NASA

Aeronautical Engineering
A Continuing Bibliography with Indexes

NASA SP-7037(147)
April 1982

National Aeronautics and Space Administration

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ACCESSION NUMBER RANGES

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

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NASA SP-7037(147)

AERONAUTICAL ENGINEERING

A CONTINUING BIBLIOGRAPHY WITH INDEXES

(Supplement 147)

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 March 1982 in

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

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INTRODUCTION

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

This supplement to *Aeronautical Engineering -- A Continuing Bibliography* (NASA SP-7037) lists 347 reports, journal articles, and other documents originally announced in March 1982 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA).*

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

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

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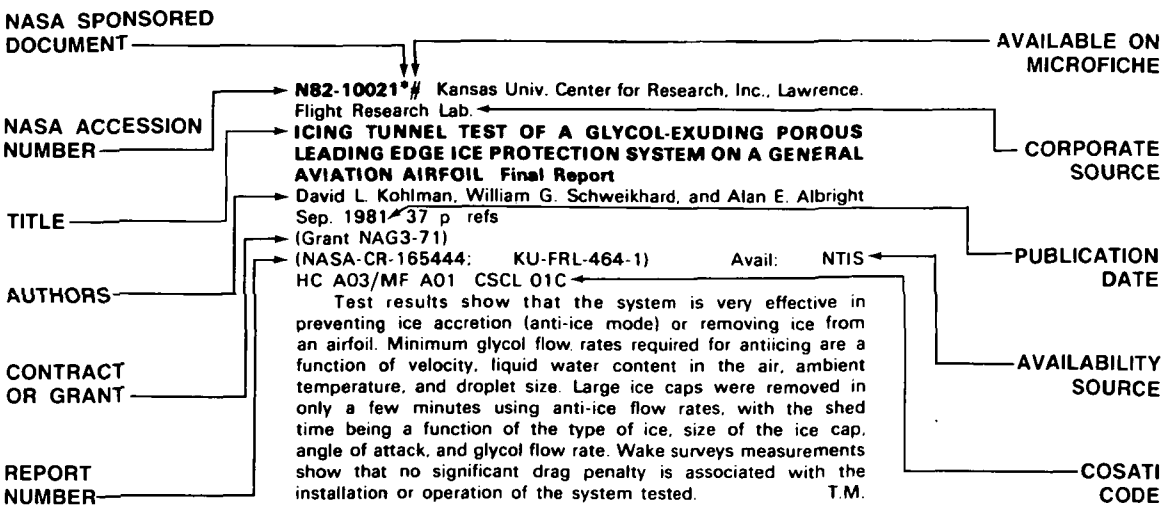

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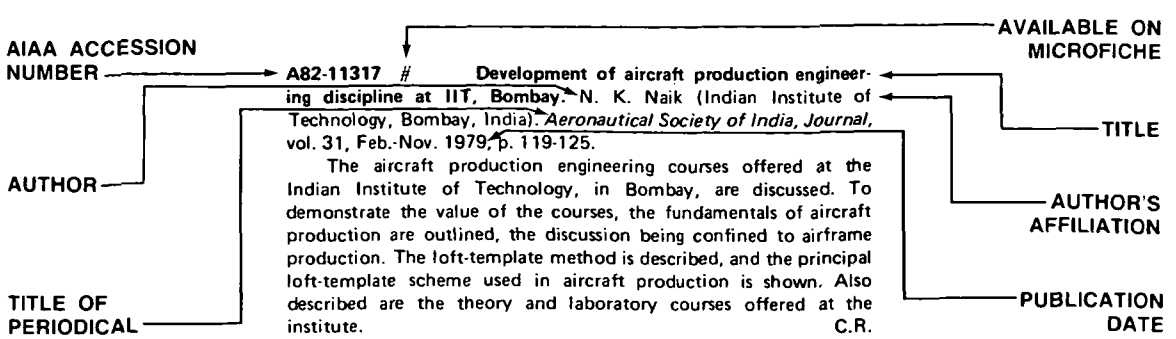

AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 147)

APRIL 1982

IAA ENTRIES

A82-16025 **A high strength ejector release unit for the Tornado.** L. Botting (Normalair-Garrett, Ltd., Yeovil, Somerset, England). *Aircraft Engineering,* vol. 53, Nov. 1981, p. 10-15.

The development of bomb ejector release units (ERU) is traced, and an ERU suitable for the MACE form of suspension is described. The design of the ERU is provided, noting its use on the Tornado and its acceptability for NATO armaments. Reduced drag has been experienced by use of the ERU, and sway-bracing is achieved without crutch arms, although these can added with a conversion kit. A 3.3 m/sec ejection velocity has been measured for a store mass of 544 kg within a reaction limitation of 44.5 kn. The unit withstands 30 firings before maintenance, and recommendations for system alterations for use with smart weapons are outlined. M.S.K.

A82-16040 # **On unsteady aerodynamic forces and moments of the circular cascading blades /Experiments of the outward-flow case/.** K. Nishioka and H. Kuroda (National Defense Academy, Yokosuka, Kanagawa, Japan). *JSME, Bulletin,* vol. 24, Oct. 1981, p. 1739-1747. 15 refs.

The unsteady forces and moments acting on the blades of centrifugal machines which vibrate harmonically in a torsional mode about the mid-chord have been studied experimentally. At small interblade phase angles, the unsteady normal forces and moments are found to vary periodically as a function of the cascade geometry, flow coefficient, and the wake length of vortex distribution; for small flow coefficients, the damping moments become negative. When the interblade phase angle is more than 180 deg, the aerodynamic damping moment becomes negative for relatively small reduced frequencies. As the interblade phase angle increases still further, the damping moment becomes negative even at comparatively large reduced frequencies. Experimental results are in qualitative agreement with theory. V.L.

A82-16091 # **Workshop report for the AIAA 6th Aeroacoustics Conference.** C. K. W. Tam (Florida State University, Tallahassee, FL). *Journal of Aircraft,* vol. 18, Dec. 1981, p. 1005-1010. 5 refs.

Summaries are given of the workshops conducted at the AIAA 6th Aeroacoustics Conference, each summary having been prepared by the workshop chairman. The six workshops are: jet noise, duct acoustics, turbomachinery noise, aircraft interior noise, airframe and propulsive lift noise, and propeller and helicopter noise. It is noted that the primary purpose of the workshops is to provide a forum where new ideas and concepts can be openly discussed and controversies freely debated. C.R.

A82-16092 # **Infrared emissions from turbofans with high aspect ratio nozzles.** R. Decher (Washington, University, Seattle, WA). *Journal of Aircraft,* vol. 18, Dec. 1981, p. 1025-1031. 12 refs.

A mixed flow turbofan is analyzed from the point of view of IR emission characteristics. A simple absorption coefficient model of the core flow gas displays the potential effectiveness of high aspect ratio nozzles as a variable in the design of aircraft engine installations for low IR signature. The simplicity of the model described and the limited view perspectives used to assess the signature restrict the usefulness of the results to that of guiding preliminary design. In general, more precise solutions are complex and depend on specification of a relatively large number of independent variables to describe the source - seeker geometry, weather, etc. The level of effort to carry out more accurate analysis may be inconsistent with the preliminary design process where simple criteria such as those described may be sufficient to select the best of several candidate designs. The influence of cycle parameters is assessed using an n-th power dependence of radiation on temperature and a simple mixing model to estimate the core length. The analysis shows that cycle parameters which improve cycle efficiency and thus fuel consumption also reduce IR emissions. Bypass ratio near unity gives low IR signature for both optically thin and thick spectral regions. (Author)

A82-16093 # **Symmetric flow characteristics of thin rectangular wings.** E. S. Larson (Flygtekniska Forsoksanstalten, Stockholm, Sweden). *Journal of Aircraft,* vol. 18, Dec. 1981, p. 1070, 1071. 7 refs. Research supported by the Defence Materiel Administration.

Semiempirical analytic expressions are presented which are shown to contain in themselves Mach number influences that are in very good agreement with the investigated panel method results for M less than or equal to 1, the intended regime of application of the equations. The differences between the equations and the theoretical results are small and in fact only of minor significance when shortcut evaluations are desired. It is noted, however, that a comparison with relevant transonic experimental results, if such results existed, would show an appreciable discrepancy in the transonic regime as a result of the neglect of genuine transonic terms in the linearized theory. C.R.

A82-16135 # **Aerospace highlights 1981.** *Astronautics and Aeronautics,* vol. 19, Dec. 1981, p. 24-34, 36-40, 42-108.

Topics such as air transportation systems, aeroacoustics, aerospace power systems, aircraft design, interactive computer graphics, and flight simulation are considered. Attention is also given to flight mechanics, extendible exit cones, general aviation systems, LTA vehicles, and testing programs. Plasma dynamics and lasers are discussed, as are solid rockets, propellants, software systems, sensors, marine technologies, and CAD/CAM. Finally, papers are presented on terrestrial energy systems, structural dynamics, space sciences, space structures, thermophysics, V/STOL aircraft, aerospace maintenance, communications, economics, and electric propulsion, as well as materials, management, and guidance and control. M.S.K.

A82-16143 **Aircraft composite materials and structures.** S. J. Dastin (Grumman Aerospace Corp., Advanced Development Section, Bethpage, NY). *SAMPE Journal,* vol. 17, Nov.-Dec. 1981, p. 10-15.

A ten year advanced composite aircraft structural history is reviewed. Composite material development is traced from fiberglass epoxy to mixed fiber polymer hybrids containing boron, graphite and Kevlar. Typical composites processing and tooling approaches utilized in the industry is given along with techniques being developed for high volume production. (Author)

A82-16145 **The well tempered transport aircraft engine /The Sir Henry Royce Memorial Lecture/.** J. G. Borger. *Aeronautical Journal,* vol. 85, Nov. 1981, p. 395-413.

An historical account is presented of the development, over 45

years, of nine piston and eight turbofan and turbojet engines as installed in 22 different transport aircraft. Attention is given to the contribution of engine design to improvements in overall aircraft performance, as highlighted by such contrasting figures as (1) the 600-800 hour overhaul periods considered acceptable during the Second World War and the 10,000-hour periods typical of present transport aircraft, and (2) the 150 mph speeds and 2400-mile ranges of 84,000-lb aircraft carrying 20 passengers by comparison to 550 mph, 4500-mile range figures for 800,000-lb aircraft carrying 450 passengers. Performance figures are given for engines representative of the state-of-the-art at pivotal points of engine and airframe design development. O.C.

A82-16147 Digital active control system for load alleviation for the Lockheed L-1011. G. E. Bendixen (Rockwell International Corp., Cedar Rapids, IA), R. F. O'Connell, and C. D. Siegert (Lockheed-California Co., Burbank, CA). *Aeronautical Journal,* vol. 85, Nov. 1981, p. 430-436. 5 refs.

A digital active control system (ACS) is described which is used to reduce maneuver and gust loads in the extended-wing L-1011 TriStar, permitting improved aircraft performance with minimal wing structure changes. Reliability requirements aimed at high system availability are satisfied by means of a dual-dual, fail operational system architecture in which each of the two ACS computers contains two digital processors. The digital computer provides for control of the aileron servos, self-test capability and redundancy management. Attention is given the compatibility of automatic and primary flight control systems, the digital sensor data transfer functions of the ACS computer and its Algol-like software configuration, redundancy management, and servo and computer monitoring. O.C.

A82-16148 Scattering of sound by a vortex ring. T. Kambe and U. M. Oo (Kyushu University, Fukuoka, Japan). *Physical Society of Japan, Journal,* vol. 50, Oct. 1981, p. 3507-3516. 13 refs.

The scattering of a plane acoustic wave by a vortex ring is analyzed in terms of the Lighthill theory of aerodynamic sound generation. A formula for the scattered pressure is obtained from the term representing the interaction of the sound wave with the flow in the source terms of the inhomogeneous wave equation, and is applied to the case of scattering by a circular vortex ring in translational motion. Scattering amplitudes and cross sections are evaluated numerically for the case of slow motion. The total scattering cross section is found to depend not only on the wavelengths of the incident wave, but on the Mach number and direction of a vortex motion. A comparison reveals the scattering power of the vortex ring to be small in relation to that of a solid sphere of the same size. S.C.S.

