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A Continuing Bibliography with Indexes

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AERONAUTICAL ENGINEERING

A Continuing Bibliography

Supplement 139

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 August 1981 in

- *Scientific and Technical Aerospace Reports (STAR)*
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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 381 reports, journal articles, and other documents originally announced in August 1981 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*.

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

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

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

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

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

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TYPICAL CITATION AND ABSTRACT FROM *IAA*

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

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

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AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 139)

SEPTEMBER 1981

IAA ENTRIES

A81-34022 ***Results of thermal tests on the GTA-18 gas turbine unit with the RD-ZM-500 jet engine.*** V. P. Polivanov, G. G. Ol'khovskii, L. V. Povolotskii, M. P. Kaplan, L. A. Chernomordik, A. O. Bumarskov, I. N. Skvirskii, P. I. Korzh, and A. G. Tumanovskii (Khar'kovskii Turbinnyi Zavod, Kharkov, Ukrainian SSR; Vsesoiuznyi Teplotekhnicheskii Institut, Moscow; Soiuztekhenergo, USSR). *(Teploenergetika,* vol. 27, Aug. 1980, p. 23-28.) *Thermal Engineering,* vol. 27, Aug. 1980, p. 432-436. Translation.

The GTA-18 gas turbine plant (15-20 MW) has been tested on liquid fuel (aviation kerosene and diesel fuel) at ambient temperatures of 20-27 and -2 C and on natural gas at +5 and -10 C. The tests were conducted under industrial conditions at a heat and power generating facility. At +15 and +5 C, power outputs of 16.8 and 18.6 MW and efficiencies of 20.3 and 21.1%, respectively, have been obtained. V.L.

A81-34120 # **Finite element analysis of self-excited vibrations of helicopter rotor blades.** Z. Dzygadlo and W. Sobieraj. *Journal of Technical Physics,* vol. 21, no. 4, 1980, p. 489-504. 7 refs.

The finite element method is used to analyze the self-excited vibrations of a helicopter rotor blade, taking into account the critical flutter parameters. The case considered is that of a hovering helicopter, with material damping and aerodynamic forces taken into account. It is assumed that the geometric parameters of the blade, its moments of inertia and rigidities, and the aerodynamic forces and moments may vary linearly along the elements, while finite jumps of the values of these parameters may occur at the edges of the elements; this makes possible the modeling of blades with various distributions of parameters. The present finite element was verified for various models of helicopter blades, and the convergence of the results was found to be sufficiently rapid. P.T.H.

A81-34121 # **Quarter-scale testing of an advanced rotor system for the UH-1 helicopter.** J. D. Berry (U.S. Army, Structures Laboratory, Hampton, Va.). *American Helicopter Society, Annual Forum, 37th, New Orleans, La., May 17-19, 1981, Paper.* 8 p. 13 refs.

An advanced rotor system designed for the UH-1 helicopter was tested at quarter scale in hover and simulated forward systems flight along with a standard (baseline) rotor system. Rotor tip speed was held at 248.2 m/sec matching the full-scale nominal value (Mach scaling). In hover, the advanced rotor system demonstrated the capability of lifting an additional 320 kg out-of-ground effect throughout most of the power range of the UH-1 helicopter. In forward flight, the system showed a significant reduction in power required throughout the range of advance ratios tested, and power decrements from 47 kW to 120 kW were shown. Mach-scale testing of advanced rotor designs for performance improvements offers a safe and economical method for defining rotor performance before full-scale flight/wind-tunnel testing. K.S.

A81-34151 **The F100 engine.** L. T. G. Lancaster (USAF, Nellis AFB, Nev.) and R. E. Eshbach (United Technologies Corp., Pratt and Whitney Aircraft Group, West Palm Beach, Fla.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801110.* 7 p.

The F100 engine, whose development was begun in early 1970, and which is used in the advanced tactical fighter F-15 and F-16 aircraft, is reviewed. It is a low by-pass, high-compression-ratio, twin spool, augmented turbofan engine in the 25,000 pound thrust class. Design features include variable geometry in both the fan and the compressor, a short annular combustor, a mixed flow augmentor with thrust modulation, and a variable area balanced beam nozzle. Through the use of advanced engineering design and material technologies, the goal of the high thrust-to-weight ratio of 8:1 or better was met. Some of the major contributions to the high performance of the engine are high aerodynamic stage loadings, high-temperature turbine with advanced cooling features, variable internal aerodynamics, and high-strength and low-weight alloys. Maintenance is simplified by its modular structure, each module being interchangeable from engine to engine at the intermediate maintenance level. For the first time in engine development, engine characteristics were optimized for the complete weapons system. To maintain the engine's superior performance, development is directed towards an advanced version of the F100 engine, known as the Derivative Engine. K.S.

A81-34152 * **Improved components for engine fuel savings.** R. J. Antl and J. E. McAulay (NASA, Lewis Research Center, Cleveland, Ohio). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801116.* 17 p. 11 refs.

NASA programs for developing fuel saving technology include the Engine Component Improvement Project for short term improvements in existing air engines. The Performance Improvement section is to define component technologies for improving fuel efficiency for CF6, JT9D and JT8D turbofan engines. Sixteen concepts were developed and nine were tested while four are already in use by airlines. If all sixteen concepts are successfully introduced the gain will be fuel savings of more than 6 billion gallons over the lifetime of the engines. The improvements include modifications in fans, mounts, exhaust nozzles, turbine clearance and turbine blades. D.B.

A81-34153 **JT8D performance improvement to offset rising fuel costs.** R. K. Fahle (United Technologies Corp., Commercial Products Div., East Hartford, Conn.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801117.* 7 p.

The performance improvement program being conducted for the JT8D turbofan engines, encompassing both retrofit kits and major modification undertakings, is described. Changes are being made to the fan, compressor, and turbine sections of the various JT8D series (1 through 17R), in order to improve component efficiency levels and decrease specific fuel consumption. Retrofit packages will provide SFC reductions of 2.1% for -1 and -7 series engines, 3% for the -9 series, and 5.5% for -15, -17 and -17R engines at cruise conditions, with comparable figures at other conditions. Specific components described are: fan inlet case, low and high pressure compressors, high-pressure air-cooled turbine blade flow patterns and seals, and low-pressure turbine stages. O.C.

A81-34154 * Performance deterioration of commercial high-bypass ratio turbofan engines. C. M. Mehalic and J. A. Ziemianski (NASA, Lewis Research Center, Cleveland, Ohio). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801118.* 14 p. 17 refs.

NASA programs for improving aircraft engine fuel efficiency include the Engine Component Improvement Project of which the Engine Diagnostics section is to identify performance deterioration factors for the JT9D and CF6 high-bypass ratio turbofan engines and to develop technology for fuel consumption reduction. The program tests and inspects engines, examines deteriorated elements, formulates deterioration trends and models, identifies specific causative events or modules and determines mechanisms. Results show that short-term performance deterioration is less than 1% of cruise specific fuel consumption and is caused by flight loads or thermal damage due to rubbing of turbine blade tips against shrouds. Long-term deterioration is 2.5-3% of cruise specific fuel consumption after 2500-3000 flights and mechanisms are thermal damage to blade tips with rubbing and damaged airfoils and parts. D.B.

A81-34155 * A status report on the Energy Efficient Engine Project. L. E. Macioce, J. W. Schaefer, and N. T. Saunders (NASA, Lewis Research Center, Cleveland, Ohio). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801119.* 18 p. 18 refs.

The Energy Efficient Engine (E3) Project is directed at providing, by 1984, the advanced technologies which could be used for a new generation of fuel conservative turbofan engines. This paper summarizes the scope of the entire project and the current status of these efforts. Included is a description of the preliminary designs of the fully developed engines, the potential benefits of these advanced engines, and highlights of some of the component technology efforts conducted to date. (Author)

A81-34156 * The NASA high-speed turboprop program. J. F. Dugan, B. A. Miller, E. J. Graber, and D. A. Sagerser (NASA, Lewis Research Center, Cleveland, Ohio). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801120.* 21 p. 21 refs.

NASA's Advanced Turboprop Project is a three-phase effort initiated in 1978 to provide technology readiness for Mach 0.7 to 0.8 turboprop-powered aircraft; with the potential for fuel savings and DOC reductions of up to 30 and 15%, respectively, relative to current in-service aircraft. This paper reviews the status of Phase I in the areas of propeller aeroacoustics, propeller structures, turboprop installed performance, aircraft cabin environment, and turboprop engine and aircraft studies. Current plans to establish large-scale propeller characteristics and to conduct high-speed propeller flight research tests using a modified testbed aircraft are also presented. (Author)

A81-34157 A review of the installation, performance and economic aspects of a high altitude facility for small gas turbines. G. Koury (Pratt and Whitney Aircraft of Canada, Ltd., Longueuil, Quebec, Canada). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801121.* 9 p.

A new Canadian facility capable of simulating high altitude conditions (up to 40,000 ft) for testing the performance of small gas turbine engines is discussed in terms of technical and economic advantages. The modification project to change an existing facility into a test cell capable for high altitude testing is described and the main control room, vacuum chamber, high precision and mechanical instruments needed to obtain pressure and temperature control are discussed. Comparing the ground level with existing flying test bed facilities, the former was seen to adapt more easily to different engine models due to fewer constraints on weight and space. It is concluded that a high quality performance data can be obtained at considerably lower cost and in relatively shorter time, when testing is not exclusively done in a flying test bed, but in conjunction with the new ground facility. E.B.

A81-34158 * Description of the warm core turbine facility and the warm annular cascade facility recently installed at NASA Lewis Research Center. W. J. Whitney, R. G. Stabe, and T. P. Moffitt (NASA, Lewis Research Center, Cleveland, Ohio). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801122.* 9 p.

The two new facilities have been installed and operated at their design or rated conditions. The important feature of both of these facilities is that the ratio of turbine inlet temperature to coolant temperature encountered in high temperature engines can be duplicated at moderate turbine inlet temperature. Included in the discussion are the limits of the facilities with regard to maximum temperature, maximum pressure, maximum mass flow rate, turbine size, and dynamometer torque-speed characteristics. (Author)

A81-34159 A forward look at gas turbine testing facilities. W. L. Webb (United Technologies Corp., West Palm Beach, Fla.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801124.* 10 p.

Requirements for future high thrust-to-weight gas turbine engine testing facilities and the parameters that generate them are reviewed. Much longer in-service life of future engines than those of the past, and higher thrust-to-weight and lower fuel consumption compared to earlier engines require a more demanding development and in-service support testing. Testing facilities must be capable of fulfilling the testing objective to meet the in-service performance, availability and durability, and they must be capable of completing these objectives in an economical manner. Specific requirements for full engine test facilities include (1) thrust ranges from 500 to 50,000 lbs plus transient response capability of 10,000 lb sec; and (2) for afterburning engines, the capability to manage exhaust gas temperatures in the range of 3000 F. Improved simulation technology will improve the design cycle, and the controls development can be improved with expanded control development facilities, which should be capable of testing the control system's functional operation in an environment that duplicates that of the engine. K.S.

A81-34162 The all-electric airplane as an energy efficient transport. M. J. Cronin (Lockheed-California Co., Burbank, Calif.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801131.* 17 p. 19 refs.

A presentation is made of the performance, efficiency, and economic gains expected from the application of recent advances in such technologies as microprocessors, solid-state power switching, samarium-cobalt motor/generators and fly-by-wire/power-by-wire, to a next-generation advanced transport aircraft (ATA) design. It is shown that it is feasible to transfer all tasks normally associated with engine compressor-bleed air pneumatic systems, and high pressure hydraulic systems, to electrical and electromechanical devices. Total take-off gross weight savings for the all-electric system are estimated at 23,500 lb. The details of an all-electric secondary power system are furnished to demonstrate the obviation of all hydraulics, propulsion efficiency losses (through engine bleed), pneumatic devices, separate engine start systems, and complex mechanical control devices, while significantly improving logistics and maintenance. O.C.

A81-34163 * Air transport flight parameter measurements program - Concepts and benefits. G. J. Morris and N. L. Crabill (NASA, Langley Research Center, Hampton, Va.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801132.* 9 p.

A program is described in which statistical flight loads and operating practice data for both narrow- and wide-body airline transport aircraft, intended primarily for use by manufacturers in updating design criteria, are obtained from existing, on-board digital flight data recorders. Procedures for editing and processing the data are explained, and differences between these and past NACA/NASA analog data are discussed. One major such difference is the automatic bandpass filtering of normal acceleration data to separate high-frequency gust response from low-frequency maneuver response. Plans and preliminary efforts for the development of an on-board data processing system, able to derive statistical aircraft operating parameters directly from real-time data, are also reviewed. O.C.

A81-34164 * Fog dispersion. W. Frost (FWG Associates, Tullahoma, Tenn.), L. S. Christensen (ARO, Inc., Arnold Air Force Station, Tenn.), F. G. Collins (Tennessee, University, Tullahoma, Tenn.), and D. W. Camp (NASA, Marshall Space Flight Center, Huntsville, Ala.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801133.* 17 p. 27 refs. Contract No. NAS8-33541.

A study of economically viable techniques for dispersing warm fog at commercial airports is presented. Five fog dispersion techniques are examined: evaporation suppression, downwash, mixing, seeding with hygroscopic material, thermal techniques, and charged particle techniques. Thermal techniques, although effective, were found to be too expensive for routine airport operations, and detrimental to the environment. Seeding or helicopter downwash are practical for small-scale or temporary fog clearing, but are probably not useful for airport operations on a routine basis. Considerable disagreement exists on the capability of charged particle techniques, which stems from the fact that different assumptions and parameter values are used in the analytical models. Recommendations resulting from the review of this technique are listed, and include: experimental measurements of the parameters in question; a study to ascertain possible safety hazards, such as increased electrical activity or fuel ignition during refueling operations which could render charged particle techniques impractical; and a study of a single charged particle generator. K.S.

A81-34165 *Methods for the verification and validation of* digital flight control systems. W. E. Larsen (FAA, Moffett Field, Calif.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801134.* 7 p.

A NASA/FAA/Aerospace industries program concerned with the improvement of regulatory government agencies' understanding of airborne digital systems assurance technology, and with the evaluation and improvement of the tools and methods of this technology, is described. A near-term, representative digital flight control system is used to evaluate the tools and methods developed. The experimental facility used incorporates aircraft, sensor actuator and environmental models, automated software verification tools, and hardware verification and system validation tools, and is able to undertake such tasks as failure effect evaluation and electrical power disturbance effects on Reconfigurable Digital Flight Control Systems (RDFCS), in addition to maintaining a criteria data base. O.C.

A81-34166 * Loss model for off-design performance analysis of radial turbines with pivoting-vane, variable-area stators. P. L. Meitner (U.S. Army, Propulsion Laboratory, Cleveland, Ohio) and A. J. Glassman (NASA, Lewis Research Center, Cleveland, Ohio). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801135.* 11 p. 6 refs.

An off-design performance loss model for a radial turbine with pivoting, variable-area stators is developed through a combination of analytical modeling and experimental data analysis. A viscous loss model is used for the variation in stator loss with setting angle, and stator vane end-clearance leakage effects are predicted by a clearance flow model. The variation of rotor loss coefficient with stator setting angle is obtained by means of an analytical matching of experimental data for a rotor that was tested with six stators, having throat areas from 20 to 144% of the design area. An incidence loss model is selected to obtain best agreement with experimental data. The stator vane end-clearance leakage model predicts increasing mass flow and decreasing efficiency as a result of end-clearances, with changes becoming significantly larger with decreasing stator area. O.C.

A81-34167 An experimental and theoretical investigation of a twin-entry radial flow turbine under non-steady flow conditions. M. Farrashkhalvat and P. C. Baruah (University of Manchester Institute of Science and Technology, Manchester, England). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801136.* 18 p.

A computational model for the simulation of a twin-entry, radial-inflow turbine operating under full and partial-admission conditions is presented for a single turbine speed. It is assumed that the flow is one-dimensional, and that the flow process through the boundary is quasi-steady, implying that the steady flow characteristics of the turbine can be used for nonsteady flow equations. It is found that the predictions of this model are strongly dependent on turbine steady flow characteristics. The results obtained with the present method under partial admission conditions are unsatisfactory, even with extensive experimental data to represent the boundary conditions. O.C.

A81-34168 * An experimental evaluation of the performance deficit of an aircraft engine starter turbine. J. E. Haas (U.S. Army, Research and Technology Laboratories, Cleveland, Ohio), R. J. Roelke (NASA, Lewis Research Center, Cleveland, Ohio), and P. Hermann (Sundstrand Corp., Rockford, Ill.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801137.* 10 p.

An experimental investigation is presented to determine the aerodynamic performance deficit of a 13.5 - centimeter-tip-diameter aircraft engine starter turbine. The two-phased evaluation comprised both the stator and the stage performance, and the experimental design is described in detail. Data obtained from the investigation of three honeycomb shrouds clearly showed that the filled honeycomb reached a total efficiency of 0.868, 8.2 points higher than the open honeycomb shroud, at design equivalent conditions of speed and blade-jet speed ratio. It was concluded that the use of an open honeycomb shroud caused the large performance deficit for the starter turbine. Further research is suggested to ascertain stator inlet boundary layer measurements. E.B.

A81-34169 * Composite wall concept for high-temperature turbine shrouds - Heat transfer analysis. L. P. Ludwig and F. S. Stepka (NASA, Lewis Research Center, Cleveland, Ohio). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801138.* 9 p. 13 refs.

The variables affecting the design of a composite turbine shroud, consisting of a metal base, an interlayer of porous metal, and an outer layer of yttria-stabilized zirconia, are analyzed. Results show that significant reductions in the cooling-air to gas-flow ratio are indicated for the composite shrouds compared to an all-metal shroud that was only impingement air cooled. The good insulating properties of the ceramic reduced the temperatures of the porous metal and support wall significantly. For a given porous metal density and coolant- to gas-flow ratio, decreasing the thickness of the porous metal and increasing ceramic thickness resulted in lower support wall temperatures. To maintain given allowable inter-layer temperatures and coolant- to gas-flow ratios, porous-metal density or thermal conductivity must increase as the ratio of the thickness of the ceramic-to-porous metal decreases. It is concluded that a 1.78 mm thickness of porous material with a density of 0.2 and a 1.78 mm thickness of ceramic appears to be a good composite wall configuration for the assumed conditions. E.B.

A81-34170 * Future challenges in V/STOL flight propulsion control integration. S. P. Roth, R. J. Miller (United Technologies Corp., Pratt and Whitney Aircraft Group, West Palm Beach, Fla.), and J. Mihaloew (NASA, Lewis Research Center, Cleveland, Ohio). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801140.* 15 p. 6 refs.

A survey of propulsion control requirements forming part of an advanced V/STOL control requirements study has to date determined, among other findings: (1) that the dependence of V/STOL flying qualities on propulsive lift makes it necessary to identify propulsion control requirements early in a development program; (2) that V/STOL controls of the future should relieve the pilot of control functions and elevate him to the position of a flight operations manager, with substantial gains in capability and/or safety; and (3) that research is required to define the V/STOL control system reliability requirements and specific component reliability allocations. An interactive, integrated design process for the realization of these objectives is also described. O.C.

A81-34171 **A comparison of propulsion systems for V/STOL supersonic combat aircraft.** W. J. Lewis and P. Simpkin (Rolls-Royce, Ltd., London, England). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801141.* 13 p.

Three lift/propulsion concepts for a V/STOL supersonic combat aircraft have been compared. The intention was to show the effect of the propulsion system on aircraft weight and size, performance, and life cycle costs for: (1) vectored thrust with plenum chamber burning (bypass air augmentation); (2) lift engines and a lift/cruise reheated turbofan; and (3) a reheated lift/cruise turbofan with a remote augmented lift system. For a postulated deck-launched intercept mission, the vectored thrust propulsion system with plenum chamber burning gives the smallest and cheapest aircraft having the required performance. In addition, for a given take-off ground run, the vectored-thrust-powered aircraft has the longest fighter escort mission radius. (Author)

A81-34172 **Development and applications of MIL-STD-1553.** A. Crossgrove (Boeing Military Airplane Co., Seattle, Wash.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801142.* 18 p.

The MIL-STD-1553, Aircraft Internal Time Division Command/Response Multiplex Data Bus, a military standard which is one of the basic standardization tools being used by the DOD for avionic interfaces, is presented. The integration flexibility that is available in 1553 systems is one of the key features of this method of integration. The standard establishes requirements for information transfer formats and electrical interface characteristics. Current examples are presented of 1553 multiplexing in aircraft, and include systems that range from simple sensors to complex subsystem integration, as well as development and production systems. Implementations that closely follow the requirements of 1553 (USAF), 1553A and 1553B are also described, the examples being: the B-52 offensive avionics system, the advanced attack helicopter, the high performance Doppler Velocity Sensor, and the Light Airborne Multipurpose System. K.S.

A81-34173 **A multiplexed digital voice intercommunications system for military applications.** R. F. Bolt and B. D. Sanderson (U.S. Navy, Naval Avionics Center, Indianapolis, Ind.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801144.* 9 p. 5 refs.

The Multiplexed Digital Voice Intercommunications System (MUDIV ICS) has demonstrated the feasibility of applying digital voice techniques to an ICS. The system also provides an important tool in the evaluation of voice digitization techniques for suitability in military platforms subjected to severe noise environments. Planned intelligibility test results will provide an objective basis for the selection of the optimum digitization technique and sampling rate for the Avionics Components and Subsystems (AVCS) program ICS. This design will be translated into a militarized package upon completion of the voice digitization selection. Projections based on the complexity of this system indicate a 30% reduction in volume and 60% reduction in power consumption by comparison with existing analog audio ICS. O.C.

A81-34174 **The evolution of fiber optics in avionics.** C. R. Husbands (Mitre Corp., Bedford, Mass.), P. Currier (General Dynamics Corp., St. Louis, Mo.), and D. R. Porter (ITT, ITT Electro Optical Products, Roanoke, Va.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801145.* 7 p. 7 refs.

Fiber optics was first proposed for communications in July 1966. Since that time commercial and military programs have evolved fiber optics to a state where practical and economically competitive systems are being implemented. This paper explores the development of fiber-optic components and systems in aircraft. The major benefits of a fiber-optic system are presented, highlighting less obvious features such as reduced susceptibilities to nuclear phenomena and electromagnetic compatibility. A survey of contracted and independent programs in industry is presented that shows those areas where feasibility and proof-of-concept in airborne systems have been demonstrated. The evolution of fiber-optic standardization is also presented, and shows how an effort is being made to confine the direction of fiber-optic systems without excluding technological advances. (Author)

A81-34175 **IMUX - High speed communications bus.** J. P. Gross, S. L. Broadhead, and J. D. Moore (SCI Systems Inc., Government Div., Huntsville, Ala.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801146.* 11 p. 7 refs. Navy-supported research.

The Information Multiplex (IMUX) bus is a high speed serial data bus used on military airborne and ground transportable communications systems. A contention protocol is used to provide simplified bus management, i.e., no central controller, fast access for bus users, speed expansion up to 20 Mbits/sec, and system configuration flexibility required in these applications. A hardware fabrication and testing program which demonstrates concept feasibility is described. Results of a computer simulation study reveal bus utilizations up to 95% of maximum bit rates, transmission delay times of less than 1 ms, and stable bus operation. (Author)

A81-34176 **The GTCP331 Auxiliary Power Unit for the next generation commercial transports.** R. E. Wells and A. L. Romanin (AiResearch Manufacturing Company of Arizona, Phoenix, Ariz.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801147.* 19 p.

Various aspects of the GTCP311 Auxiliary Power Unit (APU) program to be utilized in future commercial jet services are discussed, and data related to the different design configurations, and criteria for power class selections are described in terms of technological advancements, environmental factors, and economic considerations. Studies show that an APU based on a production turboprop engine power section (TPE311), directly driving a load compressor and gearbox, is economically the best choice. Two models designed for the Airbus A.300/A/310 aircraft and the Boeing 767/757 aircraft are described. Operational features provided by the APU are compressed air for cabin air conditioning, main engine starting, electrical power for both ground and flight operation, standby hydraulic power (via a turbopump), and inflight anticing. The APU microprocessor electronic controller facilitates safe, precise, and fuel efficient operation. Internal engine treatment in both inlet and exhaust gas flow paths assure excellent APU noise characteristics, meeting current and future environmental requirements. E.B.

A81-34177 * **Some advantages of methane in an aircraft gas turbine.** R. W. Graham and A. J. Glassman (NASA, Lewis Research Center, Cleveland, Ohio). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801154.* 9 p. 22 refs.

Because liquid methane may be obtained from existing natural gas sources or produced synthetically from a range of other hydrocarbon sources (coal, biomass, shale, organic waste), it is considered as an aviation fuel in a simplified cycle analysis of the performance of a turboprop engine intended for operation at Mach 0.8 and 10,688 m altitude. Performance comparisons are given for four cases in which the turbine cooling air is either not cooled or cooled to -111, -222, and -333 K, and the advantages and problems that may be expected from direct use of the cryogenic fuel in turbine cooling are discussed. It is shown that while (1) methane combustion characteristics are appreciably different from those of Jet A fuel and will require the development of different combustor designs, and (2) the safe integration of methane cryotanks into transport aircraft structures poses a major design problem, a highly fuel-efficient turboprop engine fueled by methane appears to be feasible. O.C.

A81-34178 Fuel efficiency improvements to the T56 turboprop engine. H. Munevar (U.S. Air Force Academy, Colorado Springs, Colo.) and F. Verkamp (General Motors Corp., Detroit Diesel Allison Div., Detroit, Mich.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801158.* 11 p.

An overview is given to the performance, fuel efficiency, reliability and life cycle objectives of the T56 turboprop engine Engine Model Derivative Program EMDP. Improvements over currently operational engines of 10.5% in specific fuel consumption, and 24% in power output, are being achieved at low cost and low risk through the exclusive use of previously demonstrated component technology and the highly conservative conditions of a 2110 F turbine inlet temperature and 12:1 cycle pressure ratio. Engines already in use, such as those of the Air Force's 720 C-130 cargo aircraft, will be reconfigured with a retrofit kit in the course of normal engine overhaul. Investment recovery is estimated to lie within four years of fleet retrofit. O.C.

A81-34179 Technology advances allow multiple role radar design for the F/A-18. R. E. White (Hughes Aircraft Co., Arlington, Va.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801163.* 9 p.

Air-to-air radar systems (which require extremely fast data processing rates and a variable waveform transmitter capability to achieve an all-aspect, all-altitude target detection capability) differ greatly from air-to-surface radar systems (which are optimized when they have large data storage and management capacities and high resolution wave-forms). The all-digital AN/APG-65 radar, the primary sensor for the all-weather F/A-18 multi-role tactical aircraft, has features needed for both systems. A review of the major advances that led to the feasibility of the multimission radar system is presented. The magnetron, the fire control systems, the coherent pulse Doppler radar, the traveling wave tube, and the programmable signal processor all led to the development of the AN/APG-65 radar. K.S.

A81-34180 History of SAE Committee S-7, Flight Deck and Handling Qualities Standards for Transport Category Aircraft. S. Flower. *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801165.* 8 p.

An historical outline is presented of the formation, development and activities of the Society of Automotive Engineers (SAE) Committee S-7, Flight Deck and Handling Qualities Standards for Transport Category Aircraft. The accomplishments of successive committee chairmen are discussed, in addition to the numerous organizational changes made within the committee, which have over the years resulted in the extension of its membership to include foreign airline and manufacturing representatives. O.C.

A81-34181 Flight control systems go digital - More than a binary mechanization of analog predecessors. R. H. Parker and H. R. Urling (Sperry Corp., Sperry Flight Systems Div., Phoenix, Ariz.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801166.* 10 p.

Digital flight-control systems which are now replacing analog-type systems in commercial air transport, are smaller, lighter and have superior high-speed computing power. The degree of flight automation is notably increased, with a considerable drop in pilot intervention while problems of automatic transition from one flight condition to another can be controlled by digital technology. System availability is greatly strengthened by improved maintenance based upon automatic monitoring by digital processors. D.B.

A81-34182 Strapdown navigation comes of age. D. L. Bjorndahl (Litton Industries, Aero Products Div., Canoga Park, Calif.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801167.* 9 p.

The strapdown Inertial Reference System to be used in the Boeing 757 and 767 and the A310 aircraft is compared to the gimballed system, and the differences between the two mechanizations are discussed. Although the reliability, accuracy, and general acceptability of the existing gimbal designs are well documented, the decision in favor of the strapdown IRS is based on three main reasons: (1) the cost of the life cycle, assembly, test, and maintenance of the laser gyro is lower; (2) a single strapdown IRS can perform the functions of a gimballed IRS plus separate body-mounted angular rate and linear acceleration packages, thus reducing the number of installed LRUs and interconnecting wiring; and (3) the avionics interfaces are all digital, and improvements in overall avionics reliability can be expected concurrently with reduced hardware and installation costs. Finally, it is mentioned that the digital character of the strapdown mechanization allows its use in the new digital aircraft without the need for A/D or D/A conversion electronics. E.B.

A81-34183 Application of CRT displays to the cockpit of tomorrow. A. J. Dandekar (Rockwell International Corp., Collins Air Transport Div., Cedar Rapids, Iowa). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801168.* 8 p.

The 757/767 and A310 airliners' Electronic Flight Instrument System (EFIS) generally, and the 757 Engine Indication and Crew Alerting System (EICAS), A310 Electronic Warning and System Displays (EWSD), and 767 Caution Annunciator Indicator (CAI) systems in particular, are examined to show an extensive and refined use of CRTs and associated display graphics. The shadow mask CRTs employed offer the full color spectrum for displays, and use integral contrast enhancement filters in conjunction with high-resolution shadow mask tubes to make the displays exceptionally readable under all lighting conditions. The architecture of the display systems presented reflects the consensus of the air transportation industry, based on operational requirements, technological considerations, regulatory and installation constraints, and reliability, maintainability, and support considerations. O.C.

A81-34184 757/767 flight management system. R. A. Peal (Boeing Commercial Airplane Co., Seattle, Wash.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801169.* 19 p.

The 757/767 Flight Management System (FMS) is analyzed in terms of design technology features, functional requirements, functional partitioning, interface signal control, and economic considerations. Important features of the FMS, such as automatic/manual flight profiles for optimum economics, all-weather landing including roll-out guidance, electronic primary flight instruments based on color CRTs, inertial attitude/velocity reference based upon laser gyros, improved caution/warning and other improved performance/functional features, are described. The current development status and the remaining design/development/test activities necessary for the completion of the system are discussed. It is noted that the FMS will include all new equipment based upon a new circuit technology and supporting data transmission systems. An elaborate system of testing and critical design review for final certification of the FMS is described, with the need for the development of appropriate Automatic Test Equipment (ATE) expressed. It is concluded that current efforts are centered around defining some configuration of modular ATE that can provide a level of test equipment proliferation not yet available. E.B.

A81-34185 **Integrated CAD/CAM for the 1980s.** E. N. Nilson (United Technologies Corp., Pratt and Whitney Aircraft Group, East Hartford, Conn.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801170.* 8 p.

The importance of the application of an integrated interactive computing structure for CAD/CAM is now becoming widely recognized. Some major technological obstacles remain with respect to geometric modeling, data base management systems, and computer operating systems in particular. The prognosis for the solution of these problems is discussed; special attention is given to the impact of the NASA IPAD (Integrated Programs for Aerospace-vehicle Design) project, the Air Force ICAM (Integrated Computer-Aided Manufacturing) program; and the possible long-range effects of the proliferation of minicomputer-based interactive drafting and other systems are examined. (Author)

A81-34187 **Inspection of turbine blades using computer aided laser technology.** R. S. Pinter, R. G. Alcoke, R. A. Ekvall, D. S. Steele, and W. H. Wright, Jr. (General Electric Co., Fairfield, Conn.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801173.* 10 p. Contract No. F33615-77-C-5188.

The design, development, and test results of a noncontacting, semiautomatic laser gage dimensional inspection system demonstrator, capable of measuring complex airfoil shapes, are presented. Tests have shown the ability of the system to inspect ten representative characteristics of a TF 39 engine second-stage high-pressure turbine blade. With the exception of the pressure face points of the dovetail contour, the measured accuracy and repeatability of each characteristic was within the equal-to or greater-than 15% criterion of the program, representing an improvement factor over the applicable manual gaging method of between 1.3 and 25. O.C.

A81-34188 * **HiMAT systems development results and projections.** L. E. Brown, Jr., M. H. Roe, and R. A. Quam (Rockwell International Corp., North American Aircraft Div., Los Angeles, Calif.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801175.* 15 p. USAF-NASA-sponsored research.

Significant findings of the Highly Maneuverable Aircraft Technology Remotely Piloted Research Vehicle (HiMAT RPRV) flight test program are presented. Among the topics covered are: aerodynamic scaling relationships, the aeroelastic tailoring of wing and canard twist and camber, and laminate graphite/epoxy composite primary structure performance under high-g loading maneuvers. Attention is also given to the set of actuators used in the test and development program, with a view to the minimization of costs through modularity and interchangeability of components and the extensive use of off-the-shelf equipment. The relationship between composite ply geometry and the shape and magnitude of aeroelastic deformations during maneuvering is discussed in detail. O.C.

A81-34189 **Feasibility of forward-swept wing technology for V/STOL aircraft.** S. G. Kalemaris (Grumman Aerospace Corp., Bethpage, N.Y.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801176.* 10 p. Contract No. N00019-79-C-0435.

An assessment is given of the combination of vectored-thrust, two- and three-nozzle fanjet powerplants with forward-swept wing (FSW) V/STOL fighter configurations. Three configurations underwent wind tunnel tests: one with aft-swept wings and two with forward swept wings. Emphasis was placed throughout the test program on the isolation of possible improvements in engine-airframe interference during VTOL operation. A preliminary evaluation of test results indicates that the design of a single lift/cruise-engined fighter with excellent supersonic performance is feasible, which may be used in air defense, close air support, and strike roles. O.C.

A81-34190 **Air combat advantages from reaction control systems.** D. W. Lacey (U.S. Naval Material Command, David W. Taylor Naval Ship Research and Development Center, Washington, D.C.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801177.* 14 p.

The results of both digital and manned simulation studies of the effect of roll and yaw reaction jets on high angle of attack maneuverability are presented. It is shown that (1) roll response is improved due primarily to the ability to yaw the aircraft at high attack angles, and the use of dihedral effect; (2) roll response is primarily a function of yawing moment control power, rather than rolling moment due to ailerons and/or reaction jets at high angles of attack; (3) improved roll response leads to large gains in combat maneuverability and effectiveness, as measured in the study by a 'Time On Advantage' parameter; and (4) comparable combat effectiveness gains may be obtained by thrust vectoring or any other control system that does not suffer from flow separation and/or low dynamic pressure problems. O.C.

A81-34191 * **Preliminary aerodynamic characteristics of several advanced VSTOL fighter/attack aircraft concepts.** W. P. Nelms and D. A. Durston (NASA, Ames Research Center, Moffett Field, Calif.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801178.* 23 p. 14 refs. NASA-Navy-sponsored research.

VSTOL attack aircraft to be developed in the mid- or late-1990's and research programs dealing with possible characteristics are discussed. Design studies of horizontal attitude takeoff and landing (HATOL) and vertical attitude takeoff and landing (VATOL) type aircraft were executed and wind tunnel models were built and tested. The configurations tested were a wing-canard HATOL concept with jet-diffuser ejectors as a vertical lift system and a variety of the same with nacelles which are closer together. Other proposals were a HATOL concept with wing-canard design and two vertical tails on twin afterbodies, and a VATOL concept which is tailless with an extended leading-edge wing to increase lift. Aerodynamic uncertainties were defined and wind tunnel tests were made. Special research concerning top-mounted air induction systems is also covered. D.B.

A81-34192 **V/STOL capability by modifying CTOL aircraft.** R. E. Kuhn. *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801179.* 21 p. 7 refs.

The status of V/STOL technology is reviewed and the possibility investigated to modify CTOL aircraft for V/STOL capability. Operation, maintenance, logistic, and command-and-control problems in operating the Harrier V/STOL aircraft on carriers are discussed, and different types of V/STOL features described. Two major aircraft/mission areas where V/STOL capability and experience are not currently available are discussed. One is the air superiority area requiring supersonic capability and the other includes long range or endurance and/or high altitude with moderately high subsonic speeds for ASW, AEW, and Missileer missions. E.B.

A81-34193 * **AD-1 oblique wing aircraft program.** W. H. Andrews, A. G. Sim, R. C. Monaghan, L. R. Felt, T. C. McMurty (NASA, Flight Research Center, Edwards AFB, Calif.), and R. C. Smith (NASA, Ames Research Center, Moffett Field, Calif.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801180.* 9 p. 7 refs.

The oblique wing concept for super- and subsonic transport was assessed by analysis and wind tunnel radio control model and remotely piloted vehicle testing. A one-sixth scale wind tunnel model and a low speed manned oblique wing research airplane (AD-1) were developed. Model wind tunnel test data on dynamic structural response characteristics were used in a simulator to develop the control system. The airplane is of simple design with fiber glass skin, weight of approximately 2100 lbs and speeds of up to 175 knots at altitudes up to 15,000 ft. Flight testing will investigate handling and flying qualities, oblique wing flight control characteristics, aeroelastic wing design and will compare actual with predicted aerodynamic characteristics. Nineteen flights were made at 12,000 to 13,000 feet with speeds of 100-160 knots. Flutter clearance as a function of wing sweep angle is now under investigation. D.B.

A81-34194 **Materials and processes for aircraft environmental controls in the 1990's.** E. J. Delgrosso, T. Zajac, and J. Tseka (United Technologies Corp., Hartford, Conn.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801181.* 10 p. 10 refs.

Changes in materials and processes expected to be used in aircraft environmental control systems (ECS) in the 1990s are analyzed, and a forecast is presented. Results of the study show that the most advanced development would be in the use of a cast high strength alloy steel, i.e., a steel with below 8% alloy content, and a 225 KSI annealed tensile strength. To assure complete densification and enhancement of properties, the casting would be HIP, and modification of its surface chemistry could be achieved through ion implantation. As candidate methods for imparting surface protection, laser glazing and chemical vapor deposition are mentioned. The anticipated changes in the materials and techniques used for construction of ECS components are: the development of rapid solidification rate powders for the production of some alloy systems such as Al-Mg-Li, bearing alloy CRB-7, and titanium alloys, 'near-net-shape' processing, and the use of advanced fiber-reinforced plastics. E.B.

A81-34196 **U.S. Navy/USAF development of Tactical Aircrew Combat Training System/Air Combat Manuevering Instrumentation /TACTS/ACMI/.** D. P. Dunbar, Jr. (U.S. Navy, Naval Air Systems Command, Washington, D.C.) and D. M. Jennings (SRI International, Menlo Park, Calif.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801183.* 9 p.

The inflight aircrew training system called Tactical Aircrew Combat Training System (TACTS) by the U.S. Navy and Air Combat Maneuvering Instrumentation (ACMI) by the U.S. Air Force was originally developed to improve aircrew performance in air-to-air combat. Five installations are now operational - four in the United States and one in Sardinia, for USAFE. The system features (1) real-time tracking, integration, processing, and display of maneuvering aircraft in flight and associated flight data, (2) computer simulation of weapon system employment against which aircrews can exercise their abilities in flight, and (3) magnetic recording of exercise data for subsequent replay of alphanumeric and three-dimensional graphic displays of in-depth analysis. The versatility of the generic system design and the fund of significant data it can produce have led to the continuing expansion of its applications. Extended applications include air-to-surface and electronic warfare training, tactics and weapons system development, and test and evaluation of aircraft and weapons systems. (Author)

A81-34198 **Energy maneuverability displays for air combat training.** V. R. Pruitt (McDonnell Aircraft Co., St. Louis, Mo.) and W. F. Moroney (U.S. Naval Postgraduate School, Monterey, Calif.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801185.* 10 p.

Two types of energy maneuverability displays have been developed for use in air combat maneuvering (ACM) training. One type of display is used on the ground in connection with the U.S. Navy's Tactical Air Combat Training System (TACTS) facility and the other is a helmet-mounted display for use during inflight air combat training. Both displays employ energy maneuverability concepts which show the key maneuvering parameters of maximum sustained turn rate, minimum sustained turn radius, corner turn, and areas of energy gain and loss as functions of aircraft performance and structural limits. Both have shown significant potential for enhancing ACM training effectiveness. (Author)

A81-34199 **Simulated A-10 combat environment.** R. S. Kellogg, D. C. Prather, and C. Castore (USAF, Human Resources Laboratory, Williams AFB, Ariz.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801187.* 5 p.

Pilot training for combat in a simulated hostile environment was done by using the Advanced Simulator for Pilot Training (ASPT) and a statistical analysis of the extent and kind of learning that took place is given. Seven combat-ready A-10 pilots flew 20 successive sorties a day, and performance curves were drawn based upon both offensive and defensive procedures. A full combat scenario was produced by a computer-generated imagery presented in the ASPT/A-10 simulator, which included HUDs. All seven subjects showed increased capacity to perform after repeated training runs in the simulator. The overall analysis of all pooled data showed a statistical significance at the 0.05 level. Further studies are suggested. E.B.

A81-34200 **New hydraulic system technology for future aircraft.** K. E. Binns (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, Ohio). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801188.* 16 p.

In the next 10 to 15 years, it is predicted that hydraulic system technology will require some major advancements to compete with other technologies and to meet new aircraft requirements. Fly-by-wire flight control systems, onboard digital computers, and other aircraft trends will act as catalysts for this new technology. This paper summarizes the results and status of ongoing research and development programs being conducted to establish new hydraulic system technology. In addition to these ongoing programs, the author provides his projections of new technology which has merit for future aircraft applications. (Author)

A81-34201 **The use of power-adaptive and power-reversible flight control actuation systems to achieve hydraulic power and system weight savings.** C. W. Robinson (Boeing Military Airplane Co., Wichita, Kan.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801190.* 7 p.

The terms power adaptable and reversible are defined with respect to the application of hydraulic or electrical power to the positioning of a loading aircraft control surface, taking into account load-adaptable servoactuators and power-reversible servoactuators. Two new types of servoactuators are proposed which are intended to be power-reversible and thus to adapt their power demand more fully to changes of load magnitude, speed, and direction. The mechanism of the digital electrohydraulic actuator consists of a rotary hydraulic valve driven by an electrical stepping motor. The sequential actuator system has good power-reversible capability and, in contrast to the digital electrohydraulic actuator or to the Boulton Paul stroked-pump servo, does not suffer appreciable hydraulic power losses in meeting steady state loads. G.R.

A81-34202 **Secondary power system options for future military aircraft.** E. T. Raymond (Boeing Military Airplane Co., Wichita, Kan.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801192.* 22 p.

The findings and recommendations of a study of secondary power system alternatives for future twin-engined military transport aircraft are presented. Five major system arrangements are analyzed, each comprising among its power sources and driven equipment: the main engines, engine-mounted accessory gearboxes, airframe-mounted accessory drive gearboxes, electric batteries, auxiliary power units, various integrated power units that can be integrated in two or more modes, ran air turbines, and mono- and bi-propellant emergency power units. The comparative impact of the arrangement of these systems on aircraft weight, range, and life-cycle cost are estimated. It is concluded that the predominant life cycle cost driver for systems configured with available components is the logistic support cost. O.C.

A81-34203 **Digital computer simulation of aircraft hydraulic systems.** R. J. Levek (McDonnell Aircraft Co., St. Louis, Mo.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801193.* 15 p. 11 refs. USAF-sponsored research.

