HF prediction techniques for Northern latitudes, and the role of channel evaluation techniques are addressed in order to acquaint the research worker with the status and trends in airborne HF communications and to indicate where further work may profitably be undertaken to eventually improve system performance. A.R.H.

N80-19374# Royal Aircraft Establishment, Farnborough (England). Radio and Navigation Dept.
HF COMMUNICATION TO SMALL LOW FLYING AIRCRAFT
N. M. Maslin *In* AGARD Spec. Topics in HF Propagation Nov. 1979 13 p refs

Avail: NTIS HC A25/MF A01

HF (2-30 mHz) radio communication is a principal means of beyond line of sight communication to aircraft. There are particularly serious problems for the small aircraft. Many factors degrade the overall received signal-to-noise ratio both at the ground and in the aircraft. To achieve satisfactory results, careful consideration should be given not only to the terminal radio equipment but also to the long term geographic planning and to the management of the frequencies to be used over mobile HF links. The worst HF communication problems occur for a short range air-ground sky-wave link at night which requires frequencies at the low end of the HF band. Working over a longer range link increasing the 'optimum working frequency', thus avoiding the poor antenna efficiencies and generally reducing external noise levels. It is shown that good frequency management, ground antenna directivity and the use of a number of geographically separated remote receiving stations are vital in providing satisfactory communications reliability to the small aircraft. Author

N80-19375# Army Avionics Research and Development Activity, Fort Monmouth, N. J. Communication and Sensor Div.
MODERN HF COMMUNICATIONS FOR LOW FLYING AIRCRAFT
John F. Brune and Bernard V. Ricciardi *In* AGARD Spec. Topics in HF Propagation Nov. 1979 15 p refs
Avail: NTIS HC A25/MF A01

An application of the HF propagation phenomenon that can provide relatively short range, reliable, terrain independent communications is described. It has been shown that communica-

tions out to ranges of 50 km, under varying terrain conditions, to and from low flying aircraft, is an extremely difficult problem especially for air mobile tactical forces. The US Army under the Nap-of-the-Earth Communications (NOE Comm) System program conducted extensive tests and analysis using the HF media for tactical communications with low-flying aircraft. The use of the near-vertical-incidence skywave (NVIS) portion of the HF channel for aircraft communications is described. The HF-SSB radio systems have the capability of operating in either a ground wave or NVIS mode. For the NVIS mode, the energy is directed vertically to the ionosphere and returned to the surface of the earth. The NVIS mode provides umbrella type coverage. Because of NVIS propagation, HF-SSB systems with appropriate antennas have the capability of providing communications coverage out to ranges greater than 50 km in any type of terrain. The NVIS mode is terrain independent. The characteristics of the HF NVIS mode are considered and the features required of a modern HF radio system to make efficient and practical utilization of the already overcrowded HF band are noted. A.R.H.

N80-19377# Royal Aircraft Establishment, Farnborough (England). Radio and Navigation Dept.
ASSESSMENT OF HF COMMUNICATIONS RELIABILITY
N. M. Maslin *In* AGARD Spec. Topics in HF Propagation Nov. 1979 12 p refs

Avail: NTIS HC A25/MF A01

The concept of circuit reliability for an HF sky-wave link is discussed. Its frequency dependence is considered together with the relationship to the median received signal-to-noise ratio for a given HF circuit. The importance of a study of this kind is the ability to be able to quantify changes that could be made for an HF circuit, in terms of reliability improvements, and hence to make decisions of the cost effectiveness of increasing transmitter power, antenna efficiencies, directional antenna design. A.R.H.

N80-19429# Autonetics, Anaheim, Calif. Strategic Systems Div.
SOLID STATE POWER CONTROLLER VERIFICATION STUDIES Final Technical Report, Oct. 1978 - Jan. 1979
Carl O. Linder Jan. 1979 195 p
(Contract F33615-78-C-2065; AF Proj. 3145)
(AD-A078238; C79-85/201; AFAPL-TR-79-2029) Avail: NTIS HC A09/MF A01 CSCL 01/3

This report documents the design and test of the Solid State Power Controllers (SSPCs) for the B-1 aircraft. The SSPCs were in qualification testing when the B-1 program was terminated. The testing and completion of the B-1 SSPC program, considered crucial to the advancement of the state-of-the-art in SSPC technology, is concluded and documented in this report. This report documents the accomplishments of the B-1 SSPC program together with the results of the tests completed during the study. Recommendations for future SSPC activities are included in the final section. A proposed MIL-P-81653 specification is attached as Appendix A. Author (GRA)

N80-19435# Autonetics, Anaheim, Calif. Strategic Systems Div.
FLAT BUS FAULT SENSORS Final Report, Oct. 1978 - Oct. 1979
Carl O. Linder Oct. 1979 48 p
(Contract N62269-78-C-0213)
(AD-A077060; C79-951/201; NADC-77336-60) Avail: NTIS HC A03/MF A01 CSCL 09/3

This report documents the development of an electric power distribution fault sensing technique for use on a 270 Vdc, two wire, flat bus, ungrounded aircraft power distribution system for operation in composite aircraft structures. The effort, performed by the Strategic Systems Division of Rockwell International, included the development, fabrication and delivery of six fault sensor breadboards. Author (GRA)

N80-19454*# Florida Univ., Gainesville. Dept. of Engineering Sciences.
VORTICITY ASSOCIATED WITH MULTIPLE JETS IN A CROSSFLOW
Susan Braden 25 Apr. 1980 39 p refs Presented at the AIAA Southeastern Regional Student Conf., Atlanta, 24-25 Apr. 1980
(Grant NsG-2288)
(NASA-CR-162855) Avail: NTIS HC A03/MF A01 CSCL 20D

Vortex patterns from multiple subsonic jets exiting perpendicularly through a flat plate into a subsonic crossflow were investigated. Tandem and transverse jet configurations were examined using a paddle wheel sensor to indicate the presence and relative magnitude of streamwise vorticity in the flow. Results are presented in the form of contour plots of rotational speed of the paddle wheel as measured in planes downstream from the jets and perpendicular to the crossflow. Well developed diffuse contrarotating vortices were observed for the configurations studied. The location and strength of these vortices depended on the multiple jet configuration and the distance downstream from the jets. K.L.

N80-19495*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DAMPING IN TAPERED ANNULAR SEALS FOR AN INCOMPRESSIBLE FLUID
David P. Fleming Apr. 1980 22 p refs
(NASA-TP-1646; E-124) Avail: NTIS HC A02/MF A01 CSCL 11A

Damping in annular seals is calculated for an incompressible fluid. Results show that damping in tapered seals optimized for stiffness is considerably less than that in straight seals for the same minimum clearance. Damping in rotating seals can promote fractional frequency whirl. Neglecting fluid acceleration makes solution much easier, but leads to errors in calculated damping of up to 16 percent. K.L.

N80-19497*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FERROGRAPHIC AND SPECTROGRAPHIC ANALYSIS OF OIL SAMPLED BEFORE AND AFTER FAILURE OF A JET ENGINE
William R. Jones, Jr. Feb. 1980 20 p refs
(NASA-TM-81430; E-353) Avail: NTIS HC A02/MF A01 CSCL 21E

An experimental gas turbine engine was destroyed as a result of the combustion of its titanium components. Several engine oil samples (before and after the failure) were analyzed with a Ferrograph as well as plasma, atomic absorption, and emission spectrometers. The analyses indicated that a lubrication system failure was not a causative factor in the engine failure. Neither an abnormal wear mechanism, nor a high level of wear debris was detected in the oil sample from the engine just prior to the test in which the failure occurred. However, low concentrations of titanium were evident in this sample and samples taken earlier. After the failure, higher titanium concentrations were detected in oil samples taken from different engine locations. Ferrographic analysis indicated that most of the titanium was contained in spherical metallic debris after the failure. K.L.

N80-19499*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
ON THE CHARACTERISTICS OF CENTRIFUGAL-RECIPROCATING MACHINES
W. H. Higa 1 Feb. 1980 28 p
(Contract NAS7-100)
(NASA-CR-162881; JPL-Pub-79-108) Avail: NTIS HC A03/MF A01 CSCL 13I

A method of compressing helium gas for cryogenic coolers is presented which uses centrifugal force to reduce the forces on the connecting rod and crankshaft in the usual reciprocating compressor. This is achieved by rotating the piston-cylinder assembly at a speed sufficient for the centrifugal force on the piston to overcome the compressional force due to the working fluid. The rotating assembly is dynamically braked in order to recharge the working space with fluid. The intake stroke consists of decelerating the rotating piston-cylinder assembly and the exhaust stroke consists of accelerating the assembly. K.L.