A82-16153 Effect of fleet size on estimates of safety against airframe fatigue (Vliv velikosti flotily na odhad unavove spolehlivosti draku letounu). V. Nejedly. *Zpravodaj VZLU,* no. 3, 1981, p. 111-126. 22 refs. In Czech.

A method is proposed for determining the effect of fleet size on the values of safety coefficients used for aircraft service life estimation. The proposed theoretical solution is based on a statistical analysis of the fatigue damage sequence. Results are presented in a graphical form convenient for practical applications. V.L.

A82-16164 The application of programmable pocket calculators for computations during survey flights. H. C. Zorn (International Institute for Aerial Survey and Earth Sciences, Enschede, Netherlands). *ITC Journal,* no. 3, 1981, p. 308-333.

Computation during survey flights can be effectively achieved using a programmable pocket calculator such as the Hewett-Packard C41 model. Using this calculator, formulas and programs have been developed for computing survey turns; wind star; heading and ground speed, given wind vector and required course; pressure altitude required to reach required true altitude; and true airspeed given indicated airspeed, air temperature, and pressure altitude. Other potential applications include the conversion of latitude and longitude to UTM zone and coordinates, and great circle and loxodrome computations. S.C.S.

A82-16172 Supersonic nozzles without shocks. M. Burnat (Warszawa, Uniwersytet, Warsaw, Poland). *Archiwum Mechaniki Stosowanej,* vol. 33, no. 1, 1981, p. 117-132. 7 refs.

The Busemann hodograph technique is extended to three-dimensional flows of ideal gases. By using the proposed method of Bernoulli manifolds, it is shown that there exists a wide class of nozzles which transform one uniform supersonic flow into another one without shock. The present analysis can provide a basis for a numerical method aimed at constructing nozzles with specified characteristics. V.L.

A82-16174 Improvement of the first-ply-failure strength in laminates by using softening strips. C. T. Sun (Purdue University, West Lafayette, IN) and P. M. Voit. *Composites Technology Review,* vol. 3, Fall 1981, p. 109-113. U.S. Department of Transportation Contract No. RC-92004.

Results of a study of softening strips for various laminates are reported. Baseline systems, all graphite/epoxy laminates, were subjected to stress analysis by means of a finite element program using equivalent elastic constants, with a maximum stress criterion of the first ply failure. Softening strips were added and the tests were repeated. The strip reduced the stress concentration in notched laminated composites and increased the load carrying capability for the first ply failure. It is noted that stresses in individual plies must be calculated to determine the ply failure strength, and also that the width of the softening strip significantly affects the load-carrying capability of laminates. The results are applicable to aircraft structures with fastener holes subject to stress concentrations. M.S.K.

A82-16178 The Federal Radionavigation Plan. W. K. May (U.S. Coast Guard, Washington, DC). *(Institute of Navigation, Annual Meeting, Annapolis, MD, June 9-11, 1981.) Navigation,* vol. 28, Fall 1981, p. 231-246.

Policies and plans for the U.S. radionavigation services which are delineated by the Federal Radionavigation Plan are described. Areas of authority and responsibility as well as management structure for defining cost requirements and cost-effective operation are provided, along with various navigation phases and current and future requirements for each phase. Federally operated systems with a high degree of common use, both military and civil, including Loran-A, Loran-B, Omega, VOR, VOR/DME, VORTAC, TACAN, ILS, TRANSIT, MLS, Radiobeacons, and the Navstar GPS are examined for a suitable mix to satisfy user requirements. A preliminary recommendation for the future navigation mix will be issued by the DOD/DOT in 1983, and a decision at the national level will be forthcoming in 1986. It is noted that maritime navigation is tending toward a minimum number of systems, while aviation has witnessed heavy investments in VOR/DME. M.S.K.

A82-16187 Determination of the flammability characteristics of aerospace hydraulic fluids. C. E. Snyder, Jr. (USAF, Materials Laboratory, Wright-Patterson AFB, OH), A. A. Krawetz, and T. Tovrog (Phoenix Chemical Laboratory, Inc., Chicago, IL). *(American Society of Lubrication Engineers, Annual Meeting, 35th, Anaheim, CA, May 5-8, 1980.) Lubrication Engineering,* vol. 37, Dec. 1981, p. 705-713; Discussion, p. 713, 714.

The hazards associated with the flammability characteristics of aerospace hydraulic fluids are well known. In an effort to reduce these hazards, commercial airlines converted to the use of a phosphate-ester-based, fire-resistant hydraulic fluid with the advent of jet aircraft in the early 1950s. More recently, some of the military aircraft were converted to a compatible, synthetic-hydrocarbon-based hydraulic fluid for the same reason. The flammability characteristics of these and other aerospace hydraulic fluids and test methods used to determine them are discussed. Since a deficiency exists in the area of determination of the flame and/or fire-propagation characteristics of fluids and lubricants, a new test method was developed and is described. The degree of correlation of the data from this test method with other flammability tests is discussed. (Author)

A82-16267 † An experimental study of the combustion of liquid hydrocarbon fuel sprayed into a diffusion hydrogen-air jet (Eksperimental'noe issledovanie goreniia zhidkogo uglevodorodnogo topliva raspylennogo v diffuzionnom vodorodno-vozdushnom fakele). Iu. M. Annushkin and G. F. Maslov. *Fizika Goreniia i Vzryva,* vol. 17, Sept.-Oct. 1981, p. 34-38. 7 refs. In Russian.

Simultaneous combustion of liquid hydrocarbon fuel and gaseous hydrogen has been investigated experimentally using a

coaxial jet placed in an air stream along the central axis of a subsonic wind tunnel of 160 mm diameter. It is shown that when the liquid fuel is sprayed into the stream, stable combustion with moderate flame lengths is achieved in a high-velocity air stream even at low hydrogen concentrations. V.L.

A82-16289 † **Mechanism for the elimination of instability in a shimmy problem (Mekhanizm ustraneniia neustoichivosti v zadache o shimmi).** L. G. Lobas and N. V. Nikitina (Akademiia Nauk Ukrainskoi SSR, Institut Mekhaniki, Kiev, Ukrainian SSR). *Matematicheskaia Fizika,* no. 30, 1981, p. 24-28. In Russian.

A theoretical study is presented of a square-law damper suitable for reducing the shimmy of a landing gear strut. Numerical integration shows that the square-law damper leads to the stabilization of self-oscillations, which are then reduced by dry friction. B.J.

A82-16290 † **Self-oscillations of the front caster wheel strut for a given track width under the assumption of the wheel drift hypothesis (Avtokolebaniia orientiruiushcheisia stoiki shassi pri nalichii vynosa kolesa v predpolozhenii gipotezy uvode).** L. G. Lobas (Akademiia Nauk Ukrainskoi SSR, Institut Mekhaniki, Kiev, Ukrainian SSR). *Matematicheskaia Fizika,* no. 30, 1981, p. 28-34. In Russian.

A theoretical analysis of the self-oscillations of a front caster wheel strut is presented. The dependence of the limit-cycle amplitude on the characteristics of a square-law damper connected in parallel to the elastic element is determined. Numerical results are presented on the occurrence of self-oscillations at velocities above the critical one. B.J.

A82-16335 FILE-IB aircraft flight test program. H. M. Thomas (Martin Marietta Aerospace, Denver, CO). In: Guidance and control 1981; Proceedings of the Annual Rocky Mountain Guidance and Control Conference, Keystone, CO, January 31-February 4, 1981. San Diego, CA, Univelt, Inc., 1981, p. 363-378. 5 refs. (AAS 81-041)

The Feature Identification and Location Experiment (FILE-IB) is an earth observation experiment, which was successfully flown on the NASA CV-990 aircraft. The FILE-IB classifies earth scenes into four categories: water, bare land, vegetation, and cloud/snow. The FILE system consists of three major elements: electronics for experiments control, sensors to provide multispectral image data, and a buffer memory and magnetic tape recorder for data storage. The sensors have two silicon-charged coupled device television cameras, one for the 650 nanometer (VR) band, and the other for the 850 nanometer (NIR) band. The data, obtained during eight flight missions over low altitude regions of the U.S. west coast, were analyzed on both a micro and a macro scale: the micro scale analysis, which concentrates on individual scenes, identifies specific classification problems; the macro scale analysis, operating on the statistics for the population of all the scenes, ensures that the algorithm performs well over a variety of scenes. J.F.

A82-16404 # **Direct approach to aerodynamic design problems.** W. C. Chin. *ASME, Transactions, Journal of Applied Mechanics,* vol. 48, Dec. 1981, p. 721-726. 11 refs.

'Direct' small disturbance approaches to inviscid aerodynamic 'inverse' or 'design' problems in two- and three-dimensional subsonic, supersonic, and transonic flow are presented which extend the stream function method of Chin and Rizzetta (1979). The shape solutions generally involve nonlinear differential equations of mixed type for scalar 'streamlike' functions. Dualities relating the analysis problem for camber to the design problem for thickness and the design problem for camber to the analysis problem for thickness are given for planar flow; both closed trailing edges and cusped ones, which are generally opened and which model the displacement effects of viscous wakes, are treated. C.R.

A82-16417 # **Resonant whirling of aircraft propeller-engine systems.** S. H. Crandall and J. Dugundji (MIT, Cambridge, MA). *ASME, Transactions, Journal of Applied Mechanics,* vol. 48, Dec. 1981, p. 929-935. 5 refs.

At a critical speed, a light aircraft can experience severe vibrations in steady flight in which the propeller blades vibrate at one frequency while the engine block vibrates at a lower frequency. A model is presented which explains this phenomenon. A three-bladed propeller-engine system is considered to have six rigid-body degrees of freedom plus six blade vibration degrees of freedom. This system is analyzed and simplified by introducing a constraint based on observation of the flight phenomenon. Multiblade coordinates are introduced and a linear eigenvalue problem is derived which describes whirling motions of the engine coupled to progressive waves of blade deformation which circle the propeller disk. These whirling motions are excited by harmonics of the transverse forces on the engine due to the explosive gas pressures in the cylinders. The effects of varying the propeller blade pitch angle are studied and a high-speed instability mechanism is examined. (Author)

A82-16428 # **Cavitation inception in spool valves.** C. S. Martin (Georgia Institute of Technology, Atlanta, GA), H. Medlarz (Karlsruhe, Universität, Karlsruhe, West Germany), D. C. Wiggert (Michigan State University, East Lansing, MI), and C. Brennen (California Institute of Technology, Pasadena, CA). *ASME, Transactions, Journal of Fluids Engineering,* vol. 103, Dec. 1981, p. 564-575; Discussion, p. 575, 576. 40 refs. Contract No. F33615-77-C-2036.

Cavitation has been investigated in directional control valves in order to identify damage mechanisms characteristic of components of aircraft hydraulic systems. Tests have been conducted in a representative metal spool valve and in a model three times larger. Data taken under noncavitating conditions with both valves showed that the position of the high-velocity annular jet shifts orientation, depending upon valve opening and Reynolds number. By means of high-frequency response pressure transducers strategically placed in the valve chamber cavitation could be sensed by the correlation of noise with a cavitation index. The onset of cavitation can be detected by comparing energy spectra for a fixed valve opening and a constant discharge. Another sensitive indicator of cavitation inception is the ratio of cavitating to noncavitating spectral densities. The incipient cavitation number as defined in this investigation is correlated with the Reynolds number for both valves. (Author)

A82-16432 # **Aerodynamic effects of shape, camber, pitch, and ground proximity on idealized ground-vehicle bodies.** A. R. George (Cornell University, Ithaca, NY). *ASME, Transactions, Journal of Fluids Engineering,* vol. 103, Dec. 1981, p. 631-637; Discussion, p. 637, 638. 17 refs.

A82-16456 Applications for Nonweiler Waverider spacecraft. D. Lunan. *British Interplanetary Society, Journal (Space Chronicle),* vol. 35, Jan. 1982, p. 45-47. 11 refs.