Aircraft hydraulic system designs are analyzed before fabrication by means of four digital computer programs: Steady State Flow Analysis defines system flow and pressure distribution for loads and rates; Hydraulic Transient Analysis predicts system responses to sudden load-flow variations; Hydraulic System Frequency Response simulates hydraulic activity and Hydraulic Transient Thermal Analysis supplies data on thermal factors. The programs were applied to F-4, F15, F-18 and YAV-8B (Harrier) aircraft and Space Shuttle systems. Operating conditions are simulated and complex multi-branched systems are modelled. Particular success was achieved in sizing systems and the handling of transient or frequency limits and performance requirements for extreme temperatures. D.B.

A81-34204 **Real-time microprocessor technology applied to automatic braking systems.** E. A. Hirzel (Crane Co., Hydro-Aire Div., Burbank, Calif.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801194.* 7 p.

Real time digital units utilizing microprocessors perform automatic braking functions and are now replacing analog technology. The automatic system monitors takeoff conditions and applies brakes without pilot intervention if takeoff criteria are not satisfied. Timing is decisive because of runway length and speed and braking must be controlled in order to avoid skid. The system also automatically controls braking for landings. The system is reliable because of redundancy and a built-in continuous self-testing capacity for monitoring faults without interfering with automatic braking and anti-skid functions. D.B.

A81-34205 **Evolution of an optical control system for aircraft hydraulics.** N. L. Seymour (Parker Bertea Aerospace Group, Control Systems Div., Irvine, Calif.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801195.* 11 p. 5 refs.

It is pointed out that fly-by-wire controls are vulnerable to lightning strikes, electromagnetic interference, and electromagnetic pulses. Replacing electrical wiring to actuators with optical fiber-guides can minimize this vulnerability. Two approaches to the incorporation of optical signal paths in actuation systems are described. One concept requires implementation of 'local' electronics while the other seeks to eliminate even this requirement. Both are expected to be flight tested in the near future. Attention is given to an integrated servo module, an electronic controlled signalling system, a Hydra optic servo system, a Hydra optic actuator, a passive actuator control system, a transducer optical circuit, and transducer prototype hardware. G.R.

A81-34206 * **Reverse thrust performance of the QCSEE variable pitch turbofan engine.** N. E. Samanich, D. C. Reemsnyder, and H. E. Bloomer (NASA, Lewis Research Center, Cleveland, Ohio). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801196.* 30 p. 15 refs.

Results of steady-state reverse and forward-to-reverse thrust transient performance tests are presented. The original QCSEE 4-segment variable fan nozzle was retested in reverse and compared with a continuous, 30-deg half-angle conical exlet. Data indicated that the significantly more stable, higher pressure recovery flow with the fixed 30-deg exlet resulted in lower engine vibrations, lower fan blade stress and approximately a 20% improvement in reverse thrust. Objective reverse thrust of 35% of takeoff thrust was reached. Thrust response of less than 1.5 sec was achieved for the approach and the takeoff-to-reverse thrust transients. (Author)

A81-34207 **The role of the turboprop in the air transportation system for the 1980's and onward.** J. J. Foody and S. C. Colwell (Fairchild Industries, Inc., Germantown, Md.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801197.* 34 p. 25 refs.

The historical development of the U.S. short-haul air market in relation to equipment availability is reviewed, and projections of future developments in this market based on inherent demand factors and the introduction of new technology aircraft are discussed. It is argued that recent developments in turboprop technology, in conjunction with the abandonment of short-haul routes by the larger air carriers equipped with jet aircraft, has spurred the development of fuel-efficient turboprop engines that could spawn a new family of short-haul commercial aircraft. The likelihood and potential benefits of such a development are assessed by comparison of current and projected turboprop technology with prospective turbofan systems. Technological improvements, as measured by fuel consumed and aircraft operating costs, are compared for aircraft with up to 100 passengers at ranges of up to 850 miles. O.C.

A81-34208 * **Small Transport Aircraft Technology /STAT/ Propulsion Study.** R. W. Heldenbrand, C. F. Baerst, and J. H. Rowse (AiResearch Manufacturing Company of Arizona, Phoenix, Ariz.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801198.* 11 p. Contract No. NAS3-21997.

The NASA Small Transport Aircraft Technology (STAT) Propulsion Study was established to identify technology requirements and define the research and development required for new commuter aircraft. Interim results of the studies defined mission and design characteristics for 30- and 50-passenger aircraft. Sensitivities were defined that relate changes in engine specific fuel consumption (SFC), weight, and cost (including maintenance) to changes in the aircraft direct operating cost (DOC), takeoff gross weight, and empty weight. A comparison of performance and economic characteristics is presented between aircraft powered by 1980 production engines and those powered by a 1990 advanced technology baseline engine. (Author)

A81-34209 **Full Authority Digital Electronic Control turbofan engine demonstration.** R. W. Vizzini (U.S. Navy, Naval Air Propulsion Center, Trenton, N.J.), T. G. Lenox (United Technologies Corp., Pratt and Whitney Aircraft Group, East Hartford, Conn.), and R. J. Miller (United Technologies Corp., Pratt and Whitney Aircraft Group, West Palm Beach, Fla.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801199.* 7 p. Navy-sponsored research.

The design, demonstration, and evaluation of an engine-mounted Full Authority Digital Electronic Control (FADEC), capable of controlling an advanced variable gas turbine engine in an advanced supersonic Navy fighter aircraft, is presented. The design incorporates many advanced technology features including micro-electronics, extensive fault tolerance capability, and high-speed digital communication using optic fiber data link. The test program is described, and it includes open loop environment bench testing, closed loop bench testing, and testing on an F401 afterburning turbofan engine at sea level and at nine altitude conditions, from 7000 to 50,000 ft, and at Mach numbers from 0.3 to 1.6. A total of over 7000 hr of control operation was completed including 1100 hr operation with engine-mounted units. A total of 68 hr of engine operation with the FADEC/F401 system was obtained without a hardware malfunction. In addition to the advanced electronic circuitry employed in this system, this was the first demonstration of optic digital data communication with engine-mounted equipment. K.S.

A81-34210 **An application of redundancy in digital electronic engine control.** J. Kniat (United Technologies Corp., Pratt and Whitney Aircraft Group, East Hartford, Conn.) and J. A. Bluish (Bendix Corp., Southfield, Mich.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801200.* 18 p.

A cooperative program to demonstrate the improved capability of a totally Electronic Propulsion Control System (EPCS) for aircraft gas turbine engines is described, and the new technology is analyzed in terms of aircraft system and engine system requirements. Economic factors, such as low weight, high operational reliability, easy maintenance, and low life-cycle cost are discussed. The different steps of the program are outlined and the design configuration process addressed such issues as: control system requirements and specifications, electronic engine control hardware requirements, fuel control unit hardware requirements, system functional description, single channel description, multiple microprocessor, pressure subsystem, redundancy implementation and fault detection, reliability/temperature considerations, and system verification and validation tests. The EPCS was implemented with dual channel, full authority, fault tolerant digital electronic controllers, a fuel control unit, and a monitor box. Besides the redundancy of the two controllers a data cross-talk channel allowed the sharing of data between the two controllers. The flexibility of the system to accommodate reprogramming changes was demonstrated during test flights on a Boeing 747. E.B.

A81-34211 **Flight test reliability demonstration of electronic engine controls.** D. M. Newirth (United Technologies Corp., Pratt and Whitney Aircraft Group, East Hartford, Conn.) and C. J. Bosco (United Technologies Corp., Hamilton Standard Div., Windsor Locks, Conn.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801201.* 14 p. 7 refs.

Before a gas turbine electronic control system can be considered for in-service aircraft use, a reliability evaluation must be accomplished. One method of accelerating the electronic control maturing process is to establish and conduct a Reliability Assurance Program, such as the flight test reliability demonstration, which is presented. The EEC-102 electronic engine control unit was mounted on a center engine of a Boeing 727 aircraft. The control performance was recorded by a monitor unit installed in the rear stairwell area of the aircraft. The reliability evaluation system, the electronic control design, and the design of the monitor unit are described. System bench certification of the electronic control and the monitor unit included extreme temperature testing, altitude testing, and electromagnetic compatibility testing. The reliability prediction for the EEC-102 electronic control was based on a typical mission profile. After 20 months (as of July 1, 1980) of flight test reliability evaluation, 13 controls had accumulated over 70,000 hours of electrical-on-time aboard 10 airline-operated Boeing 727 airplanes. The high-time unit accumulated over 8000 hours without any electronic component failures. K.S.

A81-34212 **Full authority digital electronic control application to a variable cycle engine.** R. W. Vizzini (U.S. Navy, Naval Air Propulsion Center, Trenton, N.J.) and P. D. Toot (General Electric Co., Fairfield, Conn.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801203.* 9 p. Contracts No. N00019-76-C-0423; No. N00019-75-C-0521; No. F33657-75-C-0529.

This paper describes the design, fabrication, and system bench testing of an advanced Full Authority Digital Electronic Control (FADEC) in preparation for fullscale testing on a variable cycle aircraft engine. This control provides all computation and signal-handling capability necessary for the advanced variable cycle engine control task, and is designed to meet challenging reliability, weight, envelope, and life cycle cost objectives. Advanced controller techniques, a unique Failure Indication and Corrective Action feature which allows continued engine operation without significant performance degradation under multiple fault conditions, and use of large-area multilayer ceramic hybrid modules will be demonstrated for the first time in an on-engine control system. (Author)

A81-34213 **Evaluation of several control/display concepts for V/STOL shipboard landing.** S. T. Donley (U.S. Naval Material Command, Naval Air Development Center, Warminster, Pa.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801205.* 30 p. 13 refs.

The relative merits of three flight control laws and two distinctly different Head-Up Display concepts have been evaluated in a piloted simulation for the task of landing a generic lift/cruise fan V/STOL aboard a DD-963 class destroyer. Results indicate that airwake turbulence in the vicinity of the landing pad dominates landing performance. A high level of vehicle augmentation, in the form of a translational relative velocity command/relative position hold control law, was required to achieve acceptable pilot ratings in higher than 30 kts wind-over-deck conditions. (Author)

A81-34214 **Velocity command/position hold - A new flight control concept for hovering VTOL aircraft.** R. L. Stapleford (Systems Technology, Inc., Hawthorne, Calif.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801206.* 10 p. 5 refs. Navy-supported research.

A new flight control concept for a hovering VTOL aircraft has been developed. The main feature of this system is that deflection of a pilot's controller produces a linear velocity command with position hold when the controller is centered. Another novel feature is that horizontal commands both tilt the aircraft and deflect the thrust vector, while the position feedbacks only deflect the thrust vector. This system has been evaluated in two piloted simulations of landing a VTOL aircraft on a small ship. The pilots consistently rated this system better than three other, more conventional, control systems. (Author)

A81-34215 * **Flight test experience using advanced airborne equipment in a time-based metered traffic environment.** S. A. Morello (NASA, Langley Research Center, Hampton, Va.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801207.* 11 p. 10 refs.

A series of test flights have demonstrated that time-based metering guidance and control was acceptable to pilots and air traffic controllers. The descent algorithm of the technique, with good representation of aircraft performance and wind modeling, yielded arrival time accuracy within 12 sec. It is expected that this will represent significant fuel savings (1) through a reduction of the time error dispersions at the metering fix for the entire fleet, and (2) for individual aircraft as well, through the presentation of guidance for a fuel-efficient descent. Air traffic controller workloads were also reduced, in keeping with the reduction of required communications resulting from the transfer of navigation responsibilities to pilots. A second series of test flights demonstrated that an existing flight management system could be modified to operate in the new mode. O.C.

A81-34216 **The CADAM system for aircraft structural design.** R. J. Ricci and S. J. Smyth (Lockheed-California Co., Burbank, Calif.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801208.* 15 p. 5 refs.

The use of interactive computer graphics for aircraft structural design, using the Computer-graphics Augmented Design and Manufacturing system in conjunction with surface definition and finite element model programs, is discussed. Beginning with a basic concept, configuration geometries are generated for analysis, preliminary design, loft, and production design organizations. Significant cost and time savings are demonstrated by use of the system in the design of a smaller horizontal tail for L-1011 airliner derivatives. In addition, the ability of the method described to perform more iterations in the development of a new product than was formerly possible, with great accuracy, is stressed. These productivity gains are crucial in light of the existing shortage of experienced designers. O.C.

A81-34217 **Adhesive bonding of aircraft primary structures.** L. J. Hart-Smith (Douglas Aircraft Co., Long Beach, Calif.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801209.* 17 p. 13 refs. USAF-supported research.

Important aspects of the Primary Adhesively Bonded Structures Technology program are discussed, with a view to promoting further use of the emerging technology. Emphasis is put on (1) the structural benefits and limitations of bonding, by comparison with riveting; (2) the design of bonded joints; and (3) the integration of design, tooling, and manufacturing approaches. It is shown that adhesive bonding is superior to mechanical attachments wherever the bond is stronger than the members being joined, and that mechanical attachments remain necessary where the members are stronger than the bonds. It was also found that the adhesive bonding of the fuselage frame tees makes possible a far more benign failure mode for skin cracks than has been customary for riveted structures, and that adhesively bonded joints have a great insensitivity to large flaws. O.C.

A81-34218 **Integrated active controls impact on supersonic cruise vehicle structural design.** L. F. Jurey and N. Radovcich (Lockheed-California Co., Burbank, Calif.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801210.* 11 p. 22 refs.

The application of integrated active controls to high performance aircraft has been made feasible by recent advances in active control technology. This paper summarizes some of these advances. One approach to the methodology for synthesizing active control transfer functions is reviewed. Application of this methodology to a supersonic cruise vehicle is discussed. Significant structural weight savings were realized using active controls for this vehicle. Among the several design advantages noted is the ability to avoid expensive redesign of structurally deficient aircraft by means of active controls. (Author)

A81-34219 **Acoustic emission techniques for in-flight structural monitoring.** B. Parrish (Parrish and Hill, Norman, Okla.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801211.* 6 p. 6 refs.

The sensing of elastic energy in the form of acoustic emission by highly sensitive piezoelectric transducers which 'hear' the ultrasonic fracture of the material provides the basis for a system which could continuously monitor the aircraft structure during flight and warn of impending failure. The concept of fracture toughness, which is a measure of the ability of a material to resist failure in the presence of a crack, is reviewed. It is noted that acoustic emission energy levels associated with an unstable crack extension are relatively high and are thus easier to detect in the in-service environment than are those associated with stable crack growth. A shortcoming of the current NDI methods is that a small stable crack would not be detectable and could propagate catastrophically on a flight immediately following an inspection; such inspections would also require 900 manhours per aircraft and would cause each aircraft to be grounded for about 15 days per year. The acoustic emission detection system for stable crack growth must recognize unique attributes of the structure which it monitors and it must be immune to the unique attributes of the aircraft noise environment. K.S.

A81-34220 **Advanced graphite composites in the 757/767.** G. L. Brower (Boeing Co., Seattle, Wash.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801212.* 9 p.

A status report is given of the development of graphite and Kevlar/graphite-epoxy composite secondary structures for the 757 and 767 airliners, including engine nacelles and cowling, rudder, ailerons and flaps, and landing gear doors and access panels. Total weight savings of 1250 lb have been estimated. Attention is given to the problem of galvanic corrosion at aluminum main structure/graphite composite secondary structure interface points, and to the development of fast, economical structural element fabrication systems such as a prepreg laminate pultrusion device that incorporates a microwave curing chamber. It is also shown that the use of graphite/epoxy composites in primary structures would lead to a reduction in the use of aluminum of 33%, pending only a sufficient reduction in composite fabrication costs. O.C.

A81-34221 * **Design, fabrication and test of a complex helicopter airframe section.** M. J. Rich (United Technologies Corp., Sikorsky Aircraft Div., Stratford, Conn.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801213.* 10 p. Army-sponsored research; Contract No. NAS1-13479.

A design solution is developed for the fabrication of an all-composite helicopter airframe cabin roof structure. Although this is inherently a complex structure, the parts count has been minimized by the avoidance of many mechanical fasteners, and a weight reduction of 26% has been obtained. The reduction of parts and elimination of mechanical fasteners will also result in a lowering of labor costs. The bonded graphite/epoxy elements of the structure employed aluminum tooling with control on all mating surfaces to yield accurate bond lines. A summary of static test results is presented for the basic structure and for the structure with mechanically fastened skin stiffeners. It is shown that the shear buckles caused the skin to peel from the stiffeners at about 960 lb/in. shear flow, calling for the addition of stiffeners with more bond area. O.C.

A81-34222 **Maintenance program analysis for aircraft structures of the 80's - MSG-3.** T. M. Edwards, Jr. and R. G. Wilson (United Air Lines Maintenance Operations Center, San Francisco, Calif.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801214.* 19 p. 13 refs.

The history, philosophy, and procedures of aircraft maintenance program analysis are outlined and explained. Among the details developed are the relationship of the scheduled structural maintenance program to the consequences of structural item functional failure, the susceptibility to damage of a structure, and the degree of difficulty involved in the detection of such damage. An introduction is given to the 'MSG-3 Structural Maintenance Program Development Logic', in order to show how each of the sources of deterioration (fatigue, environment, accidental damage) are assessed separately to provide a structural inspection program for the timely detection of emerging problems. O.C.

A81-34224 **Overview of ARP 1587 aircraft gas turbine Engine Monitoring System guide.** T. Warwick (United Technologies Corp., West Palm Beach, Fla.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801218.* 7 p. 5 refs.

A81-34225 **Current and future use of an AIDS integrated EMS.** H. C. Vermeulen (KLM-Royal Dutch Airlines, Schiphol Airport, Netherlands). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801219.* 18 p. 10 refs.

Several examples of the use of an Aircraft Integrated Data System (AIDS)-integrated Engine Monitoring System (EMS) are presented, followed by a description of an advanced EMS specified for the A300/A310-series aircraft. Among the applications envisaged for such a system are: (1) loop recording, (2) trending of recorded data for the ten previous flights, (3) sensor error detection, (4) operational limit exceedance detection, (5) engine parameter raw data sets storage, and (6) stall detection. At present, EMS applications extend to long-term trend analysis, mission analysis and life accounting, trouble and incident analysis, and engine starting problems, auto-acceleration, and compressor stalls. O.C.

A81-34226 **TF41/A7-E engine monitoring system implementation experience.** L. R. DeMott (General Motors Corp., Detroit Diesel Allison Div., Indianapolis, Ind.). *Society of Automotive*

Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801222. 17 p. 12 refs.

Computerized monitoring of engine operations is a recent concept and the Inflight Engine Condition Monitoring System (IECMS) as part of the concept was developed in the late 1960's. Airborne computerized monitoring is followed by ground-based computer analysis generating printouts of maintenance needs. The concept was found feasible and a system prototype was tested. The preproduction program with a total of 6000 flight hours showed positive results and increased engine maintenance efficiency and a production program was implemented with the only negative feature system cost. A more reliable and cost effective airborne computer is to be developed with the ground-based computer improved. IECMS is now operational on the U.S. Navy A7-E aircraft. D.B.

A81-34227 **TriStar engine monitoring in British Airways.** E. R. White (British Airways, Hounslow, Middx., England). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801224.* 27 p.

A cost-effective engine monitoring system (EMS) for the TriStar RB211 engines, and the philosophy leading to its design and integration with the existing maintenance structure are presented. The EMS design arose out of several factors, which include the necessity to integrate engine recording with other AIDS user requirements, i.e., autoland development and flight operations. The routine outputs, i.e., performance, vibration and compressor efficiency trends, starting and inlet guide vane scheduling graphs, are produced mainly for maintenance to assist with incipient fault detection and troubleshooting. For longer term investigations on operational, management, and logistics problems, further routine outputs such as take-off and climb derate monitors and time/temperature analysis, are described. All above analyses produce frequency histograms for each engine, giving a measure of life usage of hot end during installation. The benefits of the four levels of use of engine AIDS data, are each illustrated by an example. K.S.

A81-34228 **An alternative approach to engine rating structures using monitoring systems.** C. H. Buck and D. Lewis (Rolls-Royce, Ltd., London, England). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801225.* 10 p.

Optimal selection of engine size for multi-engine helicopters has been based upon engine rating structures but specified power/time limitations do not always fit real use conditions as concerns power requirements, operational environments, emergencies, special requirements and pilot behavior. Engine monitoring systems involving microprocessors can follow actual engine operation. Data can be used to reevaluate engine ratings, carry out better qualification testing and allow more flexible engine use when the pilot faces special conditions, since the system can be integrated into the aircraft computer system with data display and possible interrogation by pilot or ground maintenance facilities. D.B.

A81-34229 **Multi service applications for advancing blade concept aircraft.** L. G. Knapp (United Technologies Corp., Sikorsky Aircraft Div., Stratford, Conn.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801226.* 13 p.

Information stemming from the flight test program of the XH-59A Advancing Blade Concept (ABC) technology demonstrator aircraft has been used to generate a series of new design solutions for Army, Navy, Marine Corps and Air Force applications. The studies clearly show that the ABC concept provides efficient solutions for missions requiring 200 to 300 knot flight speeds combined with: (1) compactness for forward basing or nap of earth operations; (2) superior agility throughout its speed range; (3) low external noise; (4) efficient hover or loiter; (5) one-engine-inoperative hover; (6) rapid and repetitive speed changes; or (7) inherent battlefield survivability. Similar solutions are presented for future Army light aircraft, Army attack VTO, Air Force combat, search and rescue, Navy ASW, and Marine Corps transport and escort/attack missions. (Author)

A81-34230 **Nuclear hardness assurance for aeronautical systems.** R. P. Patrick (USAF, Strategic Air Command, Offutt AFB, Neb.) and J. M. Ferry (USAF, Weapons Laboratory, Kirtland AFB, N. Mex.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801227.* 19 p. 16 refs.

Nuclear hardness assurance for aircraft and airborne systems is considered from the point of view of an affordable research program's formulation and management prior to systems acquisitions. Among the threats to aircraft primary and secondary structures, flight crews, and electronics are: (1) blast overpressures of 1-3 psi for a 1 megaton blast, (2) blast-generated gusts of 75-100 ft/sec, (3) thermal emissions of 20-80 cal/sq cm, and (4) radiation effects such as neutron influence, gamma rate, total gamma dose, and electromagnetic pulse (EMP). The Hardness Assurance Documentation Program is introduced as a method by which hardened baseline systems meeting program requirements can be updated throughout the design and development process. Emphasis is placed on the unique vulnerability of electronic components to nuclear blast effects, above all the EMP generated by high-altitude detonations. O.C.

A81-34231 **AV-8B operational features for rapid deployment.** R. G. Showers (McDonnell Aircraft Co., St. Louis, Mo.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801228.* 8 p.

A81-34232 **Overview of aviation energy programs and supply problems.** R. Bowles (U.S. Department of Energy, Washington, D.C.) and J. V. Cignatta (Mueller Associates, Inc., Baltimore, Md.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801230.* 14 p. 42 refs.

In order for aviation to remain an efficient, cost-effective means of transportation, a comprehensive and systematic program to alleviate the industry's petroleum dependency is necessary. This paper describes research being conducted to (1) assess problem areas affecting production of current jet aviation fuels, (2) evaluate energy conservation measures, and (3) develop alternative fuels. (Author)

A81-34233 **Unistructure - A new concept for light weight integrally stiffened skin structures.** D. J. Brimm (Chem-tronics, Inc., El Cajon, Calif.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801231.* 11 p.

Unistructure is a new concept for light weight integral rib-reinforced skin structures that is readily adaptable to many configurations. The rib cross sections are a form of I beam. The rib reinforcing patterns considered here are isogrid and waffle, (i.e. triangular and rectangular constructions) but any desirable form can be produced. This paper provides an over-view of the methods of fabrication and the structural performance features of Unistructure. Comparisons are made with honeycomb, skin/stringer, and integral-machined structures. These comparisons indicate that the combined ease-of-fabrication and performance advantages of Unistructure warrant its consideration in many applications. (Author)

A81-34235 **The development of a lightweight aircraft towing tractor.** N. D. Eryou, W. J. Owens (DEW Engineering and Development, Ltd., Canada), and R. D. Herbert (Department of National Defence, Ottawa, Canada). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801237.* 7 p. Research supported by the Department of National Defence.

A81-34236 **Rebuild of aircraft ground support equipment.** N. D. Eryou (DEW Engineering and Development, Ltd., Canada) and M. P. Jacobs. *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801238.* 6 p.

A81-34237 **F-15 nose landing gear shimmy, taxi test and correlative analyses.** D. T. Grossman (McDonnell Aircraft Co., St. Louis, Mo.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801239.* 13 p. 5 refs.

F-15 taxi tests and analyses were performed to evaluate the effects of aircraft design changes on nose landing gear shimmy. The fuel capacity of the F-15 was increased with an associated increase in the maximum take-off gross weight from 56,000 to 68,000 lbs, necessitating the use of a heavier nose landing gear wheel and tire, increased tire pressure, and a modified oleo load-stroke curve. The trade-offs between a laboratory dynamometer shimmy test and an aircraft taxi test are presented, and the operational aspects of the taxi test are discussed. Service experience indicated a clear sensitivity of shimmy speed to strut torsional freeplay. A schematic diagram of the mathematical model of the strut torsional degrees of freedom used in the shimmy analysis is presented, including the three nonlinearities: strut torsional freeplay, Coulomb-type friction in the strut bearings, and a velocity-squared damper in the steering actuator. The results confirm the limit cycle nature of the shimmy phenomenon and correlate well with the taxi test results. Additional analyses indicated the sensitivity of the shimmy to changes in tire parameter values and strut friction coefficients. K.S.

A81-34238 **The domain of the turboprop airplane.** J. W. Sandford (de Havilland Aircraft of Canada, Ltd., Downsview, Ontario, Canada). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801242.* 37 p. 9 refs.

The rising cost of fuel and its effect on turbofan and turboprop aircraft operating costs are considered, and a forecast of future equipment applications to short-haul traffic in anticipation of technological and economic trends is made. It is shown that promising turboprop engine, airframe, aerodynamic, and propeller advances will allow full expansion into the commuter/regional markets opening as a result of U.S. deregulation. Within the commuter airline system, STOL aircraft operating with area navigation and microwave landing aids will increase the usable capacity of existing airports and runways. Because a number of the advanced technology features in question have begun to be incorporated into 30-passenger class turboprop aircraft, the development of a 100-passenger turboprop that cruises at M 0.6 appears to be possible in the late 1980s. O.C.

A81-34239 **Commuter turboprop propulsion technology.** R. Hirschkron and R. E. Warren (General Electric Co., Lynn, Mass.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801243.* 11 p.

The key elements and significant results to date of the Small Transport Aircraft Technology (STAT) commuter aircraft propulsion and fuel efficiency requirements study are presented. The approach used was to define a 30- and 50-passenger commuter aircraft, powered by the appropriate scaling of the current CT7-5 powerplant, and then select such technology features as highly loaded axial compressor stages, multiblade centrifugal impeller, and advanced diffuser and combustor on the basis of direct operating costs merit factors in order to arrive at an advanced turboprop engine. Preliminary designs were then executed. Additional technologies integrated into the designs are: combustor thermal barrier coatings, active clearance control for the high pressure turbine, and high modulus propeller driveshaft. O.C.

A81-34240 **The High Performance Auxiliary Power Unit technology demonstrator program.** E. A. Lake (USAF, Wright-Patterson AFB, Ohio), W. Green (Avco Corp., Avco Lycoming Stratford Div., Stratford, Conn.), and P. Letourneau (Sundstrand Corp., Rockford, Ill.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801148.* 10 p.

The High Performance Auxiliary Power Unit (HPAPU) is based upon a modified Avco Lycoming 101 series gas turbine engine. The engine serves to drive a load compressor and generator through a gearbox adapted for the purpose. The resulting 500 hp class auxiliary power unit has met or surpassed its required demonstration of duty cycles, continuous full power operation, and the ability to function over a wide environmental envelope. In addition, the HPAPU has exhibited a specific fuel consumption less than design and much less than the program's designated maximum allowable. The paper describes the HPAPU system. Characteristics which enhance its durability and maintainability are discussed. Performance data are presented which validate its capability from -70 F to + 135 F and from sea level to 25,000 feet pressure altitude. (Author)

A81-34241 **Development requirements for integrated aircraft power systems.** S. W. Mitnik and L. W. Norman (AiResearch Manufacturing Company of Arizona, Phoenix, Ariz.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801149.* 7 p.

It is shown that an expanded integrated power system development process can provide significant benefits to future aircraft. The recently completed first step in this development process has been the definition of a 200-hp Auxiliary Power Unit (APU) for fighter/attack and V/STOL aircraft whose technology, when fully developed, will form the basis for the development of production systems for all aircraft of this category. The expanded power system development process will result in the greatest possible reliability for the lightest and most efficient system for its application. Among the capabilities promised are independence from ground support equipment, minimum ground operation of propulsion engines, propulsion system/accessory system operational compatibility, fuel and lubricant conservation and maintenance procedure simplicity. O.C.

A81-34242 **The status of the expendable gasifier program.** H. F. Due, Jr. and A. Gabrys (Teledyne, Inc., Teledyne CAE, Toledo, Ohio). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801151.* 15 p.

A low cost expendable gasifier is being developed for use as a common component with new jet fuel starters and small turbojets and turbofans. The design stresses economy and low cost to be attained by limiting pressures and temperatures with use of economical materials, simplicity and expendability, high production rates (500 per year with unit price of approximately $7800 in 1976 currency), capacity for 20 hour lifespan at maximum power or 2000 starts. The gasifier is designed to produce a jet fuel starter power of 170 KW (230 hp). Low cost prototype manufacturing processes were adequate and the full-scale unit was successfully tested in turbojet operation. In-flight performance was evaluated by simulation of altitudes and Mach numbers with unit operated at 100% speed over entire range. Net measured thrust was in good agreement with computed performance. Estimated savings from the throwaway unit range from a factor of 3 to 10. D.B.

A81-34243 * **Rating hydrogen as a potential aviation fuel.** R. D. Witcofski (NASA, Langley Research Center, Hampton, Va.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 80-1152.* 11 p. 25 refs.

The viability of liquid hydrogen, liquid methane, and synthetic aviation kerosene as future alternate fuels for transport aircraft is analyzed, and the results of a comparative assessment are given in terms of cost, energy resource utilization, areas of fuel production, transmission airport facilities, and ultimate use in the aircraft.

important safety (fires) and some environmental aspects (CO2 balance) are also described. It is concluded that fuel price estimates indicate the price of synthetic aviation kerosene (synjet) would be approximately half of the price calculated for liquid hydrogen and somewhat less than that of liquid methane, with synjet from oil shale reported to be the least expensive. E.B.

A81-34244 **Status of the program to develop LH2 for aircraft.** G. D. Brewer (Lockheed-California Co., Burbank, Calif.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801153.* 11 p. 6 refs.

The first research and development phase of a comprehensive program proposed for the proving of liquid hydrogen (LH2) as an aircraft fuel is described. After consideration of synthetic jet fuel and liquid methane as additional alternatives for the replacement of petroleum-derived Jet A, and the advantages of LH2 noted, detailed attention is given such issues as the global availability, low-pollution combustion products, relative safety, process energy requirements, direct operating costs, and the detailed concerns of an international, coordinated research effort for the period 1981-83. This program addresses three major areas of development: (1) aircraft and engine studies; (2) aircraft and engine development; and (3) hydrogen production and ground facilities. The program is estimated to cost $73.6 million. O.C.

A81-34245 **Aerodynamic surface cooling for laminar flow control for hydrogen-fueled subsonic aircraft.** G. R. Cunnington, Jr. and R. T. Parmley (Lockheed Research Laboratories, Palo Alto, Calif.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801155.* 9 p. 12 refs.

The nature and magnitude of the potential of cryogenic-fueled aircraft designs for laminar flow control, by use of the sensible heat of the stored fuel to cool aerodynamic surfaces, are explored. It is shown that cooling the boundary layer below adiabatic wall conditions delays turbulent region transition and reduces frictional drag, with preliminary design calculations promising, for the case of liquid hydrogen and nitrogen heat-transfer fluid, 20% fuel requirement reductions in a M 0.85-cruise, 400-passenger aircraft on a 12,000 km flight. The cooling system entailed is a simple, current-technology design which does not adversely affect safety or normal operational factors. It is estimated that the fuel weight savings will be greater than the added cooling system weight, although further, experimental studies are needed to verify the accuracy of drag-reduction predictions. O.C.

A81-34246 **Developing a Fighter Engine Derivative of the B-1/F101 engine.** T. M. Bartsch and C. W. Posson (USAF, Aeronautical Systems Div., Wright-Patterson AFB, Ohio). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801156.* 14 p.

A status report is presented for the F101 Derivative Fighter Engine (DFE) development program, which undertook the use of the B-1 bomber F101 engine core in a smaller low-pass fanjet suitable for use in such existing fighter aircraft as the F-14 and F-16. This entailed: (1) the reduction of a 45-in.-diam, two-stage, 2.2 pressure-ratio fan with a 3.2-ratio, 38-in.-diam, three-stage fan; (2) a modification of the augmentor, which in the new version has twice as many spraybars; and (3) redesign of compressor and low-pressure turbine configurations. Significant amounts of both ground and flight testing are shown to provide a firm base for a decision to continue the development program, and establish an expertise that can promptly lead to a production engine design. Exceptionally low program costs and development time have been demonstrated. O.C.

A81-34329 **AIRCAT 500 ATC systems for Australia and Mexico.** R. Gourjon and G. Höller (Thomson-CSF, Division T-VT, Meudon-la-Forêt, Hauts-de-Seine, France). *Interavia,* vol. 36, May 1981, p. 459-461.

Automated Integrated Radar Control of Air Traffic (AIRCAT) systems have been developed for Australia and Mexico. Typical AIRCAT 500 systems comprise primary and secondary plot extractors and duplicated radar data processing minicomputers. Based on the designated flight plan and the data base, the computer formulates a list of waypoints, time of overflight and the control sector for flight management. Each control sector has an autonomous radar display, an alpha-numeric keyboard, a rolling-ball controller and a telephone or airground radiotelephone system. The standard software includes both operational programs and a library of program production aids. The system selected for Mexico is an AIRCAT 500-2 system with four Solar 16/65 computers. The Australian system includes AIRCAT 500-10 multiradar tracking systems for Melbourne and Adelaide. S.C.S.

A81-34330 **Electronic displays and computerized NAV systems for commuters and business aircraft.** C. Bulloch. *Interavia,* vol. 36, May 1981, p. 484, 485.

An Electronic Flight Director System (EFDS-85) has been designed for commuter and business aircraft. A full installation would have five electronic displays where available information can be switched from one screen to another and data can be superimposed. The systems will interface with existing FMS-90 flight management systems and LRN-85 long-range navigation systems. The VNI-80 vertical navigation system, in conjunction with the FMS-90 system, provides a basis for computer-directed 3-dimensional navigation. The scope of the LRN-85 system has been expanded and a lightweight 20-waypoint area navigation system, the ANS-31C, has been developed. The ANS-31C features automatic correction of slant-range errors and time and speed outputs. S.C.S.

A81-34336 **Integration of navigational information in aircraft.** V. D. Hopkin (RAF, Institute of Aviation Medicine, Farnborough, Hants., England). *Journal of Navigation,* vol. 34, May 1981, p. 240-246.

Navigational aids such as ground-based transmitting beacons and computer systems are assessed. Future developments are outlined noting comprehensive flight directors, an airborne air traffic situation display, cathode-ray tubes and radar, television and infrared sensors. By interfacing a moving map display to the aircraft's navigational systems, continuously generated imagery can be correlated with maps. The basic aspects of human error and safety procedures are considered. S.C.S.

A81-34337 **Solo navigation in a light aircraft.** D. Cyster (RAF, London, England). *(Royal Institute of Navigation, Meeting, Cardiff, Wales, Apr. 23, 1980.) Journal of Navigation,* vol. 34, May 1981, p. 260-268.

A solo flight from Dunsfold, England to Sydney, Australia in a vintage Tiger Moth in 1978 is described. Attention is given to the navigation procedures, the various weather conditions encountered and flight planning. S.C.S.

A81-34352 # **CAD - The designers' new tool.** S. J. Smyth (Lockheed-California Co., Burbank, Calif.). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display on Frontiers of Achievement, Long Beach, Calif., May 12-14, 1981, Paper 81-0850.* 7 p.

The problems and benefits of using computer aided design (CAD) by aircraft designers for production engineering are presented. The Computer-graphics Augmented Design and Manufacturing system (CADAM) (a set of computer programs which comprise both interactive on-line functions and batch operations, and permit the construction and geometry for drawing production, certain steps of design analysis, and data base management) is used to illustrate the application of computer graphics to aircraft design. A brief description of the system and the design process using the system are given. The use of the system for all phases of design eliminates the necessity of designers redrawing the same component over and over. This raises the productivity ratio and increases the cost-effectiveness of the system. K.S.

A81-34353 # **ICAM 'Manufacturing Cost/Design Guide' /MC/DG/.** B. R. Noton (Battelle Columbus Laboratories, Columbus, Ohio). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display on Frontiers of Achievement, Long Beach, Calif., May 12-14, 1981, Paper 81-0855.* 31 p.

The ICAM (Integrated Computer-Aided Manufacturing) MC/DG Data Development Program, which enables airframe and avionic designers, at all levels of the design process, to perform quick, simple, cost-trade comparisons of manufacturing processes, is presented. A model was developed showing the contents, manufacturing cost-drivers, data requirements, and designer-oriented formats for conventional and new technologies. Demonstration sections developed for sheet metal aerospace discrete parts, first-level mechanically-fastened assemblies, and advanced composites fabrication were utilized to conduct structural performance and manufacturing trade-studies on fuselage shear-panels in aluminum, titanium, and composites. Sections were also developed for test inspection and evaluation for various materials, and manufacturing man-hour data were developed for base parts and discrete parts. A design engineer, utilizing the MC/DG cost-driver effects and cost-estimating data formats, performed a cost trade analysis of 10 different advanced composite designs. The trade study required only about eight hours. The normal method would have required approximately 40 hours of work and a calendar span of one week for turn-around. K.S.

A81-34354 # **Flight control and display computation - A 25-year perspective.** S. S. Osder (Sperry Corp., Sperry Flight Systems, Phoenix, Ariz.). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display on Frontiers of Achievement, Long Beach, Calif., May 12-14, 1981, Paper 81-0865.* 10 p. 5 refs.

The paper presents a report of the evolution of flight control and display computation mechanizations from the beginnings of major advances in silicon technology to the current state of the art of high speed microcomputers. The manners in which redundancy management requirements saturated the capability of analog technology in the late 1960s and digital mechanizations have alleviated those hardware limitations but still face major challenges in the systems engineering/software area are shown. The computer resource requirements for implementing current digital flight control systems are reviewed and techniques for implementing improved control laws are described. Also, the factors which influenced the transition of flight displays from the electromechanical technology to computer driven CRTs are described and the computation resources needed for current electronic displays are summarized. (Author)

A81-34361 # **The art of single-engine aircraft design.** J. C. Berwick (Cessna Aircraft Co., Wichita, Kan.). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display on Frontiers of Achievement, Long Beach, Calif., May 12-14, 1981, Paper 81-0914.* 6 p.

Informal and historical consideration is given the inherent configurational possibilities and actual design evolution of single-engine general aviation aircraft. Attention is given the compromises formulated between what is aerodynamically ideal and what is expedient either for ease and low cost of manufacture or passenger comfort. High and low wing and fore and aft engine configurations are considered. O.C.

A81-34362 # **Turbine engine design.** C. B. Wrong (Pratt and Whitney Aircraft of Canada, Ltd., Longueuil, Quebec, Canada). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display on Frontiers of Achievement, Long Beach, Calif., May 12-14, 1981, Paper 81-0915.* 28 p.

The history of the PT6 powerplant is discussed with the objective to demonstrate the value of finding a simple solution to given design problems. The PT6 was conceived as a powerplant, nominally of 500 horsepower, aimed at helicopter and executive turboprop markets. The only realistic choice of engine cycle was that of a free power turbine dictated essentially by helicopter requirements, freedom from controls complexity, and substantially easier starting characteristics. A major turning point in the quest for a configuration which blended aerodynamic and mechanical simplicity, was the adoption of the back-to-back rotor system. Attention is given to a pipe diffuser, problems of disk attachment, integral turbine vane rings, fused power turbine blades, and the jet flap. G.R.

A81-34363 * # **NASA aeronautics R&T - A resource for aircraft design.** W. B. Olstad (NASA, Washington, D.C.). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display on Frontiers of Achievement, Long Beach, Calif., May 12-14, 1981, Paper 81-0925.* 15 p.

This paper discusses the NASA aeronautics research and technology program from the viewpoint of the aircraft designer. The program spans the range from fundamental research to the joint validation with industry of technology for application into product development. Examples of recent developments in structures, materials, aerodynamics, controls, propulsion systems, and safety technology are presented as new additions to the designer's handbook. Finally, the major thrusts of NASA's current and planned programs which are keyed to revolutionary advances in materials science, electronics, and computer technology are addressed. (Author)

A81-34364 # **The Tactical Air Forces - Outlook for the next decade.** C. H. Cathey, Jr. (USAF, Tactical Air Command, Langley AFB, Va.). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display on Frontiers of Achievement, Long Beach, Calif., May 12-14, 1981, Paper 81-0932.* 6 p.

Tactical airpower progress over the next decade must be carefully planned to meet the evolving threat. Adequate force size must be achieved and maintained. Stable procurement is needed to maintain an acceptable average force age. The threat dictates a quality force of hard-hitting, deployable, reliable aircraft and effective weapons. Near-term improvements include avionics for night attack, radar and ECM performance increases. New systems will improve the capability to locate, target and destroy the vast array of enemy defenses. Air superiority will see radar improvements and advances in air-to-air missiles. The primary thrust in the command, control and communications area is to sustain effective communications in the face of the electronic combat threat. Finally, development and fielding of a new fighter aircraft must be undertaken. The next generation fighter will require tradeoffs, and hard decisions, across all aspects of aircraft design and performance characteristics. (Author)

A81-34693 **New method for cast superalloy frames - Segmented mold and HIP utilized.** W. Schweikert and P. G. Bailey (General Electric Co., Aircraft Engine Group, Cincinnati, Ohio). *ManTech Journal,* vol. 5, no. 3, 1980, p. 28-32. USAF-supported research.

The segmented mold process and a hot isostatic pressing (HIP) technique have been applied to the manufacture of aircraft engine frames and casings. Improved dimensional control is achieved by using metal chills in the wax patterns. Since the mold is segmented, the chills may be removed during the firing. The best mechanical properties are achieved from material hot isostatically pressed at 2125 F. Normal specification aging at 1325 F and 1150 F improved low-cycle fatigue life. Homogenization and densification eliminated porosity in casting. The HIP technique improves weldability and machinability. The technique may be applied to a low-pressure turbine nozzle band casting and low-pressure turbine casing. S.C.S.

A81-34696 * **A description of the general aviation fixed wing accident.** D. S. Hall (Crash Research Institute, Tempe, Ariz.). *SAFE Journal,* vol. 11, Spring 1981, p. 6-10. NASA-supported research.

The Emergency Local Transmitter (ELT) is a radio transmitter with a self-contained power source designed to provide notification of and homing to aircraft accident sites. The Crash Research Institute has monitored general aviation fixed-wing accidents in the United States and in Canada and has found that: (1) the ELT was destroyed in approximately 25% of all fatal accidents; (2) the ELT activated in about 62% of the fatal accidents, 69% of the fatal with survivors accidents, almost 80% of the serious accidents and about 57% of the minor accidents; (3) in fatal accidents the aircraft sections least likely to be destroyed are the vertical and horizontal tail surfaces; (4) antenna cable disconnection and antenna breakage caused failure to transmit usable signals; and (5) initial alerting control occurred in nearly half of the situations where the ELT aided in search. S.C.S.