N80-19509# SKF Industries, Inc., King of Prussia, Pa.
ESTABLISHMENT OF ENGINEERING DESIGN DATA FOR HYBRID STEEL/CERAMIC BALL BEARINGS Final Report, Apr. 1978 - Aug. 1979
F. R. Morrison, J. Pirvics, and T. Jonushonis Sep. 1979 63 p refs
(Contract N00019-78-C-0304)
(AD-A078934; SKF-AL79T033) Avail: NTIS HC A04/MF A01 CSCL 11/6

A hybrid steel/ceramic angular contact ball bearing was designed for optimum performance at 2.5 x 10 to the 6th power DN. A lot of bearings was fabricated to this design and life tests were conducted under two different loads. A detailed failure anlaysis was completed to define the causes for the premature silicon nitride ball failures. GRA

N80-19519# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
AVIONICS RELIABILITY, ITS TECHNIQUES AND RELATED DISCIPLINES
Manfred C. Jacobson (AeG-Telefunken, Ulm, West Germany) Oct. 1979 536 p refs In ENGLISH and FRENCH Conf. held in Ankara, 9-13 Apr. 1979
(AGARD-CP-261; ISBN-92-835-0254-X) Avail: NTIS HC A23/MF A01

A state of the art review of topics related to reliability and logistics in avionics systems is given. General concepts, reliability/availability requirements and demonstration, reliability and maintainability practices and effects in avionics design, development and production, software reliability, and logistics support aspects are among the topics discussed.

N80-19520# Naval Postgraduate School, Monterey, Calif.
AN ANALYSIS OF THE EVOLUTION OF THE RELIABILITY AND MAINTAINABILITY DISCIPLINES
M. B. Kline, J. Di Pasquale, T. A. Hamilton, and R. L. Masten *In* AGARD Avionics Reliability, Its Tech. and Related Disciplines Oct. 1979 24 p Prepared in cooperation with Naval Weapons Center
Avail: NTIS HC A23/MF A01

The results of a study of the development of the reliability and maintainability (R&M) disciplines are presented. The exponential rate of growth shown during this period is an indication of the dynamic nature and importance of these disciplines to system development, design, and operation. Family trees of each discipline developed to indicate the growth and branching of the relevant subject matter are presented. The direction and rate of growth of these disciplines in each of the decades of interest are analyzed along with projections of current and future trends. Applications of R&M in both the private and public sectors, including defense, space, energy, transportation, industrial and consumer items, are examined. J.M.S.

N80-19521# Royal Signals and Radar Establishment, Malvern (England).
DIFFICULTIES IN PREDICTING AVIONICS RELIABILITY
J. E. Green *In* AGARD Avionics Reliability, Its Tech. and Related Disciplines Oct. 1979 7 p refs

Avail: NTIS HC A23/MF A01

Avionics reliability prediction techniques are considered with particular attention given to factors which significantly influence reliability. These include types of aircraft, the duration and type of sortie, the frequency of use, and the incidence of reported but unconfirmed failures which nevertheless result in maintenance actions. It is shown that failures are nonexponentially distributed during a sortie, although conventional predictions are based on the exponential distribution. Therefore, various proposals for predicting avionics reliability are presented to overcome this discrepancy. The difficulties in making predictions for the latest microelectronic devices are considered with reference to MIL-HDBK-21 B and emphasis on the potential reliability of LSI and microprocessors. The significance of the choice of quality factors is noted. J.M.S.

N80-19522# Naval Postgraduate School, Monterey, Calif.
RELIABILITY GROWTH MODELS
W. M. Woods *In* AGARD Avionics Reliability, Its Tech. and Related Disciplines Oct. 1979 21 p refs

Avail: NTIS HC A23/MF A01

The concept of reliability growth models is introduced. Two reliability growth models are presented, one for time data and one for attributes data. Their uses are discussed and the methods for evaluating them are presented in graphical and tabular form. Both models show reasonable accuracy for reasonable amounts of testing under a wide variety of actual reliabilty growth and nongrowth. J.M.S.

N80-19523# Elektronik-System G.m.b.H., Munich (West Germany).
A SIMULATION PROGRAM FOR THE DETERMINATION OF SYSTEM RELIABILITY OF COMPLEX AVIONIC SYSTEMS
Christian Krause and Hubert Limbrunner *In* AGARD Avionics Reliability, Its Tech. and Related Disciplines Oct. 1979 9 p ref
Avail: NTIS HC A23/MF A01

The simulation program SIMZUV which computes system reliability according to the Monte Carlo method is described. This program enables the realistic consideration of complex failure logics of meshed systems, couplings of failures of different units and different mission phases, which is possible by the selection of a certain formulation of these marginal conditions. In its capacity as a simulation program, SIMZUV is capable of considering condition and time dependent failure rates and various unit reliability functions. It is shown that it is possible to perform the simulation of a substitute system of higher failure rates with short computer time, after a transformation of the failure rates. It is demonstrated that the reliability curve of the actual system can be computed from the reliability curve of the substitute system via a linear system of equations.

N80-19532# Thomson-CSF, Malakoff (France).
METHODS USED FOR DISCERNING THE RELIABILITY OF MILITARY AIRCRAFT RADAR [METHODES UTILISEES POUR CONNAITRE LA FIABILITE D'UN RADAR D'AVION D'ARMES]
J. C. Charlot *In* AGARD Avionics Reliability, Its Tech. and Related Disciplines Oct. 1979 20 p In FRENCH

Avail: NTIS HC A23/MF A01

In an effort to ascertain the reliability of a radar onboard a military aircraft, Thomson-CFS formed an organization to collect and process the information necessary to measure the mean time of good operation. The methods for data acquisition, the members of the organization in 1979, the data management, and prospects for the future (extension to other equipment and information concerning component fabrication) are discussed.
Transl. by A.R.H.

N80-19533# Draper (Charles Stark) Lab., Inc., Cambridge, Mass.
A FAULT TOLERANT ARCHITECTURE APPROACH TO AVIONICS RELIABILITY IMPROVEMENT
Donald C. Fraser and John J. Deyst *In* AGARD Avionics Reliability, Its Tech. and Related Disciplines Oct. 1979 9 p refs
Avail: NTIS HC A23/MF A01

A difficult technology challenge in the reliability of avionics systems for advanced aircraft is identified. Three architectures are compared on the basis of a number of criteria which together constitute the issues which must be examined when considering the overall reliability, maintenance, and support problem. It is concluded from these comparisons and the limitations identified in contemporary approaches that the only effective and practical solution to the reliability challenge is through architecture. An advanced integrated, distributed fault and damage tolerant digital avionics system architecture is summarized which shows promise of meeting this challenge. Author

N80-19534*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

TRENDS IN RELIABILITY MODELING TECHNOLOGY FOR FAULT TOLERANT SYSTEMS
Salvatore J. Bavuso *In* AGARD Avionics Reliability, Its Tech. and Related Disciplines Oct. 1979 12 P refs
Avail: NTIS HC A23/MF A01 CSCL 14D

Developments in reliability modeling for large fault tolerant avionic computing systems are presented. Issues of state size and complexity, fault coverage, and practical computation are addressed. A two-fold developmental effort is described based on the structural and fault coverage modeling approaches. A technique which was successfully applied to an 865 state pure death stationary Markov model is presented. Of particular interest is a short computer program which executes very quickly to produce reliability results of a large state space model. This model also incorporates fault coverage states for processor, memory, and bus line replaceable units. A second structural reliability modeling scheme is aimed at solving nonstationary Markov models. This technique provides the tool required for studying the reliability of systems with nonconstant failure rates and includes intermittent/transient faults, electronic hardware which exhibits decreasing failure rates, and hydromechanical devices which typically have wearout failure mechanisms. Several aspects of fault coverage, including modeling and data measurement of intermittent/transient faults and latent faults, are elucidated and illustrated. The CARE II (computer-aided reliability estimation) coverage is presented and shortcomings to be eliminated are discussed. K.L.