The use of the Waverider concept for an atmospheric entry vehicle is discussed. The Waverider has a flat upper surface, a straight leading edge, and anhedral 'V' shaped wings. Entering an atmosphere at near-orbital speed, the craft would fly with nose-up at a high angle of incidence, riding a plasma shock wave, heating to an equilibrium temperature of 1500 C, and offer the opportunity for a low-speed landing at a wider choice of sites than the Shuttle. The flat upper surface protects against radio black-out and can be used as a platform for planetary exploration instruments. Martian aerographic, and Venus and Jupiter missions are examined, noting that the Waverider would probably never land on Venus and Jupiter due to its aerodynamic characteristics and the densities and wind speeds of the two planets' atmospheres. The use of mass-driver launched Waveriders to deliver raw materials directly from the moon to earth is also explored. D.H.K.

A82-16557 Management of a large avionics project. H. R. Sandilands (Marconi Avionics, Ltd., Hemel Hempstead, Herts., England) and B. Taylor (Marconi Avionics, Ltd., St. Albans, Herts., England). *IEE Proceedings, Part F - Communications, Radar and Signal Processing,* vol. 128, pt. F, no. 7, Dec. 1981, p. 408-411.

The management of a major avionics project is discussed, using as an example the Airborne Early Warning Nimrod Mission System Avionics project, sponsored by the UK Ministry of Defense. A multilayer project family tree is outlined; this family tree structure is the basis for the identification and interrelation of all the elemental and incremental tasks which must be performed to implement the project. It serves to allocate managerial responsibility for conduct and achievement on a direct, one-to-one basis. It is fundamental to all management and control activities, such as cost and timescale estimation and attribution, preparation of program networks, identification of milestones and key events, allocation of resources,

preparation of management information, as well as progress, cost and performance reporting. It may even play a future role in forming the contract with the customer. J.F.

A82-16558 Special problems associated with aircraft radomes. D. A. Conti (British Aerospace Public, Ltd., Co., Dynamics Group, Stevenage, Herts., England). *IEE Proceedings, Part F - Communications, Radar and Signal Processing,* vol. 128, pt. F, no. 7, Dec. 1981, p. 412-418. 13 refs.

The paper discusses the design and manufacturing aspects of nose radomes for high-speed aircraft. Aircraft radomes are an acceptable comprise of the conflict between the electrical, structural, environmental and aerodynamic requirements. The paper reviews the requirements placed on the design and summarizes the basic radome design and construction methods, as applied in current radome technology, concluding with an examination of the shortcomings of existing radomes and an indication of possible solutions to current problems. (Author)

A82-16559 Advanced cockpit for tactical aircraft. G. Roe (British Aerospace Public, Ltd., Co., Aircraft Group, Brough, Humberside, England). *IEE Proceedings, Part F - Communications, Radar and Signal Processing,* vol. 128, pt. F, no. 7, Dec. 1981, p. 419-426. 8 refs.

The progressive development of aircraft systems and changes in their requirements over the past 20 years are shown to have affected the cockpit of the Harrier aircraft. Several mature technologies, as well as several which are likely to mature within the next ten years are described. Ways in which these technologies may be used to redesign an all-electronic cockpit, while still meeting the pilot's basic need to remain in overall control of the aircraft and its system, are discussed. A final advanced cockpit design is offered: it consists of a side-mounted flight controller and sliding-throttle arrangement, with the appropriate controls and switches to facilitate a hands-on-throttle-and-stick operation. All once-aflight-type switches are located on the right console, reducing hands-off stick operation, while all major system panels are located on the left console. When possible, all controls are located on a priority and frequency-of-use basis. J.F.

A82-16560 Techniques for overhead-wire detection. K. E. Potter (Royal Signals and Radar Establishment, Malvern, Worcs., England). *IEE Proceedings, Part F - Communications, Radar and Signal Processing,* vol. 128, pt. F, no. 7, Dec. 1981, p. 427-432.

The paper describes three wire detection techniques. A millimetre-wave pulsed radar system operating on the grating returns from wires with a regular mechanical structure is discussed. Experimental evidence at 35 GHz proves the operational philosophy of the system and suggests that higher frequencies would produce more successful results. A passive 50 Hz system operating on the magnetic flux produced by live overhead power cables is shown to be capable of indicating the presence and direction of such wires at ranges in excess of 500 m. Finally, a CO2 pulsed laser radar is discussed together with a processing algorithm to highlight wire presence. It is shown that identification of a 1/8 in. diameter wire at 200 m range and in a visibility of 200 m is possible using only 4 W of laser power. (Author)

A82-16561 Trends in maintainability and reliability of avionics systems with particular reference to DCAD Technical Publication 1/77. A. F. Loy (Ministry of Defence /Procurement Executive/, London, England). *IEE Proceedings, Part F - Communications, Radar and Signal Processing,* vol. 128, pt. F, no. 7, Dec. 1981, p. 433-439. 6 refs.

The procurement situation with respect to reliability and maintainability (R&M), prior to the DCAD Technical Publication 1/77 (1978), is reviewed first. The general contents of the document and the translation of the document's principles into a form suitable for contracts are then discussed. Application of the publication is outlined, and an indication is given of the direction R&M activity should proceed in order to meet the challenges of future systems. Particular attention is given to the reliability parameter, which has presented a more serious problem during the design, development, and production phases. J.F.

A82-16562 Head-up displays - The integrity of flight information. L. L. Dopping-Hepenstal (British Aerospace Public, Ltd., Co., Aircraft Group, Kingston-upon-Thames, Surrey, England). *IEE Proceedings, Part F - Communications, Radar and Signal Processing,* vol. 128, pt. F, no. 7, Dec. 1981, p. 440-442.

Single-pilot military aircraft are usually designed with head-up displays (HUD), which enhance the safe operational flight envelope and the flexibility of weapons delivery. The shortcomings of the self-monitoring circuits in these HUD systems require the pilot to continually cross-check the display with the conventional head-down instruments. A fully integrated approach to the system design is required which would tackle the subject as a whole, and not as a set of individual equipment-related problems. Sensor redundancy is the most straightforward way to improve system integrity, but is likely to have the highest cost, weight, and installation penalty. A general solution will probably not be found, since each aircraft system will have to be studied with respect to its equipment fit, as well as its operational task and environment. J.F.

A82-16563 VOR waveform synthesis and calibration. R. W. White, R. N. Clarke, and R. W. Yell (National Physical Laboratory, Teddington, Middx., England). *IEE Proceedings, Part F - Communications, Radar and Signal Processing,* vol. 128, pt. F, no. 7, Dec. 1981, p. 443-450. 9 refs.

The development and assessment of two standard VHF omni-range radial systems (VOR) waveform synthesizers and a VOR waveform decoder are considered. The synthesizers are designed to regenerate waveforms for calibrating aircraft receivers on the ground. One synthesizer, a computer-controlled system, is excellent for producing imperfect waveforms; the second synthesizer standard is a compact portable unit suitable for field system testing and standards dissemination. The decoder design is based on digital sampling and storage of one cycle of the composite audio waveform; the data is then Fourier transformed and analyzed to determine the FM depth and the differential phase of the two 30 Hz modulating signals, the VOR bearing angle. The standard synthesizer and decoder standards have demonstrated uncertainties not exceeding the 95% confidence level. The sensitivity of the detection method to digitization uncertainties, asynchronism between decoder and generator, anharmonic 9.96 kHz subcarriers, and random amplitude and phase noise is also investigated. J.F.

A82-16564 Design and performance of airborne radomes - A review. G. A. E. Crone (ESA, European Space Research and Technology Centre, Noordwijk, Netherlands), A. W. Rudge (ERA Technology, Ltd., Leatherhead, Surrey, England), and G. N. Taylor (Royal Signals and Radar Establishment, Malvern, Worcs., England). *IEE Proceedings, Part F - Communications, Radar and Signal Processing,* vol. 128, pt. F, no. 7, Dec. 1981, p. 451-464. 68 refs.

Radomes for airborne amplification can be classified as either (1) large aircraft radomes of the nose-cone or under-fuselage type, (2) small aircraft radomes flush-mounted to the airframe, or (3) missile radomes. The geometry of the radome often leads to severe degradation of the electrical performance of any enclosed antenna. The requirement for a good aerodynamic shape is shown to influence the electromagnetic design of the radome, and the choice of dielectric materials is limited by the needs for structural strength, low weight, thermal stability, and rain erosion resistance. The radome performance may also be compromised by the scattering of electromagnetic waves from metallic pilot tubes and lightning protection strips outside the radome, as well as dielectric pressure tubes within it. The electromagnetic design of the three types of radomes are reviewed, sources of degradation of the enclosed antenna radiation pattern are examined, and the design requirements of the radomes, with respect to their operational environment, are discussed. J.F.

A82-16692 A method for predicting the lifetime of gas turbine blades. H. Policella and J.-P. Culié (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *Fatigue of Engineering Materials and Structures,* vol. 4, no. 2, 1981, p. 157-172. 17 refs.

The article describes a method developed at ONERA for predicting the lifetime of gas turbine blades. This method makes use of non-linear viscoplastic constitutive laws, the problem being solved from a plane cross section assumption and through a time-step linearization. The initiation of the first macroscopic crack is calculated from a stabilized cycle condition. A blade test rig has been

developed for checking the method under load and temperature conditions that are as close as possible to operational ones. The results of two series of test on convenction cooled IN100 blades prove the method to be acceptable to design engineers. (Author)

A82-16734 Technological innovation for success - Liquid hydrogen propulsion. J. L. Sloop (International Consultants on Energy Systems, Bethesda, MD). In: Between Sputnik and the Shuttle - New perspectives on American astronautics. San Diego, CA, Univelt, Inc., 1981, p. 225-239. 23 refs.

Hydrogen produces the highest exhaust velocity of all chemical fuels, thus producing the highest rocket velocities, but also has a low density, only one-quarter that of water. The development of hydrogen as a rocket fuel was begun in the early 1900s, though experiments were few due to the difficulty of obtaining liquid hydrogen. Para- and orthohydrogen were discovered in 1926, and catalysts to prevent the natural conversion of para to ortho, which tended to boil away liquefied hydrogen, were invented in the 1950s. Rocket testing using liquid hydrogen began in the 1940s, and the demand for liquid hydrogen increased for testing of thermonuclear weapons, although the supply of LH did not grow until the possibility for its use as a fuel for high altitude reconnaissance planes was investigated. Once NASA was created, the progress of an LH fueled stage for the Atlas rocket accelerated LH research, and led to NASA control of the development of the Saturn CV launch vehicle. An alternative use of liquid hydrogen as an automotive fuel is indicated. M.S.K.

A82-16746 Noise control measures in the new Singapore International Airport. R. B. W. Heng (National University of Singapore, Kent Ridge, Singapore). *Applied Acoustics,* vol. 14, Nov.-Dec. 1981, p. 439-453. 9 refs.

Noise control designs for the passenger terminal building of the Singapore International Airport are discussed. Three internal noise level areas were defined: noncritical public areas, general office areas, and conference rooms and the VIP lounge. Overall facade sound insulation comprised 27 mm of laminated glass. Rockwool blankets and perforated metal sheets were used in ceilings to lower reverberation levels in public areas. All contracted components were laboratory tested as a quality control procedure. Sound insulation requirements ranged from 32-45 dB, including doors, and an articulation loss level of 20% was set as a maximum for the distributed speaker public address system. M.S.K.

A82-16800 Grumman Tomcat - In a class of its own. R. M. Braybrook. *Air International,* vol. 22, Jan. 1982, p. 23-30.

Design, performance, and operational features of the F-14A Tomcat fighter are discussed. The validity of the variable geometry wings was established by NASA in wind tunnel tests which defined hinge points far enough away from the fuselage to stabilize the aerodynamic center in its rearward movement during a swept back mode. The Tomcat has a maximum mission weight of 70,426 lb with six Phoenix missiles, a maximum speed over Mach 2, can take off in 1300 ft, and land at 122 kt in 2500 ft. The wings sweep from 20-68 deg, roll is provided by differential tailplane movements, and the plane flies with no angle-of-attack restrictions. The weapons and target detection systems are described, noting the presence of an IR sensor to offset radar deficiencies in a jamming environment. Future versions of the F-14 will feature television for long range visual target identification, an improved Phoenix missile with longer range and better target resolution in a cluttered environment, and an expanded computer radar memory. M.S.K.