A81-34697 **A study of factors affecting aircrew survivability following emergency escape over water.** H. T. Pheeny and F. H. Richards (U.S. Navy, Naval Weapons Center, China Lake, Calif.). *SAFE Journal,* vol. 11, Spring 1981, p. 23-27. 5 refs.

Noncombat emergency escapes from U.S. Navy aircraft over water during the period 1970-1979 are analyzed with a view towards determining the nature and relationships of the factors influencing aircrew survivability. Sequences of emergency escape procedures to be performed after ejection or bailout at high and low altitudes as specified by the Naval Air Training and Operating Procedures Standardization (NATOPS) manuals for 52 naval aircraft are tabulated and compared with records of ejections and bailouts, with particular emphasis on those occurring from 1974 through 1979. Little commonality is found among the NATOPS manuals reviewed with regard to the post-egress and water survival phases, and a significant difference is found between the procedures specified and actually performed by escaping aircrew. In addition, a review of course outlines for water survival training conducted in four different Navy programs indicates that different post-egress and water survival procedures were being taught, a possible source of confusion among aircrews. A review of problems encountered by surviving crewmembers during the water survival phase indicates parachute entanglement to be the most common problem. It is concluded that the nonstandardization of post-escape procedures is one of the major deterrents to aircrew survivability in the water, and objectives of the Parachute Entanglement Avoidance Techniques program currently under way to improve aircrew survivability are outlined. S.C.S.

A81-34851 **Thermomechanical behavior of a mechanically alloyed Al-4.0Mg powder alloy.** Y.-W. Kim and L. R. Bidwell (USAF, Materials Laboratory, Wright-Patterson AFB, Ohio). *Scripta Metallurgica,* vol. 15, May 1981, p. 483-486. 8 refs.

A81-34870 # **The medical use of the helicopter in the field of air rescue (L'impiego sanitario dell'elicottero nell'ambito del soccorso aereo).** G. Rotondo (Aeronautica Militare, Servizio di Sanità, Rome, Italy). *Rivista di Medicina Aeronautica e Spaziale,* vol. 43, Jan.-June 1980, p. 17-33. 18 refs. In Italian.

The numerous possibilities for the use of helicopters as ambulances in the rescue and transportation of the ill, and of accident victims from places difficult to reach by road vehicles are discussed. In addition to the relatively few limitations inherent in the use of heliambulances, emphasis is placed on the possibility of outfitting these craft with emergency medical equipment that will permit the administering of first aid en route to hospital facilities. Also described is the heliambulance equipment and experience of the Italian Air Force's 15th Wing SAR, which operates AB.204 and HH-3F helicopters. O.C.

A81-35008 # **Analytic determination of the kinematic and energy parameters of aircraft braking during the landing run (Analityczne wyznaczanie kinematycznych i energetycznych parametrow hamowania samolotu przy dobiegu).** A. Derkaczew. *Instytut Lotnictwa Prace,* no. 84, 1981, p. 3-17. In Polish.

The equation of motion of an aircraft during the landing run is presented, and an analytical method is developed for calculating the main braking parameters, including the braking path, the braking power and energy, and the braking moment that can be exerted as a function of the speed of the landing run. These parameters are determined taking into account the action of the brakes and the auxiliary braking devices (the thrust reversers and the brake parachutes). Some recommendations are made concerning the selection of the correct value for the braking moment, and the applicability of aerodynamic brakes for various types of aircraft. B.J.

A81-35009 # **Test stand for the study of flow systems in wind tunnels (Stoisko do badan ukladow przeplywowych w tunelu aerodynamicznym).** R. Jozwiak. *Instytut Lotnictwa Prace,* no. 84, 1981, p. 41-56. 11 refs. In Polish.

A test stand and a noncontact air supply system have been developed for the investigation of jet-blowing models in wind tunnels. Particular attention is given to the testing of blown flaps. The performance of the test stand and of the air supply system was found to be satisfactory. B.J.

A81-35021 **SINTAC and its position-finding performance (Le SINTAC et ses performances en localisation).** L. Milosevic, M. Ronsin, and J.-C. Charavit (Thomson-CSF, Paris, France). *(NATO, AGARD, Congress, 38th, London, England, Oct. 14-17, 1980.) Navigation* (Paris), vol. 29, Apr. 1981, p. 141-160. In French.

The current state of development of SINTAC (French acronym for integrated navigation, telecommunications and collision-avoidance system) is reviewed in relation to the position-finding performances attained. The factors associated with the procedure of distance measurement according to the time of arrival of an identifiable event used for navigation with SINTAC, which is presently in the phase of exploratory development for compatibility with JTIDS, are discussed. Particular attention is then given to the factors influencing the precision of time measurement by the system, including signal format, the components of the transmission/reception circuit in the terminal, and the method of signal detection employed. The precision of hour of arrival measurements is also shown to be influenced by the filtering apparatus, the limiter amplifier, the delay lines, the threshold detector, and the synchronization apparatus, as well as multipath propagation. The influence of the Kalman filtering navigation algorithm employed on localization performance is also examined in relation to results of performance simulations undertaken for aircraft navigation, and it is noted that the results confirm theoretical predictions regarding the improvement in performance associated with an improvement in synchronization, and the importance of the estimation process. A.L.W.

A81-35022 **MLS - An example of microprocessor utilization (Le MILS - Un exemple d'utilisation du microprocesseur).** B. Létoquart and J.-M. Skrzypczak (Thomson-CSF, Division T-VT, Meudon-la Forêt, Hauts-de-Seine, France). *Navigation* (Paris), vol. 29, Apr. 1981, p. 174-187. In French.

The MLS currently under development to replace the standard ILS by the mid-1990s is discussed with particular emphasis on the role of microprocessors in the measurement of time differences. The principles of the MLS, which provides an aircraft with its position in spherical coordinates with respect to the runway by the transmission of signals in the GHz range conveying azimuth and elevation angle information, are reviewed, and its principle advantages over the ILS related to the greater volume of data transmittable in the microwave range are indicated. The use of microprocessors in MLS ground stations for the generation of the complex MLS sequential transmissions is then considered, and a microprocessor developed for use in an azimuth ground station is described, with attention given to the synchronization, command processor and control processor circuits and the software employed. A.L.W.

A81-35023 **Perspectives on the civil utilization of the Navstar/GPS (Les perspectives de l'utilisation civile du Navstar/GPS).** W. C. Euler and L. J. Jacobson (Magnavox Advanced Products and Systems Co., Torrance, Calif.). *(Institute of Navigation, Annual Meeting, 36th, Monterey, Calif., June 23-26, 1980.) Navigation* (Paris), vol. 29, Apr. 1981, p. 188-200. 19 refs. In French.

Various aspects of the development and utilization of the Navstar/GPS for civil applications as an aid to maritime navigation are discussed. The legislative history of planning for Navstar GPS in the civil sector, which culminated in the adoption of a resolution calling for the study of radio navigation systems in order to determine the most effective method of reducing the proliferation of such systems in 1979, is outlined. The growing use of satellite navigation in this period is pointed out, and results of tests indicating the precision of the Navstar GPS system with respect to vertical and horizontal position and velocity are indicated. Potential cost savings offered by the system to civil users are evaluated in relation to the costs of the Navstar system and the similar Transit system. Attention is also given to questions of the specifications of the system for civil applications and means of establishing and collecting charges for system utilization. It is pointed out that while the Navstar development program has progressed remarkably in the past five years, little has been done in the way of developing civil applications, and it is concluded that the establishment of a firm national policy concerning civilian use of Navstar GPS is necessary for optimizing the planning and evolution of navigation equipment. A.L.W.

A81-35024 **Feederjet for the 'eighties.** *Air International,* vol. 20, June 1981, p. 267-272, 301.

A detailed and wide-ranging introduction is given to the development and construction history, novel design features, structure, systems and powerplant of the BA 146-100. Intended for low-density/short haul passenger routes, the four-engine fanjet aircraft is to serve as replacement for twin-turboprop designs currently in service with small and medium-sized airlines. Performance figures are: 419 kts maximum cruise speed above 22,000 ft; range with maximum payload 510 nautical miles; standard seating 82 (at 33 in pitch, arranged six abreast with a central aisle). The configuration of the BA 146 is unique in that the high-wing carry-through structure entails no intrusion into the cabin ceiling. A production rate of three aircraft per month is planned, beginning in the second half of 1983. O.C.

A81-35025 **A new lightweight fighter.** R. Braybrook. *Air International,* vol. 20, June 1981, p. 291-295.

Detailed consideration is given to the range of operational capability, economic and industrial criteria that must be met by a new light fighter design. Emphasis is given to the advantage that may be gained by choosing among existing and relatively developed powerplants, and the modification of recently introduced but well-tested airframes to accept less expensive and more fuel-efficient powerplants than those currently employed. In addition to such already-contending light fighter designs as the F-16, the J-79-engined F-16 export version, and the F-5G, novel airframe configurations proposed by British Aerospace, Grumman, General Dynamics and Rockwell International are featured. Canard and forward-swept wing configurations, and the F404 and RB.199 engines, figure prominently in the discussion. Prices range from $6 million for the F-5G to $12 million for the F-16A. O.C.

A81-35026 # **Oscillating airfoils in shock-free transonic flows.** B. K. Shivamoggi (Princeton University, Princeton, N.J.). *Revue Roumaine des Sciences Techniques, Série de Mécanique Appliquée,* vol. 25, Sept.-Oct. 1980, p. 661-663.

An extension of Reissner's integral equation formulation for oscillating airfoils in subsonic flows to shock-free transonic flows is presented. A thin airfoil undergoing small amplitude harmonic oscillations is considered analytically assuming linearized perturbations of an exponential form. A linear sum of partial differential equations with limiting coefficients allows consideration of very low frequency cases, the pressure on the body is defined, and an explicit solution for bounded conditions is obtained. D.H.K.

A81-35551 * # **Estimation of dynamic stability parameters from drop model flight tests.** J. R. Chambers (NASA, Langley Research Center, Hampton, Va.) and K. W. Iliff (NASA, Flight Research Center, Edwards, Calif.). *NATO, AGARD, Lecture Series on Dynamic Stability Parameters, Moffett Field, Calif., Mar. 2-5, 1981 and Rhode-Saint-Genèse, Belgium, Mar. 16-19, 1981, Paper.* 14 p. 10 refs.

A recent NASA application of a remotely-piloted drop model to studies of the high angle-of-attack and spinning characteristics of a fighter configuration has provided an opportunity to evaluate and develop parameter estimation methods for the complex aerodynamic environment associated with high angles of attack. The paper discusses the overall drop model operation including descriptions of the model, instrumentation, launch and recovery operations, piloting concept, and parameter identification methods used. Static and dynamic stability derivatives were obtained for an angle-of-attack range from -20 deg to 53 deg. The results of the study indicated that the variations of the estimates with angle of attack were consistent for most of the static derivatives, and the effects of configuration modifications to the model (such as nose strakes) were apparent in the static derivative estimates. The dynamic derivatives exhibited greater uncertainty levels than the static derivatives, possibly due to nonlinear aerodynamics, model response characteristics, or additional derivatives. (Author)

A81-35552 * # **Applications of dynamic stability parameters to problems in aircraft dynamics.** J. R. Chambers, D. J. DiCarlo, and J. L. Johnson, Jr. (NASA, Langley Research Center, Hampton, Va.). *NATO, AGARD, Lecture Series on Dynamic Stability Parameters, Moffett Field, Calif., Mar. 2-5, 1981 and Rhode-Saint-Genèse, Belgium, Mar. 16-19, 1981, Paper.* 13 p. 10 refs.

The paper presents highlights of a recent study which illustrates the application and analysis of dynamic stability parameters. More specifically, the investigation consisted of an evaluation of the effects of wing leading-edge modifications on the stalling and spinning characteristics of a single-engine general aviation research airplane. The results of the investigation illustrate how dynamic stability parameters measured in wind-tunnel tests are used to predict the spin resistance of this class of aircraft; and that autorotation criteria can be derived from the relationships which exist between static and dynamic aerodynamic characteristics. (Author)

A81-35553 * # **In-flight jet engine noise measurement system.** V. H. Knight, Jr. (NASA, Langley Research Center, Flight Electronics Div., Hampton, Va.). *Instrument Society of America, International Instrumentation Symposium, 27th, Indianapolis, Ind., Apr. 27-30, 1981, Paper.* 13 p. 6 refs.

An instrumentation system in flight tests for noise research is described which utilizes miniature transducers to measure low-amplitude, high-frequency fluctuating pressures in a jet engine mounted under the wing of a turboprop aircraft. The system employs a rotor-mounted FM telemeter to acquire data from eight fan-blade-mounted transducers which are subjected to up to 75,000 g's of loading. Data is transmitted from the rotor to an antenna mounted in the inlet-duct wall using a low-power, close-coupled RF link. The blade pressures and other inlet and stator-vane fluctuating pressures are recorded on airborne, magnetic-tape recorders. The flight instrumentation described also includes PCM techniques to encode and record a variety of quasi-static measurements to provide engine and aircraft performance data. The instrumentation and experimental measurements are of value to an improved understanding of noise sources in jet engines and for the advancement of jet-engine ground noise testing techniques. (Author)

A81-35567 **Control system design using graphical decomposition techniques.** F. J. Evans, C. Schizas, and J. Chan (Queen Mary College, London, England). *IEE Proceedings, Part D - Control Theory and Applications,* vol. 128, pt. D, no. 3, May 1981, p. 77-84.

If system state-space equations are mapped into a digraph, the algorithmic decomposition into connected subsystems, together with the application of sensitivity analysis, provides an alternative approach to quasioptimization and pole assignment. Added benefits come from the subsequent reduction of many difficulties inherent in the numerical solution of large problems, and from more realistic feedback configurations. A specific aircraft stability problem is discussed. (Author)

A81-35630 # **History of the Pegasus vectored thrust engine.** S. Hooker (Rolls-Royce, Ltd., Bristol, England). *Journal of Aircraft,* vol. 18, May 1981, p. 322-326.

An historical account is given of the conceptual, design, and prototype test and development phases of the Pegasus vectored-thrust powerplant used by Harrier/AV-8 V/STOL fighter aircraft. Attention is given to the availability of research funds from the Mutual Weapons Development Program and of a tested core engine design (that of the Bristol Orpheus) on which to base the more advanced three-stage fan Pegasus engine, and the highly innovative step taken in the contrarotation of high pressure compressor and fan spools to minimize the effect of gyroscopic forces during combat maneuvering and transition from vertical to horizontal flight and vice versa. Emphasis is also placed on the importance of flight test development of the engine bleed air-fed, stabilizing 'puffer' jets at the wingtips, nose, and tail of the prototype P1127 aircraft. O.C.

A81-35631 # **Three-dimensional oscillatory piecewise continuous-kernel function method. I - Basic problems. II - Geometrically continuous wings. III - Wings with geometrical discontinuities.** I. Lottati and E. Nissim (Technion - Israel Institute of Technology, Haifa, Israel). *Journal of Aircraft,* vol. 18, May 1981, p. 346-363. 32 refs.

The two-dimensional subsonic, piecewise continuous-kernel function method used in the study of oscillatory and steady flows is extended to three-dimensional problems involving finite-span wings, with emphasis on the choice of spanwise pressure polynomials and collocation points and numerical integration techniques. The rapid convergence and high-accuracy characteristics of the three-dimensional, piecewise continuous-function method are then demonstrated by means of a large number of numerical examples dealing with three-dimensional wings without geometrical discontinuities along their spans. Finally, the method is applied to wings with geometrical discontinuities such as leading-edge extension, leading-edge and trailing-edge control surface rotations, and gaps of various sizes around the trailing-edge control surface. Comparison of these results with those obtained by the vortex- or doublet-lattice methods indicates the superiority of the piecewise continuous-kernel function method. O.C.

A81-35632 # **Assessment of propeller influence on lateral-directional stability of multiengine aircraft.** R. S. van Rooyen and M. E. Eshelby (Cranfield Institute of Technology, Cranfield, Beds., England). *Journal of Aircraft,* vol. 18, May 1981, p. 364-371. 11 refs. Research supported by the South African Council for Scientific and Industrial Research.

Using a twin-engine turboprop aircraft, flight measurements were made to supplement the very limited data on the effects of propellers on the individual lateral static and dynamic stability derivatives. It is found that the propeller slipstream significantly affects the wing contribution to the derivative l sub v. A significant reduction in recovery time from the spiral mode instability in low-speed, high-power conditions is consequently found. Propeller disk contribution to the overall damping in yaw derivative n sub r is also found to be significant. Propeller contributions to y sub v and n sub v, due to the known 'fin' effect, are found to be small for the test aircraft. Existing expressions to calculate propeller influence on l sub v, n sub v, and y sub v are shown to be adequate, while an expression to calculate the propeller contribution to n sub r, which appears not to have been analyzed before, is presented. (Author)

A81-35634 # **Trailing-edge airframe noise source studies on aircraft wings.** W. M. Dobrzynski (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Abteilung technische Akustik, Braunschweig, West Germany). *(American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 6th, Hartford, Conn., June 4-6, 1980, Paper 80-0976.) Journal of Aircraft,* vol. 18, May 1981, p. 397-402. 13 refs.

From surface pressure measurements near the trailing edges of business jet and wide-body commercial aircraft wings under realistic flight conditions (within a range of flight speeds and typical flap deflection angles), the spectral distribution of pressure intensities and coherences were determined and compared to corresponding results from model and glider measurements, respectively. On the basis of integral pressure field coherence dimensions deduced from measured data, it is shown that the use of the hydrodynamic edge-model to predict the farfield-radiated trailing-edge noise of a commercial aircraft in cruise configuration provides reasonable agreement with measured data when the lower bound pressure spectrum and related integral pressure correlation scales are employed. O.C.

A81-35635 # **Measurement of derivatives for an oscillating airfoil with flap.** V. J. E. Stark (Saab Scania AB, Linkoping, Sweden). *Journal of Aircraft,* vol. 18, May 1981, p. 403-407. 21 refs. Research supported by the Forsvarets Materielverk.

The nine derivatives associated with plunge, pitch, and flap rotation are determined for a NACA 64(2)A015 airfoil profile with 42% flap, by measuring forces and moments for a Reynolds number of 430,000 in two-dimensional flow in a water tunnel. The derivatives are compared to results of a computer program based on inviscid thick-wing theory. Significant deviations thought mainly due to viscous effects were found, in particular for flap moment due to unit plunge, pitch, and flap rotation and for lift and pitching moment due to unit flap rotation. O.C.

A81-35636 # **Minimum fuel paths for a subsonic aircraft.** E. Large (Marconi Space and Defence Systems, Ltd., Stanmore, Middx., England). *Journal of Aircraft,* vol. 18, May 1981, p. 410-414. 6 refs.

A method is presented for the determination of fuel consumption-minimizing, optimal flight paths of subsonic aircraft. It is shown that this method is a simple extension of that given by Large (1978) for supersonic aircraft and missiles, and that unlike normal trajectory calculations (where velocity falls off as the path angle increases), optimal path velocity must increase with path angle in order to minimize the gravity loss. O.C.

A81-35647 * **The challenge of unsteady separating flows.** W. J. McCroskey (NASA, Ames Research Center; U.S. Army, Moffett Field, Calif.). *American Society of Civil Engineers, Engineering Mechanics Division, Journal,* vol. 107, June 1981, p. 547-563. 30 refs.

It is noted that the general fluid dynamic problem of unsteady separation at most practical Reynolds numbers remains an unsolved one and that no completely reliable prediction techniques exist at the present time. The modern design engineer must therefore draw from a combination of approximate theories, empirical correlations of data, and finite difference programs based on uncertain physical modeling of turbulence. An attempt is made to describe the basic features of several representative classes of problems for which unsteady effects produce strong or unusual changes in the separation characteristics of the flow. The analysis concerns itself largely with external flow, and emphasis is placed on the physical phenomena involved. C.R.

A81-35668 **Determination of the vorticity on a wing of small aspect ratio in a hypersonic stream.** V. N. Golubkin. *(Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza,* Sept.-Oct. 1980, p. 175-178.) *Fluid Dynamics,* vol. 15, no. 5, Mar. 1981, p. 779-781. 6 refs. Translation.

In the present paper, a formula for the flow component of vorticity on a small-aspect-ratio wing in hypersonic gas flow is derived within the framework of shock layer theory. It is shown that for some specific wing configurations and flow conditions, the structure of the flow can be significantly affected by large local values of vorticity. V.P.

A81-35674 **A very complete electronic warfare system (Un système de guerre électronique très complet).** G. Collin. *Air et Cosmos,* vol. 19, May 16, 1981, p. 31-33, 35. In French.

The electronic warfare system represented by the equipment on board the Atlantic Nouvelle Génération (ANG) aircraft, which will become operational in 1985, is presented. The primary mission of ANG is long-range maritime surveillance of surface and submerged objects, by all means applicable, including an X-band radar, an infrared detector, visual cameras and binoculars, a magnetic anomaly detector, active and passive jettisonable buoys and passive countermeasures in wavelengths from UHF to microwave. Facilities also exist for the interpretation of this information, as well as active countermeasures and attack. The backbone of the electronic warfare system is a Digibus multiplexed digital bus linking the various sensors, calculators and peripheral equipment. Two inertial navigation stations are provided, together with a digital automatic pilot system, and missions are designed to be performed by a crew of 12, with the flight commander seated to the right of the copilot. The ANG thus represents the results of an integrated approach to mission and equipment design, utilizing the most advanced technology in various fields. A.L.W.

A81-35723 * # **Wake vortex alleviation.** G. C. Greene (NASA, Langley Research Center, Subsonic Aerodynamics Branch, Hampton, Va.). *AIAA, SAE, ASCE, ATRIF, and TRB, International Air Transportation Conference, Atlantic City, N.J., May 26-28, 1981, AIAA Paper 81-0798.* 10 p. 14 refs.

This paper describes some of the National Aeronautics and Space Administration's (NASA's) recent and current research on aerodynamic techniques for minimizing the aircraft trailing vortex hazard. The potential benefits and operating problems of the more promising concepts are discussed. Recent flight-test results are presented which show that essentially total vortex alleviation can be achieved at a 3 nautical mile separation distance by oscillating the aircraft's lateral-control surfaces. While not operationally practical, these results suggest that it may be possible to minimize the wake hazard by exciting longitudinal instabilities. (Author)

A81-35724 **Systems costing of hovercraft, hydrofoils and wing-in-ground effect machines. III.** J. M. L. Reeves and D. P. Findley. *High-Speed Surface Craft,* vol. 20, May 1981, p. 24-31. 6 refs.

Two mathematical models are examined: (1) Hydrofoil Analysis and Design (HANDE), a hydrofoil computer-aided design tool used to assist in development investigations, including cost impacts; and (2) Advanced Naval Vehicle Individual Life-Cycle Cost (ANVIL), the result of a two-year cost analysis effort examining advanced air and surface vehicles. The models are discussed in terms of inputs, program logic, and output. Typical costs are then generated for hovercraft, hydrofoil ships, and wing-in-ground-effect machines. Where appropriate, costs include research and development, investment, and operations and support costs. O.C.

A81-35734 # **Experimental method for determining the parameters of onboard microwave-radiometer antennas (Eksperimental'naia metodika opredeleniia parametrov antenn radioteplovykh bortovykh kompleksov).** V. M. Veselov, Iu. A. Militskii, V. G. Mirovskii, E. A. Sharkov, and V. S. Etkin (Akademiia Nauk SSSR, Institut Kosmicheskikh Issledovanii, Moscow, USSR). *Issledovanie Zemli iz Kosmosa,* Mar.-Apr. 1981, p. 63-75. 27 refs. In Russian.

A method is proposed for determining the width of the radiation pattern, the scattering coefficient, the averaged main-lobe and side-lobe brightness temperatures, and the mutual angular distribution of pattern centers of a spaceborne or airborne microwave radiometer. A method for performing absolute and relative microwave-radiometry experiments is also discussed. B.J.

A81-35739 # **Comparative efficiency of aircraft and satellites in the remote sensing of earth resources (O sravnitel'noi effektivnosti samoletov i sputnikov v issledovaniiakh prirodnykh resursov zemli).** Ia. L. Ziman (Akademiia Nauk SSSR, Institut Kosmicheskikh Issledovanii, Moscow, USSR) and D. N. Mishev (B'lgarska Akademiia na Naukite, Tsentralna Laboratoriia po Kosmicheski Izsledvaniia, Sofia, Bulgaria). *Issledovanie Zemli iz Kosmosa,* Mar.-Apr. 1981, p. 97-102. In Russian.

A criterion for estimating the remote-sensing efficiency of aircraft and satellites is proposed, and a semiempirical method for the computation of this criterion is described. The proposed method is used to estimate the comparative efficiency of the An-30 aircraft, the Tu-134 aircraft, and Meteor satellites. It is shown that, in general, no one of these vehicles is more effective in terms of remote sensing than any of the others, and that it is possible to delineate conditions under which the use of one of the vehicles would be optimal. B.J.

A81-35771 **Wind shear detection - Automatic alerting system for airport applications.** *Airport Forum,* vol. 11, Apr. 1981, p. 107, 108.

The Low-Level Wind Shear Alert System (LLWSAS), developed by the FAA and introduced in 1977, is a real-time microcomputer-controlled data acquisition, analysis, and display system which collects wind direction and wind speed data from six anemometers. The system operates at ground level, and it automatically provides advance warning of low-level wind shears approaching the glide slope and takeoff zones near the runway thresholds. When the vector difference of the measured wind vector at the boundary location and the measured wind vector at the center field location is 15 knots or greater, the system automatically alerts the controllers. The wind shear alarm feature of the display identifies each boundary anemometer where a wind shear is occurring and identifies the wind direction and speed at the boundary location. When controllers receive a wind shear alarm, they relay the information to pilots in the airport area by voice communication. A total of 58 systems are operational now (1981) at U.S. airports. K.S.

A81-35772 **Mission-dedicated vehicle for passenger rescue from burning aircraft.** N. Hering. *Airport Forum,* vol. 11, Apr. 1981, p. 110, 111.

The Rescue Lift Cabin, a system for the rescue of passengers and the crew from burning aircraft in the landing and takeoff areas of airports, is presented. Patented in 1980, the rescue vehicle is to have the following overall characteristics: all-terrain capabilities, a cabin equipped with appropriate emergency systems for the temporary reception and treatment of passengers, a quick-lift system between the cabin and the chassis to raise the cabin to the height of the aircraft exits, fire-fighting capabilities, and driving positions at both ends. K.S.

A81-35891 # **Experimental study of multiple paths by a bistatic method of synthetic aperture.** D. Medynski, J. Fritz, and J. Dorey (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *Le Recherche Aérospatiale* (English Edition), Jan.-Feb. 1981, p. 9-13. Translation.

A bistatic side-looking synthetic-aperture technique has been developed to characterize the spatial distribution of ground clutter around an omnidirectional antenna. The technique has been successfully used at three sites, an airport, a sea shore, and a wooded area. In the examples presented, a good distinction was made between two types of ground echoes: those with a low backscattering coefficient, probably omnidirectional and intervening only at a small distance from the receiving antenna; and those with a high reflectivity coefficient, corresponding to large scatterers whose influence can be felt at greater distances. B.J.

A81-35892 # **Braking of an aircraft tyre.** L. Anquez and A. Monthulet (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *La Recherche Aérospatiale* (English Edition), Jan.-Feb. 1981, p. 15-35. Translation.

A three-part scheme has been developed for calculating the braking capacity of a tire on a runway of given characteristics. First, a numerical model of the tire was developed, involving the use of the finite element method in large displacements, large deformations, and nonlinear constitutive laws. Second, a local law representing the friction of rubber on a given runway was defined, and a finite element of unilateral link friction was obtained. Finally, a calculation strategy for solving the problem in spite of its strong nonlinearities and instabilities was proposed. This scheme was used to study the braking of a wheel with a smooth surface. B.J.

A81-35915 # **Aerodynamic load distribution along the span of an asymmetric wing (Raspredelenie aerodinamicheskoi nagruzki po razmakhu antisimmetrichnykh kryl'ev).** A. M. Razdobarin. *TsAGI, Uchenye Zapiski,* vol. 11, no. 4, 1980, p. 124-128. In Russian.

Lifting surface theory is used to develop an algorithm for computing aerodynamic load distribution along the span of an asymmetric wing at subsonic speed. A digital-computer program using FORTRAN was developed for the computations. Calculations of load distribution on an asymmetric wing are compared with those for a symmetric wing. The influence of the aspect ratio and planform of the wing on the load distribution are taken into account. B.J.

A81-35916 # **Calculation of supersonic flow around a wing with constant curvature of its leading edges (Raschet sverkhzvukovogo obtekaniia kryla s nepreryvnoi kriviznoi perednikh kromok).** A. P. Kosykh. *TsAGI, Uchenye Zapiski,* vol. 11, no. 4, 1980, p. 129-138. 9 refs. In Russian.

A numerical investigation is presented of the flow of an inviscid non-heat-conducting gas around a wing with hyperbolic leading edges in the plane of the flow. The nonlinear differential Euler and energy conservation equations describing the system are solved by a marching scheme from section to section in the plane of symmetry of the delta wing. The smooth profile of the leading edges is found to weaken the internal compression shock formed along the curved edge, although it is not completely eliminated. The thermal peaks formed along the windward edge are also observed to be preserved, although heat transfer is decreased in magnitude or displaced downstream. A.L.W.

A81-35920 # **An experimental investigation of the thrust and discharge characteristics of multinozzle low-head ejectors (Eksperimental'noe issledovanie tiagovykh i raskhodnykh kharakteristik mnogostvol'nykh nizkonapornykh ezhektorov).** Iu. A. Lashkov and E. A. Shumilkina. *TsAGI, Uchenye Zapiski,* vol. 11, no. 4, 1980, p. 154-158. In Russian.

Results of tests carried out on an axisymmetric ejector having a variable number of active nozzles (1, 7, 19), and a common cylindrical mixing chamber are presented. The length of the mixing chamber is varied within wide limits, as is the ratio of the area of the entrained gas to that of the actuating gas. The ejector is found to be suitable for use as a low-head jet compressor and as a device for thrust augmentation at various types of installations working with gases in motion. C.R.

A81-35927 * **Wind tunnel determination of dynamic cross-coupling derivatives - A new approach.** E. S. Hanff and J. Orlik-Rückemann (National Aeronautical Establishment, Ottawa, Canada). *(Israel Annual Conference on Aviation and Astronautics, 22nd, Tel Aviv and Haifa, Israel, Mar. 12, 13, 1980.) Israel Journal of Technology,* vol. 18, no. 1-2, 1980, p. 3-12. 6 refs. Contract No. NASw-3079.

The latest developments in the NAE ongoing dynamic stability research program are briefly summarized. Emphasis is placed on the recently developed wind-tunnel data reduction procedures used to obtain cross and cross-coupling derivatives due to an oscillatory motion. These procedures, which account for the dynamic behaviour of the model-balance subsystem, are described for the balance configurations currently in use. The principles on which they are based, however, are quite general and can therefore be applied to other balance configurations. Two full-model dynamic stability apparatuses are described and typical results, obtained from dynamic calibrations as well as from wind-tunnel experiments, are presented. (Author)

A81-35939 **Numerical solution of a supersonic ejector pump.** A. Ziv (Technion - Israel Institute of Technology; Armament Development Authority, Haifa, Israel) and M. Wolfshtein (Technion - Israel Institute of Technology, Haifa, Israel). *(Israel Annual Conference on Aviation and Astronautics, 22nd, Tel Aviv and Haifa, Israel, Mar. 12, 13, 1980.) Israel Journal of Technology,* vol. 18, no. 1-2, 1980, p. 104-111. 6 refs.

A supersonic ejector pump is considered. The performance of the system is studied by a combination of a one-dimensional non-viscous and an axially-symmetric turbulent method; The results show that the performance of the system may be improved by increasing the stagnation pressure and temperature of the primary fluid, or by lowering the viscosity of the secondary fluid. (Author)

A81-36455 # **Calculation of supersonic flow past interfering wings (Raschet sverkhzvukovogo obtekaniia interferiruiushchikh kryl'ev).** A. N. Minailos. *TsAGI, Uchenye Zapiski,* vol. 11, no. 5, 1980, p. 7-17. 8 refs. In Russian.

A numerical method involving the solution of the complete Euler equations is used to investigate supersonic flow past an arrangement of wings. Two problems are solved. In the first problem, two thin delta wings are in a canard configuration; the present results are compared with those obtained using linearized equations of gasdynamics. In the second problem, two thin delta wings are symmetrically located beneath a wing of greater aspect ratio. B.J.

A81-36464 # **Concerning one self-similarity property in flutter analysis (Ob odnom svoistve avtomodel'nosti v zadache o flattere).** Ia. M. Parkhomovskii and L. S. Popov. *TsAGI, Uchenye Zapiski,* vol. 11, no. 5, 1980, p. 103-108. In Russian.

A relationship between two properties of critical flutter velocity is established: the slight dependence on changes of wing mass and the increas of critical flutter velocity by about the sq rt. of n times with a decrease in air density of n times. A dimensional analysis is used to obtain several qualitative relationships in the region of wing parameters where these properties are operative. It is shown that, outside of this region, conventional antiflutter tools require correction. B.J.

A81-36467 # **The effect of the aspect ratio of delta wings on the structure of the near vortex wake (O vliianii udlineniia treugol'nykh kryl'ev na strukturu blizhnego vikhrevogo sleda).** E. P. Vizel'. *TsAGI, Uchenye Zapiski,* vol. 11, no. 5, 1980, p. 119-125. 10 refs. In Russian.

An experimental study was presented of separated flow past several thin plane delta wings with aspect ratios in the range 0.5-4. Particular consideration was given to the configuration of the vortex sheet forming the near vortex wake in a wide range of angles of attack; the relationship between the vortex sheet configurations and pressure changes and aerodynamic characteristics was investigated. It is shown that in the aspect ratio range of 1-2 the vortices have a positive effect on the lift force of the thin wings. B.J.

A81-36468 # **The influence of surface roughness on boundary layer flow and separation at transonic speeds (Vliianie nerovonostei poverkhnosti na obtekanie i otryv pogranichnogo sloia pri transzvukovykh skorostiakh).** Z. A. Anan'eva, E. Kh. Orlovskaia, and V. M. Fomin. *TsAGI, Uchenye Zapiski,* vol. 11, no. 5, 1980, p. 126-130. In Russian.

A81-36472 # **The problem of the minimum-time turn of a maneuverable aircraft velocity vector to a specified course angle (K zadache o minimal'noi prodolzhitel'nosti razvorota vektora skorosti manevrennogo samoleta na zadannyi ugol kursa).** V. T. Pashintsev.

TsAGI, Uchenye Zapiski, vol. 11, no. 5, 1980, p. 148-156. 8 refs. In Russian.

The minimum-time turn problem is examined for fixed finite flight path angles, altitudes, and speeds. An approximate formula is presented which provides a way to express an optimum rule for angle-of-roll control as a function of the instantaneous values of phase coordinates defining aircraft motion in the scan plane. The accuracy of the proposed formula is illustrated by examples. V.L.

A81-36473 # **Some characteristics of aircraft motion at large angles of attack (Nekotorye osobennosti dvizheniia samoleta na bol'shikh uglakh ataki).** G. A. Kvashnina, A. I. Kur'ianov, and G. I. Stoliarov. *TsAGI, Uchenye Zapiski,* vol. 11, no. 5, 1980, p. 157-161. In Russian.

The dynamics of the disturbed motion of an aircraft model with a large aspect ratio wing in the presence of antidamping zones at subsonic speeds is analyzed theoretically and experimentally. It is shown that the transient is characterized by damped oscillations about a stable balance angle of attack if the latter is located in the nonseparated flow region. A nonlinear change of the static longitudinal moment and the presence of antidamping zones have a noticeable effect on the behavior of the model at large angles of attack when the balance angle of attack lies in the separated flow region. In this case, there is a considerable difference between the experimental transient and calculations based on common static and dynamic characteristics. V.L.

A81-36474 # **Relationship between creep characteristics and fracture resistance under the combined effect of fatigue and creep (Sviaz' mezhdu kharakteristikami polzuchesti i soprotivleniem razrusheniiu pri sovmestnom deistvii ustalosti i polzuchesti).** S. I. Ol'kin. *TsAGI, Uchenye Zapiski,* vol. 11, no. 5, 1980, p. 162-167. 8 refs. In Russian.

Experimental data for structural aluminum alloys AK4-1AT1 and D16AT characterized by different creep resistances indicate that the notch sensitivity under creep is one of the characteristics which determine the service life of a component under the combined effect of mechanical loads and elevated temperatures. It is shown, however, that the requirements of high creep resistance and low notch sensitivity are contradictory. Therefore, a material to be used for the structural components of supersonic aircraft should have an optimum combination of creep characteristics which would provide minimum residual deformation and acceptable notch sensitivity under creep. V.L.

A81-36554 **Flight Simulation Technologies Conference, Long Beach, Calif., June 16-18, 1981, Technical Papers.** Conference sponsored by the American Institute of Aeronautics and Astronautics. New York, American Institute of Aeronautics and Astronautics, Inc., 1981. 156 p. Members, $20.; nonmembers, $30.

Papers are presented on on-line wind shear generation for flight simulator applications, design verification by emulation, and the development of a generic airplane response simulation. Low-visibility visual simulation with real fog is discussed, as is versatile and economical real-time simulation for digital flight control systems. Attention is also given to the development of a flight simulation capability in the Dynamic Environment Simulator, computer generated image system trends for the 21st century, and a microcomputer based engine model used in flight simulation applications. C.R.

A81-36555 # **A-10A Operational Flight Trainer simulator flight control system and aerodynamics.** K. L. Johnson (USAF, Aeronautical Systems Div., Wright-Patterson AFB, Ohio), A. I. Portalatin, and P. W. Rinali (Reflectone, Inc., Tampa, Fla.). In: Flight Simulation Technologies Conference, Long Beach, Calif., June 16-18, 1981, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1981, p. 1-6. (AIAA 81-0964)

The paper discusses the flight control aerodynamic and propulsive problems that occurred during development and test of the A-10A Trainer simulator and their solutions. The hardware and software design, and systems interface of these subsystems are also presented. General physical characteristics and capabilities of the A-10A aircraft and Trainer simulator are discussed. The paper proposes that a strong multidiscipline technical linkage exists between computer systems, flight control loading hardware and electronics, and aerodynamics in order to build a real time, high fidelity, Operational Flight Trainer simulator. (Author)

A81-36556 # **TA-4J spin training through simulation.** S. Ramachandran (Goodyear Aerospace Corp., Akron, Ohio) and R. T. Galloway (U.S. Navy, Naval Training Equipment Center, Orlando, Fla.). In: Flight Simulation Technologies Conference, Long Beach, Calif., June 16-18, 1981, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1981, p. 7-17. 8 refs. (AIAA 81-0965)

A methodology to provide spin training for the TA-4J pilots was formulated and implemented on the TA-4J Operational Flight Trainer (Device 2F90). User experience indicates the simulation provides worthwhile training in erect spin recognition and recovery procedures. This paper presents details of: formulation of simulation requirements, development of spin simulation, acceptance test methodology and user experience. (Author)

A81-36557 # **The Northrop F/A-18L Mission Simulator.** R. A. Weeks (Northrop Corp., Hawthorne, Calif.). In: Flight Simulation Technologies Conference, Long Beach, Calif., June 16-18, 1981, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1981, p. 18-22. (AIAA 81-0968)

This paper presents the current status of the Northrop Corporation F/A-18L Mission Simulator. The F/A-18L Mission Simulator is a real time, man-in-the-loop system simulation of the Northrop F/A-18L aircraft and its avionics/flight control systems. The primary objective of this simulation is to develop, implement and verify the integration of the F/A-18L avionics systems with the human pilot. This objective is being fulfilled by the evaluation of a simulated F/A-18L crew station in a realistic visual environment for specific Air-to-Air and Air-to-Ground mission profiles. The F/A-18L Avionics System Simulator utilizes a fixed-based visual flight simulator with a high fidelity cockpit environment. Provided in the simulation are detailed simulations of the operational characteristics of the aircraft's Radar, Head-Up Display, integrated stores management, mission computer and navigation systems. The F/A-18L Avionics System Simulator also utilizes detailed models of the airframe and flight control systems. (Author)

A81-36559 # **On-line wind shear generation for flight simulator applications.** A. B. Markov, L. D. Reid, and R. B. MacKenzie (Toronto, University, Toronto, Canada). In: Flight Simulation Technologies Conference, Long Beach, Calif., June 16-18, 1981, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1981, p. 33-41. 8 refs. Research supported by the Natural Sciences and Engineering Research Council of Canada and Transport Canada. (AIAA 81-0970)

A technique for generating on-line wind inputs for flight simulator applications has been developed. This approach yields wind inputs that are produced by a wind controller acting on the aircraft state and input vectors. The form of the wind controller is established off-line through an optimization process that selects its parameters so as to produce winds which represent some type of worst-case situation. Three such wind controllers were tested in a three degree-of-freedom fixed-base simulation of a light STOL transport. Data were collected for steep ILS approaches flown by two pilots, and an evaluation was made of the severity and realism of the generated winds. Comparisons were made with results obtained in the presence of two reference wind profiles. These tests indicate that the wind controller technique has several advantages over existing simulator wind modelling methods and that it should be assessed further in a more sophisticated flight simulator. (Author)

A81-36560 # A simulation approach to MIL-STD-1553 Multiplex Bus interfacing. R. J. Lawson and J. Murray (Gould, Inc., Simulation Systems Div., Melville, N.Y.). In: Flight Simulation Technologies Conference, Long Beach, Calif., June 16-18, 1981, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1981, p. 42-48. 6 refs. (AIAA 81-0971)

The technique developed for interfacing a 32 bit minicomputer to the MIL-STD-1553 Avionics Multiplex Bus (Mux Bus) in the F/A-18 Part Task Trainer is discussed. It is noted that the capability of access to the Mux Bus through a minicomputer provides the means of emulating any aircraft system the mission computer interfaces to in the aircraft. The capability of emulating the mission computer also exists for simulating real aircraft systems. The technique for recognizing bus requests for systems data required for simulation and responding to these requests within the timing constraints of 1553 is described, and details of bus operation specified by 1553 are given. C.R.

A81-36562 # Microcomputer based engine model used in flight simulation applications. F. E. Huguenin (Reishauer AG, Wallisellen, Switzerland). In: Flight Simulation Technologies Conference, Long Beach, Calif., June 16-18, 1981, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1981, p. 60-67. (AIAA 81-0973)

Various aspects of modeling an aircraft engine using the latest microcomputer technology are discussed. Features of microcomputer hardware design, including multi-processor architecture, are presented, with emphasis placed on real-time flight simulation. Attention is also given to the problem of modeling a CF-6/50 aircraft engine using a microprocessor. A brief overview is included of the software created for the engine model and the approach chosen for programming it. Various results of the simulation are presented, with special emphasis given to a comparison between the microcomputer based engine model and the real data provided by the Aircraft Integrated Data System of a DC-10/30 aircraft. C.R.