N80-19535# Dowty Boulton Paul Ltd., Wolvenhampton (England).
NONELECTRONIC ASPECTS OF AVIONIC SYSTEM RELIABILITY
C. V. Kenmir, R. G. Hilton, and H. H. Dixon *In* AGARD Avionics Reliability, Its Tech. and Related Disciplines Oct. 1979 12 p

Avail: NTIS HC A23/MF A01

Methods of obtaining actuation system integrity by means of redundancy are examined. The effects of control surface layout, number of power supplies, and the form of the avionics on the chosen solution are investigated. The effect of redundancy on defect rates is also discussed. Developments which improve reliability and remove constraints are considered. K.L.

N80-19536# Electronique Marcel Dassault, St. Cloud (France).
IMPACTS OF TECHNOLOGIES SELECTED ON THE RELIABILITY AND OPERATIONAL AVAILABILITY OF EQUIPMENTS. COST CONSIDERATIONS
J. M. Girard and M. Giraud *In* AGARD Avionics Reliability, Its Tech. and Related Disciplines Oct. 1979 17 p refs

Avail: NTIS HC A23/MF A01

A single criterion, V, is proposed to allow manufacturers to evaluate the merits of technological variants once an equipment baseline version is designed and quoted. The V factor is computed for an airborne digital computer, a Doppler navigational radar, and a search and rescue beacon, each considered in three different versions. K.L.

N80-19537# Rome Air Development Center, Griffiss AFB, N.Y.
A NEW APPROACH TO MAINTAINABILITY PREDICTION
Joseph J. Naresky *In* AGARD Avionics Reliability, Its Tech. and Related Disciplines Oct. 1979 14 p refs

Avail: NTIS HC A23/MF A01

A time synthesis maintainability prediction method was developed which directly relates diagnostic, isolation, and test subsystem characteristics to equipment/system maintainability parameters. A comprehensive set of time standards applicable to physical maintenance actions associated with equipment construction and packaging procedures is also provided. Predicted parameters include mean time to repair, maximum time to repair, mean maintenance man hours per repair, and fault isolation resolution. The method includes techniques for use with both preliminary and final design data. K.L.

N80-19538# Westinghouse Defense and Electronic Systems Center, Baltimore, Md.
RELIABILITY GROWTH THROUGH ENVIRONMENTAL SIMULATION
Lawrence J. Phaller *In* AGARD Avionics Reliability, Its Tech. and Related Disciplines Oct. 1979 8 p refs

Avail: NTIS HC A23/MF A01

Field data were used to identify unreliable line replaceable units and implement design improvements. The rate of reliability growth was found to be dependent on the unit complexity and the state of the art of the unit. Reliability growth occurred in both design and quality control. K.L.

N80-19539# Marconi-Elliott Avionic Systems Ltd., Rochester (England).
THE A-7 HEAD-UP DISPLAY RELIABILITY PROGRAMME
K. W. Boardman *In* AGARD Avionics Reliability, Its Tech. and Related Disciplines Oct. 1979 14 p refs

Avail: NTIS HC A23/MF A01

The evolution of the head-up display from earlier forms of weapon aiming techniques is described. The A-7 head-up display is then introduced in terms of the reliability requirements and the contracting environment. Technical innovations introduced to meet the reliability requirements are described with emphasis on thermal design, ruggedized long life cathode ray tube technology, and durability of low voltage printed circuit connectors. The cost benefit of the reliability program is discussed. K.L.

N80-19540# Army Avionics Research and Development Activity, Fort Monmouth, N. J.
MILITARY ADAPTION OF A COMMERCIAL VOR/ILS AIRBORNE RADIO WITH A RELIABILITY IMPROVEMENT WARRANTY
Earl I. Feder and Douglas L. Niemoller (Bendix Corp., Fort Lauderdale, Fla.) *In* AGARD Avionics Reliability, Its Tech. and Related Disciplines Oct. 1979 8 p

Avail: NTIS HC A23/MF A01

Low cost, small, lightweight airborne navigation receivers were acquired and reconfigured to meet U.S. Army aircraft specifications. The contract includes a clause requiring the manufacturer to assume responsibility for the field reliability and repair of each receiver for a minimum of four years. If successfully implemented, the reliability improvement warranty should increase reliability, availability, and maintainability and reduce the overall equipment life cycle costs. K.L.

N80-19543# Thomson-CSF, Paris (France). Electron Tube Div.
RELIABILITY OF HIGH-BRIGHTNESS CRTS FOR AIRBORNE DISPLAYS
J. P. Galves and J. Brun *In* AGARD Avionics Reliability, Its Tech. and Related Disciplines Oct. 1979 14 p

Avail: NTIS HC A23/MF A01

The reliability of high brightness monochrome or color cathode ray tubes (CRT's) for aircraft head-up display and head-down display systems is examined. The specification, which includes electrooptical performance and environmental conditions, defines the tube quality at zero operating time. Two typical examples of specifications are given. The problems encountered in designing tubes, and the solutions used to obtain the desired level of quality are briefly discussed. Reliability testing concerns random failures that occur during normal operation of the tube. After a short mathematical treatment of the principles involved, three examples of reliability tests carried out on CRT's are given. The electrooptical characteristics of CRT change during operation. This is mainly a cathode and screen wearing-out phenomenon. The life expectancy of a CRT depends on this evolution, and is thus a function of tube operating conditions. M.G.

N80-19546# Elliott-Automation Space and Advanced Military Systems Ltd., Camberley (England).
RELIABILITY MANAGEMENT OF THE AVIONIC SYSTEM OF A MILITARY STRIKE AIRCRAFT

A. P. White and J. D. Pavier *In* AGARD Avionics Reliability, Its Tech. and Related Disciplines Oct. 1979 13 p refs

Avail: NTIS HC A23/MF A01

The system management techniques to achieve the reliability requirements for the avionic system of the Panavia Tornado aircraft are described. The method of apportionment of these requirements to each of the constituent parts of the system is explained. The aims, cost effectiveness, and experience to date of reliability demonstrations are outlined. M.G.

N80-19549*# SRI International Corp., Menlo Park, Calif. Computer Science Lab.

FORMAL METHODS FOR ACHIEVING RELIABLE SOFTWARE

Jack Goldberg *In* AGARD Avionics Reliability, Its Tech. and Related Disciplines Oct. 1979 9 p refs

(Contracts NAS1-13792; N00123-76-C-0195)

Avail: NTIS HC A23/MF A01

Requirements for reliable avionic systems are discussed in terms of the effectiveness of programming methodology. The need for methods to cope with the complexity of critical real-time systems is emphasized. Some general concepts about formal methods are presented and an example is given of the SRI hierarchical development methodology taken from the executive system of the SIFT fault tolerant computer. Formal methods with alternatives are compared and the prospects for introducing formal methods into practice are considered. R.C.T.

N80-19551# Rome Air Development Center, Griffiss AFB, N.Y.

AN ANALYSIS OF SOFTWARE RELIABILITY PREDICTION MODELS

Alan N. Sukert *In* AGARD Avionics Reliability, Its Tech. and Related Disciplines Oct. 1979 11 p refs

Avail: NTIS HC A23/MF A01

Several mathematical models for predicting the reliability and error content of a software package were evaluated against error data extracted from the formalized testing of four software development projects. The results of the data collected are described using both Maximum Likelihood and Least Squares methods for estimating model parameters. Model predictions are compared on a total project, functional and error severity basis. Model predictions are also compared on an errors/day and errors/week basis for defining model time intervals. Conclusions concerning the application of these models are presented. R.C.T.

N80-19554# Elliott-Automation Space and Advanced Military Systems Ltd., Camberley (England).

SOFTWARE DEVELOPMENT FOR TORNADO: A CASE HISTORY FROM THE RELIABILITY AND MAINTAINABILITY ASPECT

D. J. Harris *In* AGARD Avionics Reliability, Its Tech. and Related Disciplines Oct. 1979 23 p

Avail: NTIS HC A23/MF A01

The methods and procedures adopted in the development program for the TORNADO aircraft are presented. Software development for TORNADO has been undertaken in four successive, but overlapping phases, namely definition, writing, testing and delivery. The key features in these four phases are given that have contributed to software reliability and maintainability. R.C.T.

N80-19558# Ministry of Defence, London (England). Procurement Div.