A82-16901 # Experience with high performance V/STOL fighter projects at MBB. F. Aulehla and G. K. Kissel (Messerschmitt-Bölkow-Blohm GmbH, Munich, West Germany). *American Institute of Aeronautics and Astronautics and NASA Ames Research Center, V/STOL Conference, Palo Alto, CA, Dec. 7-9, 1981, AIAA Paper 81-2614.* 16 p. 9 refs.

Flight control systems and aerodynamic aspects of experimental V/STOL aircraft are discussed. The VJ 101 C featured tilting engines for increased thrust, reheat for takeoff, simple translation, triangular decentralization of the engines for thrust modulation, and moderate ground effects. Two experimental aircraft were built, with and without reheat, capable of Mach 2 and Mach 1.04, respectively. The mechanical flight control system and tests are outlined, both for hover rig and flight configurations. Ground suction, acoustic and thermal loading, sodium silicate coatings to avoid ground corrosion, and recirculation are considered. Results of the follow-on project to the VJ 101 C, the AVS, which was developed by NASA, are reviewed, and it is noted that trends toward thrust-to-weight ratios exceeding one, in concert with low wing loading, favor the development of V/STOL aircraft. M.S.K.

A82-16902 * # A summary of V/STOL inlet analysis methods. D. P. Hwang and J. H. Diedrich (NASA, Lewis Research Center, Cleveland, OH). *American Institute of Aeronautics and Astronautics and NASA Ames Research Center, V/STOL Conference, Palo Alto, CA, Dec. 7-9, 1981, AIAA Paper 81-2628.* 8 p. 21 refs.

Methods to analyze the aerodynamic performance of V/STOL inlets at the NASA Lewis Research Center are discussed with emphasis on recent extensions and applications. Methods include the specification of the Kutta condition for a slotted inlet, the calculation of suction and tangential blowing for boundary layer control, and the analysis of auxiliary inlet geometries at angles of attack. An optimum diffuser velocity distribution is also developed, which can result in the shortest no-boundary layer control inlet and the lowest loss for the required amount of diffusion. D.L.G.

A82-16903 # Development and validation of the V/STOL aerodynamics and stability and control manual. C. Henderson and M. M. Walters (U.S. Naval Material Command, Naval Air Development Center, Warminster, PA). *American Institute of Aeronautics and Astronautics and NASA Ames Research Center, V/STOL Conference, Palo Alto, CA, Dec. 7-9, 1981, AIAA Paper 81-2611.* 8 p. 13 refs.

A V/STOL Aerodynamics and Stability and Control Manual was developed to provide prediction methods which are applicable to a wide range of V/STOL configurations in hover and transition flight, in and out of ground effect. Propulsion-induced effects have been combined with unpowered aerodynamics in a buildup of total forces and moments for the jet-lift concept, so that total aerodynamics can be used to predict aircraft stability, control, and flying qualities characteristics. Results of longitudinal aerodynamic predictions have been compared with test data, and indicate that the methods are fast, inexpensive, and within the desired accuracy for the objective preliminary design stage. D.L.G.

A82-16904 # A summary of jet-impingement studies at McDonnell Douglas Research Laboratories. W. W. Bower, K. R. Saripalli, and R. K. Agarwal (McDonnell Douglas Research Laboratories, St. Louis, MO). *American Institute of Aeronautics and Astronautics and NASA Ames Research Center, V/STOL Conference, Palo Alto, CA, Dec. 7-9, 1981, AIAA Paper 81-2613.* 13 p. 12 refs. Contracts No. N00014-76-C-0494; No. N00014-79-C-0635.

It has been the primary objective of the considered studies to determine and describe, through calculation, measurement, and visualization of the flowfields, the basic character of isolated and interacting impinging jets. The secondary objective has been to provide computed and experimental flow properties which can be used in the development and verification of empirically based prediction methodologies for complete aircraft configurations. The studies have resulted in the solution of the Reynolds-averaged Navier-Stokes and Jones-Launder turbulence model equations for two- and three-dimensional configurations and in the acquisition of an extensive data base and flow-visualization photographs for these configurations. G.R.

A82-16905 # An investigation of the use of a propulsive wing/canard concept for improved maneuvering. V. R. Stewart (Rockwell International Corp., Columbus, OH). *American Institute of Aeronautics and Astronautics and NASA Ames Research Center, V/STOL Conference, Palo Alto, CA, Dec. 7-9, 1981, AIAA Paper 81-2622.* 8 p.

The propulsive wing concept is an extension of the flap boundary layer control utilized on several aircraft configurations. Several studies have been made regarding the benefits of the propulsive wing in STOL operation. However, the propulsive wing/canard provides performance benefits also in areas other than STOL. It is expected to improve the maneuvering capability by providing reduced drag at high lift coefficients without appreciably

affecting the low lift drag. An increase in the buffet free load factor can also be expected with the blown wing and canard. Attention is given to a program to investigate the wing/canard at maneuvering conditions, and tests at ranges of blowing coefficients equivalent to STOL operation. G.R.

A82-16906 # **Advanced technology airfoil development for the XV-15 tilt-rotor vehicle.** J. C. Narramore (Bell Helicopter Textron, Fort Worth, TX). *American Institute of Aeronautics and Astronautics and NASA Ames Research Center, V/STOL Conference, Palo Alto, CA, Dec. 7-9, 1981, AIAA Paper 81-2623.* 10 p. 15 refs.

Advances in the state-of-the-art of aerodynamics, dynamics, and structures suggest that the flight envelope of the tilt-rotor VTOL vehicle XV-15 can be expanded by an improved rotor blade design. A description is presented of an intensive airfoil development study which has been conducted in connection with the conceived possibilities. State-of-the-art design techniques were used to produce the new sections, and a wind tunnel 'fly-off' between the best airfoils was held. Advanced technology airfoils demonstrated significant improvements in aerodynamic characteristics compared to existing XV-15 blade airfoils. G.R.

A82-16907 * # **Ground test of a large scale 'D' vented thrust deflecting nozzle.** E. W. Rosenberg (McDonnell Aircraft Co., St. Louis, MO) and R. S. Christiansen (NASA, Ames Research Center, Moffett Field, CA). *American Institute of Aeronautics and Astronautics and NASA Ames Research Center, V/STOL Conference, Palo Alto, CA, Dec. 7-9, 1981, AIAA Paper 81-2630.* 10 p.

Future V/STOL aircraft will require efficient techniques for changing the thrust vector from the vertical direction for VTOL operation to the horizontal direction for conventional flight. Most V/STOL concepts utilize thrust vectoring nozzles to provide this variation in the thrust vector direction. An experimental test program was initiated to demonstrate the capabilities of a large scale 'D' vented thrust deflecting system coupled with a high bypass ratio turbofan engine. Data were obtained for a 'D' vented nozzle mounted behind a YTF-34-F5 turbofan engine. Preliminary data are presented for a variety of test conditions. Attention is given to aspects of 'D' vented nozzle design, the test apparatus, engine-nozzle compatibility, exit area variation, longitudinal vectoring performance, nozzle temperature distribution, and large scale - small scale comparisons. G.R.

A82-16908 # **NASA V/STOL Propulsion Control Analysis - Phase I and II program status.** R. J. Miller, S. P. Roth, and W. B. Kerr (United Technologies Corp., Government Products Div., West Palm Beach, FL). *American Institute of Aeronautics and Astronautics and NASA Ames Research Center, V/STOL Conference, Palo Alto, CA, Dec. 7-9, 1981, AIAA Paper 81-2632.* 11 p.

NASA-Lewis Research Center initiated the V/STOL Propulsion Control Analysis Program in 1979 in order to take advantage of advanced electronic control technology for the next generation of V/STOL aircraft. The rationale, methods, and criteria developed during Phase I and Phase II of the program are discussed first. The development of an integrated flight and propulsion control system is then described. Most V/STOL aircraft under consideration depend on reaction thrusters or separate lift engines for attitude control and on engine thrust variations for height control. S/CTOL aircraft vector-thrust for pitch control during low speed operation. The baseline propulsion control system provides a thrust level response of 10 rad/sec and a vectoring response of 22 rad/sec. The requirements of the control components include: (1) redundant electronic control computers with minimum software and 100% Fault Coverage; (2) prime reliable electromechanical actuator interfaces; (3) miniature, digitally compatible sensors with easily detected failure modes; and (4) dual element, fail operational fuel pumps. J.F.

A82-16909 * # **V/STOL propulsion control technology.** H. Brown (General Electric Co., Cincinnati, OH). *American Institute of Aeronautics and Astronautics and NASA Ames Research Center, V/STOL Conference, Palo Alto, CA, Dec. 7-9, 1981, AIAA Paper 81-2634.* 10 p. Contract No. NAS3-22057.

Results of a NASA sponsored study of V/STOL Propulsion Control Analysis are presented. The study involved propulsion control requirements, design concepts and procedures, and control designs for supersonic V/STOL. A variable cycle engine with a remote augmented lift system was used as a basis for establishing typical operating requirements and control concepts, and a nonlinear engine model was developed for control development as a precursor to a real-time simulation capability. A simplified aircraft model was also used to investigate transition requirements, and a long-range technology plan was developed to define subsequent program requirements for achieving a real-time piloted simulation capability. D.L.G.

A82-16910 * # **Piloted simulation of hover and transition of a vertical attitude takeoff and landing aircraft.** G. C. Hill (NASA, Ames Research Center, Moffett Field, CA). *American Institute of Aeronautics and Astronautics and NASA Ames Research Center, V/STOL Conference, Palo Alto, CA, Dec. 7-9, 1981, AIAA Paper 81-2636.* 8 p. 9 refs.

Piloted simulation studies of candidate control systems for VATOL aircraft were conducted on a six degree of freedom simulator. Hover and transitions from wing-born to hovering flight were performed, with and without turbulence, on a representative high performance fighter configuration. Deflection of the rear engine nozzle provided pitch and yaw control moments in concert with reaction controls for roll. Unique motion cues in hover result from the vertical displacement of the cockpit and the thrust vectoring nozzles. Abundant control power available with moderate engine nozzle deflection combined with rate feedback for stability augmentation provided very satisfactory control. (Author)

A82-16911 * # **Thrust reversing effects on twin-engine aircraft having nonaxisymmetric nozzles.** F. J. Capone, R. J. Re, and E. A. Bare (NASA, Langley Research Center, Transonic Aerodynamics Div., Hampton, VA). *American Institute of Aeronautics and Astronautics and NASA Ames Research Center, V/STOL Conference, Palo Alto, CA, Dec. 7-9, 1981, AIAA Paper 81-2639.* 15 p. 21 refs.

The effects of thrust reversing on stability, control and vertical tail loads of advanced fighter aircraft are reviewed. Several static test stand and wind tunnel investigations of nonaxisymmetric nozzles with integral thrust reversers are presented, and it is found that base drag on the aft face of reverser panels of blockers provides a significant contribution to in-flight thrust reverser performance. The location of tail surfaces relative to the thrust reverser has significant impact on control surface effectiveness, and depending on thrust reverser location, large vertical tail side force can result from the use of in-flight thrust reversers. It is concluded that highly effective nonaxisymmetric nozzle reversers can be designed to achieve a 50% static reverse thrust. D.L.G.

A82-16912 # **Greenlandair VTOL transportation study.** R. R. Reber (Bell Helicopter Textron, Fort Worth, TX). *American Institute of Aeronautics and Astronautics and NASA Ames Research Center, V/STOL Conference, Palo Alto, CA, Dec. 7-9, 1981, AIAA Paper 81-2642.* 6 p.

An operational and economic analysis was conducted on Greenlandair, a large helicopter commuter operation. Results indicate that the airline could realize a significant increase in available seat miles with a decrease in total cost by replacing the fleet of helicopters and fixed-wing aircraft with Tiltrotors. The Tiltrotor can fly 2.5 times faster than the helicopters, and 25% faster than the presently used turboprop aicraft. Fuel consumption could be reduced by one half, and with additional savings on maintenance, crew costs, and ground support costs, plus expanded flight schedules, the airline could achieve a net yearly savings of over 2 million dollars. D.L.G.