A81-36563 # Versatile and economical real-time simulation for digital flight control systems. J. W. Benson, D. B. Mulcare, and J. B. Hoenes (Lockheed-Georgia Co., Marietta, Ga.). In: Flight Simulation Technologies Conference, Long Beach, Calif., June 16-18, 1981, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1981, p. 68-73. (AIAA 81-0974)

An exceptionally efficient real-time airplane model is implemented on a PDP 11/60 and can be used for either analytical or system simulation. The six degree of freedom discrete state model, which iterates the dynamics at up to 100 Hz and a quasistatic trim model are mechanized such that transitioning from one flight case to another is possible. Aside from the state model, the efficiency of the simulation is due to the organization of the simulation software and the utilization of PDP 11/60 operating system. (Author)

A81-36564 # Design verification by emulation. N. Szabo (Singer Co., Link Flight Simulation Div., Sunnyvale, Calif.). In: Flight Simulation Technologies Conference, Long Beach, Calif., June 16-18, 1981, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1981, p. 74-77. (AIAA 81-0975)

Virtually all airlines use currently calligraphic computer-generated images (CGI) to train their pilots. CGI systems have, however, two limitations, which are related to an inability to generate sufficient detail, and to quantization effects in the digital computational process. Investigations have been conducted with the objective to minimize the effect of image quality deficiencies on the training value. The only way to evaluate necessary compromises is to compare several different approaches. A laboratory was established with the capability to generate in nonreal time images which are stored on a video disk. The images can be played back to portray a moving scene. The laboratory is described, taking into account a visual system emulator, radar emulation, and the use of the laboratory to determine image quality. It is pointed out that the testing of suitable approaches in real-time hardware would cost about 30 times as much as the expenditures involved in the employment of the adopted emulation procedure. G.R.

A81-36566 # Development of a flight simulation capability in the dynamic environment simulator. W. B. Albery (USAF, Medical Research Laboratory, Wright-Patterson AFB, Ohio). In: Flight Simulation Technologies Conference, Long Beach, Calif., June 16-18, 1981, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1981, p. 92-97. (AIAA 81-0978)

The paper discusses the conversion of the Air Force Medical Research Laboratory's (AFAMRL) human-operable centrifuge from an acceleration stress research device to an operational flight simulator complete with a cockpit and out-the-window visual system. The integration of a Digital Avionics Information System (DAIS) with the facility and the unique problem of transmitting signals over three sets of slip rings is discussed. Using existing hardware and software at Air Force Wright Aeronautical Laboratories, AFAMRL is turning their centrifuge into a flight simulator. (Author)

A81-36568 # Development of a generic airplane response simulation. C. F. Suchomel and D. J. Moorhouse (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, Ohio). In: Flight Simulation Technologies Conference, Long Beach, Calif., June 16-18, 1981, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1981, p. 104-115. 15 refs. (AIAA 81-0980)

Piloted simulation is seen to be beset by two problems. The first is that the flying qualities specification criteria are written in terms of classical response modes. The second derives from the fact that a simulation of an actual system is not a good research tool because of the extreme difficulty in varying the response parameters in a controlled manner. A simulation model is proposed that is formulated directly in terms of response variables. This is done by combining linear transfer function representations of response to control and disturbance inputs with the nonlinear inertial terms. The development and formulation of the model are discussed in detail, and the rationale, assumptions, and limitations are described. It is noted that an apparent limitation, indicated by the use of linear transfer functions, can be removed by scheduling parameters of the transfer functions with other response variables to attain a level of complexity appropriate to the experiment being carried out. C.R.

A81-36569 * # Low-visibility visual simulation with real fog. W. D. Chase (NASA, Ames Research Center, Moffett Field, Calif.). In: Flight Simulation Technologies Conference, Long Beach, Calif., June 16-18, 1981, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1981, p. 116-128. 17 refs. (AIAA 81-0982)

An environmental fog simulation (EFS) attachment was developed to aid in the study of natural low-visibility visual cues and subsequently used to examine the realism effect upon the aircraft simulator visual scene. A review of the basic fog equations indicated that two major factors must be accounted for in the simulation of low visibility - one due to atmospheric attenuation and one due to veiling luminance. These factors are compared systematically by (1) comparing actual measurements to those computed from the fog equations, and (2) comparing runway-visual-range-related visual-scene contrast values with the calculated values. These values are also compared with the simulated equivalent equations and with contrast measurements obtained from a current electronic fog synthesizer to help identify areas in which improvements are needed. These differences in technique, the measured values, the features of both systems, a pilot opinion survey of the EFS fog, and improvements (by combining features of both systems) that are expected to significantly increase the potential as well as flexibility for producing a very high-fidelity low-visibility visual simulation are discussed. (Author)

A81-36572 # **Improved G-Cueing System.** E. B. Bose, W. P. Leavy, and S. Ramachandran (Goodyear Aerospace Corp., Akron, Ohio). In: Flight Simulation Technologies Conference, Long Beach, Calif., June 16-18, 1981, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1981, p. 139-146. 5 refs. (AIAA 81-0987)

A G-Seat employing both hydraulic and pneumatic systems has been designed. The advantages of this design are much reduced response time, availability of both onset and sustained cues, good high-frequency response and sufficient excursions to provide vestibular cues in all degrees of freedom except pure lateral translation. The design also features a microprocessor resulting in: a self-contained G-Cueing System that can be easily fitted into any simulator with minimal changes to the host computational hardware or software; significantly reduced host computer requirements; and a sampling rate of up to 240 Hz without increasing the computational burden on the host simulator. A helmet loader was also designed to supplement the motion cues. The paper presents G-Cueing system design details and pilot evaluation. (Author)

A81-36573 # **Physiological effects of high-G flight - Their impact on flight simulator design.** F. M. Cardullo (New York, State University, Binghamton, N.Y.). In: Flight Simulation Technologies Conference, Long Beach, Calif., June 16-18, 1981, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1981, p. 147-153. USAF-sponsored research. (AIAA 81-0986)

The physiological effects of high G flight have been studied and related to the flight simulator environment. Means of stimulating or simulating some of these phenomena are discussed. The physiological effects treated include cardiovascular, vision, respiratory, tactile and proprioceptive. The most important of these are the cardiovascular since they are the genesis of the well known effects on vision. These effects were examined in terms of the geometry of the diminution of visual field and the associated dynamics. A description of several means of creating this effect in the simulator is presented. These include means of actually inducing the visual effects by stimulating the appropriate response of the cardiovascular or respiratory system. (Author)

A81-36614 **Theory and application of finite element analysis to structural crash simulation.** A. B. Pifko and R. Winter (Grumman Aerospace Corp., Bethpage, N.Y.). *(George Washington University and NASA, Symposium on Computational Methods in Nonlinear Structural and Solid Mechanics, Washington, D.C., Oct. 6-8, 1980.) Computers and Structures,* vol. 13, June 1981, p. 277-285. 32 refs.

Crashworthiness as a structural design requirement for occupant-carrying vehicles has recently received attention in U.S. military standards. Computational aspects related to crashworthiness evaluation methods are discussed. Attention is given to the development of computational methods used for crash simulation, the requirements of a finite element solution to the problem, and two large structural crash simulation problems considered at an American aerospace company. It is pointed out that the application of nonlinear finite element techniques to the crashworthiness evaluation of structures is a challenging endeavor. The results shown for the two sample analyses indicate that theoretical crash simulations can be economically used as part of the overall design process. G.R.

A81-36651 **The titanium industry and the fabrication of semimanufactures for aeronautics (L'industrie du titane et la fabrication des demi-produits pour l'aéronautique).** B. de Gelas (Société Cezus, Ugine, Savoie, France). *L'Aéronautique et l'Astronautique,* no. 87, 1981, p. 4-6. In French.

The place of the aeronautical sector in the titanium industry is discussed, and advanced techniques used for the production of titanium semimanufactures are pointed out. The worldwide distributions of titanium reserves and titanium production facilities are reviewed, and it is noted that almost 95 percent of titanium ore produced is destined for the pigment industry. The remainder of the ilmenite, rutile and anatase extracted is subjected to one of various extractive processes to obtain titanium metal of purity greater than 99.6 percent in the form of a titanium sponge, most of which is then used in the manufacture of aeronautical components. A consumable electrode process is then used for obtaining dense ingots weighing 2 to 5 tons from the titanium sponges, and conventional processes used in the steel industry are employed to transform the ingots into semimanufactures, including bars, small bars and wires, sheets and plates, and drawn and cast products. A.L.W.

A81-36653 **Industrial titanium alloys - Use and characteristics (Alliages de titane industriels - Emploi et caractéristiques).** M. Dupont (Service Technique de l'Aéronautique, Paris, France). *L'Aéronautique et l'Astronautique,* no. 87, 1981, p. 9-12. In French.

The properties of titanium alloys are discussed in relation to their applications in the aircraft industry. Following a brief review of the major characteristics which justify the use of titanium alloys and the types of titanium alloys currently employed, the criteria taken into account in the selection of titanium alloys for aircraft components are examined. Particular attention is given to applications of titanium alloys in airframes, including slightly stressed components, mechanically stressed components, hydraulic pipes and fastener attachments, and in engines, including rotating members. Finally, means of reducing the utilization costs of titanium alloys by forming and welding techniques including hot isothermal pressing, isothermal forging and superplastic forming with diffusion welding, and powder metallurgy techniques are indicated. A.L.W.

A81-36657 **Titanium forging - Stamping /stamp, screw-press/, circular rolling and isothermal forging (Le forgeage du titane - Estampage /pilon, presse à vis/ laminage circulaire et forgeage isotherme).** J. Duriau (SNECMA, Gennevilliers, Hauts-de-Seine, France). *L'Aéronautique et l'Astronautique,* no. 87, 1981, p. 29-37. 9 refs. In French.

The physical and mechanical processes involved in the forging of titanium are discussed in order to illustrate the constraints characterizing the forging process. The physical conditions required for the forging of titanium are compared with those used in the forging of steels, and differences in allowable temperature ranges, time spans, finishing requirements and resulting local shear regions are pointed out. The relative advantages of forging titanium in the beta and alpha plus beta phases are considered for various applications, and the sensitivity of titanium alloys to strain rates encountered during forging is discussed. The process of isothermal forging, in which titanium alloys are deformed at very low rates resulting in pieces with low flow stresses and significant ductility, is examined in detail. Examples are then presented of the series of conventional forging operations employed for the fabrication of an aircraft engine rear suspension mounting, external hatch shoe, high-power compressor disk, static clamp and compressor rotor blade. A.L.W.

A81-36659 **The state of the technologies involved in the forming of TA6V titanium alloy (Etat des technologies relatives au formage de l'alliage de titane TA6V).** E. Huellec (Société Nationale Industrielle Aérospatiale, Suresnes, Hauts-de-Seine, France). *L'Aéronautique et l'Astronautique,* no. 87, 1981, p. 47-52. In French.

The state of the technology of the hot forming of titanium and its alloys is reviewed with particular reference to titanium alloy TA6V, which has been widely used for aircraft structures over the past decade. Particular attention is given to the processes of hot stamping, creep forming, relaxation forming and superplastic forming. It is pointed out that the processes surveyed are well suited for the small production runs and rates typical of aeronautical construction activities, and that the costs of these processes will probably be reduced in the near future. A.L.W.

A81-36663 **The bonding of titanium and its alloys (Le collage du titane et de ses alliages).** C. Bezaud (Société Nationale Industrielle Aérospatiale, Paris, France). *L'Aéronautique et l'Astronautique,* no. 87, 1981, p. 81, 82. In French.

The bonding of titanium and titanium alloys in aeronautical structures is discussed. Applications of titanium bonding with carbon resin and boron resin composites in aircraft of French manufacture are indicated, and it is noted that only those pieces with titanium force introduction inserts, such as the Mirage F1 empennage and the M 2000 fin, can be considered as having working bonds. The effects of various surface treatments including sanding, chemical conversion layers and sulfuric anodization on the quality of the adhesion of bonds to titanium and its alloys are examined, and considerations in the choice of adhesive for titanium-titanium bonding and carbon-titanium bonding by simple and situ polymerization processes are discussed. It is concluded that the bonding of titanium should pose no particular problems as long as an appropriate surface treatment is realized. A.L.W.

A81-36664 **Fabrication problems related to the contamination of titanium alloys (Problèmes de fabrication liés à la contamination des alliages de titane).** R. Chevalier (SNECMA, Service Traitements et Matériaux, Corbeil Essonnes, Essonne, France). *L'Aéronautique et l'Astronautique,* no. 87, 1981, p. 83-88. In French.

Consideration is given to problems of crack formation and fracture encountered during the fabrication of titanium turbojet engine components which are related to the contact of the titanium alloy with certain substances. Conditions favoring the development of stress corrosion in titanium alloys are identified, including the presence of directed tensile stresses, the sensitivity of the substrate and the presence of contaminating agents in fabrication and testing, particularly halogenated organic solvents, certain alcohols, soluble oils and certain metals. Precautions to be taken to prevent the cracking of titanium during fabrication are then presented, with attention given to means for avoiding contamination by the elimination of halogenated solvents and alcohols in degreasing, pickling, the removal of oxide layers, rinsing, manipulation with white gloves, and avoiding contact with cadmium and other embrittling metals. A.L.W.

A81-36665 **The present and future applications of titanium alloys - Airframes, helicopters, missiles (Applications présentes et futures des alliages de titane - Cellules, hélicoptères, engins).** G. Hilaire (Société Nationale Industrielle Aérospatiale, Paris, France). *L'Aéronautique et l'Astronautique,* no. 87, 1981, p. 88-91. In French.

The use of titanium alloys in the nonengine components of conventional aircraft, helicopters and missiles is discussed as regards present characteristics and future possibilities. The importance of titanium alloys in aeronautics is related to its high specific strength, its high-temperature behavior and properties including rust resistance, superplasticity in diffusion welding, and dilatation coefficient. Disadvantages include its high price, difficulties with supply, high machining costs, and properties such as its poor friction coefficient and difficulty of surface preparation. In the next five to ten years, the use of titanium alloys in the construction of subsonic and supersonic commercial aircraft, military aircraft, helicopters, and ballistic and tactical missiles is not expected to increase, and will only increase subsequently pending the results of attempts to lower prices, develop new techniques of powder metallurgy, superplastic forming and diffusion welding, increase supplies and improve technical properties. A.L.W.

A81-36666 **The present and future applications of titanium alloys in engines (Les applications présentes et futures des alliages de titane dans les moteurs).** R. Brunetaud (SNECMA, Paris, France). *L'Aéronautique et l'Astronautique,* no. 87, 1981, p. 91-93. In French.

The advantages and disadvantages, applications and potential of titanium alloys in turbojet engines are reviewed. Advantages include high strength, elastic limit, fatigue life and creep limit related to density at temperatures up to 500-550 C and excellent wet corrosion behavior, while disadvantages are related to high price, difficult handling, sensitivity to treatments risking the introduction of hydrogen, high nondetection of high interstitial defects, sensitivity to saline corrosion at high temperature, and poor abrasion and friction characteristics. Although no material can compete with titanium alloys in rotor disks and fan blades, other materials including nickel-base alloys, stainless steels and polyimide composites may be suitable for high-pressure compressors, low-pressure compressor rectifiers, compressor and center chambers and fluid ducts. Progress expected in the use of titanium alloys in aircraft engines is dependent upon improvements in mechanical performance, and a reduction in price. A.L.W.

A81-36680 # **Estimated service life of gas turbine engine compressor blades (Raschetnaia otsenka zhivuchesti kompressornykh lopatok GTD).** A. V. Prokopenko and M. V. Baumshtein (Akademiia Nauk Ukrainskoi SSR, Institut Problem Prochnosti, Kiev, Ukrainian SSR). *Problemy Prochnosti,* May 1981, p. 32-37. 6 refs. In Russian.

Experimentally derived relationships between the fatigue crack growth rate and the stress intensity factor are used to estimate the service lives of gas turbine compressor blades of VT3-1 alloy and steel Kh17N2. It is shown that the service life of the titanium alloy blades is an order of magnitude less than that of the steel blades. Exposure to a sea salt solution substantially reduces the critical loads of crack growth in titanium and steel blades but has little effect on their service lives. V.L.

A81-36718 # **Dynamics and calculations for an aircraft landing gear pneumatic shock absorber system (Il complesso pneumatico-ammortizzatore degli - Dinamica e calcoli).** G. Corbetta. *Ingegneria,* Mar.-Apr. 1981, p. 65-78. 8 refs. In Italian.

A number of approaches to the functional characterization of an aircraft landing gear pneumatic shock absorber system are integrated, with particular attention to the bounce phase of operation, or the return of the gear to initial position after impact with the ground. The study includes the numerical analysis of a realistic example. O.C.

A81-36737 **Effectiveness of a gas curtain in Laval nozzles under nonrated flow conditions.** E. P. Volchkov, V. K. Koz'menko, and V. P. Lebedev. *(PMTF - Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki,* July-Aug. 1980, p. 91-96.) *Journal of Applied Mechanics and Technical Physics,* vol. 21, no. 4, Jan. 1981, p. 511-516. 11 refs. Translation.

Heat-transfer singularities induced by the interaction of shocks with the boundary layer arise in the supersonic part of a Laval nozzle under overexpansion conditions. It is necessary to consider both the thermal and dynamic characteristics of the flow in the design of gaseous screens for the thermal protection of the nozzle walls. This paper presents experimental results on the efficiency of gaseous screens in supersonic conical nozzles under overexpansion conditions. The screen is formed by the injection of air through an annular slot at the nozzle inlet. P.T.H.

A81-36738 **Calculation of the nonlinear aerodynamic characteristics of a wing of finite span.** V. A. Algazin. *(PMTF - Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki,* July-Aug. 1980, p. 97-107.) *Journal of Applied Mechanics and Technical Physics,* vol. 21, no. 4, Jan. 1981, p. 516-525. 13 refs. Translation.

A general system of nonlinear equations is obtained for flow past a wing of finite-span moving in an ideal incompressible fluid from a state of rest. This system is solved by successive linearization for a series of discrete time moments. The solution of the linear problem is obtained by the Algazin-Gorelov method (1974) modified so that the approximation of the vortex-sheet intensity by spectral splines is used only to determine the relations between different components of discrete singularities. Numerical calculations are performed by a model that accounts for a vortex sheet which converges only with the trailing edge of the wing. The structure of the vortex sheet behind the wing was studied along with its influence on the aerodynamic characteristics of rectangular wings of different aspect ratios. P.T.H.

A81-36940 # **Laser-optic method for investigating the trajectories and bending-torsional deformations of lifting propeller blade models (Lazerno-opticheskii metod issledovaniia traektorii dvizheniia i izgibno-krutil'nykh deformatsii lopastei modelei nesushchikh vintov).** D. D. Gribanov, V. P. Kulesh, A. K. Martynov, A. A. Orlov, and S. D. Fonov. *TsAGI, Uchenye Zapiski,* vol. 11, no. 6, 1980, p. 88-95. In Russian.

A differential laser method for determining the forms and trajectories of motion of helicopter blades in a wind tunnel is described. The analysis and accuracy of the method are examined, and the experimental setup is described. Experimental results are presented on the trajectories and bending-torsional deformations of hinged and hingeless blade models. B.J.

A81-36944 # **Calculation of flow past wings with supersonic sharp edges (K raschetu obtekaniia kryl'ev so sverkhzvukovymi ostrymi kromkami).** A. G. Zarubin. *TsAGI, Uchenye Zapiski,* vol. 11, no. 6, 1980, p. 120-124. 5 refs. In Russian.

Godunov's numerical method is used to investigate flow past a delta wing with supersonic sharp edges. Calculations are performed for a plane wing with a sweep angle of 45 deg, of a freestream Mach number 2.94, and an angle of attack of 12 deg. The method delineates the perturbed-flow boundary as the boundary of the computational region, and defines the singularity on the edge for flow above the wing. Numerical results are compared with experimental results and with results obtained by another numerical method. B.J.

A81-36967 **A new helicopter map display device HKG-5 (Ein neues Hubschrauberkartengerät HKG-5).** E. Wildermuth (Stuttgart, Universität, Stuttgart, West Germany). *Ortung und Navigation,* no. 1, 1981, p. 64-76. In German.

Many helicopters are provided with navigation installations, which are calculating continuously the coordinates of aircraft position. The identification of the points on the map which correspond to those coordinates is often difficult. It would, therefore, be a great advantage if the onboard navigation installations could be equipped with a device which transforms the position coordinates immediately into an indication of the aircraft position on the navigation chart. The specifications for a suitable device satisfying the requirements are discussed. The specifications were implemented in a device designed jointly by persons of the University of Stuttgart and a West German company. The device utilizes a 8-bit microprocessor. It is currently tested in an aircraft. Attention is given to device characteristics, operational details, and the employed navigation charts. G.R.

A81-37114 # **INTERSCAN - The development and international acceptance of a new microwave landing system for civil aviation.** H. B. O'Keeffe (Department of Transport, Melbourne, Australia). *Institution of Engineers (Australia), Electrical Engineering Transactions,* vol. EE 16, June 1980, p. 78-81.

The INTERSCAN project represents a considerable achievement for Australia, resulting from technological diplomacy at the international level and the development of a landing system of superior characteristics. The existing instrument landing system, standardized by the ICAO, had two basic limitations: (1) its guidance signal could be degraded by signal reflections from the surrounding terrain, and (2) it provided only a single fixed approach path. The INTERSCAN project developed a microwave landing system (MLS) operating at 5000 MHz or higher, based on time reference scanning beam techniques. Although up against considerable international opposition, Australia convinced the U.S. of INTERSCAN's superiority in its first flight (1974), which used U.S. ground equipment and an Australian receiver, thus demonstrating the diversity of equipment that could be used for its implementation. The ICAO selected the system eleven years after its proposal as a standard landing system for civil aviation. J.F.

A81-37126 **Fatigue of fibrous composite materials; Proceedings of the Symposium, San Francisco, Calif., May 22, 23, 1979.** Symposium sponsored by the American Society for Testing and Materials. Edited by J. B. Wheeler. Philadelphia, Pa., American Society for Testing and Materials (ASTM Special Technical Publication, No. 723), 1981. 319 p. $30.

Among the topics discussed are: fatigue characterization, effect of post buckling and effect of ply constraint in laminate composites; the bolt hole growth, notched specimen fatigue properties and elevated temperature fatigue behavior of graphite/epoxy composites; and the mechanisms of fatigue and damage initiation in such advanced composite systems as carbon-carbon and boron-aluminum. Attention is also given to off-axis fatigue, compression load spectrum truncation effects, compression fatigue in the presence of stress raisers, and proof test effects on strength and fatigue life. O.C.

A81-37127 **Effect of post buckling on the fatigue of composite structures.** J. E. Rhodes (Lockheed-California Co., Burbank, Calif.). In: Fatigue of fibrous composite materials; Proceedings of the Symposium, San Francisco, Calif., May 22, 23, 1979. Philadelphia, Pa., American Society for Testing and Materials, 1981, p. 3-20.

Allowables for post buckling of monolithic composite panels are established. Attention is given to related aluminum experience, composite fatigue considerations, a simple strip theory approach for a post-buckling evaluation, compression panel test results, and fatigue results. A program initiated to determine the post-buckling behavior of thin graphite/epoxy sheet composite panels in shear is also discussed. The program was also concerned with a study of the fatigue capability of panels subject to repetitive buckling. A post-buckling static capability in compression and shear for flat panels was demonstrated in the investigation. A post-buckling repeated loading capability in shear for flat panels was also shown. G.R.

A81-37136 **Compression fatigue behavior of graphite/epoxy in the presence of stress raisers.** M. S. Rosenfeld and L. W. Gause (U.S. Naval Material Command, Naval Air Development Center, Warminster, Pa.). In: Fatigue of fibrous composite materials; Proceedings of the Symposium, San Francisco, Calif., May 22, 23, 1979. Philadelphia, Pa., American Society for Testing and Materials, 1981, p. 174-196. 7 refs.

The results of an experimental program for the characterization of compression and reversed loading fatigue behavior of graphite/epoxy composites in the presence of stress raisers are presented. The two stress raisers considered were an open hole and low-velocity, hard-object impact damage. Constant and variable-amplitude tests performed on the open hole specimen to determine compression fatigue and failure mechanism indicate that fatigue life under compression and reversed loading is less than for tension-tension loading and will be an important design consideration in future composite applications. The failure mechanism is characterized as the local progressive failure of the matrix near the stress raiser, resulting in delamination, with final failure by fiber buckling. The results of post-impact property tests show that subvisual damage can degrade compression static and fatigue strength. O.C.

A81-37137 * **Effects of truncation of a predominantly compression load spectrum on the life of a notched graphite/epoxy laminate.** E. P. Phillips (NASA, Langley Research Center, Hampton, Va.). In: Fatigue of fibrous composite materials; Proceedings of the Symposium, San Francisco, Calif., May 22, 23, 1979. Philadelphia, Pa., American Society for Testing and Materials, 1981, p. 197-212. 9 refs.

Constant amplitude and transport wing spectrum compressive loading tests were used to explore the fatigue behavior of a notched, graphite/epoxy T300/5208 laminate specimen. Results indicate that

(1) the amount of buckling near the notch allowed in the tests significantly affected fatigue life; (2) load spectrum truncation at either high or low ends produced lives greater than those obtained for the baseline complete-spectrum test, but with greater impact at the high-load end; and (3) the predictions of the Palmgren-Miner cumulative damage theory were found to always be far longer than those obtained in the spectrum loading tests. O.C.

A81-37143 **A periodic problem in viscoelasticity with variable coefficients.** M. Raous (CNRS, Laboratoire de Mécanique et d'Acoustique, Marseille, France). *International Journal of Engineering Science,* vol. 19, no. 8, 1981, p. 1145-1168. 26 refs.

A numerical method is proposed for solving the problem of a plate subjected to evolutive thermal gradients and dynamic loads observed in turbine blades. The temperature range is between ambient temperature and 1100 C in the course of time, and the temperature varies by several hundreds degrees/cm. A law of viscoelasticity of the fluid type with variable coefficients is adopted, and secular terms of displacement and strain are brought into evidence. A finite element method is used, and stability arising from the use of explicit numerical integration methods of the Runge-Kutta type is shown. Results of error estimates are given for the discretization in time and space. The numerical results relate to Maxwell's law, because it is the simplest linear law which gives secular displacement in strain terms; due to the linearity of the law, results are precise and explicit. The method is applied to study a plate undergoing thermal stress encountered by an aircraft turbine blade during flight or at overspeed. Results, discussed from the mechanical viewpoint, disclose concentrated stress areas corresponding to the cracked areas observed on actual turbine blades. K.S.

A81-37166 **Mirage 2000, a totally multi-purpose aircraft (Le Mirage 2000, avion totalement polyvalent).** G. Collin and J. Morisset. *Air et Cosmos,* vol. 19, May 30, 1981, p. 23, 24, 29-31. In French.

The flight testing history, avionics and weapons systems of the multipurpose Mirage 2000 fighter aircraft are discussed on the occasion of its completion of over 1000 flights. Since the first test flight of the first prototype in March, 1978, the four single-seat and one two-seater prototypes in service have demonstrated the capabilities of the aircraft and its systems, including fly-by-wire and automatic pilot, at velocities up to 800 knots as well as at high angle of attack and low velocity, and acceleration up to 9 g. Production versions of the Mirage 2000 are currently under construction, together with two new prototypes corresponding to the 2000 N, a nuclear attack aircraft intended for terrain-following flights at low altitude. The Mirage 2000 is intended as both a flighter in air-to-air missions, for which it can carry two Matra Magic missiles for close combat and two Matra Super 530 D or F missiles for interception purposes, and an air-to-ground attack aircraft. The avionics of the Mirage 2000, currently at an advanced stage in flight testing, comprise a Doppler radar, head-up and head-down displays, inertial guidance, and automatic pilot, all controlled by a multiplexed digital line bus. A.L.W.

A81-37299 **Supersonic aircraft test experience - Test techniques and data analysis methods.** R. Abrams (USAF, Flight Test Center, Edwards AFB, Calif.). *Society of Flight Test Engineers, Journal,* vol. 3, May 1981, p. 2-27.

Subsonic flight test techniques and data analysis methods cannot be used to determine the performance characteristics of an aircraft under supersonic flight conditions. The constant Mach altitude method depicts maximum range conditions at altitudes below the maximum power ceiling, while the constant Mach cruise climb method depicts these conditions at maximum power ceiling. An autopilot should be used to maintain stabilized supersonic cruise conditions, and a continuous data record, provided by the vernier out of an FPA, can determine when this has been achieved. Flight test results are standardized by correcting the constant altitude cruise data to a predetermined set of reference cruise conditions as a function of weight; maximum power cruise data are corrected by an iteration process to find the reference cruise ceiling. An aircraft's subsonic cruise capabilities can be determined under engine-out conditions, and the results analyzed using the iteration process. A sawtooth climb method can be used for multiengine jet aircraft to determine climb performance at low speed, engine-out conditions. Two methods, radar tracked decelerations and radar tracked deceleration descents, are used to obtain supersonic airspeed calibration information, and the drag polar is calculated and shown on a graph. J.F.

A81-37300 **Hydroplaning and coefficient of friction in wet runway testing.** R. H. Danhof (USAF, Flight Test Center, Edwards AFB, Calif.). *Society of Flight Test Engineers, Journal,* vol. 3, May 1981, p. 28-40. 5 refs.

Wet runway aircraft performance tests have shown that the coefficient of friction decreases on a wet runway, resulting in increased stopping distances. This phenomenon can be explained by the principles of semisolid friction and by determining the coefficient of friction between two solid substances. In contrast to the results obtained on a dry runway, tests have shown that the total coefficient of friction is an inverse function of velocity on a wet runway. An aircraft can reach a velocity at which its tires are entirely supported by water, a phenomenon known as hydroplaning. Extensive studies have been conducted to define the exact mechanisms of both dynamic and viscous hydroplaning, and to predict the speed at which total dynamic hydroplaning will occur. Dynamic hydroplaning results from the hydrodynamic lift forces that develop when a tire moves across a fluid covered surface; viscous hydroplaning, on the other hand, is primarily dependent upon the runway surface texture, and practically independent of tire inflation pressure and the vertical load. It also occurs at very low ground speeds. The braking coefficient of friction and the wet runway loss of braking effectiveness due to hydroplaning are plotted for analysis. J.F.

A81-37335 # **Accuracy and application of a second-order theory for three-dimensional supersonic and low hypersonic unsteady flows aroung a thin wing.** F. Qiang, W. Gu, and L. He (Academia Sinica, Mechanics Institute, Beijing, Communist China). *Acta Aeronautica et Astronautica Sinica,* vol. 2, Mar. 1981, p. 1-9. 9 refs. In Chinese, with abstract in English.

A three-dimensional, unsteady-flow, second order non-homogeneous differential equation is derived by the superposition of a small disturbance on a steady, three-dimensional flow. Based on the assumption of high Mach number, this equation reduces to a form analogous to that for steady flow; making it possible to solve the equation by methods used in steady flow second-order theory. In the course of solution, the flows are constrained and corrected according to the Poincare-Lighthill-Krook method, thereby eliminating singularities. The method is used to treat the unsteady problem for delta wings with low aspect ratio and supersonic leading edges, within a Mach number range from supersonic to low hypersonic values with reduced frequencies up to near unity. O.C.

A81-37337 # **The biparametric cycle count method and the principle of simplification.** Z. Jiang. *Acta Aeronautica et Astronautica Sinica,* vol. 2, Mar. 1981, p. 21-31. 18 refs. In Chinese, with abstract in English.

Using the Dutch NLR method, a simplification principle incorporating variable mean value and two-wave methods is proposed. Flight test measurements of a fighter aircraft over 50 flight hours are used for the calculation of life estimates by means of two count methods and four simplification principles. All facts confirm the usefulness of the theoretical analysis given in working out the load spectra of fighters. O.C.

A81-37340 # **Tests for inlet distortion in a two-spool turbojet engine on the ground test bed.** F. Jiang (Shenyang Liming Machinery Co., Shenyang, Communist China). *Acta Aeronautica et Astronautica Sinica,* vol. 2, Mar. 1981, p. 59-68. 5 refs. In Chinese, with abstract in English.

The results of tests for inlet total pressure distortion effects on a two-spool turbojet engine's performance and stability are reported. Both the low and high pressure compressors are three-stage, and distortion is generated by metallic mesh screens. Compressor surge was induced by a fuel flow step generator. It was found that when jet nozzle area was increased from 100% to 142%, the operating line of the low pressure compressor falls significantly irrespective of whether the inlet flow is distorted. Surge and operating lines were determined with and without distortion, and test results are given in terms of the relationship of pressure ratio to corrected mass flow and corrected speed. It is concluded that the surge margin and characteristic compressor lines are affected not only by inlet, but also outlet conditions, and that the characteristic lines of independent components could not be used as a substitute for a fully assembled engine's testing. O.C.

A81-37341 # **Fundamental investigation on jet engine ignition of fuel sprays and its application.** N. Chen (Beijing Institute of Aeronautics and Astronautics, Beijing, Communist China). *Acta Aeronautica et Astronautica Sinica,* vol. 2, Mar. 1981, p. 69-74. 12 refs. In Chinese, with abstract in English.

An investigation based on the results of recent fundamental research work on jet engine ignition of fuel sprays shows that the prevailing store of energy in high-energy ignition equipment should not be further increased. The effective approaches to the improvement of ignition performance are instead: (1) the enhancement of fuel spray quality; (2) the sustaining of optimum spark time; (3) the maintaining of an electric pole distance somewhat greater than quenching distance; and (4) the pre-heating of starting fuel. O.C.

A81-37343 # **Development of an astro-inertial hybrid navigation system and a star tracker.** G. Shen, S. Qin, Q. Chang, and D. Zhou (Chinese Aeronautical Establishment, Airborne Radar Institute, Communist China). *Acta Aeronautica et Astronautica Sinica,* vol. 2, Mar. 1981, p. 87-94. In Chinese, with abstract in English.

A summing-up of monopulse technique application studies for airborne radar is presented, including a description of typical airborne monopulse radar systems. Taking the amplitude-comparison monopulse technique as an example, essential characteristics of such systems are investigated. The application of the monopulse technique to angle-measurement and tracking in airborne applications is described, and factors influencing the accuracy of such functions are identified along with the performance levels of ECCM. Applications such as multifunction airborne systems, air-to-ground ranging, and terrain avoidance and following are also discussed. O.C.

A81-37414 **Advanced generating system equipment for aircraft.** R. J. Kennett (Lucas Aerospace, Ltd., Shirley, W. Midlands, England). *Aeronautical Journal,* vol. 85, Apr. 1981, p. 127-133. Research supported by the Ministry of Defence (Procurement Executive) and Department of Industry.

Constant frequency ac generating systems for aircraft are reviewed, noting the predominating hydromechanical variable-ratio transmission systems. Constant speed drive has been implemented in four forms: electromechanical, pneumatic, mechanical (traction) and hydromechanical. Power generation is based on a three-stage brushless ac generator. Variable speed, constant frequency systems have been developed around two approaches: a dc link system and a cycloconverter system. Recent developments include a 24,000 rev/min ac generator, hydromechanical transmission and the integration of the generator and transmission. The potential reliability of the CCFG concept is under examination. S.C.S.

A81-37415 **Civil aircraft design for fuel reduction.** W. Tye. *Aeronautical Journal,* vol. 85, Apr. 1981, p. 134-142. 11 refs.

Various considerations regarding civil aircraft design for fuel reduction are assessed. Long- and short-term energy supplies are noted and aviation fuel costs are discussed. Growth trends in air traffic are estimated and alternate fuels are considered. The design factors having particular significance to fuel economy are identified as specific fuel consumption, lift/drag ratio and aircraft weight relative to the payload carried. Engine developments are considered along with aerodynamic gains, improved structural materials and active control technology. Potential radical advances are identified as laminar flow aircraft and turbo-props. S.C.S.

A81-37416 **Airline flight departure procedures - Choosing between noise abatement, minimum fuel consumption and minimum cost.** R. E. Jones (Airbus Industrie, Blagnac, Haute-Garonne, France). *Aeronautical Journal,* vol. 85, Apr. 1981, p. 154-166. 13 refs.

The primary factors concerning aircraft departure are identified as minimum community noise impact, minimum fuel consumption and minimum cost. Computer models have been developed to calculate aircraft departure performance. Results are presented for B737-200 aircraft with three different departure procedures and for B747-200 aircraft with three different departure procedures. Fuel saving/engine maintenance cost trade-off results are discussed. S.C.S.

A81-37433 # **Input impedance of a resonator-slot ring antenna on a spherical layer (Vkhodnoe soprotivlenie kol'tsevoi rezonatorno-shchelevoi antenny na share so sloem).** O. A. Shunin. *Radioelektronika,* vol. 24, May 1981, p. 85-87. In Russian.

A method is developed for determining the effect of feed design parameters and the spherical dielectric layer on the input impedance, and amplitude-phase distribution of a resonator-slot ring antenna for use on board aircraft. The numerical algorithm and program which are presented make it possible to perform the computer-assisted design of a resonator-slot ring antenna on a spherical surface with a uniform dielectric layer. B.J.

A81-37480 **Wing with finite span in a transonic flow.** V. A. Eremenko and O. S. Ryzhov (Akademiia Nauk SSSR, Vychislitel'nyi Tsentr, Moscow, USSR). *(Akademiia Nauk SSSR, Doklady,* vol. 254, no. 2, 1980, p. 313-316.) *Soviet Physics - Doklady,* vol. 25, Sept. 1980, p. 661-663. 14 refs. Translation.

The paper considers the steady transonic flow past a finite-span wing with markedly subsonic flow at infinitely distant points; under these conditions regions can form on both sides of the wing in which the Mach number exceeds 1. The problem is solved by a finite-difference scheme that is based on the relaxation method. It is shown that if the velocity of the oncoming flow is sufficiently great, the local supersonic zones merge, going outside of the limits of the wing, both behind and to the sides. An increase in the span of the wing leads to an increase in the size of the regions with local supersonic flow. P.T.H.

A81-37522 # **Coming challenge - Integrating the technologies for forward-swept-wing fighters.** M. R. Robinson and J. M. Rodriguez (Rockwell International Corp., North American Aircraft Div., Los Angeles, Calif.). *Astronautics and Aeronautics,* vol. 19, June 1981, p. 56-58, 62. 7 refs.

A forward-swept wing (FSW) technology-integration demonstrator project is discussed. The advanced technologies incorporated by the next-generation air-to-air fighter include, in addition to the FSW: (1) close-coupled canard; (2) advanced composite primary structures; (3) aeroelastic tailoring; (4) relaxed static stability; (5) fly-by-wire digital controls; and (6) advanced integrated subsystems. Among the benefits to be derived from the FSW configuration are: (1) higher maximum useable lift; (2) improved flutter characteristics; and (3) reduced supersonic drag. The better volume distribution of this configuration near the center of gravity is also praised. The primary consideration of the demonstrator program is to produce advanced aircraft at high rates, within budget constraints, and maintain them at high readiness and reliability despite their use of advanced weapons and avionics. O.C.

A81-37523 # Flight-management system - Key to the advanced-technology fighter. C. A. Crother (Rockwell International Corp., North American Aircraft Div., Los Angeles, Calif.). *Astronautics and Aeronautics,* vol. 19, June 1981, p. 59-62.

Digital flight-management system (FMS) design considerations are presented for a technology-integration demonstrator aircraft incorporating forward swept wing (FSW) and control configured vehicle (CCV) features. A distributed-processor architecture is chosen for the system because of: (1) the rising cost of software relative to hardware; (2) the rapid expansion of microprocessor capabilities relative to their size; and (3) the fact that distributed microprocessors allow distributed redundancy management, while a centralized microprocessor may require 60% of its capacity for such tasks. The system described is currently undergoing testing and design refinement in the course of both the HiMAT and FSW advanced fighter aircraft development programs. Emphasis is given to the effect of static instability characteristics on hydraulic control system weight. O.C.

A81-37524 # Goals of flight management system integration for a forward-swept-wing demonstrator aircraft. A. J. Ostheimer (United Technologies Corp., Hamilton Standard Div., Windsor Locks, Conn.). *Astronautics and Aeronautics,* vol. 19, June 1981, p. 63-66.

A redundancy strategy is described for the flight management system (FMS) of a next-generation, forward-swept wing (FSW) fighter aircraft. The system is able to: (1) detect virtually all failures; (2) limit the effects of a failure; (3) either make the failure 'transparent' or place the entire system in such a state that failure recovery is possible; and (4) report the failure to a higher level that will direct an intelligent recovery. The system's flight-critical signal include input signals, actuator monitors, and digital control unit (DCU) calculated commands. It is shown that expansion of redundancy-management attributes to cover key parameters in system life-cycle costs can bring even greater benefits to the design. O.C.

A81-37568 Finite-difference gradients versus error-quadrature gradients in the solution of parameterized optimal control problems. D. Kraft (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Dynamik der Flugsysteme, Oberpfaffenhofen, West Germany). *Optimal Control Applications and Methods,* vol. 2, Apr.-June 1981, p. 191-199. 8 refs.

Two nonlinear programming algorithms based on the Lagrangian function are compared with respect to their computational efficiency for solving parameterized optimal control problems. If the most efficient, constrained variable metric method together with forward-difference gradients is used, the formulation and implementation of the adjoint variables can be avoided. This is especially convenient in the design phase of large complex systems. (Author)

A81-37571 # Future strike aircraft design synthesis. R. K. Schaefer, Jr. and R. E. Smith (McDonnell Aircraft Co., St. Louis, Mo.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0371.* 14 p. 13 refs.

The development of a dedicated air-to-surface, all-weather aircraft designed for battlefield interdiction and for deep-penetration strikes against high-value, fixed targets is considered. Two alternatives are proposed: the Supersonic High Altitude Penetrator (SHAP) and the Subsonic Low Altitude Penetrator (SLAP), and the inherent conflicts between such requirements as supersonic cruise persistence, transonic maneuvering, reduced vehicle observables and short field operation are emphasized. A review is made of emerging applicable technologies, such as primary structure advanced metallics and composites, two-dimensional thrust vectoring, advanced containerized munitions and all-weather avionics, with attention to their cost and reliability; and the performance requirements imposed by alternative mission profiles are detailed. O.C.

A81-37631 # Inlet distortion and blade vibration in turbomachines. Y. Tanida and T. Nagashima (Tokyo, University, Tokyo, Japan). *Tokyo, University, Institute of Space and Aeronautical Science, Report* no. 591, vol. 46, Feb. 1981, p. 93-103. 5 refs.

The nonuniformity of inlet flows through a test compressor stage is studied along the lines of three-dimensional, semi-actuator disk theory. Results show that rotor blade vibration greatly influences the attenuation rate of distortion. The effects of rotor/stator separation, circumferential modal index and the tilting of inlet distortion are also demonstrated. The main restriction in the application of the model is that the wavelength of disturbances in the cascade region must be large compared with the blade spacing, which will be allowed for most of the circumstances appearing in the interaction problems between inlet distortion and cascade blades. O.C.