THE INTEGRATED MANAGEMENT OF RELIABILITY AND MAINTAINABILITY IN PROCUREMENT

S. E. Shapcott and K. A. Brown *In* AGARD Avionics Reliability, Its Tech. and Related Disciplines Oct. 1979 4 p

Avail: NTIS HC A23/MF A01

An effective procurement strategy for reliability and maintainability is discussed as documented in the DCAD Technical Publication 1/77: Achievement of Avionic Reliability and Maintainability through Integrated Management. The evolution of the strategy is reviewed, the requirements of the strategy are discussed, and the implementation of the strategy is examined. A.W.H.

N80-19560# Ministry of Defence, London (England).

COMPUTER SIMULATION MODEL OF THE LOGISTIC SUPPORT SYSTEM FOR ELECTRICAL ENGINEERING TEST EQUIPMENT

C. J. P. Haynes *In* AGARD Avionics Reliability, Its Tech. and Related Disciplines Oct. 1979 13 p

Avail: NTIS HC A23/MF A01

A simulation model of the existing logistic support system for electrical engineering test equipment, developed as a research tool for evaluating the adequacy of analytical provisioning models is described. Two further simulations, developed to model alternative logistic support systems and to compare these with the current maintenance organization, are also described. The present logistic support system, the development of the three simulation models, and their potential uses are discussed. A.W.H.

N80-19566*# Boeing Co., Wichita, Kans.

DEVELOPING, MECHANIZING AND TESTING OF A DIGITAL ACTIVE FLUTTER SUPPRESSION SYSTEM FOR A MODIFIED B-52 WIND-TUNNEL MODEL Final Report, Jul. 1975 - Jan. 1980

John R. Matthew Mar. 1980 129 p refs

(Contract NAS1-14031)

(NASA-CR-159155; D3-1168-1) Avail: NTIS HC A07/MF A01 CSCL 01A

A digital flutter suppression system was developed and mechanized for a significantly modified version of the 1/30-scale B-52E aeroelastic wind tunnel model. A model configuration was identified that produced symmetric and antisymmetric flutter modes that occur at 2873N/sq m (60 psf) dynamic pressure with violent onset. The flutter suppression system, using one trailing edge control surface and the accelerometers on each wing, extended the flutter dynamic pressure of the model beyond the design limit of 4788N/sq m (100 psf). The hardware and software required to implement the flutter suppression system were designed and mechanized using digital computers in a fail-operate configuration. The model equipped with the system was tested in the Transonic Dynamics Tunnel at NASA Langley Research Center and results showed the flutter dynamic pressure of the model was extended beyond 4884N/sq m (102 psf). J.M.S.

N80-19567# General Dynamics Corp. Fort Worth, Tex.

FASTENER HOLE QUALITY, VOLUME 1 Final Technical Report, Jun. 1976 - Oct. 1978

P. J. Noronha, S. P. Henslee, D. E. Gordon, Z. R. Wolanski, and B. G. W. Lee Wright-Patterson AFB, Ohio AFFDL Dec. 1978 165 p

(Contract F33615-76-C-3113; AF Proj. 486U)

(AD-A077859; FZM-6809-Vol-1; AFFDL-TR-78-206-Vol-1)

Avail: NTIS HC A08/MF A01 CSCL 13/5

This report describes the development of the equivalent initial flaw size concept as a potential design tool and the generation of equivalent initial flaw size data as a function of several manufacturing and design variables. Several factors or mechanisms that strongly affected the fatigue behavior of fastener holes have been identified and corrected to achieve a 100% improvement in fatigue life. Some of these improvements are being implemented in the F-16 production program and the improved drilling will be implemented in the C5A-H Modification Program. GRA

N80-19569# Air Force Materials Lab., Wright-Patterson AFB, Ohio.

AN ANALYSIS OF RESIDUAL STRESSES AND DISPLACEMENTS DUE TO RADIAL EXPANSION OF FASTENER HOLES Final Report, Jan. 1975 - Dec. 1978

A. F. Grandt and R. M. Potter Jul. 1979 37 p refs
(AF Proj. 2307)
(AD-A076370; AFML-TR-79-4048) Avail: NTIS HC A02/MF A01 CSCL 01/3

Pre-expanding fastener holes with an oversize mandrel has received considerable attention for use in aircraft structures, since this process has been shown to greatly improve the fatigue life of fastener holes. The deformation theory of plasticity is used here to determine the residual stress and displacement field caused by this process. Employing plane stress assumptions, general results are obtained for various interference levels and are presented in a graphical form useful to the designer. In addition, this analysis indicates that there is an optimum level of interference dependent primarily on the plate geometry. The optimum interference levels agree well with experience values established by fatigue testing in aircraft structural alloys. GRA

N80-19576# British Aerospace Aircraft Group, Brough (England).
SOME RECENT MEASUREMENTS OF STRUCTURAL DYNAMIC DAMPING IN AIRCRAFT STRUCTURES
E. J. Phillips *In* AGARD Damping Effects in Aerospace Struct. Oct. 1979 15 p refs

Avail: NTIS HC A09/MF A01

Values of structural damping obtained during a flutter investigation of a strike aircraft in several wing store configurations, in which the wings were excited by impulses at the wing tips are presented. A vibration test on a large underwing pylon mounted pod during which three suspensions were represented, and a vibration test on a box section shelf mounted on antivibration mounts are described. During the flutter investigation the structural damping was determined from the time decay of filtered accelerometer signals. In the vibration tests, the test items were excited sinusoidally and damping was obtained from accelerometer response curves at resonance. A.W.H.

N80-19580# Politecnico di Milano (Italy). Istituto di Ingegneria Aerospaziale.
DAMPING PROBLEMS IN ACOUSTIC FATIGUE
Vittorio Giavotto, Marco Borri, and Giorgio Cavallini (Pisa Univ.) *In* AGARD Damping Effects in Aerospace Struct. Oct. 1979 11 p refs
Avail: NTIS HC A09/MF A01

Damping information necessary for the fatigue design of wideband noise excited structures is identified. Damping mechanisms are considered and damping test results are presented for stiffened panels typical of aerospace structures. The need for models capable of accurately estimating damping effects is emphasized. K.L.

N80-19582# Air Force Materials Lab., Wright-Patterson AFB, Ohio.
VISCOELASTIC DAMPING IN USAF APPLICATIONS
D. I. G. Jones, J. P. Henderson, and L. C. Rogers (AFFDL, Wright-Patterson AFB, Ohio) *In* AGARD Damping Effects in Aerospace Struct. Oct. 1979 24 p refs

Avail: NTIS HC A09/MF A01

The use of viscoelastic damping technology for vibration control in the United States Air Force is reviewed. The potential payoff in improved performance and maintainability of vibration critical systems such as large flexible spacecraft structures, digital electronics systems, and rotating jet engine components is very high. K.L.

N80-19584# Istituto di Tecnologia Aerospaziale, Rome (Italy).
DAMPING EFFECTS IN JOINTS AND EXPERIMENTAL TESTS ON RIVETED SPECIMENS
Luigi Balis Crema, Antonio Castellani, and Alfonso Nappi (SIAI Marchetti) *In* AGARD Damping Effects in Aerospace Struct. Oct. 1979 17 p refs

Avail: NTIS HC A09/MF A01

The importance of dynamic damping is highlighted with emphasis on the effect of riveted joints on energy dissipation. The state of the art in the field of joint damping is illustrated with reference to several theories on damping mechanisms. Results of tests carried out on specimens with riveted joints are discussed. K.L.

N80-19693# SRI International Corp., Menlo Park, Calif.
ATMOSPHERIC ELECTRICITY AND MILITARY OPERATIONS Final Report
J. E. Nanevicz Nov. 1978 8 p refs
(Contract N00014-77-C-0326)
(AD-A078482) Avail: NTIS HC A02/MF A01 CSCL 04/2

Contents: An Airborne Electric Field-Meter System Used for Studying Electric Field Structure Near Thunderstorm Cells; A Triggered Lightning Strike to an Instrumented Learjet Aircraft; and Instrumented Learjet Aircraft Measurements of Static Electric Fields in and Around Florida Thunderstorm anvils. GRA

N80-19703*# FWG Associates, Inc., Tullahoma, Tenn.
FOG DISPERSION Final Report
Larry S. Christensen and Walter Frost Mar. 1980 128 p refs
(Contract NAS8-33095)
(NASA-CR-3255) Avail: NTIS HC A07/MF A01 CSCL 04B

The concept of using the charged particle technique to disperse warm fog at airports is investigated and compared with other techniques. The charged particle technique shows potential for warm fog dispersal, but experimental verification of several significant parameters, such as particle mobility and charge density, is needed. Seeding and helicopter downwash techniques are also effective for warm fog disperals, but presently are not believed to be viable techniques for routine airport operations. Thermal systems are currently used at a few overseas airports; however, they are expensive and pose potential environmental problems. K.L.