A82-16913 # **V/STOL status from the engine technology viewpoint.** G. M. Lewis and W. J. Lewis (Rolls-Royce, Ltd., Bristol, England). *American Institute of Aeronautics and Astronautics and NASA Ames Research Center, V/STOL Conference, Palo Alto, CA, Dec. 7-9, 1981, AIAA Paper 81-2648.* 10 p.

Directions for designs and powerplant configurations for V/STOL aircraft are explored. The Harrier is the only V/STOL aircraft in service, having performed for over 12 yr. Rolls-Royce has studied engines with powered lift separation from forward propulsion, and engines with composite lift/propulsion modes, resulting in concentration on vectored thrust using rotating or deflected nozzles. The necessity for higher combat performance creates a need for higher specific thrust for supersonic flight (Mach 2), which is

achievable with plenum chamber burning. The core flows are exhausted through separate nozzle systems for independent control. Intake in a V/STOL follows a short path and results in nonuniform flow, and testing is described to account for the effects of nonuniform static pressures and temperatures. M.S.K.

A82-16914 * # Helical helicopter approaches with microwave landing system guidance. L. A. McGee, J. D. Foster, and D. C. Dugan (NASA, Ames Research Center, Moffett Field, CA). *American Institute of Aeronautics and Astronautics and NASA Ames Research Center, V/STOL Conference, Palo Alto, CA, Dec. 7-9, 1981, AIAA Paper 81-2654.* 13 p. 8 refs.

It is desirable that the landing approach of helicopters and V/STOL aircraft into a congested airport equipped with a microwave landing system (MLS) can take place essentially independent of CTOL traffic. The helical approach has been proposed as one way to provide aircraft separation while requiring minimum airspace. A helical descent makes it possible for the helicopter to lose altitude in a confined airspace without descending along an excessively steep glide slope. This avoids helicopter handling problems which occur at slow airspeeds. Preliminary flight-test data are presented regarding the operational feasibility of the helical approach under IFR conditions where the primary guidance information is from an MLS. G.R.

A82-16915 # Maintenance problems associated with the operation of the F402 /Pegasus/ engine in the AV-8A /Harrier/ aircraft. C. W. Stanley and W. E. Hood (U.S. Navy, Cherry Point, NC). *American Institute of Aeronautics and Astronautics and NASA Ames Research Center, V/STOL Conference, Palo Alto, CA, Dec. 7-9, 1981, AIAA Paper 81-2656.* 8 p.

The U.S. Marine Corp (USMC) has been operating the only V/STOL attack aircraft in the western world since 1971. Some of the maintenance problems experienced are related to the unique V/STOL design criteria of the Pegasus engine. However, the major part of the required maintenance effort is found to involve the more conventional engine problems. A description of the aircraft engine is provided and the problems resulting from V/STOL design demands are examined. Attention is given to the fuel system control, the engine air bleed, foreign object damage to the hp compressor, and the engine exhaust system. G.R.

A82-16916 # A low cost maritime control aircraft-ship-weapons system. H. Fluk (U.S. Naval Air Engineering Center, Lakehurst, NJ). *American Institute of Aeronautics and Astronautics and NASA Ames Research Center, V/STOL Conference, Palo Alto, CA, Dec. 7-9, 1981, AIAA Paper 81-2660.* 10 p. 7 refs.

It is pointed out that the long-range antiship standoff missile is emerging as the foremost threat on the seas. Delivered by high speed bombers, surface ships, and submarines, a missile attack can be mounted against selected targets from any point on the compass. An investigation is conducted regarding the configuration of a system which could most efficiently identify and destroy standoff threats before they launch their weapons. It is found that by using ships for carrying and launching missiles, and employing aircraft with a powerful radar only for search and missile directing operations, aircraft cost and weight can be greatly reduced. The employment of V/STOL aircraft in preference to other types of aircraft makes it possible to use ships of smaller size for carrying the aircraft. However, in order to obtain an all-weather operational capability for the system, ships are selected which are still big enough to display the required stability in heavy seas. G.R.

A82-16917 # Type 'A' V/STOL - One aircraft for all support missions. W. H. Adelt (McDonnell Aircraft Co., St. Louis, MO). *American Institute of Aeronautics and Astronautics and NASA Ames Research Center, V/STOL Conference, Palo Alto, CA, Dec. 7-9, 1981, AIAA Paper 81-2661.* 14 p. 5 refs.

An investigation is conducted regarding the feasibility of developing a single support aircraft type for the Navy, taking into account the current naval inventory of utility aircraft types. Support mission characteristics are examined, giving attention to antisubmarine warfare, airborne early warning, marine assault, carrier on board delivery/vertical on board delivery, the aerial tanker mission, long-range rescue, surface attack, and aspects of combat, search, and rescue. With the aid of a sample design for a V/STOL aircraft with a medium disc loading lift system it is demonstrated that it is now possible to design an aircraft which, with minor modifications, can meet the wide variety of support missions. G.R.

A82-16972 # Airbus - Perspectives for the future (Airbus - Perspectivas para el futuro). K. Schleicher Tafel (Construcciones Aeronáuticas, S.A., Madrid, Spain). *IAA/Ingeniería Aeronáutica y Astronáutica,* vol. 33, Nov. 1981, p. 5-16. In Spanish.

The derivation of future commercial aircraft in the 150-300 seat range from the A-300 and A-310 design, according to a staged program of development and technology transfer, is described. After brief consideration of the distribution of program responsibilities among the members of the Airbus consortium, and the derivation of the A-310 from the A-300, attention is given to the features of the A-300-600 series aircraft, which incorporates and A-310 rear fuselage and will replace the A-300 toward the end of 1984. Also considered are (1) the long-term replacements of the A-300 and A-310, the twin-aisle TA-9 and TA-11, respectively, and (2) the single- aisle A-320, which is to be a new design for the short-range market and the precursor of a new family of aircraft in the 125-175 seat range. The A-320 is compared to the 737, DC9 and 757 aircraft. O.C.

A82-16973 # The justification of the need for ILS by means of cost/benefit methods (Justificacion de la necesidad de un ils mediante tecnicas costo/beneficio). E. Lallemand Abella. *IAA/Ingeniería Aeronáutica y Astronáutica,* vol. 33, Nov. 1981, p. 33-36. In Spanish.

FAA criteria for the establishment of an Instrument Landing System (ILS) at a given airport have been applied since 1977 in light of cost/benefit studies. The criteria apply to airports with regular jet aircraft traffic which are open to use by general aviation aircraft, and are applicable to other airports in which (1) the number of yearly landing approaches under instrument-only control is greater than a minimum figure and (2) the cost/benfit ratio is better than unity. Attention is given to benefits both annually and in the long term, as well as investment and operating costs. Benefits are defined in terms of regularity of operations and the statistical reduction of accident rates. O.C.

A82-17116 † A method for locating aircraft wing damage by nonlinear vibration analysis (Ob odnom metode poiska poverzhdeniia kryla samoleta, osnovannom na analize ego nelineinykh kolebanii). S. L. Tsyfanskii, V. M. Ozhiganov, A. B. Milov, and Iu. N. Nevskii. *Voprosy Dinamiki i Prochnosti,* no. 39, 1981, p. 3-10. 7 refs. In Russian.

A procedure is proposed for the electrical modeling of the vibrations of a spar wing with a crack. A diagnostic technique based on the spectral analysis of ultraharmonic vibrations is described. V.L.

A82-17124 Some aerodynamic aspects of hang gliding. A. Fischer (Dortmund, Universität, Dortmund, West Germany). *Endeavour,* vol. 5, no. 4, 1981, p. 152-157.

Hang gliding began with experiments for spacecraft return to earth using delta wings for gliding. Manipulation of the steering bar on modern hang gliders is outlined, along with the high-strength, light-weight construction. The pointed nose of early gliders is actually suitable only for supersonic craft, and led to the addition of a permanently adjusted elevator to eliminate flap induced dive. Hang glider wings have a lift coefficient of one, a glide angle of 1:10, and a sink ratio of 0.9 m/sec. A progression toward elliptical wings is noted, and designs for semi-rigid and powered gliders are discussed. The addition of a motor leads to stability and thrust axis considerations as well as weight penalties and greater induced drag. Finally, ultralights are mentioned, including the canard and the solar powered aircraft. M.S.K.

A82-17135 Design procedures for compressor blades (Entwurfsverfahren für Verdichterschaufeln). H. Starken (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Antriebstechnik, Cologne, West Germany). *DFVLR-Nachrichten,* Nov. 1981, p. 49-51. In German.

The conventional methods for the design of the blades in the case of axial turbomachines are considered, taking into account difficulties concerning the determination of optimal blade profiles. These difficulties have been partly overcome as a consequence of the

introduction of new numerical methods during the last few years. It is pointed out that, in the case of the subsonic range, a new procedure is now available for the determination of the form of blade profile on the basis of a given velocity distribution on the profile surface. The search for a profile form with favorable characteristics is consequently transformed into a search for a favorable velocity or pressure distribution on the blade. The distribution of velocities depends to a large degree on the characteristics of the profile boundary layers. The considered concept is not new. However, its practical implementation has only recently become possible. The employment of the new design procedure is illustrated with the aid of an example involving a concrete design problem. G.R.

A82-17136 The German-Dutch wind tunnel as aeroacoustic experimental installation (Der Deutsch-Niederländische Windkanal als aeroakustische Versuchseinrichtung). K.-J. Schultz (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Abteilung technische Akustik, Braunschweig, West Germany). *DFVLR-Nachrichten,* Nov. 1981, p. 52-56. In German.

The construction of the currently largest European low-speed wind tunnel was completed as a joint project of the Federal Republic of Germany and the Netherlands. The aeroacoustic configuration of the wind tunnel makes use of an open test section and a free jet of air having a length of 20 m. A 8 x 6 m nozzle is employed. Acoustic distant field measurements with respect to test objects exposed to the airstream are possible. Attention is given to the performance of distant field measurements, the sound-absorbing wall surfaces, the acoustic characteristics of the test chamber, and aspects of acoustic calibration. A few characteristic experimental results are also reported. G.R.

A82-17137 Current investigations regarding noise research in the Braunschweig Center of the German Institute for Research and Experimentation in Aeronautics and Astronautics (Aktuelle Arbeiten der Lärmforschung im DFVLR-Zentrum Braunschweig). H. Heller (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Abteilung technische Akustik, Braunschweig, West Germany). *DFVLR-Nachrichten,* Nov. 1981, p. 56-61. In German.

The German Institute for Research and Experimentation in Aeronautics and Astronautics has established, four years ago, the Department of Technical Acoustics in its Braunschweig research center to conduct research related to the occurrence of noise. The initiation of the investigations conducted in the new department was motivated by the desirability to reduce noise produced at airports, in traffic, and in connection with industrial processing operations. The organizational relation of the Department of Technical Acoustics to the research sector of fluid mechanics takes into account the fact that, in aeronautics, the generation of noise is frequently a consequence of turbulent flow and separation processes. Attention is given to investigations concerning the noise produced by aircraft with propeller drive, studies related to helicopter noise, and research regarding the noise generated in connection with the flow of air around aircraft or automobiles. Activities with respect to a use of the German-Dutch Wind Tunnel for aeroacoustic studies are also considered and an outlook concerning future developments is provided. G.R.

A82-17149 Turboprop resurgence - The next step. B. Rek. *Interavia,* vol. 36, Dec. 1981, p. 1245-1247.

The prospects for the development of turboprop commercial aircraft in the 40- to 80-seat capacity range are assessed, with attention to the PW120, CT7-5 and -7, and TPE331-14/15 powerplants. Among the performance requirements of aircraft of this class are a cruise speed of approximately 740 km/hr, and a cruise altitude of more than 30,000 ft. These levels of performance would eliminate block-time penalties over sectors of up to 900 km. Among existing designs that may be developed to satisfy the emerging market for state-of-the-art 40-80 seat airliners are the F27, 748, Dash 7, F28 and BAe 146. The aircraft are expected to incorporate advanced avionics, Microwave Landing System (MLS) capability, composite primary structures, supercritical wing aerodynamics, and propfan rotors. O.C.

A82-17243 Crack edge instability - A criterion for safe crack propagation limit in thin sheets. B. K. Parida (Indian Institute of Technology, Kharagpur, India). In: Fracture and fatigue: Elasto-plasticity, thin sheet and micromechanisms problems; Proceedings of the Third European Colloquium on Fracture, London, England, September 8-10, 1980. Oxford, Pergamon Press, 1980, p. 307-314. 5 refs.