STAR ENTRIES

N81-24020# Aeronautical Systems Div., Wright-Patterson AFB, Ohio. Directorate of Equipment Engineering.
AERONAUTICAL SYSTEMS TECHNOLOGY NEEDS: ESCAPE, RESCUE AND SURVIVAL AND TEST FACILITIES AND TEST EQUIPMENT Annual Report
Clifton J. Miller Feb. 1981 94 p Supersedes ASD-TR-80-5010, ASD-TR-80-5011
(AD-A097827; ASD-TR-81-5008; ASD-TR-80-5010; ASD-TR-80-5011) Avail: NTIS HC A05/MF A01 CSCL 01/3

This report is a part of a compilation of formalized Technology Needs covering Equipment Subsystems as identified in the Aeronautical Systems Division. They are based on development/operational experience, systems studies and new concepts - all related to future system applications. Their presentation is to serve threefold purpose; i.e., guidance for technology program, proven developmental potential, and engineering data/requirements essential for technology use in systems. The identified needs delineate progress desired in performance, control, design flexibility, safety and cost. GRA

N81-24022*# *National Aeronautics and Space Administration.* Langley Research Center, Hampton, Va.
DESIGN AND EXPERIMENTAL RESULTS FOR A NATURAL-LAMINAR-FLOW AIRFOIL FOR GENERAL AVIATION APPLICATIONS
Dan M. Somers Jun. 1981 104 p refs
(NASA-TP-1861; L-14117) Avail: NTIS HC A06/MF A01 CSCL 01A

A natural-laminar-flow airfoil for general aviation applications, the NLF(1)-0416, was designed and analyzed theoretically and verified experimentally in the Langley Low-Turbulence Pressure Tunnel. The basic objective of combining the high maximum lift of the NASA low-speed airfoils with the low cruise drag of the NACA 6-series airfoils was achieved. The safety requirement that the maximum lift coefficient not be significantly affected with transition fixed near the leading edge was also met. Comparisons of the theoretical and experimental results show excellent agreement. Comparisons with other airfoils, both laminar flow and turbulent flow, confirm the achievement of the basic objective. Author

N81-24023*# Boeing Vertol Co., Philadelphia, Pa.
FLAP SURVEY TEST OF A COMBINED SURFACE BLOWING MODEL: FLOW MEASUREMENTS AT STATIC FLOW CONDITIONS
Toshiyuki Fukushima Mar. 1978 64 p refs
(Contract NAS2-9693)
(NASA-CR-152124) Avail: NTIS HC A04/MF A01 CSCL 01A

The Combined Surface Blowing (CSB) V/STOL lift/propulsion system consists of a blown flap system which deflects the exhaust from a turbojet engine over a system of flaps deployed at the trailing edge of the wing. Flow measurements consisting of velocity measurements using split film probes and total measure surveys using a miniature Kiel probe were made at control stations along the flap systems at two spanwise stations, the centerline of the nozzle and 60 percent of the nozzle span outboard of the centerline. Surface pressure measurements were made in the wing cove and the upper surface of the first flap element. The test showed a significant flow separation in the wing cove. The extent of the separation is so large that the flow into the first flap takes place only at the leading edge of the flap. The velocity profile measurements indicate that large spanwise (3 dimensional) flow may exist. T.M.

N81-24024*# Old Dominion Univ., Norfolk, Va. Dept. of Mechanical Engineering and Mechanics.
DEVELOPMENT OF A NONLINEAR VORTEX METHOD Progress Report, 1 Oct. 1980 - 31 Mar. 1981
Osama A. Kandil May 1981 33 p refs
(Grant NsG-1560)
(NASA-CR-164351) Avail: NTIS HC A03/MF A01 CSCL 01A

Progress is reported in the development of reliable nonlinear vortex methods for predicting the steady and unsteady aerodynamic loads of highly sweptback wings at large angles of attack. Abstracts of the papers, talks, and theses produced through this research are included. The modified nonlinear discrete vortex method and the nonlinear hybrid vortex method are highlighted. A.R.H.

N81-24025*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AERODYNAMICS, AEROELASTICITY, AND STABILITY OF HANG GLIDERS. EXPERIMENTAL RESULTS
Ilan M. Kroo Apr. 1981 109 p refs Prepared in cooperation with Stanford Univ.
(NASA-TM-81269) Avail: NTIS HC A06/MF A01 CSCL 01A

One-fifth-scale models of three basic ultralight glider designs were constructed to simulate the elastic properties of full scale gliders and were tested at Reynolds numbers close to full scale values. Twenty-four minor modifications were made to the basic configurations in order to evaluate the effects of twist, reflex, dihedral, and various stability enhancement devices. Longitudinal and lateral data were obtained at several speeds through an angle of attack range of -30 deg to +45 deg with sideslip angles of up to 20 deg. The importance of vertical center of gravity displacement is discussed. Lateral data indicate that effective dihedral is lost at low angles of attack for nearly all of the configurations tested. Drag data suggest that lift-dependent viscous drag is a large part of the glider's total drag as is expected for thin, cambered sections at these relatively low Reynolds numbers. A.R.H.

N81-24026*# Kansas Univ., Lawrence.
COMPARISON OF SELECTED LIFT AND SIDESLIP CHARACTERISTICS OF THE AYRES THRUSH S2R-800, WINGLETS OFF AND WINGLETS ON, TO FULL-SCALE WIND-TUNNEL DATA
J. Roskam and M. Williams Apr. 1981 118 p refs
(Grant NsG-1574)
(NASA-CR-165710; KU-FRL-399-3) Avail: NTIS HC A06/MF A01 CSCL 01A

All calculations were done in the stability axes system. The winglets used were constructed of modified GA(w)-2 airfoils. Aerodynamic characteristics discussed include: angle of attack; lift-curve slope; side force; yawing moments; rolling moments. S.F.

N81-24028# General Dynamics Corp., Fort Worth, Tex. Aerospace Technology Dept.
FOUNTAIN-JET TURBULENCE Final Report, 1 Oct. 1979 - 30 Sep. 1980
William H. Foley and Dennis B. Finlay Sep. 1980 21 p refs
(Contract F49620-80-C-0003; AF Proj. 2307)
(AD-A098098; AFOSR-81-0286TR) Avail: NTIS HC A02/MF A01 CSCL 20/4

A series of experiments was conducted on a model to investigate the characteristics of fountain jets that develop beneath hovering VSTOL aircraft. The results confirm the results of previous studies in that normally developing fountains possess abnormally high turbulence levels that can be reduced by the presence of trip devices placed along the fountain stagnation line. The present work shows that fountain turbulence is highly anisotropic with the intensity of the streamwise component in order of magnitude greater than the cross component. Further, the anamoly appears to occur only in fountains produced by jets of air that strike normal to the ground surface; jets that strike at angles other than the perpendicular do not appear to generate highly turbulent fountains. Author (GRA)

N81-24031# Aeronautical Research Labs., Melbourne (Australia).
TRANSONIC WIND TUNNEL MEASUREMENTS OF TAILPLANE AND ELEVATOR EFFECTIVENESS OF THE JINDIVIK 203B TARGET AIRCRAFT
B. D. Fairlie Sep. 1980 89 p refs
(AD-A098180; ARL/AERO-NOTE-400) Avail: NTIS HC A05/MF A01 CSCL 20/4

Measurements of tailplane and elevator effectiveness are reported for a 1/20th scale complete model of the Jindivik target aircraft. The model reflected the Mk.203B version of the full scale aircraft, the major features of which are as follows: short wing with Mk.8 fuel pods (with fins), nominal - 1 deg twisted flap, fixed ailerons drooped at 1 - 1/2 deg.; extended chord tailplane with a nominal setting of -1/2 deg. The tests included tailplane angles in the range -2 and 1/2 deg. to 3 and 1/2 deg. and elevator angles in the range -15 deg. to 10 deg. for Mach numbers between 0.5 and 0.9. The aircraft is shown to be generally stable throughout the tested ranges, but several small areas of instability are noted. Tailplane and elevator angles to trim are also included and both are shown to increase rapidly for Mach numbers above 0.75. Author (GRA)

N81-24034# Vereinigte Flugtechnische Werke-Fokker G.m.b.H., Bremen (West Germany).
CIVIL COMPONENT PROGRAM WING SECTION. NEW CALCULATION METHODS FOR SUBSONIC AND TRANSONIC INTERFERENCE WITH PLANAR AND SPATIAL FLOWS Final Report
Heinz Jakob, Karl-Dieter Klevenhusen, and Hadwin Struck Bonn Bundesministerium fuer Forschung und Technologie Sep. 1980 121 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-W-80-022; ISSN-0170-1339) Avail: NTIS HC A06/MF A01

An appropriate hybrid procedure for modeling the flow field of supercritical wing designs is presented. A singularity method is developed which determines subsonic flow and streamline coordinates around multi-element airfoils. These coordinates are used to solve the transonic boundary value problem for multi-element configurations. The problem of evaluating planar flow is solved by a three dimensional panel method and a three dimensional difference method. As a practical example, calculations for the B10-2V wing (European AIRBUS) are detailed. Results demonstrate that the calculation method is well-formulated for revealing the influence of body or wing-engine configuration on the wing flow distribution. Author (ESA)

N81-24035*# Douglas Aircraft Co., Inc., Long Beach, Calif.
STUDY OF AIRCRAFT CRASHWORTHINESS FOR FIRE PROTECTION Final Report, 15 Apr. 1980 - 28 Feb. 1981
A. Cominsky Jan. 1981 127 p refs
(Contract NAS2-10583)
(NASA-CR-166159) Avail: NTIS HC A07/MF A01 CSCL 01C

Impact-survivable postcrash fire accidents were surveyed. The data base developed includes foreign and domestic accidents involving airlines and jet aircraft. The emphasis was placed on domestic accidents, airlines, and jet aircraft due principally to availability of information. Only transport category aircraft in commercial service designed under FAR Part 25 were considered. A matrix was prepared to show the relationships between the accident characteristics and the fire fatalities. Typical postcrash fire scenaries were identified. Safety concepts were developed for three engineering categories: cabin interiors - cabin subsystems; power plant - engines and fuel systems; and structural mechanics - primary and secondary structures. The parameters identified for concept evaluation are cost, effectiveness, and societal concerns. Three concepts were selected for design definition and cost and effectiveness analysis: improved fire-resistant seat materials; anti-misting kerosene; and additional cabin emergency exits. J.M.S.

N81-24036# Dayton Univ., Ohio.
VALIDATION OF A BIRD SUBSTITUTE FOR DEVELOPMENT AND QUALIFICATION OF AIRCRAFT TRANPARENCIES Final Technical Report, Jul. 1979 - Jul. 1980
Antonios Challita Wright-Patterson AFB, Ohio Air Force Wright Aeronautical Labs. Oct. 1980 74 p
(Contract F33615-78-C-3402; AF Proj. 2402)
(AD-A097736; UDR-TR-80-69) Avail: NTIS HC A04/MF A01 CSCL 01/3

This report describes an experimental study designed to validate a substitute bird for development and qualification of aircraft transparencies. For a substitute bird to be accepted by the transparency community it has to generate the same impact loads as real birds and damage the transparency in the same manner. Nominal 450 g real and spherical substitute birds were launched onto 0.635 cm thick polycarbonate panels at four different locations. The minimum perforation velocity was used as the main criterion to measure damage; however, perforation wasn't achieved at the center panel and at the lower, or upstream, corner. Therefore, other measures of damage were adopted for these locations; length of cracks, depth of pocket, etc. Also, temporal and spatial distribution of loads were measured for 60 and 600 g spherical substitute birds at three impact angles (90 deg, 45 deg, and 25 deg) and three velocities (100, 200, 300 m/s). Time pressure traces recorded in this program showed a rise and decay of a shock pressure; no steady state flow was observed. GRA

N81-24037# Naval Air Development Center, Warminster, Pa. Aircraft and Crew Systems Technology Directorate.
MPES NEGATIVE G RESTRAINT STRAP DESIGN OPTIONS
Thomas J. Zenobi Feb. 1981 11 p
(AD-A098030; NADC-80232-60) Avail: NTIS HC A02/MF A01 CSCL 01/3

Preliminary investigation shows that the negative G restraint configurations are viable design approaches. The restraint systems will be fabricated and incorporated into MPES. Human subjects will be used for evaluation of the negative G restraint. Areas of concern which will be studied are: crewman comfort; ease of donning/adjusting the restraint, and restraint release for man/seat separation. For measuring effectiveness of the restraint under the negative G environment, the seat/man configuration will be suspended upside-down (simulating a -1G environment) and measurements and observations will be noted. The NADC centrifuge also looms as a possible test bed for testing the negative G restraint under a variety of negative G profiles. GRA

N81-24038# Federal Aviation Administration, Washington, D.C. Office of Aviation Safety.
SUMMARY OF FEDERAL AVIATION ADMINISTRATION RESPONSE TO NATIONAL TRANSPORTATION SAFETY BOARD SAFETY RECOMMENDATIONS Quarterly Report, Jul. - Sep. 1980
J. R. Harrison Oct. 1980 254 p
(AD-A098096; FAA-ASF-81-1) Avail: NTIS HC A12/MF A01 CSCL 01/2

This report contains NTSB recommendations and all FAA responses to Board recommendations that were delivered to the Board during the applicable quarter. In addition, the report includes NTSB requests and FAA responses concerning reconsiderations, status reports, and followup actions. The Table of Contents for this report reflects only those NTSB recommendations which are still open pending FAA action (i.e., those that have not been designated as 'Closed' by the NTSB as a result of acceptable action). Accordingly, the Table of Contents may reflect a number of multiple recommendations (example: A-80-27 through 29), but background material is included only for those recommendations which remain in an 'Open' status. Background information for those recommendations which have been closed is available in FAA headquarters files. Author (GRA)

N81-24039# Federal Aviation Administration, Atlantic City, N.J. Technical Center.
EFFECT OF THERMAL RADIATION ON THE INTEGRITY PRESSURIZED AIRCRAFT EVACUATION SLIDES AND

SLIDE MATERIALS Final Report, May 1979 - Sep. 1980
Louis J. Brown, Jr. and Eldon B. Nicholas Mar. 1981 79 p refs
(FAA Proj. 181-350-320)
(AD-A098179; FAA-CT-81-28) Avail: NTIS HC A05/MF A01 CSCL 01/2

Seventeen full-scale fire tests were conducted to examine the effect of thermal radiation from a large fuel fire on the integrity of pressurized aircraft evacuation slides. Urethane nylon, aluminized urethane nylon, neoprene nylon, aluminized neoprene nylon, and aluminized neoprene Kevlar slides were tested at various distances from a 30- by 30-foot fire pit. Heat flux at the slide, inflation pressure, and air temperature were measured and motion pictures and photographs were taken during these full-scale tests. At an average heat flux level of 1.5 Btu/sq ft-second (sec) (15 feet from edge of fire pit) inservice evacuation slides failed in a nonseam area in 23 to 32 seconds. With an aluminized coating applied to the airholding surfaces, the time failure increased by more than a factor of two at the same test condition. A laboratory test method, suitable for materials qualification, was developed that exposes an evacuation slide material to a preselected radiant heat flux and pressure. Tests were conducted on new materials submitted by slide and material manufacturers, and material samples taken from the undamaged areas of full-scale test slides. A good correlation was demonstrated between the failure times measured in full-scale and laboratory tests. Author (GRA)

N81-24040*# Bendix Corp., Teterboro, N. J. Flight Systems Div.
COCKPIT SIMULATION STUDY OF USE OF FLIGHT PATH ANGLE FOR INSTRUMENT APPROACHES Final Report, Mar. - Nov. 1980
B. Hanisch, H. Ernst, and R. Johnston May 1981 57 p refs
(Contract NAS1-16144)
(NASA-CR-165708; FSD-7511-81-06) Avail: NTIS HC A04/MF A01 CSCL 17G

The results of a piloted simulation experiment to evaluate the effect of integrating flight path angle information into a typical transport electronic attitude director indicator display format for flight director instrument landing system approaches are presented. Three electronic display formats are evaluated during 3 deg straight-in approaches with wind shear and turbulence conditions. Flight path tracking data and pilot subjective comments are analyzed with regard to the pilot's tracking performance and workload for all three display formats. M.G.

N81-24041# Federal Aviation Administration, Atlantic City, N.J.
VISUAL CONFIRMATION OF VOICE TAKEOFF CLEARANCE (VICON) OPERATIONAL EVALUATION, VOLUME 1 Final Report, Sep. 1977 - Oct. 1980
John J. Maurer, B. Castle, E. Rowe, B. Hughes, and R. Nelson Feb. 1981 433 p refs 2 Vol.
(FAA Proj. 143-152-400)
(AD-A097756; FAA-CT-80-60-1-Vol-1; FAA-RD-80-114-1-Vol-1) Avail: NTIS HC A19/MF A01 CSCL 17/7

An operational evaluation was conducted at Bradley International Airport, Windsor Locks, Connecticut, to test and experimental visual (light) system which would confirm the voice takeoff clearance issued by the controller. The effort was in response to the tragic incident which occurred in March of 1977 on Tenerife Island where two Boeing 747's collided because of an apparent misunderstanding of air traffic control verbal instructions. This experimental system called Visual Confirmation of Voice Takeoff Clearance (VICON) consisted of a cluster of three PAR56 lamps with green lenses which were installed at all departure points on the airport with the activation of each cluster controlled by the air traffic controller. Results indicated that the VICON system equipment and components operated in a highly reliable fashion during the entire evaluation period. Data collected and analyzed by a contractor indicated that VICON was technically feasible; however, VICON did not demonstrate that it enhanced safety. Author (GRA)

N81-24042# Federal Aviation Administration, Atlantic City, N.J.
VISUAL CONFIRMATION OF VOICE TAKEOFF CLEARANCE (VICON) OPERATIONAL EVALUATION. VOLUME 2: OPERATIONS AND MAINTENANCE MANUAL Final Report, Sep. 1977 - Mar. 1980
John J. Maurer, B. Castle, A. K. Novakoff, R. Nelson, S. Roditi, and F. P. Zito Feb. 1981 285 p 2 Vol.
(FAA Proj. 143-152-400)
(AD-A098093; FAA-CT-80-60-2-Vol-2; FAA-RD-80-114-2-Vol-2) Avail: NTIS HC A14/MF A01 CSCL 17/7

This document is Volume II of the Visual Confirmation of Voice Takeoff Clearance (VICON) Operational Evaluation. It contains working drawings and schematic diagrams, technical details, and maintenance and detailed operational procedures for the VICON system that was installed at Bradley International Airport, Windsor Locks, Connecticut. The drawings, instructions, and charts in this volume are reproduced exactly as they were used by the Bradley maintenance and air traffic control specialists; no effort was made to formalize or improve the appearance of this information. This volume, therefore, would be utilized if one is interested in considering future implementation or design modification of the VICON system. Seven appendices were added in order to consolidate under one cover the various operational, maintenance, and design details for the VICON system and its components. GRA

N81-24044# Mitre Corp., McLean, Va.
DISCRETE ADDRESS BEACON SYSTEM (DABS) DATA LINK CAPACITY UTILIZATION Interim Report
Anand D. Mundra Nov. 1980 94 p refs
(Contract DOT-FA80WA-4370)
(AD-A098173; MTR-80W301; FAA-RD-81-14) Avail: NTIS HC A05/MF A01 CSCL 17/7

The Discrete Address Beacon System (DABS) will provide the basis for the automation of many air traffic control system functions envisioned in the near future, most notable amongst these being the Automatic Traffic Advisory and Resolution Service (ATARS). This document describes a set of services that may reasonably be expected to be provided by DABS in its first ten years of deployment. It establishes approximate capacity requirement placed on the DABS sensor and upper limits on the total amount of radio signals transmitted by the sensor in order to provide these services. The analysis is based on DABS and ATARS system definitions known as of July 1979. A final report, identifying exact DABS capacity requirements for providing these services, will be published at a later date. Author (GRA)

N81-24045# Bodenseewerk Geraetetechnik G.m.b.H., Ueberlingen (West Germany).
IMPROVEMENT OF GUIDANCE AND HANDLING QUALITIES IN THE VICINITY OF AIRPORTS AND ON LANDING Final Report
Gernot Engler, Klaus Marschall, Richard Sponholz, Gerhard Weber, and Wilfried Wellern Bonn Bundesministerium fuer Forschung und Technologie Dec. 1979 165 p refs In GERMAN; ENGLISH summay
(BMFT-FB-W-79-42; ISSN-0170-1339) Avail: NTIS HC A08/MF A01

The design, development, and testing of a digital integrated flight guidance system is described. A complete uninterrupted combination of operational modes exists for the different degrees of automation considered. The structure of the autonomous digital control panel for data input and output is explained. This panel also serves as a signal interface for data transfer from the control computer. Control alogrithms and data transfer control functions are describad. The agreement between the results of ground flight simulation and the results of test flights confirmed the correctness of the hypotheses used. Author (ESA)

N81-24046# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany). Stabsabteilung Programmvorbereitung.
DEFINITION OF A SYSTEM CONCEPT STUDY FOR FUTURE AIR TRAFFIC GUIDANCE Final Report
Friedrich Suess and Heinz L. Cohrs (Standar Elektrik Lorenz A.G., Stuttgart) Bonn Bundesministerium fuer Forschung und Technologie Sep. 1980 74 p refs In GERMAN; ENGLISH

summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-W-80-008; ISSN-0170-1339) Avail: NTIS HC A05/MF A01

A system capable of handling a much greater volume of traffic in the European airspace is described. Current methods are incapable of handling the projected doubling of traffic in twenty years time. Existing traffic forecasts, current regulations and information on the performance of currently existing systems were used as a basis for the development proposed. Airborne, ground based and satellite data were employed. The different functions performed by the various elements are established together with the hierarchical relations between them. Appropriate extrapolation and optimization allows the future system to be defined. Author (ESA)

N81-24047*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.
AIRCRAFT CANOPY LOCK Patent Application
George H. Nichols, inventor (to NASA) Filed 30 Mar. 1981 14 p
(NASA-Case-FRC-11065-1; US-Patent-Appl-SN-248744) Avail: NTIS HC A02/MF A01 CSCL 01C

A manually-operable lock for releasably securing a canopy in closed condition is characterized by (1) a pair of dogs mounted in fore-and-aft alignment on the wall of the cockpit of an aircraft; (2) a pair of dog receivers mounted on the canopy in juxtaposition with the dogs when the canopy is in its closed condition; (3) a dog-actuating arm including internal and external arm components, respectively, supported for oscillation about a common axis and pivotally connected to the dogs through a pitman rod for pivotally displacing the dog; (4) a spring-loaded pin mounted on the arm and adapted to be ramp-cammed and positioned in coaxial alignment with a receiving bore, when the arm is at the limit of its forward throw; and (5) pin-release means including external and internal components, respectively, for releasing the arm for pivotal displacement. NASA

N81-24048*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.
APPLICATION OF A PERFORMANCE MODELING TECHNIQUE TO AN AIRPLANE WITH VARIABLE SWEEP WINGS
Paul C. Redin May 1981 33 p refs
(NASA-TP-1855; H-1131) Avail: NTIS HC A03/MF A01 CSCL 01C

A performance modeling concept previously applied to an F-104F G and a YF-12C airplane was applied to an F-111A airplane. This application extended the concept to an airplane with variable sweep wings. The performance model adequately matched flight test data for maneuvers flown at different wing sweep angles at maximum afterburning and intermediate power settings. For maneuvers flown at less than intermediate power, including dynamic maneuvers, the performance model was not validated because the method used to correlate model and in-flight power setting was not adequate. Individual dynamic maneuvers were matched sucessfully by using adjustments unique to each maneuver. Author

N81-24049# Dayton Univ., Ohio.
STUDY AND EVALUATION OF EXISTING TECHNIQUES FOR MEASURING AIRCRAFT WINDSCREEN OPTICAL QUALITY: DEVELOPMENT OF NEW TECHNIQUES FOR MEASURING AIRCRAFT WINDSCREEN OPTICAL DISTORTION
J. S. Harris and K. G. Harding Wright-Patterson AFB, Ohio AMRL Feb. 1981 127 p
(Contract F33615-78-C-0501; AF Proj. 7184)
(AD-A097731; AFAMRL-TR-81-25) Avail: NTIS HC A07/MF A01 CSCL 01/2

A program to study and develop techniques for evaluating windscreen optical quality was conducted in suport of the Aerospace Medical Research Laboratory's windscreen program. The bird impact resistant transparency (BIRT) windscreens under study were both thick and lightweight laminated components developed to reduce the threat to low-flying aircraft from bird impact. Visual performance is affected by several optical variables of the windscreen; however, this program addressed only the techniques used to evaluate optical distortion. Results of the study indicated that grid board photographic techniques are simple and easy to perform, but errors as large as 20% occur in manual data reduction. Point-by-point measurement of F-111 windscreen optical distortion has shown that this technique provides high accuracy, but is very time consuming. Point-by-point measurements of four representative F-11 windscreens have shown that angular deviations will not usually exceed 40 minutes of arc and that localized optical distortion effects are characterized by large, highly localized variations in angular deviations. Techniques using raster scanned laser probe beams in conjunction with ratio reflecting screens and holographic lenses could provide the capability for high speed evaluation of optical distortion in windscreens. The technique to be developed for quantified evaluation of optical distortion should be a grid board photographic system. A grid board digitization system is described to eliminate data reduction errors. GRA

N81-24050# Aeronautical Systems Div., Wright-Patterson AFB, Ohio.
METHOD FOR COMPUTATION OF STRUCTURAL FAILURE PROBABILITY FOR AN AIRCRAFT Final Report
John W. Lincoln Jul. 1980 76 p refs
(AD-A098294; ASD-TR-80-5035) Avail: NTIS HC A05/MF A01 CSCL 20/11

This report describes a procedure for computing the probability of aircraft failure of a given aircraft type as a function of flight time. Specifically, the single flight probability of failure, the aircraft probability of failure after a given number of flight hours and the expected number of aircraft losses are calculated. The approach is through fracture mechanics where the distribution of flaws in the structure is represented and combined with the probability of stress exceedance. The computation will allow for structural inspections and rework. The listing of the computer routine and a sample problem to illustrate the method is included. GRA

N81-24051# Aeronautical Research Labs., Melbourne (Australia).
A REVIEW OF AUSTRALIAN INVESTIGATIONS ON AERONAUTICAL FATIGUE Structures Technical Memo, Apr. 1979 - Mar. 1981
G. S. Jost Mar. 1981 66 p
(AD-A098300; ARL/STRUC-TM-327) Avail: NTIS HC A04/MF A01 CSCL 20/1

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 damage repair and refurbishment and fatigue life monitoring and assessment. GRA

N81-24052# Vereinigte Flugtechnische Werke-Fokker G.m.b.H., Bremen (West Germany).
CIVIL COMPONENT PROGRAM WING SECTION. TRANSONIC WING DEVELOPMENT Final Report
Reinhard Hilbig Bonn Bundesministerium fuer Forschung und Technologie Sep. 1980 81 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-W-80-021; ISSN-0170-1339) Avail: NTIS HC A05/MF A01

The transonic wing ZKP-F1, designed for the A-310 aircraft development program, is discussed. The design criteria are explained, and a design analysis is undertaken. The airfoil flow characteristics are established over major regions of the wing span. Transonic wind tunnel test results are cited which confirm design expectations, while verifying practical wing flow insensibility to interference. An advanced wing (B10.3V) which shows improved flow characteristics both in wing root and in the leading edge region along the whole wing span without affecting off-design qualities, is presented. Its planned application in the large scale A-310 model is noted. Author (ESA)

N81-24053# Vereinigte Flugtechnische Werke-Fokker G.m.b.H., Bremen (West Germany).

CIVIL COMPONENT PROGRAM WING SECTION. THE DESIGN OF THE TRANSONIC AIRFOIL VA 2 Final Report
Reinhard Hilbig Bonn Bundesministerium fuer Forschung und Technologie Sep. 1980 56 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-W-80-023; ISSN-0170-1339) Avail: NTIS HC A04/MF A01

The design lift and Mach number criteria are reviewed, and the optimization of off-design characteristics is discussed for the Va transonic wing. A design analysis is presented, citing transonic wind tunnel test results. A shock free pressure distribution is achieved for a wide range of Mach numbers and angles of attack below the design case. The off-design shock caused by overstepping design Mach number or angle of attack, respectively, can be stabilized at a limited downstream position. Author (ESA)

N81-24054# Societe Nationale Industrielle Aerospatiale, Paris (France).
QUALITY IN DESIGN [LA QUALITE DANS LA CONCEPTION]
G. Correge 1980 42 p In FRENCH Presented at FRAMATOME Conf., Paris, 26 Feb. 1980
(SNIAS-802-111-108) Avail: NTIS HC A03/MF A01

Those aspects of management which contribute to assuring the adequacy of a product (aircraft) to meet the needs of a customer for reliability, and to satisfy aeronautical certification, are analyzed. The optimal management of quality from the inception of an aircraft design to final checkout and acceptance of the manufactured system is sought. All available options are examined, following the flow of product development through the various phases of realization. Exhaustive lists of the means, methods, and mechanisms for getting the job done are presented, the favorable combination of which leads to a product well-adapted for user and official requirements. Author (ESA)

N81-24055# Societe Nationale Industrielle Aerospatiale, Paris (France).
THE AIRBUS HYDRAULIC SYSTEMS [LES SYSTEMES HYDRAULIQUES DE L'AIRBUS]
Claude Galy 1980 9 p In FRENCH Presented at Club le Pascal Conf. on Les Systemes, Paris, 12 Sep. 1980 Submitted for publication
(SNIAS-802-111-111) Avail: NTIS HC A02/MF A01

The evolution of hydraulic servocommand systems in civil aeronautics applications is briefly reviewed, leading to a functional overview of the Airbus hydraulic equipment. Taking the A300B hydraulics as an example, the design philisophy is reviewed, and the monitoring of hydraulic equipment is explained. Various control surfaces operated hydraulically are then discussed. The principal subsystems, i.e., landing gear, front wheel steering, and brakes, are also described. Safety features are analyzed, and possibilities for extending hydraulics applications, e.g., stability control, wing profile control, are reported. Author (ESA)

N81-24056# Societe Nationale Industrielle Aerospatiale, Paris (France).
GENERALITIES ON ACTIVE CONTROL. POTENTIALS AND RESEARCH TRENDS [CONTROLE ACTIF GENERALISE. POTENTIALITES ET AXES D'EFFORT]
Y. Negre 1980 22 p In FRENCH; ENGLISH summary Presented at 17th AAAF Colloq. d'Aeronyn. Appl., Grenoble, France, 12-14 Nov. 1980
(SNIAS-802-111-112) Avail: NTIS HC A02/MF A01

The applications of active control in aeronautics are arbitrarily classified, and short term potential for development is assessed. Progress is essentially reported for transport aircraft design, especially in instability control, load control and in wing camber control. Specific development programs, mainly concerning the European AIRBUS, are illustrated. Results pertain to longitudinal stability control, wing loading control, and wing camber control at high speed. Author (ESA)

N81-24057# Societe Nationale Industrielle Aerospatiale, Toulouse (France). Div. Avions.
THE FUTURE COCKPIT OF THE NEXT GENERATION OF CIVIL AIRCRAFT
J. P. Laboire Paris 1980 8 p Presented at ICAS Conf., Munich, 13-17 Oct. 1980
(SNIAS-802-111-113; ICAS-80-8.2) Avail: NTIS HC A02/MF A01

The cockpit of the Airbus A 310 which uses cathode ray tube (CRT) displays and illuminated push buttons is described. The flight deck includes six completely interchangeable CRT's for flight and navigation information and aircraft systems monitoring. Conventional instruments are used as backup. Shadow mask technology is used for the CRT's, with in-line gun alignment. Symbols are composed of strokes and seven colors are available. The primary flight display shows attitude, heading, slip, flight path vector altitude, and airspeed. The navigation display can display a map of the flight plan at various scales. Weather radar navigation data may be suferimposed. The systems monitoring CRT's display schematics of major systems, and show warnings as appropriate. Author (ESA)

N81-24058*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
FLIGHT EVALUATION OF A SIMPLE TOTAL ENERGY-RATE SYSTEM WITH POTENTIAL WIND-SHEAR APPLICATION
Aaron J. Ostroff, Richard M. Hueschen, R. F. Hellbaum, and J. F. Creedon May 1981 52 p refs
(NASA-TP-1854; L-14209) Avail: NTIS HC A04/MF A01 CSCL 01D

Wind shears can create havoc during aircraft terminal area operations and have been cited as the primary cause of several major aircraft accidents. A simple sensor, potentially having application to the wind-shear problem, was developed to rapidly measure aircraft total energy relative to the air mass. Combining this sensor with either a variometer or a rate-of-climb indicator provides a total energy-rate system which was successfully applied in soaring flight. The measured rate of change of aircraft energy can potentially be used on display/control systems of powered aircraft to reduce glide-slope deviations caused by wind shear. The experimental flight configuration and evaluations of the energy-rate system are described. Two mathematical models are developed: the first describes operation of the energy probe in a linear design region and the second model is for the nonlinear region. The calculated total rate is compared with measured signals for many different flight tests. Time history plots show the tow curves to be almost the same for the linear operating region and very close for the nonlinear region. J.M.S.

N81-24059# Lear Siegler, Inc., Grand Rapids, Mich. Instrument Div.
REQUIREMENTS, TECHNOLOGY AND CONFIGURATION EVALUATION FOR CRASH SURVIVABLE FLIGHT DATA RECORDING (CSFDR) SYSTEM Final Report, 23 Jul. 1980 - 23 Mar. 1981
Howard Branch, Barry Casey, Robert Harvey, William Plouff, John Reeves, and Steve Wichmann Wright-Patterson AFB, Ohio ASD 23 Mar. 1981 415 p
(Contract F33615-80-C-0117)
(AD-A097863; ASD-TR-81-5009) Avail: NTIS HC A18/MF A01 CSCL 14/3

This report addresses the tasks required to determine whether or not a Crash-Survivable Flight Data Recording (CSFDR) System which meets the critical performance requirements and cost constraints dictated by the attack/fighter/trainer (A/F/T) application, can be defined with current avionics technology for a volume production program. The first task addressed is that of determining the technical requirements. Following this, the tasks required to formulate the well-defined technical approach are addressed. These tasks include studies relative to standardization, expanded recording, data security, required readout equipment, and future aircraft applications. Special emphasis is given to potential memory technologies, data processing/compression techniques, and required software/firmware for the CSFDR system. Following these technical areas of study, the economic areas of life cycle costs (LCC) and cost/benefit are analyzed. The recommendation is to continue work in the CSFDR area. GRA

N81-24060# Technology, Inc., Dayton, Ohio.
STRUCTURAL INTEGRITY RECORDING SYSTEM (SIRS)

FOR U.S. ARMY AH-1S HELICOPTERS *Final Report, Oct. 1977 - Oct. 1980*
James G. Dotson and Axel W. Kolb Mar. 1981 250 p
(Contract DAAJ02-77-C-0079)
(AD-A098236; USAAVRADCOM-TR-81-D-6) Avail: NTIS HC A11/MF A01 CSCL 14/3

A research and development program for an improved Army AH-1S helicopter Structural Integrity Recording System (SIRS) was conducted to track fatigue damage accumulation on critical helicopter components. The work was divided into five tasks. Task I included modification of hardware and software of five SIRS recorders fabricated under a previous contract, recording of histogram data on flight conditions representative of current missions flown by AH-1S helicopters, determination of the tail rotor usage spectrum, and recording of flight parameters such as rotor RPM, engine torque, airspeed, altitude, acceleration, outside air temperature, gross weight, and pitch and roll attitude. Task II comprised all work required for installation of the SIRS recorders in AH-1S helicopters. Under Tasks III, IV, and V, installation of the flight recorders, monthly retrieval of data from the five aircraft, processing of data, and removal of the recorders and installation kits was performed. Recommendations for additional improvements on the recorder system and its utilization conclude this report. Author (GRA)

N81-24061# Societe Nationale Industrielle Aerospatiale, Paris (France).
DEVELOPMENT OF INSTRUMENTATION FOR PILOTS. CRT SCREENS [EVOLUTION DES OUTILS MIS A LA DISPOSITION DES PILOTES. ECRANS CATHODIQUES]
J. P. Laborie 20 Mar. 1980 13 p In FRENCH Presented at AFCET Journee l'Homme et les Automatismes, Paris, 20 Mar. 1980
(SNIAS-802-111-114) Avail: NTIS HC A02/MF A01

The development of CRT displays in the cockpit as part of the trend towards numerical flight control is reviewed. The architecture of automatic control systems is discussed, emphasizing the eventual introduction of generalized active control. The impact of digital techniques on cockpit design is illustrated. Flight instrument layouts for the advanced A-300 and for the A-310 aircraft are cited as examples. It is included that improvements in CRT technology favor their implementation in aircraft numerical control systems. Author (ESA)

N81-24062# Societe Nationale Industrielle Aerospatiale, Paris (France). Dept. des Systemes Avances.
SYSTEM DIGITIZATION: ITS EFFECT IN THE COCKPIT
J. P. Laboire 1980 35 p In ENGLISH and FRENCH Presented at 17th Gen. Assembly of European Organ. for Civil Aviation Electron., Amsterdam, 25 Apr. 1980
(SNIAS-802-111-115) Avail: NTIS HC A03/MF A01

The evolution of digital techniques in aircraft flight control, avionics and cockpit displays is traced, and anticipated installations on the advanced Airbus are mentioned. Weight savings and reliability improvements (mean time between failure) are given for categories of digital equipment. Secondary flight controls (high lift devices, air brakes and bank controls) will be digitally controlled, achieving performance improvement and weight savings. In the A 310 and advanced A 300, two cockpit options will be offered, a lateral engineer's position, or a forward facing crew cockpit. The instrument panel will include six cathode ray tube displays for flight instrumentation, navigation, warnings and system surveillance. Author (ESA)

N81-24063*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FUNDAMENTAL HEAT TRANSFER RESEARCH FOR GAS TURBINE ENGINES
Darryl E. Metzger, ed. (Arizona State Univ.) 1980 68 p refs
Presented at a Workshop Held at Cleveland, 8-9 Oct. 1980
(NASA-CP-2178; E-666) Avail: NTIS HC A04/MF A01 CSCL 21E

Thirty-seven experts from industry and the universities joined 24 NASA Lewis staff members in an exchange of ideas on trends in aeropropulsion research and technology, basic analyses, computational analyses, basic experiments, near-engine environment experiments, fundamental fluid mechanics and heat transfer, and hot technology as related to gas turbine engines. The workshop proceedings described include pre-workshop input from participants, presentations of current activity by the Lewis staff, reports of the four working groups, and a workshop summary. A.R.H.

N81-24064*# Flight Dynamics Research Corp., Van Nuys, Calif.
A JET-DIFFUSER FOR EJECTOR A V/STOL FIGHTER *Contractor Final Report, Sep. 1979 - Apr. 1981*
Morton Alperin and Jiunn-Jeng Wu Feb. 1981 50 p refs
Sponsored in part by Naval Air Development Center
(Contract NAS2-10373)
(NASA-CR-166161) Avail: NTIS HC A03/MF A01 CSCL 21E

A single ejector equipped with only one vector control jet and a diffuser flap was installed close to the leading edge of the strake of a one-fifth scale, semi-span model of the aircraft, without wing, canard, or tail surface. Tests of the system at a nozzle pressure ratio of 1.24 indicated a thrust augmentation of 1.92 and a thrust in the flight direction of about 12% of the total thrust under static conditions. An ejector stall occured at a ratio of tunnel dynamic pressure to nozzle gage pressure of about 0.008. Ejector stall speed can be delayed by using a boundary layer control jet at the front inlet lip of the ejector. T.M.

N81-24066*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
TOP-MOUNTED INLET SYSTEM FEASIBILITY FOR TRANSONIC-SUPERSONIC FIGHTER AIRCRAFT
T. L. Williams (Northrop Corp., Hawthone, Calif.), B. L. Hunt (Northrop Corp., Hawthorne, Calif.), D. B. Smeltzer, and W. P. Nelms Apr. 1981 20 p refs
(NASA-TM-81292; A-8575) Avail: NTIS HC A02/MF A01 CSCL 21E

The more salient findings are presented of recent top inlet performance evaluations aimed at assessing the feasibility of top-mounted inlet systems for transonic-supersonic fighter aircraft applications. Top inlet flow field and engine-inlet performance test data show the influence of key aircraft configuration variables-inlet longitudinal position, wing leading-edge extension planform area, canopy-dorsal integration, and variable incidence canards-on top inlet performance over the Mach range of 0.6 to 2.0. Top inlet performance data are compared with those or more conventional inlet/airframe integrations in an effort to assess the viability of top-mounted inlet systems relative to conventional inlet installations. A.R.H.

N81-24067*# Pratt and Whitney Aircraft Group, East Hartford, Conn. Commercial Products Div.
STRUCTURES, PERFORMANCE, BENEFIT, COST STUDY *Final Report*
E. Feder Apr. 1981 77 p
(Contract NAS3-22050)
(NASA-CR-165313; PWA-5706-16) Avail: NTIS HC A05/MF A01 CSCL 21E

Aircraft engine structures were studied to identify the advanced structural technologies that would provide the most benefits to future aircraft operations. A series of studies identified engine systems with the greatest potential for improvements. Based on these studies, six advanced generic structural concepts were selected and conceptually designed. The benefits of each concept were quantitatively assessed in terms of thrust specific fuel consumption, weight, cost, maintenance cost, fuel burned and direct operating cost plus interest. The probability of success of each concept was also determined. The concepts were ranked and the three most promising were selected for further study which consisted of identifying and comprehensively outlining the advanced technologies required to develop these concepts for aircraft engine application. Analytic, fabrication, and test technology developments are required. The technology programs outlined emphasize the need to provide basic, fundamental understanding of technology to obtain the benefit goals. A.R.H.

N81-24068*# Solar Turbines International, San Diego, Calif.
INTERNAL COATING OF AIR-COOLED GAS TURBINE BLADES Final Report, May 1979 - Nov. 1980
L. L. Hsu and A. R. Stetson Dec. 1980 170 p refs
(Contract NAS3-28142)
(NASA-CR-165337; SRBI-R-4828-16) Avail: NTIS HC A08/MF A01 CSCL 21E

Four modified aluminide coatings were developed for IN-792 + Hf alloy using a powder pack method applicable to internal surfaces of air-cooled blades. The coating compositions are Ni-19Al-1Cb, Ni-19Al-3Cb, Ni-17Al-20Cr, and Ni-12Al-20Cr. Cyclic burner rig hot corrosion (900 C) and oxidation (1050 C) tests indicated that Ni-Al-Cb coatings provided better overall resistance than Ni-Al-Cr coatings. Tensile properties of Ni-19Al-1Cb and Ni-12Al-20Cr coated test bars were fully retained at room temperature and 649 C. Stress rupture results exhibited wide scatter around uncoated IN-792 baseline, especially at high stress levels. High cycle fatigue lives of Ni-19Al-1Cb and Ni-12Al-20Cr coated bars (as well as RT-22B coated IN-792) suffered approximately 30 percent decrease at 649 C. Since all test bars were fully heat treated after coating, the effects of coating/processing on IN-792 alloy were not recoverable. Internally coated Ni-19Al-1Cb, Ni-19Al-3Cb, and Ni-12Al-20Cr blades were included in 500-hour endurance engine test and the results were similar to those obtained in burner rig oxidation testing. Author

N81-24069# Williams Research Corp., Walled Lake, Mich.
WR34-8 PERFORMANCE IMPROVEMENT PROGRAM. THE WR34-8 GAS TURBINE COMPRESSOR TEST Final Report
D. Best and R. Honn 3 Apr. 1981 90 p
(Contract DAAK70-80-C-0129)
(AD-A098293; WRC0129-TR-81-1; FSC-24235) Avail: NTIS HC A05/MF A01 CSCL 21/5

A rig test was conducted to identify the performance map for the Williams Research Corporation WR34 engine single-stage centrifugal compressor. At the compressor design point, which is at a corrected airflow of 0.538 lbm/sec and speed of 99,050 rpm, an efficiency of 74 percent at a pressure ratio of 4.25:1 was attained. Use of the tested compressor performance in the WR34 engine computer simulation showed that the contractual goal of 27.7 horsepower on a 107 F day at an altitude of 5000 feet can be met. GRA

N81-24071# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
TURBINE ENGINE TESTING
Jan. 1981 471 p refs In ENGLISH and FRENCH Proceedings of the 56th Symp. of the AGARD Propulsion and Energetic Panel, Turin, 29 Sep. - 3 Oct. 1980
(AGARD-CP-293; ISBN-92-835-0282-5) Avail: NTIS HC A21/MF A01

Increasing demands on turbine engines performance, durability, safety, and pollution emission require an improvement in test methods. Test methods are provided for the engine research and development engineers in order to help them meet the manufacturers', the buyers', and the users' test requirements for engine delivery, reliability, economy, and maintenance. A comprehensive survey on testing requirements for engine qualification and development are provided for both military and civil engines. Engine component testing and complete power plant testing are discussed. Trends for future testing are considered.