N80-19706# Air Force Geophysics Lab., Hanscom AFB, Mass.
PRELIMINARY ASSESSMENT OF AN AUTOMATED SYSTEM FOR DETECTING PRESENT WEATHER Instrumentation Paper
H. Albert Brown 26 Jun. 1979 37 p refs
(AD-A078031; AFGL-TR-79-0137; AFGL-IP-276) Avail: NTIS HC A03/MF A01 CSCL 04/2

The determination of subjective weather observations through the use of an automated array of weather sensors coupled with a decision tree program was examined through analysis of data gathered at the AFGL Weather Test Facility at Otis AFB, Mass. This report describes the instruments used in the array, the response of the instruments to type of weather observed, and the decision tree programs. Preliminary results indicate that a computer-controlled weather sensor array has potential value in determining objectively those types of weather previously relegated to human responsibility. Author (GRA)

N80-19809# Advisory Group for Aerospace Research and Development, Paris (France).
MODELING AND SIMULATION OF AVIONICS SYSTEMS AND COMMAND, CONTROL AND COMMUNICATIONS SYSTEMS
Jan. 1980 553 p refs Presented at the Meeting of the Avionics Panel, Paris, 15-19 Oct. 1979
(AGARD-CP-268; ISBN-92-835-0255-8) Avail: NTIS HC A24/MF A01

Simulation techniques and their applications to avionics and command, control, and communication systems associated with airborne operations are addressed. Modeling methodology, experimentation, validation, and applications are covered. Emphasis is on avionics and airborne command and control, including the range from large-scale force-effectiveness and air defense simulations through flight simulators and real time avionics simulations.

N80-19812# Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (West Germany).
REMARKS ON SIMULATION. OBJECTIVES/AREAS OF USE/POSSIBILITIES/LIMITATIONS: AN OVERVIEW

Hans M. Franke *In* AGARD Modeling and Simulation of Avionics Systems and Command, Control and Commun. Jan. 1980 27 p refs (For primary document see N80-19809 10-59)
Avail: NTIS HC A24/MF A01

An overview of the extensive application of computerized simulation to the study of flight mechanics is presented with special interest given to avionics and command and control and communication. Areas of use of simulation covered include: the field of research; planning pre-design, assessment, and feasibility; the development phase; testing; and the training simulator. Systems analysis and systems engineering activities in the planning of new weapon systems are discussed in terms of the use of simulation. J.M.S.

N80-19814# General Research Corp., Santa Barbara, Calif.
VERIFICATION AND VALIDATION OF AVIONIC SIMULATIONS
Sabina H. Saib *In* AGARD Modeling and Simulation of Avionics Systems and Command, Control and Commun. Jan. 1980 6 p (For primary document see N80-19809 10-59)
Avail: NTIS HC A24/MF A01

Avionic simulations require verification and validation so that the simulation results can be applied reliably to actual avionic systems. Software design methods as well as currently available automated aids for verification and validation are described. Reverification and revalidation of a simulation after changes are made is discussed. Simulations can be designed for ease of verification and validation. Guidelines to show how simulation software can be developed with verification in mind are presented. R.E.S.

N80-19820# Institute of Aviation Medicine, Farnborough (England).
REAL-TIME SIMULATION: AN INDISPENSABLE BUT OVERUSED EVALUATION TECHIQUE
V. David Hopkin and A. J. McClumpha *In* AGARD Modeling and Simulation of Avionics Systems and Command, Control and Commun. Jan. 1980 6 p refs

Avail: NTIS HC A24/MF A01

Real time simulation is evaluated in relation to large man machine systems, particulary air traffic control systems. The limitations to using real time simulation to study computer assistance, system capacity, workloads, stress, boredom, and attitudes are discussed. K.L.

N80-19821# Elektronik-System G.m.b.H., Munich (West Germany).
DESIGN AND SIMULATION OF A C3 SYSTEM FOR SURVEILLANCE PURPOSE
Franz Herzmann and Helmut Sanders *In* AGARD Modelling and Simulation of Avionics Systems and Command, Control and Commun. Jan. 1980 13 p refs

Avail: NTIS HC A24/MF A01

Communications, command, and control problems associated with the operation of a surveillance network and weapon systems are discussed. Tracing and allocation algorithms are designed and improved by simulating network operation. Weapon system operation, including coordination and target allocation, is also simulated. The system performance is tested using radar derived data. K.L.

N80-19823# Mitre Corp., Bedford, Mass.
THE APPLICATION OF MODELING AND SIMULATION TO THE DEVELOPMENT OF THE E-3A
A. R. Shanahan *In* AGARD Modeling and Simulation of Avionics Systems and Command, Control and Commun. Jan. 1980 14 p
Avail: NTIS HC A24/MF A01

The role of modelling and simulation in developing an airborne radar, communications, and command-control system is discussed. The modelling diversity required during different stages of system development is emphasized. K.L.

N80-19824# Analytic Sciences Corp., Reading, Mass.
E-3A NAVIGATIONAL COMPUTER SYSTEM REAL-TIME ENVIRONMENTAL SIMULATOR
Richard D. Healy and Samuel Newman *In* AGARD Modeling and Simulation of Avionics Systems and Command, Control and Commun. Jan. 1980 8 p refs Prepared in cooperation with NADC, Warminster, Pa.

(Contract N62269-79-C-0020)
Avail: NTIS HC A24/MF A01

A software life-cycle support facility under development for the E-3A navigational computer system includes a real-time environmental simulator which is used to simulate both E-3A avionics and the operational environment so that software problems with the included AN/ARN-120 Omega Navigation Equipment (ONE) can be investigated and that the impact of software changes can be assessed by a simulated mission refly. The environmental simulator is a hybrid system hosted in two digital computers connected by a specially designed real-time digital data link. Real-time simulation software performs two distinct functions: provides computer-controlled analog and digital input data to the ONE and respond to ONE guidance outputs, and provides truth-model aircraft data which can be used as a precision navigation reference. Preliminary experience related to the design and construction of the environmental simulator for the software life-cycle support facility is presented, some of the practical problems encountered in developing the simulator are described, interim resolution and potential long-term solutions and current status are discussed. Particular emphasis is placed on describing procedures used for implementing the simulator development guidelines: maximum flexibility and minimum essential design. A.R.H.

N80-19825# Boeing Aerospace Co., Seattle, Wash.
A JTIDS PERFORMANCE MODEL FOR THE E-3A
James G. Taylor *In* AGARD Modeling and Simulation of Avionics Systems and Command, Control and Commun. Jan. 1980 13 p refs
Avail: NTIS HC A24/MF A01

The communications link performance model developed to predict performance of joint tactical information distribution system (JTIDS) links between the E-3A and other aircraft and ground stations is described. The JTIDS is a time division multiple access system operating in the radio frequency band 962 to 1213 MHz and employs spread spectrum techniques. The model includes the performance effects on the JTIDS wideband frequency hopping receiver due to both the E-3A dual antenna system and specular and diffuse multipath signals. Laboratory tests were conducted which provided receiver performance data for signals routed through dual antenna and multipath simulators. This simulator approach was also used in similar tests conducted by SHAPE Technical Centre for NATO. The results were essentially identical in the two test programs. A flight test program was conducted which validated the link performance model. This validated model has greatly reduced costly E-3A flight testing and has provided predictions of JTIDS performance over a variety of communication link scenarios and flight conditions. Author

N80-19826# Marconi Space and Defence Systems Ltd., Hillend (Scotland).
A MISSION TRAINING SIMULATOR FOR THE NIMROD MR MK 2 AND SOME ASPECTS OF THE DERIVATION AND VERIFICATION OF ITS SYSTEM MODELS
K. Wells *In* AGARD Modeling and Simulation of Avionics Systems and Command, Control and Commun. Jan. 1980 6 p

Avail: NTIS HC A24/MF A01

Three MK. 1 simulators are undergoing a major avionics refit to reflect the changes in the RAF's Nimrod MR Mk. 2. This refit necessitates the modification to Mk. 2 standard of the two prime sensor systems; acoustics and radar. In addition, the navigation and central tactical systems are being updated. The modifications both to the acoustics and to the radar are discussed. The definition of operations requirement and engineering implementation specifications for both hardware and software are described. The need to verify models to reflect the continuously changing design baseline as a result of aircraft development and user experience is discussed. A.R.H.