Results from a series of experiments to determine the safe crack propagation limit of thin aluminum alloy (D16-ATV) sheets under constant amplitude fatigue loading are presented. An empirical relation is developed which can be used to predict the critical crack length associated with the onset of crack-edge instability under constant amplitude loading. The relationship used to correlate the critical half-crack length, L(cr), and the corresponding tensile stress, S, for local buckling of the free edges of a crack is given as S = K x E (T/L(cr))-squared, where T is the sheet thickness, E is the elastic modulus, and K is a constant, depending upon the material properties and the specimen geometry. The critical crack length obtained from the constant amplitude fatigue test was compared to that predicted by the empirical relation; the magnitude of maximum stress in the fatigue test is considered to be equivalent to the critical stress in predicting the critical crack length for the onset of crack-edge instability. The error involved in the prediction is shown to be small. J.F.

A82-17276 Safe and efficient management of energy; Proceedings of the Thirty-third Annual International Air Safety Seminar, Christchurch, New Zealand, September 15-18, 1980. Seminar sponsored by the Flight Safety Foundation, Boeing Commercial Airplane Co., Ministry of Transport of New Zealand, et al. Edited by L. J. Scott. Arlington, VA, Flight Safety Foundation, Inc., 1980. 336 p. $30.

Topics discussed include accident prevention and safety, air traffic management for fuel economy, and quality control of fuel from the refinery to the engine. Particular attention is given to air traffic control problems, flight crew management and cockpit performance systems, and gas path analysis for engine condition monitoring. Consideration is also given to energy conservation through airport design and management, and computer flight planning for fuel efficiency. J.F.

A82-17277 Why safety. M. Eastburn (American Airlines, Inc., New York, NY). In: Safe and efficient management of energy; Proceedings of the Thirty-third Annual International Air Safety Seminar, Christchurch, New Zealand, September 15-18, 1980. Arlington, VA, Flight Safety Foundation, Inc., 1980, p. 13-28.

It is claimed that safety and the prevention of accidents are the greatest conservers of energy. The worldwide commercial jet transport accident experience is briefly described; this description covers the period from 1959, the beginning of the air carrier jet age, through to September 1980. Aircraft lost as a result of sabotage and war-like action, as well as the six Comets lost prior to 1959, are also included in the analysis. Passenger and hull loss liability, and its effect on airline operational costs, are then discussed. Finally, it is estimated that if no action is taken to ensure their prevention, by 1986 there will be an additional 115 hull losses to the present total of 354. J.F.

A82-17278 Accident prevention - A regulators view. G. V. Hughes (Department of Transport, Canberra, Australia). In: Safe and efficient management of energy; Proceedings of the Thirty-third Annual International Air Safety Seminar, Christchurch, New Zealand, September 15-18, 1980. Arlington, VA, Flight Safety Foundation, Inc., 1980, p. 29-37.

Details of aircraft accidents in the world involving passenger fatalities on scheduled services from 1969 to 1979 are presented and compared to data on general aviation accidents for U.S. and Australian operations. It is shown that the fatalities in general aviation are much greater and continue to grow. Safety prevention is then discussed from the viewpoint of a regulator, who is responsible for the development, implementation, and monitoring of compliance with standards covering all matters to do with aircraft. Problems related to the development of comprehensive and precise standards, as well as the decision to vary these standards when necessary, are discussed. Lack of standardization of controls in fuel systems and undercarriages is used to exemplify the extent of the problem. J.F.

A82-17279 Air traffic management for fuel economy. W.

C. W. Fraes (National Air Traffic Services, London, England). In: Safe and efficient management of energy; Proceedings of the Thirty-third Annual International Air Safety Seminar, Christchurch, New Zealand, September 15-18, 1980. Arlington, VA, Flight Safety Foundation, Inc., 1980, p. 56-74. 9 refs.

Air traffic management, which includes airspace arrangements, air traffic control (ATC) facilities, and ATC procedures, is discussed. In particular, ATC capacities in the U.K. are described, with respect to their means of regulating departures and handling delays so as to minimize the total fuel consumption. It is shown that airspace arrangements and procedures should be devised and operated in such a way that would allow (1) uninterrupted climbs to cruising level; (2) maximun chance of obtaining the optimum cruising level; (3) the shortest practical mileage; and (4) the optimum descent profile. Finally, the operation of an efficient ground movement system is cited as a further means of conserving fuel. J.F.

A82-17280 The shape of the air traffic control system of the future - A U.S. perspective. S. B. Poritzky (FAA, Office of Systems Engineering Management, Washington, DC). In: Safe and efficient management of energy; Proceedings of the Thirty-third Annual International Air Safety Seminar, Christchurch, New Zealand, September 15-18, 1980. Arlington, VA, Flight Safety Foundation, Inc., 1980, p. 75-82.

Based on recommendations from the user community, the FAA has postulated a safety-and-efficiency-oriented Air Traffic Control (ATC) system, which should be in operation by the start of the 21st century. Problems in the present system are considered from an operations vantage point, as well as from an assessment of expected technology and the possible evolution of aircraft and aviation systems. There will continue to be several levels of ATC service in the U.S., ranging from a highly automated system serving fully participating aircraft in certain airspace to those in which no separation service is provided. Real-time knowledge of actual airport capacity and the use of automated runway configuration management systems will permit the use of optimum airport configurations and scheduling to achieve limited capacity gains. The ATC system will automatically make available severe weather and traffic information. One separation assurance device in particular, the Active Beacon-based Collision Avoidance System, is shown to be an efficient tail cutter which will offer benefits in relatively high-density traffic. J.F.

A82-17281 Fuel conservation now. R. A. Davis (Boeing Commercial Airplane Co., Renton, WA). In: Safe and efficient management of energy; Proceedings of the Thirty-third Annual International Air Safety Seminar, Christchurch, New Zealand, September 15-18, 1980. Arlington, VA, Flight Safety Foundation, Inc., 1980, p. 83-95.

Boeing is developing improvements for the existing production run of second generation transports, the 727 and 737 aircraft, in order to meet the escalation of jet transport fuel prices. The improvements include reduction in aircraft weight and aerodynamic drag, engine fuel efficiency, and aircraft operational improvements. Applications of a Kapton lightweight wire insulation was shown to save approximately 386 pounds for each 727 and 170 pounds for each 737. A 1% retrofit table drag reduction package is currently available for the 727. The JT8D 'A' series of engines for the -15 and -17 versions promise specific fuel consumption improvements of 5.5% to be available in 1982. The Performance Data Computer coupled with the full range Autothrottle/Speed Control will provide fuel savings up to 7% for the 727 and up to 6% for the 737. J.F.

A82-17282 Energy savings with today's technology. H. Dibley (British Airways, Heathrow, Middx., England). In: Safe and efficient management of energy; Proceedings of the Thirty-third Annual International Air Safety Seminar, Christchurch, New Zealand, September 15-18, 1980. Arlington, VA, Flight Safety Foundation, Inc., 1980, p. 97-133.

The crew of an aircraft seeks to maximize the energy available in the atmosphere and in the aircraft's fuel so as to ensure the efficient and safe operation of a flight. This is accomplished by displaying clear data in front of the crew, by providing the crew with comprehenisve but readily useable information for fuel management (enabling minimum fuel reserves to be carried out), and by relieving the crew of an unnecessary mental work load to use this information. The optimum profile for minimum fuel use involves (1) climbing with maximum thrust at an optimum speed to optimum cruise altitude for a given aircraft weight and wind gradient; (2) cruise climbing as weight decreases; (3) unrestricted descent to the destination field at optimum descent speed with the idle thrust; and (4) selection of a route which takes advantage of the wind structure to fly the minimum air miles. This can be accomplished by supplying the crew with meteorological information, the fuel flight plan, as well as knowledge of the fuel reserves. A minimum safe altitude display on the pilot's panel is also suggested. J.F.

A82-17283 Air traffic control problems and solutions. C. W. Vietor. In: Safe and efficient management of energy; Proceedings of the Thirty-third Annual International Air Safety Seminar, Christchurch, New Zealand, September 15-18, 1980. Arlington, VA, Flight Safety Foundation, Inc., 1980, p. 137-152. 14 refs.

The inefficiencies of the present Air Traffic Control (ATC) system are both costly and hazardous to the U.S. airlines network. An improved ATC system is sought which will make use of predetermined flight profiles and time schedules as well as airborne and ground-based computers for transmitting and receiving operational data. The new system is required to (1) improve safety in flight (2) make more efficient use of the airspace; (3) have greater fuel efficiency; (4) make better use of airport runways; and (5) improve flight instrument systems. Several relatively inexpensive solutions to the above criteria are discussed. J.F.

A82-17284 Productivity and safety. D. R. Clifford (Boeing Commercial Airplane, Co., Renton, WA). In: Safe and efficient management of energy; Proceedings of the Thirty-third Annual International Air Safety Seminar, Christchurch, New Zealand, September 15-18, 1980. Arlington, VA, Flight Safety Foundation, Inc., 1980, p. 153-165.

Due to the effect of fuel price increases on direct operating costs, more fuel-efficient designs for new transport aircraft are sought. This effort includes the use of increased wing span, advanced air foils, better materials, flight management avionics systems, and more efficient engines. The lower costs available through a reduction in crew complement have also been cited. Results of accident statistics are analyzed in order to resolve the controversial two or three-member flight crew issue. It is concluded that two-crew aircraft have a better safety record than three-crew aircraft, and that a jet transport designed for operation by two pilots can be at least as safe as one designed for operation by three. J.F.

A82-17285 Flight crew management and cockpit performance systems. R. N. Buck. In: Safe and efficient management of energy; Proceedings of the Thirty-third Annual International Air Safety Seminar, Christchurch, New Zealand, September 15-18, 1980. Arlington, VA, Flight Safety Foundation, Inc., 1980, p. 166-170.

The performance computer systems in jet aircraft cockpits have the potential for saving fuel and improving the efficient management of aircraft by the flight crew; they also have the potential, however, for increasing work loads, heads-down time, and certain hazards caused by error. Data must therefore be presented so that the crew has maximum use of information with minimum distraction. The performance advisory system displays information on air speed, thrust setting, and required pitch by a digital read-out or by moveable bugs on the air speed indicator and EPR gauges. Having the system work with auto throttles and a set thrust (a performance management system) relieves the crew from high concentration on thrust setting and assures that the thrust is set correctly for the current weight and altitude. A flight management system with a more comprehensive cockpit display is envisioned; it would perform such functions as maintenance monitoring, weather data collection, and center-of-gravity management. J.F.

A82-17286 Gas path analysis - A tool for engine condition monitoring. L. A. Urban (United Technologies Corp., Hamilton Standard Div., Windsor Locks, CT). In: Safe and efficient management of energy; Proceedings of the Thirty-third Annual International Air Safety Seminar, Christchurch, New Zealand, September 15-18, 1980. Arlington, VA, Flight Safety Foundation, Inc., 1980, p. 171-201. 10 refs.

Engine condition diagnostics and monitoring in all phases of

operation from the test cell to on-wing is recognized as a highly economical procedure. A technique is required, however, whereby engines can be analyzed to the module level in a reliable and technically sound way. Gas Path Analysis (GPA) with multiple simultaneous fault isolation and the ability to deal with measurement noise, has been developed to meet that need. Major GPA activity as of mid-1980 is summarized, based on its use by eight airlines. Results show that GPA is a successful technique and can be used for on-wing engine monitoring to the module level for the new generation aircraft. J.F.

A82-17287 Energy conservation through airport design and management. H. I. F. Quyang (Civil Aeronautics Administration, Taipei, Republic of China). In: Safe and efficient management of energy; Proceedings of the Thirty-third Annual International Air Safety Seminar, Christchurch, New Zealand, September 15-18, 1980. Arlington, VA, Flight Safety Foundation, Inc., 1980, p. 208-233.