N81-24072# Registro Aeronautico Italiano, Rome. Div. Generale.
OVERVIEW OF ALL CIVIL AVIATION ENGINE CERTIFICATION/DEMONSTRATION REQUIREMENTS AND RATIONALE, I.E., FAA, CAA, ETCETERA
V. Fiorini *In* AGARD Turbine Engine Testing Jan. 1981 17 p refs (For primary document see N81-24071 15-07)
Avail: NTIS HC A21/MF A01

Two outstanding codes for civil certification of aircraft turbine engines, one adopted in the U.S., FAR 33, and the other widely adopted in Europe, JAR 'E', are discussed and compared. The different existing philosphies, procedures, and different manufacturers positions on both sides of the Atlantic are examined. Significant items are identified and are discussed extensively with the purpose of detailing a comparison between the two sets of rules as follows: power ratings; endurance testing; stress and fatigue aspects of rotating parts; foreign object ingestion; ice protection; and engine fault analysis. T.M.

N81-24073# Naval Air Propulsion Test Center, Trenton, N.J.
SPECIFICATION REQUIREMENTS FOR FIGHTER ENGINES
Martin E. Dell *In* AGARD Turbine Engine Testing Jan. 1981 16 p refs
Avail: NTIS HC A21/MF A01

Military Specification MIL-E-5007D, a general specification for the development of turbofan/turbojet engines, has been used by the U.S. Government for the procurement of new engines since 1973. This specification was tailored and applied by the U.S. Navy to the F404-GE-400 engine (F-18 aircraft) development program. The military general specification philosophy for the procurement of turbojet/turbofan engines using MIL-E-5007D is discussed. With heavy emphasis on technical requirements and assurance tests related to engine durability, improvements in MIL-E-5007D over previous specifications, experiences in applying MIL-E-5007D to the F404 engine development program, and assurance test approaches being considered for a revision to MIL-E-5007D are described. T.M.

N81-24074# Bundesamt fuer Wehrtechnik und Beschaffung, Munich (West Germany).
CERTIFICATION PROCEDURE FOR MILITARY ENGINES IN GERMANY
Fritz Biel *In* AGARD Turbine Engine Testing Jan. 1981 6 p refs
Avail: NTIS HC A21/MF A01

The procedure is shown to be in agreement with the air transportation legislation of Germany. The activities in the course of development and during usage are presented with special emphasis on the aspect that the BWB-ML is only occupied with the subject of airworthiness, free from the need for the pursuance of schedule and financial matters. Differences in the procedures and the organization of other countries are shown. T.M.

N81-24075# Ministry of Defence, London (England). Directorate of Engine Technology.
SPECIFICATION AND REQUIREMENTS RATIONALE FOR MILITARY AND CIVIL HELICOPTER ENGINES
M. D. Paramour *In* AGARD Turbine Engine Testing Jan. 1981 14 p
Avail: NTIS HC A21/MF A01

The endurance and supplementary qualification testing required for the granting of Type Approval of military helicopter engines was reviewed. The rationale of these is given, and variations in different nation's requirements are discussed. A comparison is made with civil certification requirements. Attention is drawn to differences between the requirements for helicopter and fixed-wing aircraft engines. It is illustrated how service experience has revealed certain deficiencies in the test requirements, and has led to the development of more realistic procedures. The options considered for the current review of the UK qualification requirements are discussed. T.M.

N81-24076# Boeing Commercial Airplane Co., Seattle, Wash. Propulsion Technology Div.
BOEING COMMERCIAL AIRPLANE COMPANY ENGINE PROCUREMENT PRACTICES
D. C. Nordstrom, D. W. Bouwer, and R. A. Mays *In* AGARD Turbine Engine Testing Jan. 1981 5 p
Avail: NTIS HC A21/MF A01

For the past decade Boeing had a unique position among the world's commercial airframe companies in offering major portions of product line with a variety of engines supplied by all three large commercial manufacturers. An example is the 747 airplane with 15 engines at 12 thrust in 6 nacelles. New airplanes, the 757 and 767, are also being offered with several engines from the same manufacturers. Boeing developed a framework of interrelated documents and internal evaluation methodology to ensure consistency and control of these multiple engine offerings. The documentary framework currently used is defined and engine performance evaluation and development program monitoring methods are provided. T.M.

N81-24077# Lockheed-California Co., Burbank.
PROPULSION SYSTEM TESTING REQUIREMENTS FOR A COMMERCIAL TRANSPORT
J. F. Stroud *In* AGARD Turbine Engine Testing Jan. 1981 13 p ref
Avail: NTIS HC A21/MF A01

Development and demonstration testing requirements for the next family of transport engines are described. Propulsion system performance and function testing are included with emphasis on performance. Rationale is provided for the major test required. The testing requirements identified reflect experience gained in the L-1011 program. The need for integrated, closely coordinated programs involving the airframe and engine companies is stressed. The test concepts, objectives, and definition of what constitutes performance demonstration are agreed before the airplane program go-ahead. Responsibilities for the various tests are assigned to the engine and airframe companies as appropriate. The requirement for correlating ground and flight propulsion performance results is discussed. T.M.

N81-24078# Societe Nationale Industrielle Aerospatiale, Toulouse (France). Div. Avions.
PERFORMANCE CONTROL AND QUALIFICATION TESTS OF CIVIL AVIATION TURBINE ENGINES IN TESTS CONDUCTED BY AIRFRAME MANUFACTURERS [CONTROLE DES PERFORMANCES ET ESSAIS DE QUALIFICATION DES MOTEURS CIVILS DANS LE CADRE DES ESSAIS AVIONNEURS]
G. Theron *In* AGARD Turbine Engine Testing Jan. 1981 7 p In FRENCH
Avail: NTIS HC A21/MF A01

The economic return of double flow turbine engines rests for a large part on the performance at takeoff; therefore, it is very important to know the evolution of power in the turbine during this phase of flight which is characterized by a particular use of the engine. The airframe manufacturer must study the relations associated with power as a parameter of the principal behavior of the engine, after start-up as well as at increased regimes. The evolution of this same parameter of behavior (constant position of the lever) related to dynamic and thermal characteristics to which the engine is subjected must also be studied. After adjustment of the lever, the regulation system actually put into operation imperfectly controls this parameter of behavior, provoking a dispersion of these evolutions. For the next generation of engines, better performing regulators are proposed which should permit the improvement of performance and of the life of the engines. Transl. by A.R.H.

N81-24079# Rolls-Royce Ltd., Derby (England).
DEVELOPMENT OF TEST REQUIREMENTS FOR CIVIL ENGINES
J. M. Cundy *In* AGARD Turbine Engine Testing Jan. 1981 16 p
Avail: NTIS HC A21/MF A01

A typical modern testing program is described covering timescale, test hours, number of engines, and the different types of testing, such as performance, environmental, system, and mechanical testing. The effects on the program of parts with long lead times, and the requirements for separate component testing are addressed. The testing conducted for manufacturer's purpose and that required by the certification authorities are compared, both for complete engines and for separate components and rigs. Typical test programs in altitude test facilities and in flight are covered. Comparisons are drawn between modern programs and associated techniques, and those in the recent past. T.M.

N81-24080# Pratt and Whitney Aircraft, West Palm Beach, Fla. Government Products Div.
DEVELOPMENT TEST REQUIREMENTS
J. B. Fyte and J. F. Montgomery (AFAPL, Wright-Patterson AFB, Ohio) *In* AGARD Turbine Engine Testing Jan. 1981 6 p refs
Avail: NTIS HC A21/MF A01

Propulsion system test requirements are established that are to provide an operationally acceptable propulsion system, and maintenance and logistic support plans which are appropriate to the usage requirements. Specific emphasis is given to the impact of changes in weapon system characteristics and usage on engine performance, operability, and life. The concept of baseline engine characteristics, including maintenance requirements based on evolving weapon system characteristics are also considered. R.C.T.

N81-24081# General Electric Co., Cincinnati, Ohio. Aircraft Engine Business Group.
ENGINE LIFE DEVELOPMENT
Brian Brimelow *In* AGARD Turbine Engine Testing Jan. 1981 9 p ref
Avail: NTIS HC A21/MF A01

The various parameters effecting the rapid increase of operating and support costs of aircraft engine development are graphically illustrated. The range of conditions required for the aircraft to meet its mission requirements is defined. It is shown that failure to fully establish these requirements results in an inadequate test program followed by frequent engine/control removals because of adverse tolerances stack-ups of otherwise servicable components. It is further shown that given adequate definition of aircraft requirements, shop visits for operability problems can and should be targeted so that refurbishments can be carried out at the time when the engine is removed for replacement of a limited item. R.C.T.

N81-24082# Societe Nationale d'Etudes et de Construction de Moteurs d'Aviation, Moissy-Cramayel (France).
THE SPECIFICATION OF DEVELOPMENT TESTS FOR THE ENGINE OF A COMBAT AIRCRAFT [SPECIFICATION DES ESSAIS DE DEVELOPMENT POUR UN MOTEUR D'AVION DE COMBAT]
J. Caruel *In* AGARD Turbine Engine Testing Jan. 1981 9 p In FRENCH
Avail: NTIS HC A21/MF A01

The mating of SNECMA engines with Dassault Mirage airframes has given rise to a family of aircraft whose reputation is world wide. The ATAR 9C engine equips the Mirage 3, the ATAR 9K propels the Mirage 4 of the French Strategic Air Force, and the ATAR 9K50 engine is on the Mirage F1 and just recently on the Mirage 50. Naturally the development of ATAR engines from 9C to 9K50 has been essentially in augmentation of power and PC, since they passed respectively from 4.4T to 5T and from 6.2T to 7.2T. The most recent version of Mirage aircraft, the 2000, as well as the prototype Mirage 4000 are equipped with a double flux M53 simple body engine. The method by which these two engines were developed are described. A.R.H.

N81-24083# AiResearch Mfg. Co., Phoenix, Ariz. Application Development Div.
DEVELOPMENT OF TEST REQUIREMENTS FOR CIVIL AND MILITARY AUXILIARY POWER UNITS
A. L. Romanin and S. J. Baczynski *In* AGARD Turbine Engine Testing Jan. 1981 26 p

Avail: NTIS HC A21/MF A01

The history of the gas turbine auxiliary power unit (APU) is reviewed to indicate the wide variety of design and usage requirements that have evolved. Particular emphasis is given to the requirements of unattended automatic operation responsive to multiple, variable power demands. Development and proof testing programs for civil and military requirements are formulated as a function of specific user needs and the similarity of the APU and its components to proven designs. R.C.T.

N81-24084# Air France, Paris. Service des Etudes de Propulsion.

TURBINE ENGINE TESTS AS SEEN BY AN AIRCRAFT COMPANY [LES ESSAIS REATEURS VUS PAR UNE COMPAGNIE AERIENNE]
P. Chetail *In* AGARD Turbine Engine Testing Jan. 1981 13 p refs In FRENCH

Avail: NTIS HC A21/MF A01
The need for conducting specific tests on turbine engines using ground test stands was felt not only after inspection, but also at the time of their installation in the aircraft and before their being placed in the shop for repair. Monitoring the performance degradation of engines in the course of service appears to be complementary and very desirable and should become possible by virtue of the semicontinuous recording of parameters on the aircraft, as well as by advanced performance analysis such as the GRA which, on the most recent type of civil turbines, permits more reliable evaluation of engine performance at the level of principal modules than is provided by classic methods. A.R.H.

N81-24085# Ministry of Defence, London (England). Directorate of Engine Development.
ENGINE IN-FLIGHT DATA COLLECTION AND ANALYSIS IN UNITED KINGDOM AIRCRAFT
M. F. Hurry and R. B. G. Hedgecock *In* AGARD Turbine Engine Testing Jan. 1981 13 p refs

Avail: NTIS HC A21/MF A01
The scenario of aircraft engine data collection and analysis techniques in military aircraft is presented. A status review of the work in this area is provided and some of the more important factors which influenced the work on this subject are highlighted. R.C.T.

N81-24086*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INVESTIGATION OF PERFORMANCE DETERIORATION OF THE CF6/JT9D HIGH BYPASS RATIO TURBOFAN ENGINES
Joseph A. Ziemianski *In* AGARD Turbine Engine Testing Jan. 1981 14 p refs
Avail: NTIS HC A21/MF A01 CSCL 21E
The extent and magnitude of performance deterioration of the Pratt and Whitney JT9D, and the General Electric CF6 engine models is presented. Overall engine and contributing module performance deterioration with respect to flight cycles and/or time are analyzed. The overall engine performance deterioration analyses are based on data obtained from historical records, special engine tests, and tests for specific effects. Hardware inspection data from overhaul shops and special module tests are the basis for the modular performance deterioration data used in the analyses. Various damage mechanisms such as seal rubs, erosion, surface roughness and thermal distortion, and how they contribute to performance deterioration are included in the modular analyses. Results indicate that early performance deterioration occurring within the first few flights of these engines is less than 1 percent in cruise specific fuel consumption (SFC), that it is event oriented, and that it is the result of increased blade tip clearances. This performance deterioration gradually increases to about 2.5 to 3.0 percent (including the initial short term deterioration) after 2500 to 3000 flights where increased blade tip clearances, airfoil quality degradation, and thermal distortion are the contributing causes. R.C.T.

N81-24087# Societe Nationale d'Etudes et de Construction de Moteurs d'Aviation, Moissy-Cramayel (France).
DESIGN DEVELOPMENT, AND CERTIFICATION OF A CFN56 ENGINE: RESISTANCE TO THE INGESTION OF FOREIGN BODIES [CONCEPTION, DEVELOPPEMENT ET CERFIFICATION DU MOTEUR DFM56, RESISTANCE A L'INGESTION DES CORPS ETRANGERS]
In AGARD Turbine Engine Testing Jan. 1981 7 p In FRENCH

Avail: NTIS HC A21/MF A01
The theoretical approach used to proportion the head vanes of a civil turbomachine was correlated with experimental results. The two fold objective was to satisfy requirements for international certification (FAA, JAR-E) and to establish comfortable margins of mechanical resistance in order to minimize the costs of corrective action, thus alleviating the maintenance expenses of user companies. The motor, the theoretical approach, and the results of certification are described. The tests constructed and continually used to affirm the theoretical results, and which led to the final definition of the CFM56 engine are described. A.R.H.

N81-24088# Pratt and Whitney Aircraft, West Palm Beach, Fla. Government Products Div.
DERIVATION AND CORRELATION OF ACCELERATED MISSION ENDURANCE TESTING
Jack Sammons *In* AGARD Turbine Engine Testing Jan. 1981 4 p refs
Avail: NTIS HC A21/MF A01
An approach to defining the Accelerated Mission Test (AMT) program as an integral part of the overall engine development process is discussed. This includes not only the initial cycle derivation but also the necessary revisions to the AMT cycles in order to more accurately predict and detect certain failure modes. The validity of the test results are also established. A comparison of AMT engine hardware, and operational engine hardware having equivalent cyclic history, is used for this purpose. As an illustration of the benefits of AMT engine testing, data on several gas turbine engines are presented. Also included in the discussion are the various types of failure modes that are currently not detectable in the AMT type program. R.C.T.

N81-24089# National Gas Turbine Establishment, Farnborough (England). Engine Test Dept.
FREE-JET TESTING OF POWERPLANTS FOR AIRCRAFT AND MISSILES
P. F. Ashwood and P. DeB. Phil *In* AGARD Turbine Engine Testing Jan. 1981 24 p refs

Avail: NTIS HC A21/MF A01
The free-jet test facilities available at the National Gas Turbine Establishment for testing complete aircraft propulsion systems (the air intake, engine, and exhaust system) at conditions reproducing those encountered during flight are described. Supersonic and subsonic flight conditions can be simulated, both steady state and transient; the latter aspect including the effects of time-variant changes in aircraft flight speed, attitude, and engine power. The scope of free-jet testing is reviewed and compared with what can be achieved using direct-connect facilities. Subsonic free-jet tests made under the extreme conditions encountered in an icing cloud are discussed. The tests are designed to determine the effectiveness of intake and engine anti-icing equipment and the ability of the powerplant to operate satisfactorily following the shedding of ice that may have accreted on the inlet duct surfaces. M.G.

N81-24090# ARO, Inc., Arnold Air Force Station, Tenn.
INLET-ENGINE COMPATABILITY TESTING TECHNIQUES IN GROUND TEST FACILITIES
Jack T. Tate *In* AGARD Turbine Engine Testing Jan. 1981 17 p AEDC refs
Avail: NTIS HC A21/MF A01
A review of the available techniques for the evaluation of turbine engine stability is presented. Recommended test matrix selection criteria, instrumentation and test equipment requirements, test procedures, and analysis techniques are discussed with respect to turbine testing with three basic engine inlet environmental conditions: uniform, steady flow; steady-state distorted flow; and time-variant distorted flow. M.G.

N81-24091# National Research Council of Canada, Ottawa (Ontario). Engine Lab.
GAS TURBINE ENGINE TRANSIENT TESTING
D. M. Rudnitski *In* AGARD Turbine Engine Testing Jan. 1981 15 p
Avail: NTIS HC A21/MF A01
Methods for conducting extensive steady-state and transient-performance tests on J85-CAN-15 turbojet engines are discussed.

In particular the instrumentation and techniques developed to monitor and record experimental data rapidly and accurately during rapid-transient engine operation are described. The technique provides report-quality time-plots and compressor operating lines immediately after test, thus permitting rapid assessments of engine performance. M.G.

N81-24092# General Electric Co., Lynn, Mass. Aeromechanics Group.
EXPERIMENTAL VERIFICATION OF TURBOBLADING AEROMECHANICS
V. M. Cardinale, H. R. Bankhead, and R. A. McKay *In* AGARD Turbine Engine Testing Jan. 1981 38 p refs

Avail: NTIS HC A21/MF A01

Experimental aeromechanical procedures are discussed and the process of valid design assessment, avoiding highly theoretical approaches and concepts is addressed. The procedures include methods used in design verification, pre-test preparation, and instrumentation. Examples are given of typical classes of vibratory behavior and their sensitivities to both engine-system variables and in-service and flight environment effects. It is illustrated that early systematic explorations of these variables are necessary to establish these sensitivities and provide adequate margins for long service life. M.G.

N81-24093# Rolls-Royce Ltd., Bristol (England). Test Operations Dept.
BENCH TESTING OF A VECTORED THRUST ENGINE
R. H. Blake *In* AGARD Turbine Engine Testing Jan. 1981 15 p
Avail: NTIS HC A21/MF A01

The history of plant development to accommodate the test program for the thrust vectored Pegasus engine is described, including the need for thrust vector measurement and exhaust gas collectors to allow nozzle swivelling without hot gas re-ingestion. The evaluation of plant effects on engine performance and the philosophy adopted for simplified production testing in the horizontal thrust mode only are described. M.G.

N81-24094# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany).
PERFORMANCE ASSESSMENT OF AN ADVANCED REHEATED TURBO FAN ENGINE
V. Zeidler *In* AGARD Turbine Engine Testing Jan. 1981 22 p refs
Avail: NTIS HC A21/MF A01

Various approaches to determine thrust-in-flight and other appropriaters are discussed. It is noted that the degree of specialization or simplification of some methods points to the applicability; i.e., the quick estimation of actual take off thrust with regard to safety aspects in case of single engine climb-out, requires only a simple option, which produces acceptable results even if the engine is of lower instrumentation standard. On the other hand, for inflight thrust, engine performance assessment and aircraft drag analysis is calculated by an ambitious computer program using test data of engines with a higher instrumentation standard. The influence of altitude test facility testing on the accuracy is described. M.G.

N81-24095# Centre d'Essais en Vol, Istres (France).
FLIGHT TESTS OF THE ENGINES OF COMBAT AIRCRAFT: VALIDATION METHODS USED BY CEV [LES ESSAIS EN VOL DE MOTEURS D'AVIONS DE COMBAT, METHODS DE VALIDATION EMPLOYEES PARLE CEV]
In AGARD Turbine Engine Testing Jan. 1981 6 p In FRENCH

Avail: NTIS HC A21/MF A01

Validation of series standard can be definitively obtained for the engines of combat aircraft only after flight tests. The validation tests used at CEV not only assure the good operation of motors in series under the most critical conditions of use, but also verify in flight their conformity with certain contractual and regulatory requirements. Influential parameters are listed, the conditions of use which must be the object of flight tests are inventoried, and the principles of the methods used are examined. These methods consist either of testing 'extreme' motors built with chosen or regulated elements each within tolerance limits, or by simulating the extreme configurations by appropriate control of the governors. Transl. by A.R.H.

N81-24096# Centre d'Essais des Propulseurs, Orsay (France).
TESTS OF LARGE COMPRESSORS AT CE Pr [ESSAIS DE GRANDS COMPRESSEURS AU CENTRE D'ESSAIS DES PROPULSEURS]
Ph. Ramette and J. L. Freson (Service Technique de la Production Aeronautique, Paris) *In* AGARD Turbine Engine Testing Jan. 1981 8 p In FRENCH

Avail: NTIS HC A21/MF A01

The C3 test bench at CEPr permits testing large double flow compressors whose power can reach 40,000 kW. Methods used to obtain measurements on turning parts are described as well as probes for determining pressure, temperature, and vibration. Test techniques and the use of the computer to obtain the double flow compressor fields, particularly in proximity to the pump line are examined. Transl. by A.R.H.

N81-24097# Motoren- und Turbinen-Union Muenchen G.m.b.H. (West Germany).
FULL ANNULAR COMBUSTOR TEST FACILITY FOR HIGH PRESSURE/HIGH TEMPERATURE TESTING
G. Kirschey and R. Wagner (DFVLR, Cologne) *In* AGARD Turbine Engine Testing Jan. 1981 17 p refs

Avail: NTIS HC A21/MF A01

A combustor test facility is described which is capable of carrying out annular combustor research with up to 16 bar and 820 K combustor inlet conditions. The requirements for typical test procedures for high pressure/high temperature combustor testing are established and the layouts for the test installations and the test bed are specified. The testing and measuring techniques to achieve accurate high temperature measurement and gas analysis at the exit of the annular combustor are described in some detail. Results achieved by the testing show close similarity to those produced by engine testing. M.G.

N81-24098# Fiat Aviazione S.p.A., Turin (Italy).
LOW PRESSURE TURBINE TESTING
F. Rodi, M. Varetti, and R. Tomat *In* AGARD Turbine Engine Testing Jan. 1981 13 p refs

Avail: NTIS HC A21/MF A01

The engine performance simulation model, the basis of all engine work, is used for a reliable assessment of marketable performance for the prediction of the flight performance of the aircraft, for the interpretation of the engine malfunctioning and then for a correct evaluation of the engine growth potential. The accuracy of the engine model is a function of the quality of the performance characteristics used for each component. In accordance with this concept within a turbofan development program, a comprehensive investigation on the low pressure turbine was carried out in order to define the component performance with the best possible accuracy. Different kinds of tests are performed, from bidimensional, rotating cascades and a cold flow rig test to in engine component testing. The advantages and the intrinsic limits of each kind of test are discussed. Low pressure turbine theoretical prediction methods and a correlation between predictions and rig results are shown. Rig results are compared with the in engine ones measured with an appropriate instrumentation fitted on the engine. S.F.

N81-24099# Alfa Romeo S.p.A., Naples (Italy).
RIG INVESTIGATION OF A TWO STAGE SINGLE SHAFT LOW COST TURBINE
O. Natale, C. Sorrentino, and C. Massaro *In* AGARD Turbine Engine Testing Jan. 1981 15 p refs

Avail: NTIS HC A21/MF A01

The development program of a two stage, single shaft turbine is described. The program is based on tests performed in the single shaft two stage turbine configuration, the objective being the optimization of the off design performance, correct distribution of the first and second stage workload and harmonization of the nozzle throat areas. Tests were carried out or are planned to investigate the effect on the efficiency of the rotor tip clearance, Reynolds number effect and cooling flows. The analysis is compared with the predicted carpet of each stage individually and of the stages together. S.F.

N81-24100# Rolls-Royce Ltd., Derby (England). Mechanical Test Engineering Dept.
THE MECHANICAL TESTING OF COMPRESSORS AND TURBINES FOR AIRCRAFT GAS TURBINE ENGINES
D. Norris *In* AGARD Turbine Engine Testing Jan. 1981 12 p

Avail: NTIS HC A21/MF A01
Mechanical tests of major rotating components, whose failure is potentially catastrophic to an aircraft, are described in relation to proving and developing the mechanical strength of endurance of the piece. The principal tests, the techniques and some of the equipment which is employed for testing compressor and turbine components are described. The work relates to approximately ten different engine types, including the RB 211 family of engines, and to both civil and military applications. S.F.

N81-24101# Costruzioni Aeronautiche Giovanni Agusta S.p.A., Gallarate (Italy).
HELICOPTER TRANSMISSION QUALIFICATION PROCEDURES AND TESTS
A. Garavaglia and G. Gattinoni *In* AGARD Turbine Engine Testing Jan. 1981 10 p

Avail: NTIS HC A21/MF A01
The tests required to qualify helicopter transmission in conformity with the current civil and military requirements, the tests to be conducted for initial development and prequalification as the tests essential to guarantee a satisfactory maturity of the product being released for service are detailed. The features of each test technique and their significance under the various phases of the program are described. The use of ground test vehicles and intensive flight testing are pointed out with particular emphasis. S.F.

N81-24102# Naval Air Propulsion Test Center, Trenton, N.J.
HELICOPTER TRANSMISSION TESTING
Pasquale J. Mangione *In* AGARD Turbine Engine Testing Jan. 1981 34 p refs
Avail: NTIS HC A21/MF A01
Helicopter propulsion system evaluation testing is conducted on individual components in the early stages of development. The total propulsion system is not operationally tested until the components are installed in the first aircraft. As such, dynamic interface problems are not detected until this stage of the full scale development program which proves costly. To achieve more development/reliability testing and more meaningful qualification tests of the total system, the Naval Air Propulsion Center, under Naval Air Systems Command sponsorship, developed the only indoor facility in the United States capable of testing a rotorless helicopter propulsion system. The test facility is described and the rationale and capability of an integrated, dynamic test stand for total system testing is presented. S.F.

N81-24103# Societe Microturbo, Toulouse (France).
DEVELOPMENT TESTS OF AN ENGINE WITH LIMITED LIFE [ESSAIS DE DEVELOPMENT DE MOTEUR A DUREE DE VIE LIMITEE]
In AGARD Turbine Engine Testing Jan. 1981 7 p In FRENCH

Avail: NTIS HC A21/MF A01
A propulsion system with short engine life must have mass and surface thrust and a specific consumption while remaining simple in design to assure low production costs. To these qualities are added ease of integration into the airframe (increased coefficient of distortion of the air inlet, concentrated equipment, simple general shape) and a firm hold in the face of environmental influences. Development and production qualification tests are very different from those performed on piloted aircraft engines. The prinicipal tests conducted on the MICRO-TURBO TRI 60 turbojet engine during four programs for adapting the engine to pilotless vehicles are presented. Possible solutions to obtain low production cost are indicated. Transl. by A.R.H.

N81-24104# Aeronautical Systems Div., Wright-Patterson AFB, Ohio.
PREDICTION OF FUTURE TEST NEEDS, TEST FACILITIES AND PROCEDURES
Eric E. Abell *In* AGARD Turbine Engine Testing Jan. 1981 4 p
Avail: NTIS HC A21/MF A01
The requirements for future military turbine engine testing reflect a more reasonable balance between the types of validation necessary to provide satisfactory operational weapon systems. In the past a large emphasis was placed on aerodynamic and thermodynamic aspects of the engine. Durability and reliability tended to be assigned lesser priority. This situation led to problems and failures of engines in operational service. A re-examination was conducted by the USAF of the type and methods associated with qualification of military gas turbine engines. During this examination it became evident that re-emphasis on the durability aspects of the engine was necessary. S.F.

N81-24105# Politecnico di Milano (Italy).
DEVELOPMENT FOR NEW LABORATORIES FOR FUTURE TESTING
Corrado Casci *In* AGARD Turbine Engine Testing Jan. 1981 28 p refs
Avail: NTIS HC A21/MF A01
Three fundamental characteristics of aerospace systems are weight, volume, and power. Considering the use of the propeller (military or civil), two other economic factors are taken into consideration: the lowest possible obsoleteness for military use and the lowest cost of utilization for civil use. Themes of theoretical and experimental research are: (1) about the components relative to only the energetic system: subsonic and supersonic combustion processes; traditional and nontraditional combustibles; interaction between the mechanical and combustible system; with combustion in axial fluxes and deviated fluxes: spark ignition; initial combustion and relative phenomena; transitory of the combustion; the combustion regime; (2) of the fluid-dynamic system components: isolated blades of the compressor and turbine with a small rapport in subsonic and supersonic fluxes; elevated load blades in subsonic and supersonic fluxes; annular formation of the compressor and turbine; and (3) electronically servo-assisted automation during the transitory phase of any process. S.F.

N81-24106* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
VELOCITY VECTOR CONTROL SYSTEM AUGMENTED WITH DIRECT LIFT CONTROL Patent
Henry F. Tisdale, Sr. (Tisdale (Henry F., Sr.), Treasure Island, Fla.) and Wendell W. Kelly, inventors (to NASA) (Tisdale (Henry F., Sr), Treasure Island, Fla.) Issued 14 Apr. 1981 6 p Filed 28 Feb. 1979 Supersedes N79-20136 (17 - 11, p 1394) Sponsored by NASA
(NASA-Case-LAR-12268-1; US-Patent-4,261,537; US-Patent-Appl-SN-015996; US-Patent-Class-244-181; US-Patent-Class-244-195; US-Patent-Class-318-584; US-Patent-Class-364-434) Avail: US Patent and Trademark Office CSCL 01C
A pilot-controlled stability control system that employs direct lift control (spoiler control) with elevator control to control the flight path angle of an aircraft is described. A computer on the aircraft generates an elevator control signal and a spoiler control signal, using a pilot-controlled pitch control signal and pitch rate, vertical velocity, roll angle, groundspeed, engine pressure ratio and vertical acceleration signals which are generated on the aircraft. The direct lift control by the aircraft spoilers improves the response of the aircraft flight path angle and provides short term flight path stabilization against environmental disturbances.
Official Gazette of the U.S. Patent and Trademark Office

N81-24107# Council for Scientific and Industrial Research, Pretoria (South Africa).
THE STICK-FIXED LATERAL DYNAMIC STABILITY OF THE CSIR SARA II AUTOGYRO
R. A. Streather Jun. 1980 32 p refs
(NIAST-80/52) Avail: NTIS HC A03/MF A01

The analysis is based on that of the helicopter in autorotation. It is shown that the autogyro is stable in all three conventional modes of motion over the speed range from 15 to 45 m/s and for a center of gravity up to 0.3 m aft of the normal operating position. T.M.

N81-24108# Boeing Vertol Co., Philadelphia, Pa.
ADVANCED SCOUT HELICOPTER (ASH) FLY-BY-WIRE CONTROL SYSTEM PRELIMINARY DESIGN. VOLUME 1: SYSTEM DESIGN AND ANALYSIS Final Report, Mar. 1979 - Mar. 1980
Bruce L. McManus and Kenneth H. Landis Ft. Eustis, Va. Army Research and Technology Labs. Mar. 1981 153 p refs
(Contract DAAK51-79-C-0008; DA Proj. 1X4-64203-D-281)
(AD-A098155; D210-11560-1-Vol-1; USAAVRADCOM-TR-81-D-9A) Avail: NTIS HC A08/MF A01 CSCL 01/3

This preliminary design study was conducted to assess the payoffs in applying fly-by-wire and other advanced flight control concepts to the anticipated Advanced Scout Helicopter (ASH). The study compares the advanced concept systems with a dual mechanical flight control system in the following areas: handling qualities, reliability, maintainability, availability, durability, survivability, EMP/EMI/lightning tolerance, cost, and weight. The candidate vehicle for the study was the Medium Utility Transport (MUT) as defined in document USAAMRDL-TR-75-56A (gross weight 9,544 lb and useful payload 960 lb). The selected fly-by-optics and fly-by-wire candidates employ triplex in-line monitoring for primary controls and triplex cross-channel monitoring for augmentation functions. Both use of a two-axis sidearm force controller with separate collective pitch controls and directional pedals. Processing is digital, using 16-bit microprocessors. A multiprocessor approach is defined to provide hardware separation of the flight-critical primary control functions from noncritical automatic control functions. Rotor control actuators are of an integrated design having triplex electrical control elements with a dual hydromechanical output stage. Both candidates were found to be superior to the dual mechanical system in most respects. The fly-by-optics has a further advantage over the fly-by-wire in EMP/EMI/lighting tolerance, maintainability, and availability. Production acquisition and operation/maintenance costs are similar for all candidates. Further development of fiber optic transducers and interfacing hardware is required to reduce risk for the fly-by-optics candidate. GRA

N81-24109# Bristol Univ. (England). Dept. of Aeronautical Engineering.
PITCH-FLAP-PHASE COUPLING. A PRELIMINARY ANALYSIS OF AN EVOLVING CONCEPT OF HELICOPTER AUTOSTABILIZATION B.S. Thesis
S. M. Bourne and W. Y. F. Chan Jun. 1980 90 p refs
(BU-242) Avail: NTIS HC A05/MF A01

A six degree of freedom model of helicopter dynamics is presented based on Newtonian mechanics, with the acceptance of quasi-steady rotor forces and moments referred to the flight state invariant shaft axis reference system. Use of the classical small disturbance theory allows linearization, while partial differentiation furnishes all rotor forces, moments and state derivatives. The modification of rotor state derivatives with introduction of pitch-flap-phase coupling is presented. Modal analysis is effected primarily longitudinally, based on a weakly coupled systems hypothesis necessitated by low directional stability attributable to tail rotor omission. Overall asymptotic longitudinal stability of the system is achieved, subject to a future rotor stability analysis, a precondition being the reversal of the natural rotor derivatives by use of sufficient negative pitch-flap coupling. Phase lag/lead of 170-190 deg and -0.5 coupling gain infers maximum positive damping, typically 20 sec to half amplitude in the most weakly damped mode, ensuring at the same time the maintenance of the control derivatives at the desired unity level. Author (ESA)

N81-24110# Societe Nationale Industrielle Aerospatiale, Toulouse (France).
TOTAL ENERGY AND FLIGHT CONTROL [ENERGIE TOTALE ET CONDUITE DU VOL]
B. Jacquot Paris 11 Apr. 1980 17 p In FRENCH Presented at ENAC Seminaire Evolution des Systemes de Bord, Toulouse, 24-28 Mar. 1980
(SNIAS-802-111-102; AERO-454.017/80) Avail: NTIS HC A02/MF A01

Application of the concept of total energy in maintaining a trajectory, constant airspeed, or both, is modeled in vector form. Total energy is defined as the relationship between aircraft mass, velocity, and the acceleration of gravity in function of aircraft altitude. Achieving constant airspeed, whether independently or as an interaction of trajectory and velocity, is considered. Manual piloting, automatic piloting, and a combined manual/automatic system in the presence of variable wind (wind gradients problem) are treated. Results point to the advantages of having total energy feedback through cockpit instrumentation. Author (ESA)

N81-24111*# Embry-Riddle Aeronautical Univ., Daytona Beach, Fla. Aviation Research Center.
A PILOT TRAINING MANUAL FOR THE TERMINAL CONFIGURED VEHICLE ELECTRONIC ATTITUDE DIRECTOR INDICATOR
Jules Gandelman Jan. 1980 92 p refs
(Contract NAS1-15724)
(NASA-CR-159195) Avail: NTIS HC A05/MF A01 CSCL 14B

A hard copy version is presented of a 28-minute, 90 slide audiovisual program which provides the basic instructional format for introduction to the terminal configured vehicle electronic attitude director indicator (EADI) and the strategy for learning the symbols used on the EADI and their interpretation. The basic strategy is to start with known symbols and then introduce all new symbols with emphasis appropriate to their complexity and frequency of use. The upper half of each page of the manual contains a reproduction of the slide. The text associated with the slide is found on the lower half of each page and is recorded on audio tape. A.R.H.

N81-24112*# Systems and Applied Sciences Corp., Hampton, Va.
AN EXPERIMENTAL INVESTIGATION OF A LARGE DELTA P SETTLING CHAMBER FOR A SUPERSONIC PILOT QUIET TUNNEL Final Report
Michael Piatt Washington NASA Jun. 1981 81 p refs
(Contract NAS1-16096)
(NASA-CR-3436; R-SAL-03/81-03) Avail: NTIS HC A05/MF A01 CSCL 14B

The mean streamwise flow distributions and turbulence levels across the chamber were measured with a hot wire anemometer downstream of a series of porous Rigimesh plates which were shown to be an effective means of reducing the chamber acoustic disturbance levels due to upstream pipe and valve systems. Tests made with various types of flow conditioners downstream of the porous plates showed that a series of screens was the most effective means of achieving the objective of a uniform mean flow distribution with reduced vorticity levels downstream of the porous components. Frequency spectra obtained across the series of screens show that they reduce vorticity over a wide frequency range for several different initial upstream vorticity conditions. Improvements in the mechanical installation of the porous plates and damping screens and the use of porous plates with more uniform porosity should reduce the freestream velocity fluctuations to the minimum acoustic levels of about 0.5 percent. T.M.

N81-24114*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
EVALUATION OF TURBULENCE REDUCTION DEVICES FOR THE LANGLEY 8-FOOT TRANSONIC PRESSURE TUNNEL
Marion O. McKinney and James Scheiman Jun. 1981 33 p refs

(NASA-TM-81792; L-14108) Avail: NTIS HC A03/MF A01 CSCL 14B

The device test model consisted of a cooler, turning vanes, and settling chamber (immediately upstream of the contraction) in which various combinations of screens and honeycomb were tested. Conventional hot wires were used to measure the axial and lateral turbulence reduction for the different turbulence reduction devices. The final configuration chosen consisted of a honeycomb followed by five screens. T.M.

N81-24115*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

ESTIMATION OF FAN PRESSURE RATIO REQUIREMENTS AND OPERATING PERFORMANCE FOR THE NATIONAL TRANSONIC FACILITY

Blair B. Gloss and Donna Nystrom May 1981 34 p refs

(NASA-TM-81802; L-14344) Avail: NTIS HC A03/MF A01 CSCL 14B

The National Transonic Facility (NTF), a fan-driven, transonic, pressurized, cryogenic wind tunnel, will operate over the Mach number range of 0.10 to 1.20 with stagnation pressures varying from 1.00 to about 8.8 atm and stagnation temperatures varying from 77 to 340 K. The NTF is cooled to cryogenic temperatures by the injection of liquid nitrogen into the tunnel stream with gaseous nitrogen as the test gas. The NTF can also operate at ambient temperatures using a conventional chilled water heat exchanger with air on nitrogen as the test gas. The methods used in estimating the fan pressure ratio requirements are described. The estimated NTF operating envelopes at Mach numbers from 0.10 to 1.20 are presented. T.M.

N81-24116# Council for Scientific and Industrial Research, Pretoria (South Africa).

PRELIMINARY CALIBRATION OF THE TRANSONIC TEST SECTION OF THE NIAST TRISONIC TUNNEL

R. A. Streather Feb. 1981 31 p refs

(NIAST-80/19) Avail: NTIS HC A03/MF A01

Wall and center line static pressure measurements show reasonable agreement with earlier calibrations of the perforated transonic test section of the trisonic blowdown tunnel. Longitudinal Mach number distributions are found to be acceptable having a variation of + or - 0.0025 subsonically and + or - 0.005 supersonically over the test section length. Control of a Mach scan in the transonic range Mach 0.8 to 1.2 is found to be most easily achieved by variation of the settling chamber stagnation pressure at fixed second throat setting and auxiliary suction compressor by pass valve opening. Transonic drag measurements made in the perforated test section on an ogive cylinder body show discrepancies with measurements made in the closed test section and with empirical results. An explanation of these discrepancies was not found and further calibration of the transonic test section is recommended. Author

N81-24118# Federal Aviation Administration, Washington, D.C. Systems Research and Development Service.

HIGH SPEED EXIT TAXIWAYS Final Report

Feb. 1981 48 p refs

(AD-A098178; FAA-RD-81-16; ARD-500) Avail: NTIS HC A03/MF A01 CSCL 01/5

The 'high speed' runway exit, also known as angled exit, is an airport/airside design feature which can make an important contribution to increasing capacity of the national air transportation system. The present standard angle exit offers a safe and clear reduction in landing time on the runway. However, except in a very few instances, this potential is not realized. Low utilization of high speed exits, although not conclusively shown, appears to be the results of operational use only where and when need exists to expedite runway clearance. Underutilization also appears to be motivated by desire to avoid any unnecessary risk or passenger discomfort. Realization of the capacity improvement potential of high speed exits is controlled by the character of the approach control system and the operating procedures currently used by pilots and controllers. Both the average and scatter of current interarrival intervals are sufficiently large to prevent any further benefits from reduced runway time. Author (GRA)

N81-24119# Oxford Univ. (England). Dept. of Engineering Science.

A DISCUSSION DOCUMENT ON THE THERMAL DESIGN OF FORCE BALANCES FOR CRYOGENIC WIND TUNNELS

W. B. Bald Mar. 1980 41 p refs

(Contract AT/2057/072/XR/AERO)

(OUEL-1321/80) Avail: NTIS HC A03/MF A01

The design performance, and theory of unheated and heated balances are reviewed. As extensive strain gage calibration is necessary for unheated balances, they are not considered as favorable as heated ones. Five heaters are utilized in the heated balance arrangement proposed. Their role is to compensate for conductive losses and to prevent and minimize convective losses. Finite element techniques are employed, details being given about the appropriate computer packages. The results of preliminary temperature measurements made on a TEM 1004/101 half balance are given, the outputs from the thermocouples used being fed via simple conditioning amplifiers into a U.V. recorder. The results indicate that further work is necessary to optimize design and performance. Author (ESA)

N81-24120# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).

WIND TUNNEL CORRECTIONS FOR HIGH ANGLE OF ATTACK MODELS

R. O. Dietz, ed. and M. L. Laster, ed. Feb. 1981 120 p refs In ENGLISH and FRENCH

(AGARD-R-692; ISBN-92-835-0283-3) Avail: NTIS HC A06/MF A01

Several wind tunnel wall correction methods in use or under study are presented for closed, open, and ventilated wall wind tunnels. The Mach number range is generally limited up to high subsonic speeds with some techniques only useful for incompressible flow. Wall correction techniques discussed along with their attributes and disadvantages include vortex lattice, panel, system of images, wall pressure, and adaptive walls. The adaptive wall technique is a method to actively reduce or eliminate the need for wall correction and is becoming more favorable as development problems are solved.

N81-24121# National Aeronautical Establishment, Ottawa (Ontario).

CANADIAN STUDIES OF WIND TUNNEL CORRECTIONS FOR HIGH ANGLE OF ATTACK MODELS

M. Mokry *In* AGARD Wind Tunnel Corrections for High Angle of Attack Models Feb. 1981 11 p refs (For primary document see N81-24120 15-09)

Avail: NTIS HC A06/MF A01

Wind tunnel interference studies relating to testing of high angle of attack models carried out in Canada during the last decade are briefly reviewed. A test section was developed which produces adequately low corrections to test data for a wide range of sizes, shapes, and angles of attack of test airfoil. E.D.K.