N80-19829# Societe Nationale Industrielle Aerospatiale, Marignane (France.) Div. Helicopteres.

DESIGN OF A SIMULATOR FOR STUDYING THE HELICOPTER - SDVEH [CONCEPTION D'UN SIMULATEUR DE VOL D'ETUDE POUR HELICOPTER - SOUEH]

Jl. Mascle, G. Catani, M. Sellier, and Jp. Letouzey *In* AGARD Modeling and Simulation of Avionics Systems and Command, Control and Commun. Jan. 1980 13 p In FRENCH

Avail: NTIS HC A24/MF A01

The conceptual stages in the design of a flight simulator (SDVEH), which will study the specific problems in the design and flight operations of military helicopters are reported. The principle characteristics of the flight simulator are delineated and points considered critical to the development of a helicopter program are discussed. The development and organization of the project are reported and a preliminary analysis of the exact needs of the SDVEH are presented. Transl. by A.W.H.

N80-19830# Institute for Defense Analyses, Arlington, Va.

COST-EFFECTIVENESS OF FLIGHT SIMULATORS FOR MILITARY TRAINING

Jesse Orlansky and Joseph String *In* AGARD Modeling and Simulation of Avionics Systems and Command, Control and Commun. Jan. 1980 13 p refs

Avail: NTIS HC A24/MF A01

The cost and effectiveness of flight simulators used for military training are evaluated. Recent cost data of modern flight simulators are analyzed. A comparison of the skills learned in flight simulators and the effectiveness with which they are performed in actual flight versus the skills learned in actual flight only is discussed. Results show that pilots trained in the simulators use less flight time to perform various tasks than do those trained only in aircraft. A.W.H.

N80-19831# Le Materiel Telephonique, Trappes (France).

USING A LANGUAGE DEVELOPED FOR AIRCRAFT SIMULATORS [UTILISATION D'UN LANGAGE EVOLUE POUR LES SIMULATEURS D'AVIONS]

Michel G. Dreyfus *In* AGARD Modeling and Simulation of Avionics Systems and Command, Control and Commun. Jan. 1980 7 p In FRENCH; ENGLISH summary

Avail: NTIS HC A24/MF A01

The advantages and disadvantages of flight simulator computers using assembler languages and simulation computers using FORTRAN are discussed. The impact of each method on the analytical and programming methods employed at each stage of program writing, debugging, and modification is reviewed. The consequences of computing power and memory capacity are also discussed. A.W.H.

N80-19832# Royal Aircraft Establishment, Farnborough (England).

SIMULATION OF A NIGHT VISION SYSTEM FOR LOW LEVEL HELICOPTER OPERATIONS

J. N. Barrett *In* AGARD Modeling and Simulation of Avionics Systems and Command, Control and Commun. Jan. 1980 24 p

Avail: NTIS HC A24/MF A01

The development of night vision piloting aids to enable helicopters to operate at low altitude by night is discussed. An experiment which explored the problems and possibilities of a helmet mounted display for such helicopter night piloting tasks, using real time simulation techniques is described. The development of the helicopter simulation, and how the various components of the proposed night vision system were modelled and incorporated into the simulation are reported. The experimental design for the trials and how the limitations of the simulation were taken into account are discussed. A.W.H.

N80-19834# Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (West Germany).

AIR-TO-AIR ENGAGEMENT SIMULATION

Goetz Wunderlich and Roland Braun *In* AGARD Modeling and Simulation of Avionics Systems and Command, Control and Commun. Jan. 1980 14 p

Avail: NTIS HC A24/MF A01

The development of an air to air engagement simulation multiduel model which considers the aircraft, its avionics, armament, and the pilots behavior is discussed. The model will also consider the phase prior to combat including the fighter allocation, combat air patrol, ground controlled intercept capability, influence of early warning systems, etc. Assumptions, problems, and applications of the model are discussed. A.W.H.

N80-19836# Societe Nationale Industrielle Aerospatiale, Toulouse (France).

NEW POSSIBILITIES OFFERED BY A RADIO-INERTIAL HYBRID GUIDANCE SYSTEM DIGITAL SIMULATION STUDY [NOUVELLES POSSIBILITIES OFFERTES PAR UN SYSTEME DE GUIDAGE HYBRIDE RADIO - INERTIEL ETUDIE EN SIMULATION NUMERIQUE]

D. Buisson, J. Irvoas, and J. Grossin *In* AGARD Modeling and Simulation of Avionics Systems and Command, Control and Commun. Jan. 1980 25 p In FRENCH; ENGLISH summary refs

Avail: NTIS HC A24/MF A01

A radio inertial guidance system was studied to increase the accuracy of aircraft guidance along the ILS beams and to ensure continuation of automatic landing in the event of a localizer transmitter failure. Developments in the guidance system are discussed including the detection of the Loc beam centerline after an undetected failure in the monitoring of the Loc axis alignment with the runway axis. A digital simulation study which demonstrated the system performance is described. A.W.H.

N80-19837# British Aerospace Aircraft Group, Brough (England).

THE ROLE OF THE AIRCRAFT MODEL IN AVIONIC SYSTEMS SIMULATION

J. D. Bannister and R. Hicks *In* AGARD Modeling and Simulation of Avionics Systems and Command, Control and Commun. Jan. 1980 14 p refs

Avail: NTIS HC A24/MF A01

The relevance and use of the aircraft model in avionics systems simulation is discussed. The interaction between elements of the avionic systems, the vehicle dynamics and the outside world, and simulation is described. The aircraft model is discussed to indicate the choice to be made in determining the level of complexity required to fulfill differing objectives. Aircraft models of different types are described. Some algorithms and solution techniques are presented along with an indication of the limitations inherent in the models. Two contrasting simulations are discussed to show the significance of the aircraft model in relation to the avionic system simulation. The first example illustrates the use of an aircraft model in a GP computer simulation of the interception of invading aircraft. The second example discusses the aircraft model used in a pilot in the loop real time simulation of the avionics system for an attack aircraft. In both examples practical considerations are included such as processor requirements and simulation system architecture. A.W.H.

N80-19838# Battelle Columbus Labs., Ohio.

AVIONICS EVALUATION PROGRAM: SIMULATION MODELS FOR THE EFFECTIVENESS ANALYSIS OF AVIONICS

David Welp, Ken Almquist, and Larry Rainey *In* AGARD Modeling and Simulation of Avionics Systems and Command, Control and Commun. Jan. 1980 4 p Prepared in cooperation with AFAL, Wright-Patterson AFB, Ohio

Avail: NTIS HC A24/MF A01

The avionics evaluation program (AEP), a library of seven detailed avionics performance assessment models all driven by a common, interactive software package is examined. The AEP provides an efficient means for performing tradeoff analyses among cost, reliability, maintainability, and performance of avionic configurations. The models are the air to ground mission analysis program, target acquisition, weapon delivery, survivability, communications, air to air mission analysis, and dogfight analysis. Each model is described. A.W.H.

N80-19839# British Aerospace Dynamics Group, Bristol (England).

SIMULATION FOR WHOLE LIFE DEVELOPMENT

R. J. Morrow and R. Richards *In* AGARD Modeling and Simulation of Avionics Systems and Command, Control and Commun. Jan. 1980 11 p refs
Avail: NTIS HC A24/MF A01

A special prupose, real time simulator suitable for whole life development of complex avionics control systems is described. Software flexibility, a current equipment selling point, demands a reappraisal of previous equipment development procedures. Problems with high speed information handling will occur during the development of new digital controllers when used for command and control. ESM and EW system are discussed. The need to simulate those real world factors that load the information to the digital processing system under development. R.C.T.

N80-19840# Air Force Avionics Lab., Wright-Patterson AFB, Ohio.
A SIMULATION SUPPORT SYSTEM, THE DEVELOPMENT TOOL FOR AVIONIC SYSTEMS AND SUBSYSTEMS
John C. Ostgaard *In* AGARD Modeling and Simulation of Avionics Systems and Command, Control and Commun. Jan. 1980 11 p refs
Avail: NTIS HC A24/MF A01

The simulation support facility required for the development and validation of the digital avionics information system are discussed. The design requirements for an integrated simulation support system are given with emphasis on the following: avionic system support; prototype system software support; prototype system hardware support; engineering studies; maintenance augmentation; and training assistance. R.C.T.