Energy conservation principles through airport design and management are described and then compared with those applied at the Chiang Kai-Shek International Airport. The results of the comparison may be used at existing airports, where current systems and operation procedures can be evaluated, and where programs necessary to reduce energy consumption without affecting airport performance may be developed. The analysis should also be considered at the design stage of new airports, where the material specifications of an architectural structure and the technical requirements of mechanical and electrical systems with energy saving functions may be considered and reviewed in order that necessary modifications may be made as early as possible. J.F.

A82-17288 Handling problems associated with jet aircraft fuels. L. C. Quigg (Lockheed Air Terminal, Inc., Burbank, CA). In: Safe and efficient management of energy; Proceedings of the Thirty-third Annual International Air Safety Seminar, Christchurch, New Zealand, September 15-18, 1980. Arlington, VA, Flight Safety Foundation, Inc., 1980, p. 234-250. 18 refs.

A good quality control program is needed to eliminate the threat of dirty fuel, a problem that can adversely affect aircraft maintenance and safety. The contaminants that affect fuel cleanliness include particulate matter (rust, millscale, sand), water (dissolved and undissolved), surfactants (refinery carry-overs and fuel additives picked up in pipeline delivery systems), and microorganisms. If not effectively controlled or removed from the fuel, they can cause fuel-tank corrosion, tank quantity gage inaccuracies, engine fuel control problems, and filter and screen blockage. An effective quality control program will eliminate these contaminants by (1) verifying the product; (2) detecting the presence and origin of contaminants; (3) effectively removing the contaminants; (4) providing well-designed facilities; and (5) establishing a reliable inspection program. J.F.

A82-17289 Computer flight planning for fuel efficiency. L. M. Reinkens (Lockheed Aircraft Service Co., Ontario, CA). In: Safe and efficient management of energy; Proceedings of the Thirty-third Annual International Air Safety Seminar, Christchurch, New Zealand, September 15-18, 1980. Arlington, VA, Flight Safety Foundation, Inc., 1980, p. 258-269.

The need to improve fuel efficiency is forcing the aviation industry to reassess the use of computer flight planning (CFP). In the past decade, CFP was based on mechanizing manual techniques; the demand now is for CFP to take technology one step further into (1) inexpensive on-line conversational systems available throughout the world; (2) refined optimization techniques in route and profile selection to minimize fuel uplift, maximize payload, and extend range; (3) reanalysis enroute to reflect take-off variations and minimize fuel consumption; (4) reanalysis in the event of diversion to an alternate; (5) remote data base entry; and (6) refined reserve fuel consumption. The proposed interactive system and conversational network are given; differences in cruise speeds, fuel, and payload requirements of the Boeing 737 and 747 are illustrated. J.F.

A82-17290 Liquid hydrogen - An outstanding alternate fuel for transport aircraft. W. M. Hawkins. In: Safe and efficient management of energy; Proceedings of the Thirty-third Annual International Air Safety Seminar, Christchurch, New Zealand, September 15-18, 1980. Arlington, VA, Flight Safety Foundation, Inc., 1980, p. 270-295.

Liquid hydrogen is proposed as an excellent alternate aircraft fuel, owing to its worldwide availability, low cost, ability to be transported and stored without difficulty, and minimum impact on the environment. NASA compared the characteristics and performance of three aircraft using (1) synthetic Jet A, (2) liquid methane, and (3) liquid hydrogen. The liquid hydrogen aircraft was found to weigh considerably less than the others, thereby reducing the take-off gross weight. Every pound of hydrogen produces 51,590 BTU's, whereas a pound of Jet A produces only 18,400 BTU's. Moreover the liquid hydrogen aircraft uses the least energy in spite of aerodynamic disadvantages of the aircraft and high energy needs for liquefaction and the manufacturing process. Liquid hydrogen also has a fly-over noise level of 89 decibels compared to the 94 decibels for the Synjet aircraft. A simple system of laminar flow maintenance using liquid hydrogen is discussed, and several safety features of the fuel are noted. J.F.

A82-17310 # NAVSTAR Global Positioning System. J. H. Martel (USAF, Washington, DC). In: Space tracking and data systems; Proceedings of the Symposium, Arlington, VA, June 16-18, 1981. New York, American Institute of Aeronautics and Astronautics, 1981, p. 89-93.

The NAVSTAR Global Positioning System (GPS) is an important new space-based radio navigation system currently under development by the Department of Defense. The system will provide highly accurate three-dimensional position, velocity, and time information to an unlimited number of suitably equipped users anywhere on or near the earth. The system will consist of three segments: the Satellite or Space Segments, the Control Segment, and the User Segment. All three segments are currently in full scale development leading to a full three-dimensional world-wide capability by late 1987. Potential military applications of the system are virtually limitless. Potential civil applications, while currently less well defined than military uses, are also extensive. Testing of early development models have clearly demonstrated that the system has the potential to perform up to near theoretical expectations. Early problems with spacecraft atomic clocks appear to have been solved and the program is progressing on a sound technical basis. The remaining challenge is to achieve an optimum balance to assure that sufficient accuracy is available to satisfy valid civil needs without jeopardizing national security objectives. (Author)

A82-17417 Development of the Lockheed SR-71 Blackbird. C. L. Johnson. *Lockheed Horizons,* Winter 1981-1982, p. 2-7, 13-18.

An account is given of the development history of the SR-71 reconnaissance aircraft, with attention to the use of novel design concepts in high-temperature materials and their fabrication and the aerodynamics required for efficient flight at cruise speeds of Mach 3.0. Consideration is also given to the parallel development of the YF-12A, air defense long-range fighter derivative. Emphasis is placed on the integration of the J58 engine into the SR-71's nacelles, whose inlets, air bleed mechanisms and ejector underwent the greatest portion of wind tunnel testing time for optimization. Age B-120 titanium alloy was chosen as the main structural material, in the form of machined forgings and corrugated skins which resist high-temperature warping. With refueling, the special cockpit and lubrication cooling systems developed allow continuous flights of 15,000 miles. Aircraft of this type have exceeded Mach 3.0 over 11,000 times since becoming operational in 1964. O.C.

A82-17418 J58/SR-71 propulsion integration or the great adventure into the technical unknown. W. H. Brown. *Lockheed Horizons,* Winter 1981-1982, p. 7-13.

The integration of the J58 engine into the SR-71 nacelles is detailed, with attention to the accommodation of such consequences of Mach 3.0 cruise speeds as (1) engine inlet air temperatures exceeding 800 F, (2) fuel inlet temperatures of 350 F, (3) fuel temperatures ranging from 600 to 700 F at the main and afterburner nozzles, and (4) lubricant temperatures of 700-1000 F in localized parts of the engine. A new fuel and a chemical lubricant were developed to meet temperature requirements. Consideration is given to the mounting of the engine, and the air flow patterns induced in the nacelle through the actuation of bypass and suck-in doors,

centerbody bleed, and external ejector flaps. Special efforts were made in the solution of engine inlet unstart problems. Testing facilities and development program management are also considered. O.C.

A82-17419 Modern aircraft accident investigation equipment and techniques. E. J. Rosenbauer, Sr. (Lockheed Aircraft Service Co., Ontario, CA). *Lockheed Horizons,* Winter 1981-1982, p. 20-27.

A description is given of the design features and operational capabilities of the Model 109 Flight Data Recorder (FDR) and Model 209 Digital Flight Data Recorder (DFDR), with emphasis on the superior survivability standards addressed by the Model 209. The DFDR has operated properly when subjected to (1) vibrations of 5-500 Hz, at 0.036-inch double amplitude and 10 G acceleration, in 15-min cycles for a period of 1 hr in each axis; (2) impact shocks having a peak acceleration magnitude of 1000 G and 5 msec duration; and (3) flames of 1100 C over 50% of the external surface for 30 min. In addition, the data on the DFDR's recording medium remained intact after 24 hours of immersion in aircraft fuel, lubricating oil, and fire extinguishing fluids, and reproducible after 36 hours of immersion in seawater. Post-accident recorder handling and data recovery procedures are also covered. O.C.

A82-17420 The all-electric airplane - A new trend. M. J. Cronin (Lockheed-California Co., Burbank, CA). *Lockheed Horizons,* Winter 1981-1982, p. 28-39.

After a brief, historical consideration of the progress of aeronautics and of the feasibility of electrical-propulsion aircraft such as the photovoltaic Solar Challenger, a description is given of the direct operating cost reductions and system efficiencies derived from the replacement of bleed air/hydraulic/pneumatic/electrical aircraft power systems by a single, electric power system. In such a system, electric generators are the sole source of power for such functions as (1) the primary/secondary flight control system; (2) de-icing and anti-icing; (3) environmental controls; (4) electronics and avionics loads; and (5) landing gear actuation and other mechanical functions. Estimates are presented of cycled weight savings and of the power extraction penalties that may be obviated by the all-electric system. The integration of power-by-wire and fly-by-wire systems is also discussed. O.C.

A82-17531 Tensile fatigue assessment of candidate resins for use in fibre reinforced composite repair schemes. D. P. Bashford, A. K. Green (Fulmer Research Institute, Ltd., Stoke Poges, Bucks., England), K. F. Rogers, and D. M. Kingston-Lee (Royal Aircraft Establishment, Materials Dept., Farnborough, Hants., England). In: Composite structures; Proceedings of the First International Conference, Paisley, Scotland, September 16-18, 1981.
London, Applied Science Publishers, 1981, p. 555-572. Research supported by the Ministry of Defence (Procurement Executive).

Five matrix resin systems have been evaluated as potential candidates for use in a rapid repair system for aircraft skin damage, incorporating glass/carbon fiber hybrid reinforced plastics as the repair material. Two epoxy and three polyester resin systems were evaluated at 20 C. Additionally, the three polyester systems were evaluated at 0 C. The effect of contamination of metal surfaces by aviation fuel and hydraulic fluid was investigated. The properties measured were metal/composite joint overlap shear strength, as manufactured and following a fixed schedule of tensile fatigue load conditioning, and bending stiffness. These properties were determined 4 h and 24 h after fabricating the simulated repair. The resin system Quickcure QC3/Lucidol CH50/dimethyl-p-toluidine was found to give repairs equal to riveted metal plate repairs under all circumstances except to hydraulic fluid contaminated substrates at 0 C. (Author)

A82-17535 Stress intensity factor measurements in composite sandwich structures. I. Roman, H. Harel, and G. Marom (Jerusalem, Hebrew University, Jerusalem, Israel). In: Composite structures; Proceedings of the First International Conference, Paisley, Scotland, September 16-18, 1981. London, Applied Science Publishers, 1981, p. 633-645. 8 refs.

It is pointed out that although LEFM and its fracture criterion - the critical stress intensity factor - have been used in research with composites for quite some time, its applicability is not yet commonly accepted. The study described here seeks to provide an experimental certification of the applicability of the concept to a composite control surface. The structure used is constructed of angle-ply composite skins and a composite honeycomb core. The research is confined to cases of skin damage, such as surface scratches or notches, and seeks to provide a tool for determining when such forms of detectable damage become critical. It is noted that in many cases the fracture process in sandwich structures containing skin surface notches is confined to delamination in the skin at the vicinity of the notch tip; this is ultimately followed by splitting at the adhesive layer between the skin and the core. In such cases, it is possible to calculate the fracture stress of the sandwich structure from the fracture toughness of the skin. The relevant Y value is the one obtained from the new Y polynomials derived for the skin and from the corresponding ratio of notch depth to skin thickness. C.R.

A82-17538 Effects of elastomeric additives on the mechanical properties of epoxy resin and composite systems. R. J. Moulton (Hexcel Corp., Dublin, CA) and R. Y. Ting (U.S. Navy, Naval Research Laboratory, Orlando, FL). In: Composite structures; Proceedings of the First International Conference, Paisley, Scotland, September 16-18, 1981. London, Applied Science Publishers, 1981, p. 674-689. 16 refs.

Both the fracture behavior and the mechanical properties balance of fiber-reinforced composites containing a modified resin system are discussed on the basis of the results of an extensive experimental study. A series of acrylonitrile-butadiene modified epoxy polymers is used. Resin fracture energies are determined by using standard compact tension specimens and the Izod impact specimens. The elastomeric modifiers greatly increase the fracture energy of the base epoxy, and the extent of this increase is found to depend on the weight percentage and the molecular weight of the CTBN additives. In addition, post-failure fractography is also carried out to examine the system morphology for the identification of the basic mechanism of toughening. Enhanced toughness is always found to couple with trade-offs in strength and modulus. The results also show that the short beam shear test gives the interlaminar shear strength of the composite sample but not the interlaminar fracture energy. C.R.