N81-24122*# Lockheed-Georgia Co., Marietta.

A REVIEW OF THE WALL PRESSURE SIGNATURE AND OTHER TUNNEL CONSTRAINT CORRECTION METHODS FOR HIGH ANGLE-OF-ATTACK TESTS

J. E. Hackett, D. J. Wilsden, and W. A. Stevens *In* AGARD Wind Tunnel Corrections for High Angle of Attack Models Feb. 1981 16 p refs

(Contract NAS2-9883)

Avail: NTIS HC A06/MF A01 CSCL 14B

Recent developments concerning correction techniques for high angle of attack testing are reviewed and the results are presented of a letter survey on the methods now in use. The application of the wall pressure signature technique is demonstrated in experiments on several types of models. The method is shown to provide good estimates of tunnel blockage effects and extension to lift interference is discussed. It appears that correctability is limited more by the problem of determining the effects of tunnel induced velocity gradients than by ability to determine the flow field. It is suggested that passive boundary measurement technology diffuses first into high angle of attack production testing, possibly followed by partially adaptive tunnel techniques. E.D.K.

N81-24123# *Office National d'Etudes et de Recherches* Aerospatiales, Paris (France).
EXPECTED IMPROVEMENTS ON HIGH ANGLE OF ATTACK MODEL TESTING
Xavier Vaucheret *In* AGARD Wind Tunnel Corrections for High Angle of Attack Models Feb. 1981 22 p refs In FRENCH; ENGLISH summary

Avail: NTIS HC A06/MF A01
Problems encountered during tests at high angle of attack in wind tunnels are: wall interference, sting interference, and vibrations beyond the stall. The state of the art on wall interference systematically applied to the development tests is shown with several comparisons between wind tunnels or between flight and tunnels tests. The models used in unconfined flow point out some deficiencies as regards apex vortex and active jets. The control of the validity of the wall interference correction method is analyzed. E.D.K.

N81-24124# Aerodynamische Versuchsanstalt, Goettingen (West Germany).
GERMAN ACTIVITIES ON WIND TUNNEL CORRECTIONS
H. Holst *In* AGARD Wind Tunnel Corrections for High Angle of Attack Models Feb. 1981 23 p refs

Avail: NTIS HC A06/MF A01
Wind tunnel interference factors were calculated for open, closed, slotted, and perforated walls using the vortex lattice method with a homogeneous boundary condition. A more realistic pitching moment correction is obtained when the lift dependent relocation of the trailing vortices is taken into account. The inhomogeneities of lift and blockade interference parameters throughout the test section were investigated for models large in comparison to the test section dimensions. A method was developed using measured wall pressures for the correction of drag in transonic wind tunnels. For closed test sections, the image method and a modified vortex lattice method were used to evaluate wall pressure signals for correction purposes. E.D.K.

N81-24125# National Aerospace Lab., Amsterdam (Netherlands).
A REVIEW OF RESEARCH AT NLR ON WIND-TUNNEL CORRECTIONS FOR HIGH ANGLE OF ATTACK MODELS
R. A. Maarsingh *In* AGARD Wind Tunnel Corrections for High Angle of Attack Models Feb. 1981 11 p refs

Avail: NTIS HC A06/MF A01
A survey is given of past, current, and planned work at NLR in the field of wind tunnel wall interference on models at high angles of attack at low subsonic speeds. Among long term research activities those concerning slotted wall test sections play a dominant part. It is felt that an approach which makes use of measured distributions of flow quantities near the walls is the most promising one. It may be recommended also as a short term solution for some special wall correction problems arising from modern low speed wind tunnel testing in closed test sections. E.D.K.

N81-24126# Aeronautical Research Inst. of Sweden, Bromma.
A REVIEW OF SOME INVESTIGATIONS ON WIND TUNNEL WALL INTERFERENCE CARRIED OUT IN SWEDEN IN RECENT YEARS
S-E. Nyberg *In* AGARD Wind Tunnel Corrections for High Angle of Attack Models Feb. 1981 19 p refs

Avail: NTIS HC A06/MF A01
For subsonic incompressible flow the mutual circulation induced model wind tunnel interference was calculated by panel methods for large multicomponent two dimensional airfoils, for three dimensional swept wings, full or half models, and for wing-tail configurations. Wake blockage effects from a swept wing with and without high lift devices were studied experimentally. The effects of air flow leakage between half model fuselage and reflection wall were investigated. For transonic flow the flow properties of slotted walls and the influence of wall boundary layer were studied. Based on these results a numerical method was developed and so far axisymmetric calculations were carried out. The results were compared with experimental results for large blockage models. E.D.K.

N81-24127# Queen Mary Coll., London (England).
WIND TUNNEL CORRECTIONS FOR HIGH ANGLES OF ATTACK: A BRIEF REVIEW OF RECENT UK WORK
A. D. Young *In* AGARD Wind Tunnel Corrections for High Angle of Attack Models Feb. 1981 11 p refs

Avail: NTIS HC A06/MF A01
The use of adaptive walls, a panel method of model and wake representation for a two dimensional model in a wind tunnel with solid walls, the use of measured pressure distributions on tunnel floor and roof also for a two dimensional model and solid walls, a vortex lattice representation of the tunnel walls to take account of wake curvature, interference limitations on tests on V/STOL models with lifting jets, and work on blockage corrections on models with reverse thrust are discussed. Some discussion is offered on the limitations on the validity of current methods for determining wind tunnel corrections and it is argued that these limitations are least severe with the use of adaptive walls. E.D.K.

N81-24187# Army Engineer Waterways Experiment Station, Vicksburg, Miss. Structures Lab.
POROUS PORTLAND CEMENT CONCRETE: THE STATE OF THE ART Final Report, Jan. - Jul. 1980
Alfred Monahan Jan. 1981 34 p refs
(Contract DOT-FA79WAI-131)
(AD-A098177; FAA-RD-80-110) Avail: NTIS HC A03/MF A01 CSCL 11/2
This study investigates the current state of the art relating to the production and use of those porous portland cement concretes that may be suitable for the construction of porous portland cement friction courses. Porous concretes produced by gap grading or elimination of the fine aggregate fraction were found to have been used in both pavement and nonpavement applications with varied degrees of success. Nonpavement applications discussed include: porous draintiles and drains, porous concrete floors in greenhouses, and a porous concrete blanket placed on an earthfill dam. Pavement applications discussed include: a no-fines pavement layer, porous portland cement concrete pavements, and porous pavement edge drains or porous hard shoulders. Evidence as to the suitability of porous portland cement concretes for the construction of porous portland cement friction courses is inconclusive. The successful use of porous concretes in other pavement applications does, however, suggest that porous concretes may be useful in the construction of friction courses. Author (GRA)

N81-24213# Prins Maurits Lab. TNO, Rijswijk (Netherlands).
MINIMUM IGNITION ENERGY OF F40 AIRCRAFT FUEL/AIR MIXTURES [MINIMALE ONTSTEEKENERGIE VAN EEN VLIEGTUIG-BRANDSTOF F40-LUCHTMENGSEL]
J. vantHoff Aug. 1978 13 p ref In DUTCH
(PML-1978-22) Avail: NTIS HC A02/MF A01
Fuel/air mixtures were ignited in a chamber at 20 C to determine the necessity for using spark free tools during aircraft refuelling. The most readily ignited concentration was 1.15 l/cum. At an electrode distance of 1.7 mm the ignition energy was found to lie between 3.4 mJ and 3.7 mJ. The composition of F40 fuel is shown to differ from sample to sample.
Author (ESA)

N81-24283*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF HYDROPROCESSING SEVERITY ON CHARACTERISTICS OF JET FUEL FROM OSCO 2 AND PARAHO DISTILLATES
George M. Prok, Francisco J. Flores, and Gary T. Seng Jun. 1981 20 p refs
(NASA-TP-1768; E-617) Avail: NTIS HC A02/MF A01 CSCL 21D
Jet A boiling range fuels and broad-property research fuels were produced by hydroprocessing shale oil distillates, and their

properties were measured to characterize the fuels. The distillates were the fraction of whole shale oil boiling below 343 C from TOSCO 2 and Paraho syncrudes. The TOSCO 2 was hydroprocessed at medium severity, and the Paraho was hydroprocessed at high, medium, and low severities. Fuels meeting Jet A requirements except for the freezing point were produced from the medium severity TOSCO 2 and the high severity Paraho. Target properties of a broad property research fuel were met by the medium severity TOSCO 2 and the high severity Paraho except for the freezing point and a high hydrogen content. Medium and low severity Paraho jet fuels did not meet thermal stability and freezing point requirements. E.D.K.

N81-24284# Virginia Polytechnic Inst. and State Univ., Blacksburg.
THE 1H AND 13C FOURIER TRANSFORM NMR CHARACTERIZATION OF JET FUELS DERIVED FROM ALTERNATE ENERGY SOURCES Six Month Progress Report, Apr. - Sep. 1980
H. C. Dorn 1980 41 p refs
(AD-A098305) Avail: NTIS HC A03/MF A01 CSCL 20/4

This report discusses LC-superscript 1H NMR studies from semi-preparative to analytical column size in order to establish ultimate chromatographic resolution conditions. It explores quantitative approaches for LC-superscript 1H NMR including a dual effluent stream to allow introduction of a quantitative reference before the superscript 1H NMR detector. It explores quantitative and ultimate sensitivity limits for the present superscript 1H NMR LC detector including optimization of superscript 1H NMR insert for LC-superscript 1H NMR. The report provides LC-superscript 1H NMR data profiles for 10 synthetic mixtures and corresponding analytical data (e.g., total %H, %H, aromatic, %H aliphatic, %n-alkanes and branched alkanes, % alkyl aromatics and substituted naphthalenes). LC-superscript 1H NMR data profiles for 30 middle distillate fuels and corresponding analytical data is provided. This report provides static superscript 1H NMR and superscript 13C NMR quantitative data for 45 middle distillate fuels. At least six of these samples will be diesel fuel marine. It also provides static superscript 1H NMR and superscript 13C NMR quantitative data for 20 synthetic mixtures of hydrocarbons. GRA

N81-24321*# Old Dominion Univ., Norfolk, Va. Dept. of Electrical Engineering.
AIRBORNE ANTENNA PATTERN CALCULATIONS Progress Report, 1 Nov. 1980 - 30 Apr. 1981
Timothy J. Knerr and Roland R. Mielke May 1981 17 p refs
(Grant NsG-1655)
(NASA-CR-164350) Avail: NTIS HC A02/MF A01 CSCL 20N

Progress on the development of modeling software, testing software against caclulated data from program VPAP and measured patterns, and calculating roll plane patterns for general aviation aircraft is reported. Major objectives are the continued development of computer software for aircraft modeling and use of this software and program OSUVOL to calculate principal plane and volumetric radiation patterns. The determination of proper placement of antennas on aircraft to meet the requirements of the Microwave Landing System is discussed. An overview of the performed work, and an example of a roll plane model for the Piper PA-31T Cheyenne aircraft and the resulting calculated roll plane radiation pattern are included. E.A.K.

N81-24360# Norden Systems, Inc., Norwalk, Conn.
HIGH CONTRAST CRT MODULE Research and Development Technical Report, 1 Oct. 1979 - 31 Mar. 1980
Michael Kalmanash Feb. 1981 39 p refs
(Contract DAAK20-79-C-0290; DA Proj. 1L2-6374-DF-32)
(AD-A097727; Rept-1310-R-0020; DELET-TR-79-0290-1) Avail: NTIS HC A03/MF A01 CSCL 17/2

The objective of this program is the development of a miniature high contrast color CRT module compatible with the AN/APR-39 system, except for an increase in overall length compared to the monochrome AN/APR-39 display indicator. The initial interim period of this program has resulted in the development of an initial breadboard system, and the completion of packaging feasibility and initial design for the Advanced Development Model. GRA

N81-24389*# National Aeronautics and Space Administration, Washington, D. C.
AIRCRAFT ENERGY EFFICIENCY PROGRAM: LAMINAR FLOW CONTROL TECHNOLOGY
1979 8 p
(NASA-TM-82352; NF-86/8-79) Avail: SOD HC CSCL 20D

Laminar flow control system design is analyzed with emphasis on surface and structural concepts, wing structures, leading edge contamination and suction unit configurations. S.F.

N81-24443* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
TIRE/WHEEL CONCEPT Patent
Philip M. Harper, Sr., inventor (to NASA) (Boeing Commercial Airplane Co., Seattle) Issued 19 May 1981 6 p Filed 12 Dec. 1979 Continuation of abandoned US Patent Appl. SN-893865, filed 16 Apr. 1978 Sponsored by NASA
(NASA-Case-LAR-11695-2; US-Patent-4,267,992; US-Patent-Appl-SN-103836; US-Patent-Class-244-103R; US-Patent-Class-152-330RF; US-Patent-Class-152-353R; US-Patent-Class-152-353G; US-Patent-Class-152-379.4; US-Patent-Class-244-130; US-Patent-Appl-SN-893865) Avail: US Patent and Trademark Office CSCL 13F

A tire and wheel assembly is disclosed in which a low profile pneumatic tire (having sidewalls which deflect inwardly under load) and a wheel (having a rim featuring a narrow central channel and extended rim flanges) form the combination. The extended rim flanges support the tire sidewalls under static and dynamic loading conditions to produce a combination particularly suited to aircraft applications.
Official Gazette of the U.S. Patent and Trademark Office

N81-24471*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
STATIC AND YAWED-ROLLING MECHANICAL PROPERTIES OF TWO TYPE 7 AIRCRAFT TIRES
John A. Tanner, Sandy M. Stubbs, and John L. McCarty May 1981 80 p refs
(NASA-TP-1863; L-14125) Avail: NTIS HC A05/MF A01 CSCL 20K

Selected mechanical properties of 18 x 5.5 and 49 x 17 size, type 7 aircraft tires were evaluated. The tires were subjected to pure vertical loads and to combined vertical and lateral loads under both static and rolling conditions. Parameters for the static tests consisted of tire load in the vertical and lateral directions, and parameters for the rolling tests included tire vertical load, yaw angle, and ground speed. Effects of each of these parameters on the measured tire characteristics are discussed and, where possible, compared with previous work. Results indicate that dynamic tire properties under investigation were generally insensitive to speed variations and therefore tend to support the conclusion that many tire dynamic characteristics can be obtained from static and low speed rolling tests. Furthermore, many of the tire mechanical properties are in good agreement with empirical predictions based on earlier research. R.C.T.

N81-24482# Societe Nationale Industrielle Aerospatiale, Toulouse (France).
THEORETICAL AND EXPERIMENTAL STUDIES OF CRACK PROPAGATION
J. M. Thomas Paris 1980 16 p refs In FRENCH Presented at ICAS Conf., Munich, 13-17 Oct. 1980
(SNIAS-802-111-107; ICAS-80-19.1) Avail: NTIS HC A02/MF A01

The correlation between theoretical and experimental results from the study of crack propagation in aircraft structures is discussed. The experimental identification of stress intensity factors and the measurement of crack propagation rate are described. The mathematical implications of the influence of stress ratio, the effects of overloading, and of complex spectra are brought out. The utility of these data in aeronautical engineering as well as design application aspects are shown. Statistical and probabilistic treatment are also mentioned. Author (ESA)

N81-24602*# Virginia Polytechnic Inst. and State Univ., Blacksburg.
CONTINUED RESEARCH ON SELECTED PARAMETERS TO MINIMIZE COMMUNITY ANNOYANCE FROM AIRPLANE NOISE Second Year Report, Apr. 1980 - Mar. 1981
Les Frair Mar. 1981 79 p refs
(Grant NsG-1958)
(NASA-CR-164299) Avail: NTIS HC A05/MF A01 CSCL 13B

Results from continued research on selected parameters to minimize community annoyance from airport noise are reported. First, a review of the initial work on this problem is presented. Then the research focus is expanded by considering multiobjective optimization approaches for this problem. A multiobjective optimization algorithm review from the open literature is presented. This is followed by the multiobjective mathematical formulation for the problem of interest. A discussion of the appropriate solution algorithm for the multiobjective formulation is conducted. Alternate formulations and associated solution algorithms are discussed and evaluated for this airport noise problem. Selected solution algorithms that have been implemented are then used to produce computational results for example airports. These computations involved finding the optimal operating scenario for a moderate size airport and a series of sensitivity analyses for a smaller example airport. Author

N81-24679*# Tennessee Univ. Space Inst., Tullahoma. Atmospheric Science Div.
AIRPLANE WING VIBRATIONS DUE TO ATMOSPHERIC TURBULENCE Interim Report
Robert L. Pastel, John E. Caruthers, and Walter Frost Washington NASA Jun. 1981 84 p refs
(Contract NAS8-32692)
(NASA-CR-3431) Avail: NTIS HC A05/MF A01 CSCL 04B

The magnitude of error introduced due to wing vibration when measuring atmospheric turbulence with a wind probe mounted at the wing tip was studied. It was also determined whether accelerometers mounted on the wing tip are needed to correct this error. A spectrum analysis approach is used to determine the error. Estimates of the B-57 wing characteristics are used to simulate the airplane wing, and von Karman's cross spectrum function is used to simulate atmospheric turbulence. It was found that wing vibration introduces large error in measured spectra of turbulence in the frequency's range close to the natural frequencies of the wing. E.A.K.

N81-24846# Noah (J. Watson) Associates, Inc., Falls Church, Va.
A SLOT ALLOCATION MODEL FOR HIGH-DENSITY AIRPORTS Final Report
C. F. Day and J. M. White Aug. 1980 194 p refs
(Contract DOT-FA79WA-4334)
(AD-A098097; FAA-APO-80-13) Avail: NTIS HC A09/MF A01 CSCL 01/5

The slot allocation model discussed in this report is formulated as a linear programming model and tailored to operations at Washington National Airport. The model is designed to accept as input the slate of slot requests presented to the Airline Scheduling Committee for the airport. The model allocates slots among users by maximizing industry profits (the sum of profits for all airlines operating at the airport) subject to constraints on runway capacity, equity, public service and noise pollution. Two versions of the model were formulated and tested. The first leads to an allocation of slots by airline, by hour of the day, but gives no information on markets served. Some representation of markets served is desirable, particularly to judge the impact of allocation on short versus long haul service. A second version of the model was, therefore, formulated which leads to a daily allocation by airline and by market (short, medium, and long haul), but not by hour or the day. Hourly allocations can be obtained by using the daily allocations generated by the second version of the model as a constraint in the first or hourly version. Both existing and proposed operating regulations for the airport were examined and alternative objective functions (maximizing passengers carried and maximizing passenger-miles generated) were tested. Author (GRA)

N81-24855*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AIRPORT NOISE IMPACT REDUCTION THROUGH OPERATIONS
Richard DeLoach May 1981 25 p refs Presented at Aircraft Safety and Operating Problems Conf., Hampton, Va., 5-7 Nov. 1980 Submitted for publication
(NASA-TM-81970) Avail: NTIS HC A02/MF A01 CSCL 20A

The airport-noise levels and annoyance model (ALAMO) developed at NASA Langley Research Center is comprised of a system of computer programs which is capable of quantifying airport community noise impact in terms of noise level, population distribution, and human subjective response to noise. The ALAMO can be used to compare the noise impact of an airport's current operating scenario with the noise impact which would result from some proposed change in airport operations. The relative effectiveness of number of noise-impact reduction alternatives is assessed for a major midwest airport. Significant reductions in noise impact are predicted for certain noise abatement strategies while others are shown to result in relatively little noise relief. A.R.H.

N81-24856*# Oklahoma State Univ., Stillwater. School of Mechanical and Aerospace Engineering.
DIAGNOSTIC EXPERIMENTS ON SUPERSONIC JET NOISE Final Report
Dennis K. McLaughlin 30 Apr. 1981 58 p refs
(Grant NAG1-10)
(NASA-CR-164348) Avail: NTIS HC A04/MF A01 CSCL 20A

Experiments and computations on the flowfield and radiated noise of supersonic model jets are discussed. The shock associated noise produced by large scale instabilities in underexpanded supersonic jets, the nonlinear propagation distortion phenomenon in the noise radiated by supersonic model jets, and computations of instability evolution and radiated noise using the LSNOIS computer code are addressed. M.G.

N81-24857*# Kansas Univ., Lawrence. Flight Research Lab.
STUDY OF NOISE REDUCTION CHARACTERISTICS OF MULTILAYERED PANELS AND DUAL PANE WINDOWS WITH HELMHOLTZ RESONATORS
Ramasamy Navaneethan May 1981 176 p refs
(Contract NCC1-6)
(NASA-CR-164370; KU-FRL-417-16) Avail: NTIS HC A09/MF A01 CSCL 20A

The experimental noise attenuation characteristics of flat, general aviation type, multilayered panels are discussed. Experimental results of stiffened panels, damping tape, honeycomb materials and sound absorption materials are presented. Single degree of freedom theoretical models were developed for sandwich type panels with both shear resistant and non-shear resistant core material. The concept of Helmholtz resonators used in conjunction with dual panel windows in increasing the noise reduction around a small range of frequency was tested. It is concluded that the stiffening of the panels either by stiffeners or by sandwich construction increases the low frequency noise reduction. E.A.K.

N81-24862# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
TEMPORAL INTEGRATION IN LOW FREQUENCY AUDITORY DETECTION Final Report
Richard Horonjeff, Sanford Fidell, Sherri Teffeteller, and David M. Green Fort Eustis, Va. Army Research and Technology Lab. Mar. 1981 67 p refs
(Contract DAAK51-80-C-0008; DA Proj. 1L1-62209-AH-76)
(AD-A098161; BBN-4435; USAAVRADCOM-TR-81-D-8) Avail: NTIS HC A04/MF A01 CSCL 17/1

This report describes research undertaken to determine whether the Applied Technology Laboratory's existing procedures for predicting detection ranges of helicopters require revision to account for any potential differences in the time period over which people integrate signal energy at different frequencies. Findings disclosed that over the frequency range of 40 to 1000 Hz the integration time of the human auditory system was essentially invariant at approximately 240 milliseconds. Although no change to the ATL detection range program was required, incorporation of temporal effects was recommended to improve the generality of the program. GRA

N81-25041*# Kansas Univ., Lawrence. Flight Research Lab.
ICING TUNNEL TESTS OF A GLYCOL-EXUDING POROUS LEADING EDGE ICE PROTECTION SYSTEM ON A GENERAL AVIATION AIRFOIL
David L. Kohlman, William G. Schweikhard, Alan E. Albright, and Peggy Evanich May 1981 37 p refs
(Grant NAG3-71)
(NASA-CR-164377; KU-FRL-464-1) Avail: NTIS HC A03/MF A01 CSCL 01A

A glycol-exuding porous leading edge ice protection system was tested. Results show that the system is very effective in preventing ice accretion (anti-ice mode) or removing ice from an airfoil. Minimum glycol flow rates required for anti-icing are a function of velocity, liquid water content in the air, ambient temperature, and droplet size. Large ice caps were removed in only a few minutes using anti-ice flow rates. It was found that the shed time is a function of the type of ice, size of the ice cap, angle of attack, and glycol flow rate. Wake survey measurements show that there is no significant drag penalty for the installation or operation of the system tested. E.A.K.

N81-25043# Hughes Helicopters, Culver City, Calif.
WIND TUNNEL TESTS OF LARGE- AND SMALL-SCALE ROTOR HUBS AND PYLONS Final Report, Sep. 1977 - Apr. 1980
A. H. Logan, R. W. Prouty, and D. R. Clark (Analytical Methods, Inc.) Apr. 1981 136 p refs
(Contract DAAJ02-77-C-0055; DA Proj. 1L2-62209-AH-76)
(AD-A098510; HH-80-15; USAAVRADCOM-TR-80-D-21) Avail: NTIS HC A07/MF A01 CSCL 20/4

The Army YAH-64 and UH-60A helicopters were studied to determine optimum wind tunnel test procedures and to expand the experimental data base on drag reduction for rotor hubs and pylons. Full- and reduced-scale models of these helicopters were fabricated. The Hub Pylon Evaluation Rig (HPER) and the Generalized Rotor Modeling System (GRMS) were used for the experimental testing, conducted in the NASA/Langley V/STOL wind tunnel. Only the YAH-64 models underwent wind tunnel testing during this contracted effort. Plans are under way for testing of the UH-60A models. All configurations were subjected to viscous analysis using Program DRAG, a configuration modeling program. This effort included evaluation of hub fairings, pylon fences, rotor wake flow, hub rotation, engine air flow, fuselage parasite drag, empennage flow, and stabilators. The DRAG program was validated by correlation of predicted and experimentally obtained surface pressures. GRA

N81-25044# ARO, Inc., Arnold Air Force Station, Tenn.
INVESTIGATIONS OF FREE-JET TEST REQUIREMENTS AND TECHNIQUES WITH EMPHASIS ON THE ADAPTABLE JET STRETCHER Final Report, 1 Oct. 1978 - 30 Sep. 1980
R. J. Matz and E. M. Kraft Apr. 1981 76 p refs
(AD-A098710; AEDC-TR-80-35) Avail: NTIS HC A05/MF A01 CSCL 20/4

Preliminary investigations of approaches that will permit relatively large air-breathing engine/inlet/forebody systems to be tested in free-jet test facilities were accomplished. Bodies immersed in a supersonic free jet experience unacceptable flow distortions as a result of (1) bow shock reflections from the constant pressure free-jet boundary and (2) waves emanatins from the nozzle lip because of exit plume static pressure mismatch. The adaptable jet stretcher can potentially eliminate these disturbances over a range of test conditions. A rigorous mathematical proof of a jet stretcher convergence to the desired interference-free geometry was developed for supersonic flow. Convergence was also demonstrated by a computer experiment for a slender axisymmetric body in an off-design supersonic jet stretcher. Near field flow disturbances were reduced to an acceptable level after two readjustments of the jet stretcher geometry. GRA

N81-25045# Ballistic Research Labs., Aberdeen Proving Ground, Md.
SURFACE PRESSURE MEASUREMENTS ON A PROJECTILE SHAPE AT MACH 0.908 Final Report
Lyle D. Kayser Feb. 1981 33 p refs
(DA Proj. 1L1-61102-AH-43)
(AD-A098589; AD-E430597; ARBRL-MR-03079) Avail: NTIS HC A03/MF A01 CSCL 19/1

Measurements of wall static pressures on a model shape with and without a boattail are reported. The model shape is similar to the M549 external geometry. Data were obtained at M = 0.908 at 10 longitudinal positions along the model. Measurements were made at 0, 1, 2.5, and 5.0 degrees angle of attack and at circumferential positions around the model in 10 degree increments. GRA

N81-25046# United Technologies Research Center, East Hartford, Conn.
ANALYSIS OF LAMINAR AND TURBULENT SYMMETRIC BLUNT TRAILING-EDGE FLOWS Final Report, 13 Dec. 1979 - 13 Jan. 1981
V. N. Vatsa, M. J. Werle, and J. M. Verdon Apr. 1981 75 p refs
(Contract N00019-80-C-0057)
(AD-A098703; UTRC/R81-914986-5) Avail: NTIS HC A04/MF A01 CSCL 20/4

Contributions are made to interacting viscous flow theory for symmetric separated flow past blunt airfoil trailing edges. A theoretical and computational technique for predicting turbulent, high Reynolds number, separation and near wake flow is provided. A detailed assessment of a viscous/inviscid iteration and an inverse boundary layer solution procedure is provided through a systematic series of test examples. These involve subsonic laminar and turbulent flows past flat plate and thickened flat plate (blunt trailing-edged) airfoils. In addition, a general approach is outlined for incorporating local strong interaction solutions into an overall viscous solution procedure for isolated airfoils and cascades. Author (GRA)

N81-25047# Air Cruisers Co., Belmar, N.J.
DEVELOPMENT OF RETARDATION AND AUTOMATIC FLOTATION SYSTEM (R.A.F.T.) Final Report, Feb. 1976 - Jul. 1980
Donald R. Hermann and Ralph A. Miller 7 Jul. 1980 133 p refs
(Contract N62269-76-C-0293; WF60532000)
(AD-A096828; NADC-75353-60; EDN-984) Avail: NTIS HC A07/MF A01 CSCL 01/2

Design, fabrication, and initial evolution testing of prototype retardation and automatic flotation systems (RAFT) are discussed. The RAFT system is used during helicopter transfer of sensitive cargo during VERTREP operations. Design concept is based on an integrated parachute/flotation body. Overall system weight is 164 lbs. and packed volume is 4.3 cu ft. GRA

N81-25049# Committee on Government Operations (U. S. House).
AVIATION SAFETY: HAZARDOUS MATERIALS HANDLING
Washington GPO 1980 152 p refs Hearing before a Subcomm. of the Comm. on Govt. Operations, 96th Congr., 2nd Sess., 16 Aug. 1980
(GPO-69-199) Avail: Committee on Government Operations

The handling of hazardous materials, specifically the carriage of hazardous materials by air is addressed. Procedures employed at airports when handling such materials are examined in relation to the contact exposure risk to airport personnel, flightcrews, flight attendants, cargo handlers, and postal employees. J.M.S.

N81-25050*# Douglas Aircraft Co., Inc., Long Beach, Calif.
TESTING OF AIRCRAFT PASSENGER SEAT CUSHION MATERIAL, FULL SCALE. DATA, VOLUME 2 Final Report, Apr. 1980 - Mar. 1981
Kenneth J. Schutter, James G. Gaume, and Fred E. Duskin Nov. 1980 340 p
(Contract NAS9-16062)
(NASA-CR-160963; MDC-J4673-Vol-2) Avail: NTIS HC A15/MF A01 CSCL 13L

Burn characteristics of presently used and proposed seat cushion materials and types of constructions were determined. Eight different seat cushion configurations were subjected to full scale burn tests. Each cushion configuration was tested twice for a total of 16 tests. Two different fire sources were used: Jet A-fuel for eight tests, and a radiant energy source with propane flame for eight tests. Data were recorded for smoke density, cushion temperatures, radiant heat flux, animal response to combustion products, rate of weight loss of test specimens, cabin temperature, and type and content of gas within the cabin. When compared to existing seat cushions, the test specimens incorporating a fire barrier and those fabricated from advanced materials, using improved construction methods, exhibited significantly greater fire resistance. Flamability comparison tests were conducted upon one fire blocking configuration and one polyimide configuration. E.A.K.

N81-25051*# Douglas Aircraft Co., Inc., Long Beach, Calif.
TESTING OF AIRCRAFT PASSENGER SEAT CUSHION MATERIALS. FULL SCALE. TEST DESCRIPTION AND RESULTS, VOLUME 1 Final Report, 11 Mar. 1980 - 10 May 1981
Kenneth J. Schutter, James G. Gaume, and Fred E. Duskin Feb. 1981 109 p refs
(Contract NAS9-16062)
(NASA-CR-160995-Vol-1) Avail: NTIS HC A06/MF A01 CSCL 01C

Eight different seat cushion configurations were subjected to full-scale burn tests. Each cushion configuration was tested twice for a total of sixteen tests. Two different fire sources were used. They consisted of one liter of Jet A fuel for eight tests and a radiant energy source with propane flame for eight tests. Both fire sources were ignited by a propane flame. During each test, data were recorded for smoke density, cushion temperatures, radiant heat flux, animal response to combustion products, rate of weight loss of test specimens, cabin temperature, and for the type and content of gas within the cabin atmosphere. When compared to existing passenger aircraft seat cushions, the test specimens incorporating a fire barrier and those fabricated from advanced materials, using improved construction methods, exhibited significantly greater fire resistance. DOE

N81-25056# Mitre Corp., McLean, Va.
CONSOLIDATED CAB DISPLAY (CCD) SYSTEM, PROJECT PLANNING DOCUMENT (PPD)
Al Asch and L. Wuebker Feb. 1981 79 p refs
(Contract DOT-FA01-81-C-10001)
(AD-A098651; MTR-81W49; FAA-RD-81-6) Avail: NTIS HC A05/MF A01 CSCL 17/2

This report provides the planning guidance for the development, installation, testing and evaluation for the Consolidated Cab Display (CCD) System. The Federal Aviation Administration (FAA) is acquiring two systems for engineering tests and operational evaluations to determine system reliability and design acceptability to Air Traffic Control Tower (ATCT) and Terminal Radar Control (TRACON) controllers. One system will be installed at the FAA Technical Center for engineering and operational evaluations, and a second one at the Atlanta ATCT/TRACON for operational evaluations. The evaluations will provide the FAA with information for making decisions and developing programs for future automation support to the ATCT/TRACON air traffic control specialists. Author (GRA)

N81-25058# Bendix Corp., Baltimore, Md. Communications Div.
TACTICAL MINIATURE CRYSTAL OSCILLATOR Semiannual Report, 1 Oct. 1979 - 1 Apr. 1980
D. Brown and P. Stoermer Mar. 1981 61 p refs
(Contract DAAB07-78-C-2990; DA Proj. 1L1-62705-AH-94)
(AD-A098490; DELET-TR-78-2990-3) Avail: NTIS HC A04/MF A01 CSCL 17/7

This report describes the advanced development of a fast warmup tactical Miniature Crystal Oscillator (TMXO). The intended use of this TMXO is as a precision frequency/time reference in advanced communications, navigation and position location systems. The present effort is a continuation of work based on the demonstrated feasibility on previous contracts. This interim report describes work performed in evaluation of various aspects of crystals performance, and the contribution of components on oscillator long term stability. Mechanically, progress is described in material selection, process evolution and thermal analysis. Author (GRA)

N81-25059# Federal Aviation Administration, Atlantic City, N.J.
AIRPORT SURFACE DETECTION EQUIPMENT (ASDE)-3 OPERATIONAL EVALUATION Final Report, 14 Apr. - 30 May 1980
Louis A. Dvorsky, Anthony J. Swezeny, and Edwin R. Hartz Mar. 1981 37 p
(FAA Proj. 143-102-540)
(AD-A098480; FAA-CT-81-6; FAA-RD-81-2) Avail: NTIS HC A03/MF A01 CSCL 17/7

Operational tests were performed on the Airport Surface Detection Equipment (ASDE)-3 radar. Three teams of air traffic controllers, two per team, with current field ASDE-2 experience, were used as test subjects. The controllers were from the Eastern and New England Regions. These tests were conducted to determine the extent to which the ASDE-3 met requirements as presented by the Air Traffic Service and what the controllers' opinions were of the radar. Tests conducted were: airport surface coverage, capability, target detection as a function of speed between aircraft and aircraft to obstruction resolution, target size and shape determination, standing target heading, and runway clearance. Author (GRA)

N81-25060# Federal Aviation Administration, Atlantic City, N.J.
NEW TOWER CAB MOCKUP FOR PHILADELPHIA, PENNSYLVANIA Final Report, Jun. - Oct. 1980
Donald Bottomley, Edward G. Ezekiel, and Rene Matos Mar. 1981 17 p
(AD-A098528; FAA-CT-81-12; FAA-RD-80-141) Avail: NTIS HC A02/MF A01 CSCL 17/7

Mockup techniques which used foamcore and plywood were employed by the Federal Aviation Administration (FAA) Technical Center to achieve two major goals in assisting the Regional Office and the Air Traffic Control Facility to establish a new control tower at Philadelphia, Pennsylvania. Goal one was to determine the best physical location of present and planned equipment for operational positions and to suggest innovations which would improve their functional capability. Goal two was to design, develop, fabricate, and evaluate the central interior console which is not common to most tower cabs and is not a standard configuration. The result of this effort was a more functional and efficient layout for a standard 525 square foot Welton-Beckett tower cab. Several new modules were introduced to the peripheral consoles, and a unique central console was designed. A new, innovative technique was created to house the bright radar indicator tower equipment (BRITE) displays on swivel, console-height mounts. Author (GRA)

N81-25061# Ohio Univ., Athens. Dept. of Electrical Engineering.
VLF P-STATIC NOISE REDUCTION IN AIRCRAFT. VOLUME 1: CURRENT KNOWLEDGE Final Report, May 1979 - Aug. 1980
Robert W. Lilley and Ralph W. Burhans Sep. 1980 102 p refs
(Contract DOT-FA79WA-4302)

(AD-A098451; EER-48-1; FAA-RD-80-137-1) Avail: NTIS HC A06/MF A01 CSCL 17/7

In Volume 1, the results of a literature search and facilities/capabilities survey to determine existing and LF p-static knowledge and noise-reduction techniques are presented. References treating basic p-static and corona theory, airframe quieting techniques and instrumentation methods are abstracted. A description of the Ohio University research aircraft installation for discharge current and static field environment is given. Brief reference is made to lightning interference. Lighting discharges, although not p-static, are considered sources of Loran-C interference which should be characterized more specifically. Volume 2 will present recommendations for further study and experimentation to permit better understanding of Loran-C interference processes, and procedures and techniques for minimizing their effects.
Author (GRA)

N81-25062# National Telecommunications and Information Administration, Boulder, Colo.
EVALUATION OF DISCRETE ADDRESS BEACON SYSTEM (DABS) EMC
Robert M. Pratt and Jay S. Levy Nov. 1980 41 p refs
(Contract DOT-FA01-80-Y-10535)
(PB81-154387; NTIA/Rept-80-53) Avail: NTIS HC A03/MF A01 CSCL 17G

Questions were raised regarding the Electromagnetic Compatibility (EMC) of DABS because of common channel usage with the Air Traffic Control Radar Beacon System. The EMC of DABS with operational and firmly planned systems in the 960-1215 MHz band was investigated. This was accomplished by evaluating FAA theoretical calculation, measurement, and simulation results, and performing an independent analysis through theoretical calculations and computer simulations. GRA

N81-25064*# Grumman Aerospace Corp., Bethpage, N.Y.
AXISYMMETRIC & NON-AXISYMMETRIC EXHAUST JET INDUCED-EFFECTS ON A V/STOL VEHICLE DESIGN. PART 1: DATA PRESENTATION Interim Report
W. C. Schnell and G. W. Ordonez 1 May 1981 538 p refs
(Contract NAS2-9887)
(NASA-CR-166146; Rept-0747-81-Pt-1) Avail: NTIS HC A23/MF A01 CSCL 01C

A 1/8 scale jet-effects model was tested in the NASA Ames 11 ft transonic tunnel at static conditions and over a range of Mach numbers from 0.4 to 1.4. The data presented show that significant differences in aeropropulsion performance can be expected by varying the exhaust nozzle type and its geometric parameters on a V/STOL underwing nacelle installation. T.M.

N81-25065*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EVALUATION OF A PNEUMATIC BOOT DEICING SYSTEM ON A GENERAL AVIATION WING MODEL
Alan E. Albright (Kansas Univ., Lawrence), David L. Kohlman (Kansas Univ., Lawrence), William G. Schweikhard (Kansas Univ., Lawrence), and Peggy Evanich Jun. 1981 35 p refs
(Grant NAS3-71)
(NASA-TM-82363; KU-FRL-464-2) Avail: NTIS HC A03/MF A01 CSCL 01C

The aerodynamic characteristics of a typical modern general aviation airfoil were investigated with and without a pneumatic boot ice protection system. The ice protection effectiveness of the boot was studied. This includes the change in drag on the airfoil with the boot inflated and deflated, the change in drag due to primary and residual ice formation, drag change due to cumulative residual ice formation, and parameters affecting boot effectiveness. Boot performance was not affected by tunnel total temperature or velocity. Marginal effect in performance was associated with angle of attack. Significant effects on performance were caused by variations in droplet size, LWC, ice cap thickness inflation pressure, and surface treatment. T.M.

N81-25066*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
APPLICATION OF A FLIGHT TEST AND DATA ANALYSIS TECHNIQUE TO FLUTTER OF A DRONE AIRCRAFT
Robert M. Bennett May 1981 12 p refs
(NASA-TM-83136) Avail: NTIS HC A02/MF A01 CSCL 01C

Modal identification results presented were obtained from recent flight flutter tests of a drone vehicle with a research wing (DAST ARW-1 for Drones for Aerodynamic and Structural Testing, Aeroelastic Research Wing-1). This vehicle is equipped with an active flutter suppression system (FSS). Frequency and damping of several modes are determined by a time domain modal analysis of the impulse response function obtained by Fourier transformations of data from fast swept sine wave excitation by the FSS control surface on the wing. Flutter points are determined for two different altitudes with the FSS off. Data are given for near the flutter boundary with the FSS on. Author

N81-25067*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
RESEARCH RELATED TO VARIABLE SWEEP AIRCRAFT DEVELOPMENT
Edward C. Polhamus and Thomas A. Toll May 1981 42 p refs Presented at the Meeting of the Air Force Historical Foundation, Hampton, Va., 27 Mar. 1981
(NASA-TM-83121) Avail: NTIS HC A03/MF A01 CSCL 01C

Development in high speed, variable sweep aircraft research is reviewed. The 1946 Langley wind tunnel studies related to variable oblique and variable sweep wings and results from the X-5 and the XF10F variable sweep aircraft are discussed. A joint program with the British, evaluation of the British 'Swallow', development of the outboard pivot wing/aft tail configuration concept by Langley, and the applied research program that followed and which provided the technology for the current, variable sweep military aircraft is outlined. The relative state of variable sweep as a design option is also covered. E.A.K.

N81-25068# Aeronautical Consultant Associates, Rancho Palos Verdes, Calif.
APPLICATION OF THE JOINED WING TO CRUISE MISSILES Final Report, Phase 1
Julian Wolkovitch Nov. 1980 201 p refs
(Contract N00014-79-C-0953)
(AD-A096450; ONR-CR-212-266-1) Avail: NTIS HC A10/MF A01 CSCL 16/4

The joined wing is an airplane and missile configuration comprising two wings, a fuselage, and a fin, arranged such that the wings form diamond shapes both in plan view and in front view. Advantages for the joined wing include lightness, stiffness, low induced drag, low wave drag, high trimmed maximum lift coefficient, reduced parasite drag, and good stability and control, plus built-in direct lift and sideforce capabilities. Comparisons were made of three cruise missile configurations: conventional, joined wing, and joined wing plus canard. The latter configurations yield large advantages in range, maneuverability, and terrain-following. Optimal control theory was employed to calculate the terrain-following accuracy of each configuration.
T.M.