N80-19841# Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (West Germany).
FIRE CONTROL FOR AIR-TO-AIR GUNNERY IN HIGH PERFORMANCE FIGHTER AIRCRAFT
Hans W. Pongratz *In* AGARD Modeling and Simulation of Avionics Systems and Command, Control and Commun. Jan. 1980 13 p
Avail: NTIS HC A24/MF A01

A survey on some of the aspects in air-to-air gunnery initiated by improvements in gun fire control are summarized. The simulation models used in the TKF simulation for gun fire control and gun scoring are presented. The necessary and the possible detail and accuracy of the implemented models is considered. R.C.T.

N80-19842# Electronique Marcel Dassault, St. Cloud (France).
SIMULATION FOR INTEGRATION WITH DYNAMIC TESTS OF THE LOGICAL ELEMENTS OF PRINCIPAL ONBOARD COMPUTERS [SIMULATEUR POUR INTEGRATION AVEC TESTS DYNAMIQUES DES LOGICIELS DE CALCULATEURS ENTRAUX EMBARQUES]
E. Bouthors *In* AGARD Modeling and Simulation of Avionics Systems and Command, Control and Commun. Jan. 1980 11 p In FRENCH
Avail: NTIS HC A24/MF A01

A system is described which was designed to simulate the environment of onboard computers and to furnish control methods which permit the adjustment and validation of logical elements before the effective integration of computers in real equipment environments. The essential characteristics of the system is to simulate the equipment environments, not at the level of their intrinsic operation, but at that of their interface with the computer in temporal, interactive, and information aspects. The simulation is made by the fusion of operator information with information registered on magnetic tape. This latter information simulates the different flight phases envisaged by tests while the operator information recreates in real-time, the action of the pilot and equipment. The possibilities of operating slowly and step-by-step confer a particular efficiency to the simulation and adjustment and validation of logical elements. Transl. by A.R.H.

N80-19843# Draper (Charles Stark) Lab., Inc., Cambridge, Mass. Guidance and Navigation Advanced Programs Div.
CRUISE-MISSILE-CARRIER NAVIGATION REQUIREMENTS
George T. Schmidt and Roy H. Setterlund *In* AGARD Modeling and Simulation of Avionics Systems and Command, Control and Commun. Jan. 1980 10 p refs
(Contract F33657-78-C-0473)
Avail: NTIS HC A24/MF A01

The modeling, simulation, and performance predictions used in determining aircraft avionics and transfer alignment requirements for a generic aircraft that would launch cruise missiles over water a considerable distance from a first TERCOM update area are discussed. The methodology used in allocating the allowable navigation errors between the CM guidance system and the cruise missile carrier aircraft avionics system is described. R.C.T.

N80-19844# National Aerospace Lab., Amsterdam (Netherlands).
A FLIGHT SIMULATION INVESTIGATION ON THE FEASIBILITY OF CURVED APPROACHES UNDER MLS GUIDANCE
L. J. J. Erkelens *In* AGARD Modeling and Simulation of Avionics Systems and Command, Control and Commun. Jan. 1980 18 p refs
Avail: NTIS HC A24/MF A01

A simulation investigation concerning the possibilities of executing laterally curved approaches with a wide body type of aircraft in a microwave landing system environment is described. The approach path variables were: final approach intercept altitude and angle of the turn. An Earth fixed circular segment connected the straight preturn segment with the final segment. A flight director operating in the instrument landing system tracking mode, supplied with minor modifications in the roll bar drive, is used as the primary instrument for guidance. Additional provisions are made to enable the pilot to monitor the approach. A total number of about 450 curved approaches, performed by three pilots, are flown on the simulator under various weather conditions. In addition to tracking data, subjective information like pilot ratings and comments are gathered. Curved approaches, with turn angles up to 180 deg can be carried out safely, provided that the altitude at which the turn is completed is not less than 305 m (1000 ft). Special provisions are needed with respect to the flight director roll bar drive, in order to achieve accurate tracking on the curved segment in strong wind conditions. M.G.

N80-19845# Boston Univ., Mass.
MODELING AND FLIGHT SIMULATION OF AN ACTIVE CONFIGURED AIRCRAFT UNDER M.L.S. GUIDANCE
A. Danesi, S. Smolka, and U. Chinappi *In* AGARD Modeling and Simulation of Avionics Systems and Command, Control and Commun. Jan. 1980 16 p Prepared in cooperation with Rome Univ., Italy
Avail: NTIS HC A24/MF A01

A mathematical formulation is presented to integrate the differential equations modeling a vehicle automatically guided along a curvilinear trajectory by a microwave landing system (M.L.S.). The augmented linear state equation, representing the open loop vehicle M.L.S. observer system, is given in standard phase variable form in which the altitude perturbations from the reference trajectory and numbers of its successive derivatives are assumed as state variables involved in a multifeedback flight control system. The state equation taken into consideration in system modeling handles separately the transfer function characteristics polynomial while the dynamical effects of the system zeros are included in the algebraic output equation relating the actual altitude perturbations to the state variables defined, in a rather fictitious fashion, in a state equation. The initial conditions to be imposed in the integration process must be consistent with the physical initial conditions on the actual trajectory considered in the problem at hand and for that purpose mathematical solution to the problem of transforming the initial conditions imposed on the physical state variables to the correspondent fictitious ones, is advanced. M.G.

N80-19846# Naval Air Development Center, Warminster, Pa.
MODELING THE HUMAN OPERATOR: APPLICATIONS TO SYSTEM COST EFFECTIVENESS

Norman E. Lane, Melvin I. Strieb (Analytics, Inc., Willow Grove, Pa.), and Walter Leyland *In* AGARD Modeling and Simulation of Avionics Systems and Command, Control and Commun. Jan. 1980 13 p refs
Avail: NTIS HC A24/MF A01

A technique for predicting system effectiveness which includes a consideration of realistic operator/system interactions is described. Operator interface cost effectiveness analysis (OICEA) combines system modeling with cost projections to evaluate the cost benefits of alternative proposed designs within appropriate mission contexts. Major avionics variables are integrated into a cohesive approach which simulates hardware and software functions and the performance of an operator interacting with these components, using a model called the human operator simulator. OICEA allows for systematic variation of key factors that influence ffectiveness, including degree and type of task automation, equipment and human reliability, scenarios and tactical doctrine, and operator characteristics. The OICEA methodology is summarized and applications to avionics and sensor improvements on a fixed wing antisubmarine warfare platform are documented. M.G.

N80-19847# Naval Air Development Center, Warminster, Pa.
PREDICTING FIELD OF VIEW REQUIREMENTS FOR VSTOL AIRCRAFT APPROACH AND LANDING
Paul M. Linton and Warren F. Clement *In* AGARD Modeling and Simulation of Avionics Systems and Command, Control and Commun. Jan. 1980 17 p refs Prepared in cooperation with Systems Technology, Inc., Mountain View, Calif.

Avail: NTIS HC A24/MF A01

A rationale for quantitatively determining fixed-wing, vertical/short take-off and landing aircraft field of view requirements is developed. The interactions between human visual processes, the vehicle approach profile, and the operator flight path control performance are considered. A model specifies precise visual requirements for recovery aboard defined shipboard pads or forward sites. M.G.

N80-19861*# Intermetrics, Inc., Huntsville, Ala.
NSSC-2 OPERATING SYSTEM DESIGN REQUIREMENTS SPECIFICATION Final Report
T. T. Schansman and J. R. Bounds 15 Aug. 1979 78 p refs (Contract NAS8-33382)
(NASA-CR-161396; IR-432) Avail: NTIS HC A05/MF A01 CSCL 09B

The design requirements and implementation standards for an NSSC-2 operating system are defined. An operating system diagram is presented along with system concepts and terminology. K.L.

N80-19863*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ALGORITHM FOR CALCULATING TURBINE COOLING FLOW AND THE RESULTING DECREASE IN TURBINE EFFICIENCY
James W. Gauntner Feb. 1980 23 p refs
(NASA-TM-81453; E-384) Avail: NTIS HC A02/MF A01 CSCL 09B

An algorithm is presented for calculating both the quantity of compressor bleed flow required to cool the turbine and the decrease in turbine efficiency caused by the injection of cooling air into the gas stream. The algorithm, which is intended for an axial flow, air routine in a properly written thermodynamic cycle code. Ten different cooling configurations are available for each row of cooled airfoils in the turbine. Results from the algorithm are substantiated by comparison with flows predicted by major engine manufacturers for given bulk metal temperatures and given cooling configurations. A list of definitions for the terms in the subroutine is presented. K.L.

N80-19880# Stevens Inst. of Tech., Hoboken, N. J.
FORTRAN PROGRAM OBLIQUE IN PL-FORMAT USER'S MANUAL
Daniel T. Valentine Nov. 1979 19 p refs
(Contract N00014-77-C-0062)
(AD-A077809; SIT-DL-7-899) Avail: NTIS HC A02/MF A01 CSCL 09/2

This manual accompanies the program listings and a magnetic tape containing two files, one of program OBLIQUE and one (the second) of program OBLIQ02. The programs OBLIQUE and OBLIQ02 plus the program PPEXACT are used in the procedure described herein to compute the blade bending moments of a propeller operating in an oncoming flow inclined to the propeller shaft. The theoretical analysis leading to and the operating of PPEXACT have been described by Tsakonas, et al. GRA

N80-19948# Morgan Semiconductor, Inc., Garland, Tex.
GE-SI SUPERSONIC FLIR WINDOW Final Report, 1 Jul. 1978 - 31 Mar. 1979
A. R. Hilton Jul. 1979 49 p
(Contract F33615-78-C-5105)
(AD-A078371; AFML-TR-79-4085) Avail: NTIS HC A03/MF A01 CSCL 17/5

The purpose of the program was to evaluate the infrared optical properties and related physical properties of melt formed Germanium-Silicon alloys as potential supersonic FLIR window materials. The approach was to combine the infrared transparency of germanium with the excellent physical properties of silicon to produce a window material capable of withstanding the temperature excursions and rain drop impact occuring during supersonic flight. Attention was confined to alloys with silicon content below 50 atom % to avoid the intrinsic lattice absorption that occurs at 9 micrometers in the infrared for silicon or silicon rich alloys. A zone levelling technique was selected and modified in a manner expected to yield materials free of oxide absorption. A melt form method was selected rather than vapor phase because of the potential problems in scaling up to produce large FLIR windows. Unfortunately, the growth of alloy compositions with silicon content above 5% proved to be impossible to do at least under the operating conditions and with the equipment used. Major problems were long term temperature stability, zoning rates and reactivity of the molten alloys with quartz boats and ampoules. Although the concentration range up to 50 atom % silicon was covered, infrared transmission was not obtained for any compositions with silicon content above 5 atom%. Rain erosion samples were submitted for evaluation covering five compositions. Discussions related to the best Ge-Si alloy composition for FLIR applications are presented along with a projection of the related physical-optical parameters expected for that composition. GRA

N80-19978 Wisconsin Univ. - Madison.
STRUCTURES IN AERONAUTICAL PHRASEOLOGY: FROM ENGLISH TO SPANISH Ph.D. Thesis
Francisco Xavier Almeida 1978 425 p
Avail: Univ. Microfilms Order No. 7915065

The creation of an English Phraseology, its adoption as the International Language for Aviation, and the establishment of the official ICAO (International Civil Aviation Organization) Spanish Phraseology are traced. The regulations and structures governing civil aviation are surveyed and some of the more important studies on the formulation of the Phraseology and on its applications to actual flight conditions are examined. An unexpected result of the investigation is that aeronautical radio can be a fertile ground in which to observe without interfering with the observation, the phenomena of dialects in contact, and the modification of certain dialects as a result of sociolinguistic pressures. Some confirmation is provided for a stratification scheme for Spanish dialects which reflects a popularly held view of many native speakers of Spanish. Dissert. Abstr.

N80-19988# Committee on Science and Technology (U. S. House).
NASA AUTHORIZATION, 1981, PROGRAM REVIEW, VOLUME 2
Washington GPO 1980 275 p refs Hearings before the Subcomm. on Transportation, Aviation and Communications of

the Comm. on Sci. and Technol., 96th Congr., 1st Sess., 30-31 Oct. 1979
(GPO-56-220) Avail: Subcomm. on Transportation, Aviation and Communications

A program review of NASA activities is presented with emphasis on the progress made in aeronautics during the past 12 months. Aerodynamics, materials and structures, aeronautical propulsion, and avionics and human factors are among the topics covered. Also, advances in vehicle technology are discussed including transport aircraft, general aviation aircraft, low speed aircraft, and high speed aircraft. J.M.S.

N80-19991# Systems Technology, Inc., Hawthorne, Calif.
DEVELOPMENT OF AERODYNAMIC DISTURBANCE TEST PROCEDURES, VOLUME 1: EXECUTIVE SUMMARY Final Report, 30 Sep. 1977 - 30 Mar. 1979
Richard H. Klein and Jeffrey R. Hogue Aug. 1979 33 p refs (Contract DOT-HS-7-01716)
(PB80-108145; STI-TR-1117-1-Vol-1; DOT-HS-805078) Avail: NTIS HC A03/MF A01 CSCL 13F

The crosswind responses of twenty different vehicles were surveyed. Three test procedures were used in three different crosswind disturbance configurations. These were steering fixed, steering free, and driver control of lane position. The crosswind configurations were straight pulse, doublet pulse, and a shaped profile. Results show that passenger cars, station wagons, trucks, and most vans have virtually no crosswind sensitivity problems, whereas the VW Microbus, the pick/up camper (in winds higher than 35 mph), cars pulling trailers, and mopeds do have potential problems. GRA

N80-20018# Association for Unmanned Vehicle Systems, Dayton, Ohio.
PROCEEDINGS OF THE ASSOCIATION FOR UNMANNED VEHICLE SYSTEMS AUVS '79: 6TH ANNUAL CONVENTION
1979 165 p refs Conv. held at San Diego, Calif., 29 May - 1 Jun. 1979
(AD-A077877) Avail: NTIS HC A08/MF A01 CSCL 01/3

Contents: Unmanned Vehicles on the Tactical Battlefield - Another Beginning: Why Unmanned Vehicles Can Be Effective: Unmanned Battlefield Reconnaissance Systems For The German Army: Automated Guidance for Ground Vehicles: Cruise Missile Air Launch In the Operational Environment: Advances In Anti-Jam Transmission of Reconnaissance Imagery Data: Unmanned Seaplanes For Naval Operations: Unmanned Systems For Reducing Our Taxes: and Cruising The Planets. GRA

N80-20020# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
AIR FORCE FLIGHT DYNAMICS LABORATORY FISCAL YEAR 1981. TECHNICAL OBJECTIVE DOCUMENT
Dec. 1979 87 p refs Supersedes AFFDL-TR-78-181
(AD-A078973; AFFDL-TR-79-3133; AFFDL-TR-78-181) Avail: NTIS HC A05/MF A01 CSCL 01/3

The document presents an overview of the four Technical Planning Objectives (TPO) and supporting data for each. These are extracted from the technical plan of the Air Force Flight Dynamics Laboratory (AFFDL). Information is largely based on AFFDL fiscal 1981 technology plan omitting specific funding and timing information of an 'Official Use Only' nature. Technical objectives are described for the technical areas of Structures and Dynamics, Vehicle Equipment/Subsystems, Flight Control and Aeromechanics. Points of contact for more information in each of the areas are identified. GRA

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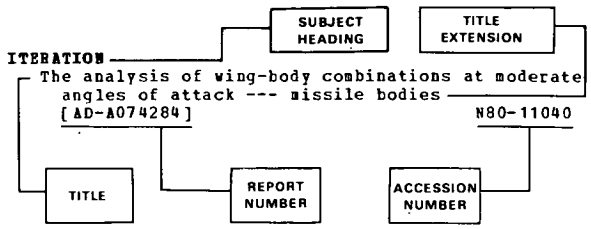

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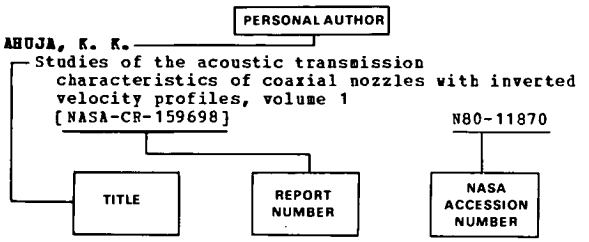

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