N81-25069# Kuhn (Richard E.), Newport News, Va.
AN ENGINEERING METHOD FOR ESTIMATING THE INDUCED LIFT ON V/STOL AIRCRAFT HOVERING IN AND OUT OF GROUND EFFECT Final Technical Report
Richard E. Khun Jan. 1981 105 p refs
(Contract N62269-80-C-0366; WF41400)
(AD-A098509; NADC-80246-60) Avail: NTIS HC A06/MF A01 CSCL 20/4

An examination and correlation of available data has shown that two different methods must be used to estimate the jet induced lift on fan and jet V/STOL aircraft in hovering flight. The basic method developed in this study is used for configurations with widely spaced jets, and the h' Method is used for configurations with closely spaced jets. The methods account for the effects of jet arrangement, configuration planform, wing height, body contour and Lift Improvement Devices (LIDs) but are limited to configurations with essentially vertical, circular jets of equal size and thrust. Suggestions for further work to evaluate and refine the methods are included. Author (GRA)

N81-25070# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.
VIBRATION TEST LEVEL CRITERIA FOR AIRCRAFT EQUIPMENT Final Report, 6 Nov. 1978 - 30 Sep. 1979
Preston S. Hall Dec. 1980 31 p refs
(AF Proj. 2402)
(AD-A098675; AFWAL-TR-80-3119) Avail: NTIS HC A03/MF A01 CSCL 14/2

This study details inhouse efforts that recommend vibration test level criteria for reliability of aircraft equipment. The study assesses the impact of current vibration test level criteria on the resultant reliability statistics of aircraft equipment. Problems of profiling mission vibration environmental stresses as compared to other environmental stresses are analyzed. An analysis of the readily available tools to determine the vibration stresses is also conducted. A comparison is made of various vibration exposure times and levels for a number of equipment under multiple tests. The resulting reliability under the multiple tests is compared to field reliability data for the equipment studied. Author (GRA)

N81-25071# Army Aeromedical Research Lab., Fort Rucker, Ala. Biodynamics Research Div.
VIBRATION IN A HELMET MOUNTED SIGHT (HMS) USING MECHANICAL LINKAGE Final Report
John C. Johnson, David B. Priser, and Robert W. Verona Mar. 1981 31 p refs
(DA Proj. 3E1-62777-A-878)
(AD-A098533; USAARL-81-3) Avail: NTIS HC A03/MF A01 CSCL 05/5

Two variations of the SPH-4 flight helmet were tested: (1) SPH-4 with standard web suspension, (2) SPH-4 with a form-fit foam liner suspension. The system was tested in the front seat of an AH-1S 'Cobra' helicopter. Five flight conditions were used in the experiment: (1) hover, (2) 40 kn, (3) 80kn, (4) 120kn, (5) standard left turn. Two conditions of the helmet mounted control linkage were tested: (1) connected, (2) disconnected. A triaxial accelerometer was mounted on top of the flight helmet to measure vibration. The following observations were made: (1) Both helmets vibrate more with the sight attached. (2) The response to the sight coupled vibration of the standard SPH-4 differed from that of the form-fit SPH-4. (3) The form-fit SPH-4 helmet vibrated more in a narrow band centered at about 30 Hz. (4) The standard SPH-4 helmet vibrated more over a wide band of frequencies above 30Hz. Concluded that the significant increase in vibration of the helmet caused by the mechanical sight linkage may be expected to degrade pilot/gunner visual performance and hearing acuity, and increase fatigue rate to some extent. GRA

N81-25072# United Technologies Corp., Windsor Locks, Conn.
REQUIREMENTS, TECHNOLOGY AND CONFIGURATION EVALUATION FOR CRASH SURVIVABLE FLIGHT DATA RECORDING (CSFDR) SYSTEM Final Report, 23 Jul. 1980 - 13 Feb. 1981
Henry R. Ask, James A. Herdon, and Donald L. White 11 Apr. 1981 222 p refs
(Contract F33615-80-E-0134)
(AD-A098584; ESP-8111; ASD-TR-81-5010) Avail: NTIS HC A10/MF A01 CSCL 01/4

The objective of this effort was to determine the requirements, configuration and cost for a standard Crash Survivable Flight Data Recorder (CSFDR) for fighter, attack and trainer aircraft. An additional objective was the determination of broader usage of a standard configuration for the tri-services along with expansion of the system to include maintenance monitoring functions. Author (GRA)

N81-25074*# General Electric Co., Cincinnati, Ohio.
DESIGN OF A V/STOL PROPULSION SYSTEM FOR A LARGE-SCALE FIGHTER MODEL Final Report
W. S. Willis May 1981 58 p refs
(Contract NAS2-10556)
(NASA-CR-166162; R81AEG257) Avail: NTIS HC A04/MF A01 CSCL 21E

Modifications were made to the existing Large-Scale STOL fighter model to simulate a V/STOL configuration. Modifications include the substitutions of two dimensional lift/cruise exhaust nozzles in the nacelles, and the addition of a third J97 engine in the fuselage to suppy a remote exhaust nozzle simulating a Remote Augmented Lift System. A preliminary design of the inlet and exhaust ducting for the third engine was developed and a detailed design was completed of the hot exhaust ducting and remote nozzle. Author

N81-25075*# Pratt and Whitney Aircraft Group, West Palm Beach, Fla. Government Products Div.
SEMI-ACTUATOR DISK THEORY FOR COMPRESSOR CHOKE FLUTTER Final Report
J. Micklow and J. Jeffers Washington NASA Jun. 1981 169 p refs
(Contract NAS3-20060)
(NASA-CR-3426; FR-12976) Avail: NTIS HC A08/MF A01 CSCL 21E

A mathematical anaysis predict the unsteady aerodynamic utilizing semi actuator theory environment for a cascade of airfoils harmonically oscillating in choked flow was developed. A normal shock is located in the blade passage, its position depending on the time dependent geometry, and pressure perturbations of the system. In addition to shock dynamics, the model includes the effect of compressibility, interblade phase lag, and an unsteady flow field upstream and downstream of the cascade. Calculated unsteady aerodynamics were compared with isolated airfoil wind tunnel data, and choke flutter onset boundaries were compared with data from testing of an F100 high pressure compressor stage. E.A.K.

N81-25076*# TRW, Inc., Cleveland, Ohio.
FABRICATION PROCESS DEVELOPMENT OF BORON/ALUMINUM FAN BLADES FOR HIGH BYPASS ENGINES Final Report, Jun. 1976 - Sep. 1979
Gordon S. Doble Feb. 1981 43 p refs
(Contract NAS3-20115)
(NASA-CR-165252; ER-8174-F) Avail: Issuing Activity CSCL 21E

Preliminary design effects were performed to establish design features for a boron-aluminum first stage CF-6 fan blade satisfactory for meeting engine aeromechanical and small bird FOD resistance requirement. Tooling for the blade was designed, constructed, and checked out by fabrication of a laminated aluminum CF-6 blade. Rapid air bonding was successfully employed to produce sound matrix bonds in a second CF-6 B/A1 blade. T.M.

N81-25077*# Pratt and Whitney Aircraft Group, East Hartford, Conn. Commercial Products Div.
ENERGY EFFICIENT ENGINE, LOW-PRESSURE TURBINE BOUNDARY LAYER PROGRAM
W. B. Gardner Apr. 1981 62 p refs
(Contract NAS3-20646)
(NASA-CR-165338; PWA-5594-141) Avail: NTIS HC A04/MF A01 CSCL 21E

A study was conducted to investigate development of boundary layers under the influence of velocity distributions simulating the suction side of two state-of-the-art turbine airfoils: a forward loaded airfoil (squared-off design) and an aft loaded airfoil (aft-loaded design). These velocity distributions were simulated in a boundary layer wind tunnel. Detailed measurements of boundary layer mean velocity and turbulence intensity profiles were obtained for an inlet turbulence level of 2.4 percent and an exit Reynolds number of 800,000. Flush-mounted hot film probes identified the boundary layer transition regimes in the adverse pressure gradient regions for both velocity distributions. Wall intermittency data showed good agreement with the correlations of Dhawan and Narasimha for the intermittency factor distribution in transitional flow regimes. T.M.

N81-25078*# General Electric Co., Lynn, Mass. Aircraft Engine Group.
PROPULSION SYSTEM STUDY FOR SMALL TRANSPORT

AIRCRAFT TECHNOLOGY (STAT) Final Report
C. E. Smith, R. Hirschkron, and R. E. Warren May 1981 216 p refs
(Contract NAS3-21996)
(NASA-CR-165330; R80AEG068) Avail: NTIS HC A10/MF A01 CSCL 21A

Propulsion system technologies applicable to the generation of commuter airline aircraft expected to enter service in the 1990's are identified and evaluated in terms of their impact on aircraft operating economics and fuel consumption. The most promising technologies in the areas of engine, propeller, gearbox, and nacelle design are recommended for future research. Each item under consideration is evaluated relative to a modern baseline engine, the General Electric CT7-5, in a current technology aircraft flying a fixed range and payload. The analysis is presented for two aircraft sizes (30 and 50 passenger), over a range of mission lengths (100 to 1100 km) and fuel costs ($264 to $396 per cu m). T.M.

N81-25079*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPARISON OF NASA AND CONTRACTOR RESULTS FROM AEROACOUSTIC TESTS OF QCSEE OTW ENGINE
H. E. Bloomer, I. J. Loeffler, W. J. Kreim, and J. W. Coats Apr. 1981 27 p refs
(NASA-TM-81761; E-824) Avail: NTIS HC A03/MF A01 CSCL 21E

The aerodynamics and acoustics of the over-the-wing (OTW) Quiet, Clean, Short Haul Experimental Engine (QCSEE) were tested. A boilerplate (nonflight weight), high-throat Mach number, acoustically treated inlet and a D-shaped OTW exhaust nozzle with variable position side doors were used. Some acoustic directivity results for the type 'D' nozzle and acoustic effects of variations in the nozzle side door positions are included. It was found that the results are in agreement with those previously obtained. E.A.K.

N81-25080*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MEASUREMENT OF AERODYNAMIC WORK DURING FAN FLUTTER
A. P. Kurkov 1981 16 p refs Proposed for presentation at the 1981 Winter Ann. Meeting of the ASME, Washington, D.C., 15-20 Nov. 1981
(NASA-TM-82652; E-911) Avail: NTIS HC A02/MF A01 CSCL 21E

Stationary high response pressure and displacement measurements are used to describe the flutter characteristics of the first fan rotor of a turbofan engine. Flutter occurred at part speed and at high incidence. Several forward and backward traveling waves were identified in a predominantly torsional flutter mode. Positive aerodynamic work contribution was confined to the region close to the leading edge and was mainly due to modes corresponding to forward traveling waves of nodal diameters in the range 3 to 5. Author

N81-25081*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF A PART-SPAN VARIABLE INLET GUIDE VANE ON THE PERFORMANCE OF A HIGH-BYPASS TURBOFAN ENGINE
George A. Bobula (AVRADCOM Research and Technology Labs., Cleveland), Ronald H. Soeder, and Leo A. Burkardt 1981 15 p refs Proposed for presentation at the 17th Joint Propulsion Conf., Colorado Springs, 27-29 Jul. 1981; sponsored by AIAA, ASME, and SAE
(NASA-TM-82617; E-869; AVRADCOM-TR-81-C-10) Avail: NTIS HC A02/MF A01 CSCL 21E

The ability of a part span variable inlet guide vane (VIGV) to modulate the thrust of a high bypass turbofan engine was evaluated at altitude/Mach number conditions of 4572 m/0.6 and 9144 m/0.93. Fan tip, gas generator and supercharger performance were also determined, both on operating lines and during fan duct throttling. The evaluation was repeated with the bypass splitter extended forward to near the fan blade trailing edge. Gross thrust attentuation of over 50 percent was achieved with 50 degree VIGV closure at 100 percent corrected fan speed. Gas generator supercharger performance fell off with VIGV closure, but this loss was reduced when a splitter extension was added. The effect of VIVG closure on gas generator performance was minimal. Author

N81-25082*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
JT9D PERFORMANCE DETERIORATION RESULTS FROM A SIMULATED AERODYNAMIC LOAD TEST
Edward G. Stakolich and William J. Stromberg (Pratt and Whitney Aircraft, East Hartford, Conn.) 1981 21 p refs Proposed for presentation at the 17th Joint Propulsion Conf., Colorado Springs, 27-29 Jul. 1981; sponsored by AIAA, SAE, and ASME
(NASA-TM-82640; E-895) Avail: NTIS HC A02/MF A01 CSCL 21E

The results of testing to identify the effects of simulated aerodynamic flight loads on JT9D engine performance are presented. The test results were also used to refine previous analytical studies on the impact of aerodynamic flight loads on performance losses. To accomplish these objectives, a JT9D-7AH engine was assembled with average production clearances and new seals as well as extensive instrumentation to monitor engine performance, case temperatures, and blade tip clearance changes. A special loading device was designed and constructed to permit application of known moments and shear forces to the engine by the use of cables placed around the flight inlet. The test was conducted in the Pratt & Whitney Aircraft X-Ray Test Facility to permit the use of X-ray techniques in conjunction with laser blade tip proximity probes to monitor important engine clearance changes. Upon completion of the test program, the test engine was disassembled, and the condition of gas path parts and final clearances were documented. The test results indicate that the engine lost 1.1 percent in thrust specific fuel consumption (TSFC), as measured under sea level static conditions, due to increased operating clearances caused by simulated flight loads. This compares with 0.9 percent predicted by the analytical model and previous study efforts. Author

N81-25083*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SELECTED RESULTS FROM COMBUSTION RESEARCH AT THE LEWIS RESEARCH CENTER
Robert E. Jones 1981 13 p refs Proposed for presentation at the 17th Joint Propulsion Conf., Colorado Springs, 27-29 Jul. 1981; sponsored by AIAA, SAE, and ASME
(NASA-TM-82627; E-880) Avail: NTIS HC A02/MF A01 CSCL 21E

Combustion research at Lewis is organized to provide a balanced program responsive to national needs and the gas turbine industry. The results of this research is a technology base that assists the gas turbine engine manufacturers in developing new and improved combustion systems for advanced civil and military engines with significant improvements in performance, durability, fuel flexibility and control of exhaust emissions. Research efforts consist of fundamentals and modeling, and applied component and combustor research. T.M.

N81-25084*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HIGH-RESPONSE MEASUREMENTS OF A TURBOFAN ENGINE DURING NONRECOVERABLE STALL
Doug Lee Apr. 1981 27 p refs
(NASA-TM-81759; E-822) Avail: NTIS HC A03/MF A01 CSCL 21E

High response measurements of a Pratt and Whitney F100(3) turbofan engine at a simulated Mach number and altitude of 1.2 and 3000 m (10,000 ft) respectively were recorded during a nonrecoverable stall. The nonrecoverable stall occurred as a result of incorrect scheduling of the high compressor variable vanes (RCVV) during an experimental engine control investigation. Recorded data indicates rotating stall originating in the high pressure compressor. From this region the disturbance propagates upstream into the fan and downstream throughout the core compressor. The rotating stall remained in the core compressor until the engine was shutdown. The fan exhibited some rotating stall, but the amplitude of the pressure oscillations were less severe. Data indicates that the fan was able to recover from the stall. Fan turbine inlet temperature (FTIT) had been decreasing until stall developed in the high-pressure compressor. From this time, FTIT increased towards its maximum temperature limit. The rising FTIT during nonrecoverable stall may be the result of incomplete combustion in the combustor and additional combustion occurring through the turbine. Author

N81-25085# Avco Lycoming Div., Stratford, Conn.
HIGH PERFORMANCE AUXILIARY POWER UNIT TECHNOLOGY DEMONSTRATOR Final Report, 1 Jul. 1977 - 31 Jul. 1980
William Green Wright-Patterson AFB, Ohio AFWAL Dec. 1980 190 p
(Contract F33615-77-C-2015; AF Proj. 2348)
(AD-A098618; LYC-80-55; AFWAL-TR-80-2100) Avail: NTIS HC A09/MF A01 CSCL 10/2

The report covers the design, procurement, and testing of two High-Performance Auxiliary Power Units in the 500 shp class. The program demonstrated the ability of the LPU-101-700 power producer, combined with a modified existing APU in an advanced state of development, to meet Air Force minimum requirements of 1.7 hp/lb and 130 hp/cu ft with an sfc of 1.0 lb/hp-hr or less. Two units were successfully subjected to extensive environmental and endurance testing. Author (GRA)

N81-25086# Hamilton Standard, Windsor Locks, Conn.
RELIABILITY ADVANCEMENT FOR ELECTRONIC ENGINE CONTROLLERS. VOLUME 2: GUIDE TO DEVELOPMENT OF HIGH RELIABILITY ELECTRONIC ENGINE CONTROLLERS Final Report, Aug. 1977 - Apr. 1980
C. Rabinowitz, R. Otterberg, K. Boucher, K. Walworth, and P. Cote Aug. 1980 249 p refs
(Contract F33615-77-C-2055; AF Proj. 3066)
(AD-A098614; HSER-7668-Vol-2; AFWAL-TR-80-2063-Vol-2) Avail: NTIS HC A11/MF A01 CSCL 21/5

Based upon the work done in evolving the preliminary design of 'Volume 1' Final Report: this document has been prepared to serve as a guide for developers of future high reliability gas turbine engine controls. After defining the control modes and requirements for a variable cycle engine various options are considered regarding system configuration, redundancy management, system simplification, and fault handling. Principles for optimizing component mix and circuit design, along with possibilities for alternative implementations are presented. To successfully control the environmental exposure of the EEC, aspects of thorough packaging design are described. The entire reliability program of an organization plays a key role in the development of high reliability controls. Major elements of a successful program are discussed. Particular emphasis is placed upon implementation of reliability tests and screens designed to enhance electronic hardware reliability. Reliability mathematical modeling techniques are utilized to evaluate control options during system trade studies and to predict and enhance reliability growth during the design and development program and the production program. GRA

N81-25087# Hamilton Standard, Windsor Locks, Conn.
RELIABILITY ADVANCEMENT FOR ELECTRONIC ENGINE CONTROLLERS, VOLUME 1 Final Report, Aug. 1977 - Apr. 1980
C. Rabinowitz, R. Otterberg, K. Boucher, K. Walworth, P. Cote, M. McGlone (Pratt and Whitney Aircraft), and J. Vernon Wright-Patterson AFB, Ohio AFWAL Jun. 1980 510 p refs
(Contract F33615-77-C-2055; AF Proj. 3066)
(AD-A098623; HSER-7667; AFWAL-TR-80-2063-Vol-1) Avail: NTIS HC A22/MF A01 CSCL 21/5

This study presents a comprehensive approach to the development of full-authority electronic engine controls which are capable of meeting the high reliability levels required of aircraft turbine engine controls. The primary groundrules and assumptions are defined, including the variable cycle engine, its control requirements, and service environment. A preliminary design is developed, beginning with a system description and reliability evaluation of a baseline system, including implementation of redundancy, back-up control provisions, and self-test. Through detailed system analyses and electrical and mechanical trade studies, a final preliminary design is derived. (Other topics covered include component baselines for reliability and cost studies, a discussion of reliability technology information exchanges with consulting organizations, a detailed description of reliability improvement measures including various levels of device screening and testing, and a cost of ownership study). Through the effective use of measures such as fault tolerant coverage and selective duplex/triplex redundancy, the final RAEEC system developed can approach high flight safety levels and the goal for maintenance MBTF of 25,000 hours. Author (GRA)

N81-25088# Federal Aviation Administration, Atlantic City, N.J.
ENGINEERING AND DEVELOPMENT PROGRAM PLAN PROPULSION SAFETY
F. Howard Apr. 1981 35 p refs
(AD-A098709; FAA-CT-81-157; FAA-ED-18-5A) Avail: NTIS HC A03/MF A01 CSCL 01/2

Assessment of technology advances relative to existing civil aviation regulations indicates that near and far term research and development is necessary to resolve potential problems areas and to improve the data base required for proper rule-making. Milestone schedules and recommended funding requirements are included for each task. The five areas of investigation are ingestion, durability, stability, fuels, and materials. The overall scope of work in safety and reliability involves investigations and evaluations in three major propulsion program subdivisions and one propulsion functional systems program area. These are: aircraft gas turbine engines, aircraft piston engines, helicopter propulsion systems, and propulsion functional systems and components. Author (GRA)

N81-25089*# Stevens Inst. of Tech., Hoboken, N. J. Dept. of Mechanical Engineering.
OVERVIEW: NASA/AF/NAVY SYMPOSIUM ON AEROELASTICITY OF TURBINE ENGINES Summary Report
F. Sisto Mar. 1981 67 p Symp. held in Cleveland, 27-29 Oct. 1980 Sponsored in cooperation with NASA and AF
(Contract N00014-79-C-0765; NR Proj. 094-391)
(NASA-CR-164419; AD-A098414; ME-RT-81003) Avail: NTIS HC A04/MF A01 CSCL 21/5

This report is a summarization in overview format of the joint NASA/AF/NAVY Symposium on Aeroelasticity of Turbine Engines held at NASA-Lewis Laboratory on October 27, 28, 29, 1980. Fifty-five presentations were made in unsteady aerodynamics and structural dynamics, including self-excited (flutter) instability and structural dynamics. Both analytical and experimental work was reported. A brief history of the subject and the text of banquet talk are included. GRA

N81-25090*# Sikorsky Aircraft, Stratford, Conn.
MAIN ROTOR SIX DEGREE-OF-FREEDOM ISOLATION SYSTEM ANALYSIS Final Report
L. B. Eastman Apr. 1981 59 p refs
(Contract NAS1-16168)
(NASA-CR-165665; SER-70471) Avail: NTIS HC A04/MF A01 CSCL 01C

The design requirements of the system have been defined and an isolator concept satisfies these requirements identified. Primary design objectives for the isolation system are 90% attenuation of all NP main rotor shaft loads at a weight penalty less than or equal to 1% of design gross weight. The configuration is sized for a UH-60A BLACK HAWK helicopter and its performance, risk, and system integration were evaluated through a series of parametric studies. Preliminary design was carried forward to insure that the design is practical and that the details of the integration of the isolator into the helicopter system are considered. Alternate ground and flight test demonstration programs necessary to verify the proposed isolator design are defined. T.M.

N81-25232*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AVIATION TURBINE FUEL PROPERTIES AND THEIR TRENDS

Robert Friedman 1981 27 p refs Proposed for presentation at the West Coast Intern. Meeting, Seattle, 3-6 Aug. 1981; sponsored by the Society of Automotive Engineers
(NASA-TM-82603; E-851) Avail: NTIS HC A03/MF A01 CSCL 21D

Fuel property values and their trends were studied through a review of a recognized, wide ranging sample population from actual fuel inspection data. A total of 676 fuel samples of Jet A aviation turbine fuel were compiled over an eleven year period. Results indicate that most fuel samples have one to three near-specification properties, the most common being aromatics, smoke point, and freezing point. R.C.T.

N81-25240# Naval Postgraduate School, Monterey, Calif.
AN INVESTIGATION OF THE COMBUSTION BEHAVIOR OF SOLID FUEL RAMJETS M.S. Thesis
Michael Emmanuel Metochianakis Dec. 1980 90 p refs
(AD-A098481) Avail: NTIS HC A05/MF A01 CSCL 21/4

An experimental investigation was conducted to determine if there was a relationship between basic fuel properties and obtainable solid fuel ramjet combustion efficiency. The thermal behavior of different fuels was examined using differential thermal analysis and gas chromatography. Hot firings were made for those fuels with significantly different thermal characteristics. Fuels that had a dominant endothermic decomposition behavior and that produced low molecular weight pyrolysis gases had high combustion efficiency in non-bypass configurations. Fuels with low temperature exothermic behavior and high molecular weight pyrolysis gases had high combustion efficiency when bypass air was used. Near wall mixing within the fuel port resulted in decreased combustion efficiency. The use of bypass air resulted in decreased combustion efficiency for plexiglas and increased combustion efficiency for HTPB based fuels. Radiation was incorporated into an existing finite difference computer model for the SFRJ combustion process and resulted in improved predictive capabilities. Author (GRA)

N81-25255# Department of Energy, Bartlesville, Okla. Energy Technology Center.
AVIATION TURBINE FUELS 1980
Ella Mae Shelton Mar. 1981 14 p refs
(DOE/BETC/PPS-81/2) Avail: NTIS HC A02/MF A01

Properties of some aviation turbine fuels marketed in the United States during 1980 are presented. The samples represented are typical 1980 production and were analyzed in the laboratories of 17 manufacturers of aviation turbine (jet) fuels. The data were submitted for study, calculation, and compilation under a cooperative agreement between the Department of Energy (DOE), Bartlesville Energy Technology Center (BETC), Bartlesville, Oklahoma, and the American Petroleum Institute (API). Results for the properties of 98 samples of aviation turbine fuels are included in the report for military grades JP-4 and JP-5 and commercial type Jet A. DOE

N81-25411*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ZERO GRAVITY TESTING OF FLEXIBLE SOLAR ARRAYS

D. T. Chung (LMSC, Sunnyvale, Calif.) and I. E. Young *In its* The 15th Aerospace Mech. Symp. May 1981 p 115-136 refs
(Contract NAS8-31352)
Avail: NTIS HC A19/MF A01 CSCL 20K

In order to develop the solar array design for solar electric propulsion and prove the feasibility for extension and retraction in space, a series of zero-g flights in a KC-135 aircraft were conducted. Six full size panels (36.83 cm. x 398.78 cm. each) and 12 half size panels were extended and retracted in the zero g provided by the KC-135. A test structure was specifically designed and built for zero g flight testing and is easily modified, depending upon the test specimen configuration. It mounts directly to the aircraft floor, with the specimen contained to survive ground handling and flight loads. The test structure is fully automatic for extension and retraction; however, there is a manual override to continue testing in the event of a power loss to the drive motors. The flexible solar array test specimen (6 panels or 12-panels) was successfully extended and retracted numerous times in the KC-135 aircraft within the zero g period of flight. Five flights successfully conducted with blanket specimens containing various panel stiffening patterns, standard cell simulation, thin cell modules, low cost cell modules, and reflectors. J.M.S.

N81-25415*# Lockheed-Georgia Co., Marietta.
HIGH FREQUENCY DRIVE MECHANISM FOR AN ACTIVE CONTROLS SYSTEMS AIRCRAFT CONTROL SURFACE
Hugh E. Smith *In* NASA. Marshall Space Flight Center The 15th Aerospace Mech. Symp. May 1981 p 173-188

Avail: NTIS HC A19/MF A01 CSCL 20K

An innovative mechanism developed to accomplish the control actuations in the presence of the many severe constraints imposed on a wind tunnel model by the tunnel installations environment is described. The mechanism developed includes several interrelated mechanical subsystems: a low inertia, antibacklash drive mechanism conversion of rotary motion to linear motion. J.M.S.

N81-25431*# Boeing Engineering and Construction, Seattle, Wash. Energy and Environment Div.
WIND LOADS ON FLAT PLATE PHOTOVOLTAIC ARRAY FIELDS Final Report
Ronald D. Miller and Donald K. Zimmerman Apr. 1981 384 p refs Sponsored by NASA and DOE Prepared for JPL
(Contract JPL-954833)
(NASA-CR-164454; DOE/JPL-954833-81/3) Avail: NTIS HC A17/MF A01 CSCL 20K

The results of an experimental analysis (boundary layer wind tunnel test) of the aerodynamic forces resulting from winds acting on flat plate photovoltaic arrays are presented. Local pressure coefficient distributions and normal force coefficients on the arrays are shown and compared to theoretical results. Parameters that were varied when determining the aerodynamic forces included tilt angle, array separation, ground clearance, protective wind barriers, and the effect of the wind velocity profile. Recommended design wind forces and pressures are presented, which envelop the test results for winds perpendicular to the array's longitudinal axis. This wind direction produces the maximum wind loads on the arrays except at the array edge where oblique winds produce larger edge pressure loads. The arrays located at the outer boundary of an array field have a protective influence on the interior arrays of the field. A significant decrease of the array wind loads were recorded in the wind tunnel test on array panels located behind a fence and/or interior to the array field compared to the arrays on the boundary and unprotected from the wind. The magnitude of this decrease was the same whether caused by a fence or upwind arrays. Author

N81-25432*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
PREDICTION OF TRANSONIC FLUTTER FOR A SUPERCRITICAL WING BY MODIFIED STRIP ANALYSIS AND COMPARISON WITH EXPERIMENT
E. Carson Yates, Jr., Eleanor C. Wynne, Moses G. Farmer, and Robert N. Desmarais May 1981 31 p refs Presented at the AIAA Dyn. Specialists Conf., Atlanta, 9-10 Apr. 1981
(NASA-TM-83126; NASA-TM-72837) Avail: NTIS HC A03/MF A01 CSCL 01C

Use of a supercritical airfoil can adversely affect wing flutter speeds in the transonic range. As adequate theories for three dimensional unsteady transonic flow are not yet available, the modified strip analysis was used to predict the transonic flutter boundary for the supercritical wing. The steady state spanwise distributions of section lift curve slope and aerodynamic center, required as input for the flutter calculations, were obtained from pressure distributions. The calculated flutter boundary is in agreement with experiment in the subsonic range. In the transonic range, a transonic bucket is calculated which closely resembles the experimental one with regard to both shape and depth, but it occurs at about 0.04 Mach number lower than the experimental one. S.F.

N81-25437# Pisa Univ. (Italy). Ist. de Aeronautica.
THE FATIGUE CRACK GROWTH UNDER VARIABLE AMPLITUDE LOADING IN BUILT-UP STRUCTURES Annual Technical Report, Sep. 1978 - Oct. 1980
A. Salvetti, G. Cavallini, and L. Lazzeri Jan. 1981 83 p refs
(Grant DA-ERO-78-G-107; DA Proj. 1T1-61102-BH-57)
(AD-A098417; ATR-2) Avail: NTIS HC A05/MF A01 CSCL 01/3

Thirty-three specimens were tested both at constant and variable amplitude loading. The specimens, cut from sheets of 7075-T6 aluminium alloy, coming from the same batch were both simple sheets and riveted stiffened panels. The constant amplitude tests on simple sheet specimens were carried out in order to obtain the average K-rate relationship and the relevant scatter of the batch of sheets. The constant amplitude tests on stiffened panel were aimed at obtaining information on rivet flexibility and friction forces. Variable amplitude tests were performed utilizing the FALSTAFF spectrum. The data on sheet specimens was used to assess the reliability of prediction methods such as those devised by Wheeler and Willenborg, and the stiffened panels test data to establish how these methods work in the case of built-up structures. The results, especially those concerning the spectrum tests on stiffened panels, are still preliminary, but significant in as far as they allow us to assess the reliability of crack grow prediction methods and to obtain a qualitative but deep insight into the phenomenon of crack growth in built-up structures. GRA

N81-25578# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
NOISEMAP: THE USAF'S COMPUTER PROGRAM FOR PREDICTING NOISE EXPOSURE AROUND AN AIRPORT
Jerry D. Speakman Dec. 1980 5 p refs
(AD-A094264; AFAMRL-TR-80-128) Avail: NTIS HC A02/MF A01 CSCL 20/1

Modeling features in NOISEMAP are described, including: excess sound attenuation under ground to ground propagation conditions that is aircraft type and power setting dependent; lateral (sideline) attenuation of flight noise levels at low aircraft to observer elevation angles; takeoff roll noise model that compensates for directivity and acceleration effects; flight profile segmentation to account for variations in engine power setting and airspeed; influence of turns on predicted flight noise level durations; effect of airbase (runway) altitude above sea level on thrust, airspeed, and acoustic impedance; and flexibility to generate noise contour maps for any specified average temperature and relative humidity conditions. S.F.

N81-25637# Weather Wing (5th), Langley AFB, Va.
TERMINAL FORECAST REFERENCE NOTEBOOK (TFRN) FOR GEORGE AFB, CALIFORNIA Final Report
4 Sep. 1980 77 p
(AD-A098438; AD-E850038; Rept-5WW/TFRN-80/001) Avail: NTIS HC A05/MF A01 CSCL 04/2

This terminal forecast reference notebook is for George AFB, CA. It describes the following topics concerning forecasting at George AFB: location, topography and local effects; impact of weather on supported units; synoptic meteorology; climatic aids; operationally significant forecast problems; rules of thumb; special synoptic study; and approved forecast studies. A forecasting guide for Cuddeback Range is also included. GRA

N81-25638# Weather Wing (5th), Langley AFB, Va.
TERMINAL FORECAST REFERENCE NOTEBOOK (TFRN) FOR LUKE AFB, ARIZONA Final Report
2 Jun. 1980 99 p
(AD-A098445; AD-E850039; Rept-5WW/TFRN-80/002) Avail: NTIS HC A05/MF A01 CSCL 04/2

This terminal forecast reference notebook is for Luke AFB, Arizona. It describes the following topics concerning forecasting weather at Luke AFB: location, topography, and local effects; impact of weather on supported units; synoptic climatology; climatic aids; operationally significant forecast problems; approved forecast studies; rules of thumb; and special synoptic studies and references. GRA

N81-25691# Army Aviation Research and Development Command, St. Louis, Mo.
AN AIRBORNE PROGRAMMABLE DIGITAL TO VIDEO CONVERTER INTERFACE AND OPERATION MANUAL
Vincent J. Organic and Edward A. Karcher Feb. 1981 62 p refs
(AD-A096422; AVRADCOM-TR-80-E-4) Avail: NTIS HC A04/MF A01 CSCL 09/2

The operational commands, data structure and storage, and interface to the airborne programmable digital to video converter (DVC) are described. The DVC accepts and converts data from an external digital computer into a standard 525 line television format which can be displayed either in black and white or color. The system was developed for night navigation/pilotage and nap of the Earth helicopter flight studies. M.G.

N81-25698*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
KONFIG AND REKONFIG: TWO INTERACTIVE PREPROCESSING TO THE NAVY/NASA ENGINE PROGRAM (NNEP)
Lawrence H. Fishbach May 1981 59 p
(NASA-TM-82636; E-889) Avail: NTIS HC A04/MF A01 CSCL 09B

The NNEP is a computer program that is currently being used to simulate the thermodynamic cycle performance of almost all types of turbine engines by many government, industry, and university personnel. The NNEP uses arrays of input data to set up the engine simulation and component matching method as well as to describe the characteristics of the components. A preprocessing program (KONFIG) is described in which the user at a terminal on a time shared computer can interactively prepare the arrays of data required. It is intended to make it easier for the occasional or new user to operate NNEP. Another preprocessing program (REKONFIG) in which the user can modify the component specifications of a previously configured NNEP dataset is also described. It is intended to aid in preparing data for parametric studies and/or studies of similar engines such a mixed flow turbofans, turboshafts, etc. E.D.K.

N81-25765*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ACOUSTIC FACILITIES FOR HUMAN FACTORS RESEARCH AT NASA LANGLEY RESEARCH CENTER: DESCRIPTION AND OPERATIONAL CAPABILITIES
Harvey H. Hubbard and Clemans A. Powell Jun. 1981 15 p refs
(NASA-TM-81975; L-14395) Avail: NTIS HC A02/MF A01 CSCL 20A

A number of facilities were developed which provide a unique test capability for psychoacoustics and related human factors research. The design philosophy, physical layouts, dimensions, construction features, operating capabilities, and example applications for these facilities are described. In the exterior effects room, human subjects are exposed to the types of noises that are experienced outdoors, and in the interior effects room, subjects are exposed to the types of noises and noise-induced vibrations that are experience indoors. Subjects are also exposed to noises in an echo-free environment in the anechoic listening room. An aircraft noise synthesis system, which simulates aircraft flyover noise at an observer position on the ground, is used in conjunction with these three rooms. The passenger ride quality apparatus, a device for studying passenger response to noise and vibration in aircraft, or in other vehicles, is described. S.F.

N81-25766*# Southwest Research Inst., San Antonio, Tex.
ENGINE ISOLATION FOR STRUCTURAL-BORNE INTERIOR NOISE REDUCTION IN A GENERAL AVIATION AIRCRAFT Final Report

James F. Unruh and Dennis C. Scheidt Washington NASA May 1981 164 p refs
(Contract NAS1-14861)
(NASA-CR-3427; SwRI-02-4860) Avail: NTIS HC A08/MF A01 CSCL 20A

Engine vibration isolation for structural-borne interior noise reduction is investigated. A laboratory based test procedure to simulate engine induced structure-borne noise transmission, the testing of a range of candidate isolators for relative performance data, and the development of an analytical model of the transmission phenomena for isolator design evaluation are addressed. The isolator relative performance test data show that the elastomeric isolators do not appear to operate as single degree of freedom systems with respect to noise isolation. Noise isolation beyond 150 Hz levels off and begins to decrease somewhat above 600 Hz. Coupled analytical and empirical models were used to study the structure-borne noise transmission phenomena. Correlation of predicted results with measured data show that (1) the modeling procedures are reasonably accurate for isolator design evaluation, (2) the frequency dependent properties of the isolators must be included in the model if reasonably accurate noise prediction beyond 150 Hz is desired. The experimental and analytical studies were carried out in the frequency range from 10 Hz to 1000 Hz. M.G.

N81-25767*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ADDITIONAL NOISE DATA ON THE SR-3 PROPELLER
James H. Dittmar and Robert J. Jeracki May 1981 16 p refs
(NASA-TM-81736; E-804) Avail: NTIS HC A02/MF A01 CSCL 20A

The noise generated by supersonic-tip-speed propellers is investigated. An eight bladed propeller was tested in the Lewis 8- by 6-foot wind tunnel with conditions providing data in the subsonic operating region of the propeller. These conditions resulted in a slight reshaping of the curve for blade passing tone as a function of helical tip Mach number as compared with previous results. Directivity curves with an additional transducer position gave an indication of a lobe pattern for this propeller that was not previously observed. The present data at the aft-most position indicate that some reflections, possibly from the test rig support strut, may have affected the data taken previously. M.G.

N81-25768*# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
VALIDATION OF HELICOPTER NOISE PREDICTION TECHNIQUES Contractor Report, 1979 - 1981
George P. Succi Apr. 1981 75 p refs
(Contract NAS1-15740)
(NASA-CR-165715) Avail: NTIS HC A04/MF A01 CSCL 20A

The current techniques of helicopter rotor noise prediction attempt to describe the details of the noise field precisely and remove the empiricisms and restrictions inherent in previous methods. These techniques require detailed inputs of the rotor geometry, operating conditions, and blade surface pressure distribution. The purpose of this paper is to review those techniques in general and the Farassat/Nystrom analysis in particular. The predictions of the Farassat/Nystrom noise computer program, using both measured and calculated blade surface pressure data, are compared to measured noise level data. This study is based on a contract from NASA to Bolt Beranek and Newman Inc. with measured data from the AH-1G Helicopter Operational Loads Survey flight test program supplied by Bell Helicopter Textron. Author

N81-26006# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
CONTRIBUTION TO THE STUDY OF NONSTATIONARY SIGNALS EMITTED BY MOVING JET ENGINES: APPLICATION TO SPECIAL ANALYSIS AND IMAGING. PART 1

Jacques Hay and Max Ernoult *In its* La Rech. Aerospatiale, Bi-Monthly Bull. No. 1980-4 (ESA-TT-672) Mar. 1981 p 69-82 refs Transl. into ENGLISH of La Rech. Aerospatiale, Bull. Bimestriel (Paris), no. 1980-4, Jul. - Aug. 1980 p 283-296 Original report in FRENCH previously announced as A80-52918/4

Avail: NTIS HC A05/MF A01

A special class of nonstationary random processes were developed in order to deduce the directivity per frequency band by associating with each spectrum, the emission angle. A time frequency spectrum is defined which is shown to be capable of giving back the correct results of the stationary case (far field). It is further shown that knowing the motion of the source, helps in improving the spectral resolution and particularly, the spectral resolution of a synthetic antenna. R.C.T.

N81-26010# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
PRESSURE DISTRIBUTION COMPUTATION ON A NON-LIFTING SYMMETRICAL HELICOPTER BLADE IN FORWARD FLIGHT
Jean-Jacques Chattot and Jean-Jacques Philippe *In its* La Rech. Aerospatiale, Bimonthly Bull. No. 1980-5 (ESA-TT-673) Mar. 1981 p 19-33 refs Transl. into ENGLISH of La Rech. Aerospatiale, Bull. Bimestriel (Paris), no. 1980-5, Sep. - Oct. 1980 p 317-330
Avail: NTIS HC A05/MF A01

Three dimensional unsteady transonic flows past helicopter rotor blades are analyzed. A computer program solving the three dimensional unsteady transonic small disturbance equation is described in detail. It can be applied to a blade of almost arbitrary geometry in the case of a nonlifting rotor. The numerical results are compared with experimental data as well as with computations. An example of application of the code is presented which concerns a blade tip. Results show weaker transonic phenomena on the advancing blade. Author (ESA)

N81-26013# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
CONTRIBUTION TO THE STUDY OF NONSTATIONARY SIGNALS EMITTED BY MOVING JET ENGINES: APPLICATION TO SPECTRAL ANALYSIS AND IMAGING. PART 2

Jacques Hay and Max Ernoult *In its* La Rech. Aerospatiale, Bimonthly Bull. No. 1980-5 (ESA-TT-673) Mar. 1981 p 57-73 refs Transl. into ENGLISH of La Rech. Aerospatiale, Bull. Bimestriel (Paris), no. 1980-5, Sep. - Oct. 1980 p 353-368

Avail: NTIS HC A05/MF A01

In order to install microphones closer to the trajectory of a swiftly moving noise source and to deduce directivities comparable to those measured in the far field, but less sensitive to propagation conditions, a special class of nonstationary random processes was studied. Conventional short time spectral analysis is reviewed; periodogram smoothing and autoregressive modal evaluation are covered. A time frequency spectrum is defined which is capable of giving correct results for the stationary case (far field). Moreover, knowing the motion of the source helps in improving spectral resolution, and particularly spatial resolution for a synthetic antenna. Dedopplerization signal processing provides a resolution similar to that obtained in static tests. Results of experiments on a point source and a jet are given. Author (ESA)

N81-26017# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
MODEL VIBRATIONS BELOW LOW SPEED STALL
X. Vaucheret *In its* La Rech. Aerospatiale, Bimonthly Bull. No. 1980-6 (ESA-TT-687) Dec. 1980 p 17-28 refs Transl. into ENGLISH of La Rech. Aerospatiale, Bull. Bimestriel (Paris), no. 1980-6, Nov. - Dec. 1980 p 387-397 Original report in FRENCH previously announced as A81-19552

Avail: NTIS HC A05/MF A01

Vibrations of a string mounted model beyond stall are analyzed, using the nonlinear equation of motion established for moderate amplitudes around high angle of attack according to a time/angle of attack cycle. The nonlinear solution yields frequency and damping variations versus amplitude and amplitude history beyond stall. A parametric study shows that the effects of maximum angle of attack and the duration of the step at this angle are decisive. For hard stall, the operator can perform the tests from indications that are aimed at avoiding amplitude divergences at nonzero frequency. Author (ESA)

N81-26022# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
CASCADE DESIGN THROUGH AN INVERSE METHOD

G. Meauze and A. Lesain *In its* La Rech. Aerospatiale, Bimonthly Bull. No. 1980-6 (ESA-TT-687) Dec. 1980 p 91-94 ref Transl. into ENGLISH of La Rech. Aerospatiale, Bull. Bimestriel (Paris), no. 1980-6, Nov. - Dec. 1980 p 459-462 Original report in FRENCH previously announced as A81-25875

Avail: NTIS HC A05/MF A01

Solutions are shown for the design of a compressor or turbine cascade. A pseudo-unsteady semi-inverse calculation method is used. Transonic and supersonic cascades are treated. There are two versions of the calculation. The first allows the determination of a blade profile with an imposed pressure distribution as a function of a linear or curvilinear abscissa, partially or totally on the suction side and on the pressure side of the profile; the solidity as well as the pressure and downstream angle are a result of the calculation. The second allows the determination of a blade profile following a given thickness law and a pressure distribution imposed only on the suction side, the solidity being given whereas the downstream angle and pressure result from the calculation. Author (ESA)

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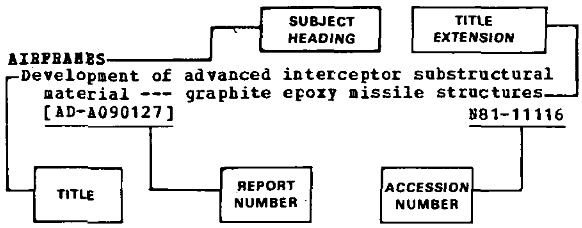

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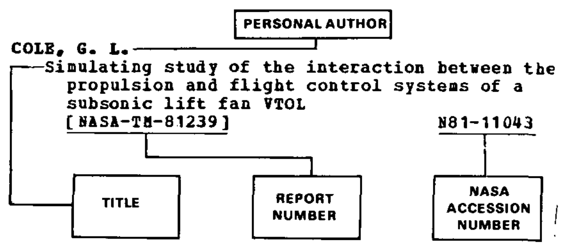

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