A82-17594 * # Multilevel optimum design of structures with fiber-composite stiffened-panel components. L. A. Schmit and M. Mehrinfar (California, University, Los Angeles, CA). *(AIAA, ASME, ASCE, and AHS, Structures, Structural Dynamics and Materials Conference, 21st, Seattle, WA, May 12-14, 1980, AIAA Paper 80-0723.) AIAA Journal,* vol. 20, Jan. 1982, p. 138-147. 14 refs. Grant No. NsG-1490.

The multilevel approach to minimum weight structural design is extended to wing box structures with fiber-composite stiffened-panel components. Strength, deflection, and panel buckling constraints are treated at the system level with equivalent-thickness-type design variables. Local buckling and panel buckling constraints are guarded against at the component level, employing detailed component dimensions as design variables. A key feature of the method is selection of change in stiffness as the component level objective function to be minimized. Numerical results are given for wing box structures with sandwich and hat-stiffened fiber-composite panels. (Author)

A82-17602 # Effect on surface pressures of trapezoidal holes in a T-38 stabilator. J. C. Westkaemper and R. M. Chandrasekharan (Texas, University, Austin, TX). *Journal of Aircraft,* vol. 19, Jan. 1982, p. 81, 82. USAF-sponsored research.

Subsonic wind tunnel measurements were made of the surface-pressure distributions on a T-38 stabilator with four configurations of trapezoidal holes, in a study of the effects of damage on wing and tail aeroelastic characteristics. The effects of the holes on surface pressures were found to follow two patterns, one for attached flow and another for separated flow, depending on the extent of leading-edge separation on the stabilator. At angles of attack of more than 6 deg, with separation, all upper surface pressures were perturbed. O.C.

A82-17603 * # Propeller tip vortex - A possible contributor to aircraft cabin noise. B. A. Miller, J. H. Dittmar, and R. J. Jeracki (NASA, Lewis Research Center, Cleveland, OH). *Journal of Aircraft,* vol. 19, Jan. 1982, p. 84-86. 8 refs.

Wind tunnel model tests support the hypothesis that a propeller tip vortex may subject a downstream wing surface to greater excitation than would be experienced by the aircraft fuselage side wall exposed to propeller-generated noise, ultimately transmitting this structural response to incident dynamic pressure to the cabin interior. Even if structure-borne excitations are less efficient than airborne excitations in the creation of cabin noise, the higher level of the former could still govern cabin noise levels. O.C.

A82-17604 # **Estimate of human control over mid-air collisions.** J. N. Anno (Research Dynamics, Inc., Cincinnati, OH). *Journal of Aircraft*, vol. 19, Jan. 1982, p. 86-88. 5 refs.

A comparison between random collision theoretical predictions and actual cases shows that while human control is very effective in air-carrier mid-air collision accidents, it is relatively ineffective in general aviation. This discrepancy may be due to traffic control, pilot training, or instrumentation. The greatest weakness of the analysis presented is the arbitrary choice of representative aircraft for the two groups considered. A more detailed analysis for general aviation aircraft is called for. O.C.

A82-17605 # **Subsonic flow over airborne optical turrets.** A. J. Laderman (Ford Aerospace and Communications Corp., Newport Beach, CA) and R. de Jonckheere (USAF, Weapons Laboratory, Kirtland AFB, NM). *Journal of Aircraft*, vol. 19, Jan. 1982, p. 88-90. 6 refs. Contract No. F2960-79-C-0010.

It is shown that a good estimate of the pressure coefficient distribution of an airborne optical turret can be provided by means of an incompressible, inviscid code, which succeeds in (1) rationalizing the results of wind tunnel test measurements and (2) accounts for the effects of turret configuration. Compressibility effects are found to be small for the freestream Mach number range considered, but an improved agreement between data and analysis is obtained by using the code in conjunction with the compressibility correction proposed. O.C.

A82-17606 # **ADEN plume flow properties for infrared analysis.** C.-W. Chu and J. Der, Jr. (Northrop Corp., Aircraft Div., Hawthorne, CA). *Journal of Aircraft*, vol. 19, Jan. 1982, p. 90-92. 5 refs.

A simple modeling technique is described for the prediction of two-dimensional nozzle plume properties in IR signature analyses. Attention is given models for converging-diverging nozzles, augmented deflecting exhaust nozzles, and two-dimensional plug nozzles with and without bypass flow and/or engine swirl. A 10-deg engine swirl was found to reduce predicted plume temperature to the extent that, although swirl is undesirable from the point of view of performance, it must be recommended for two-dimensional nozzle plume IR signature reduction. O.C.

A82-17607 # **Take-off ground roll of propeller driven aircraft.** R. J. Hawks (Tri-State University, Angola, IN). *Journal of Aircraft*, vol. 19, Jan. 1982, p. 92, 93. 5 refs.

The solution to the acceleration problem for constant power with aerodynamic drag, including lift, developed by Hawks and Sayre (1973) is applied to the take-off ground roll problem in propeller driven aircraft. The major difficulty with the constant power calculation is that the static thrust has to be infinite in order for true constant power to be maintained. The problem is avoided by treating thrust as constant at the static thrust value up to the speed where the static thrust would produce the rated thrust-power, and then treating the power as constant above that speed. O.C.

A82-17608 # **Kelvin-Helmholtz stability analysis of air cushion landing gear trunk flutter.** M. Hinchey and P. Sullivan (Toronto, University, Toronto, Ontario, Canada). *Journal of Aircraft*, vol. 19, Jan. 1982, p. 94-96. Research supported by the Natural Sciences and Engineering Research Council of Canada.

It is shown that a Kelvin-Helmholtz linear stability analysis, similar to those used for aeroelastic problems such as panel flutter, predicts a divergent oscillation at the conditions for which flutter was observed during the development of bag or trunk-type air cushion landing gear. The flutter is therefore not neccessarily the result of a static instability, as suggested by Boghani and Fish (1979). The trunk is modeled locally as a membrane of infinite extent, set parallel to the ground plane. O.C.

A82-17714 * **Calculations of lightning return stroke electric and magnetic fields above ground.** M. J. Master, M. A. Uman, Y. T. Ling, and R. B. Standler (Florida, University, Gainesville, FL). *Journal of Geophysical Research*, vol. 86, Dec. 20, 1981, p. 12127-12132. 16 refs. NSF Grant No. ATM-79-02627; Grant No. NGR-10-005-169; Contracts No. N00014-81-K-0177; No. F33615-79-C-3412.

Lin et al., (1980) presented a lightning return stroke model with which return stroke electric and magnetic fields measured at ground level could be reproduced. This model and a modified version of it, in which the initial current peak decays with height above ground, are used to compute waveforms for altitudes from 0-10 km and at ranges of 20 m to 10 km. Both the original and modified models gave accurate predictions of measured ground-based fields. The use of the calculated fields in calibrating airborne field measurements from simultaneous ground and airborne data is discussed. J.F.

A82-17733 # **Mesoscale convective weather systems and aviation operations.** R. A. Maddox and J. M. Fritsch (NOAA, Office of Weather Research and Modification, Boulder, CO). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0015.* 9 p. 10 refs.

Enhanced, infrared satellite imagery is used to reveal that meso-alpha scale convective weather systems often develop and move across the central and eastern United States. The convectively driven weather systems are called mesoscale convective complexes (MCC), and are accompanied by a variety of weather phenomena. A comparison is made of 200 mb winds with numerical forecasts, which indicates that MCCs produce large changes in the airflow within atmospheric layers heavily traversed by commercial aircraft. Examples of MCCs and their impact on aircraft operations and actual flights are also discussed. D.L.G.

A82-17734 # **The Joint Airport Weather Studies project.** J. McCarthy, J. W. Wilson (National Center for Atmospheric Research, Boulder, CO), and T. T. Fujita (Chicago, University, Chicago, IL). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0017.* 9 p. 19 refs.

Convective microburst events are analyzed and objectives of the summer, 1982 Joint Airport Weather Studies (JAWS) project are outlined. Microbursts occur on a horizontal scale of 1-4 km (misoscale), and comprise small, strong downdrafts, which cause outflows at ground level resulting in winds exceeding 40 mph. A continued outflow may lead to a gust front, a feature present in squall lines. JAWS facilities include three Doppler radars, two research aircraft, three rawinsonde units, a lightning detection system, and the Portable Automated Mesonet. High resolution data on downdrafts will provide four-dimensional details of dynamic forcing mechanisms of microbursts for modelling such events in computer simulations. The modelling will further serve for understanding the behavior of aircraft in a wind shear environment and determining the causes of microburst events. M.S.K.

A82-17735 * # **Computation of the steady viscous flow over a tri-element 'augmentor wing' airfoil.** T. A. Lasinski, A. E. Andrews, R. L. Sorenson, D. S. Chaussee, T. H. Pulliam, and P. Kutler (NASA, Ames Research Center, Moffett Field, CA). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0021.* 16 p. 14 refs.

The augmentor wing consists of a main airfoil with a slotted trailing edge for blowing, and two smaller aft airfoils which shroud the jet. This configuration has been modeled for numerical simulation by a novel discretization procedure which generates four separate grids: three surface-oriented airfoil grids and one outer free-stream grid. Grid lines and slopes are continuous across boundaries, so grid overlap at common boundaries provides boundary information without interpolation. A two-dimensional unsteady thin-layer Navier-Stokes code is used to calculate the flow for the no-blowing case at freestream Mach number = 0.7, Re = 12,600.000, and angles-of-incidence = 1.05 deg. Qualitative agreement with experimental data indicates the utility of this procedure in the analysis of multi-element configurations. (Author)

A82-17753 * # **Screech suppression in supersonic jets.** T. D. Norum (NASA, Langley Research Center, Hampton, VA). *American*

Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0050. 9 p. 12 refs.

Jet screech from underexpanded sonic nozzles has been investigated experimentally. Multiple screech modes, or stages, are found to be present at some jet operating conditions. The fundamental screech tone of each mode attains a maximum amplitude at about 20 deg from the inlet axis, with higher harmonics exhibiting multiple lobes. The directivity of each harmonic is predicted quite well from a stationary array of acoustic monopoles, with phasing between consecutive monopoles determined by the shock cell spacing and eddy convection velocity. Large reduction of screech amplitude can be obtained from modifications to the nozzle exit, although the extent of this suppression is mode dependent. (Author)

A82-17755 # **Wind tunnel investigations for the flat spin of slender bodies at high angles of attack.** H. Kubota, I. Arai, and M. Matsuzaka (Tokyo, University, Tokyo, Japan). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0054.* 12 p. 16 refs. Research supported by the Ministry of Education of Japan.

Low speed wind tunnel investigations for the flat spin of slender bodies at high angles of attack at Reynolds number of 120,000-440,000 are conducted. Effects of geometrical configuration of model, free stream Reynolds number and angle of attack on the flat spin motion are studied with spin rate measurement, associated in situ surface pressure distribution and static side force measurements. It is verified that the occurrence of the flat spin is caused by the difference of flow separation patterns near the critical Reynolds number region. The flat spin motion can be alleviated by making turbulent separation with the use of surface roughness. (Author)

A82-17788 * # **A simple finite difference procedure for the vortex controlled diffuser.** A. A. Busnaina and D. G. Lilley (Oklahoma State University, Stillwater, OK). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0109.* 9 p. 21 refs. USAF-supported research; Grant No. NAG3-74.

A simple prediction procedure for sudden expansion incompressible flows is developed and applied to the vortex controlled diffuser. Transient Navier-Stokes equations of an incompressible fluid are solved by means of their associated finite difference equations in terms of the primitive pressure velocity variables. A computer code is developed using a laminar flow simulation with free slip or no slip wall boundary conditions. In addition, predicted results confirm that effectiveness increases with increases in duct length and bleed flow rate. D.L.G.

A82-17791 # **Widely-spaced co-axial jet, diffusion-flame combustor - Isothermal flow calculations using the two-equation turbulence model.** G. J. Sturgess and S. A. Syed (United Technologies Corp., Pratt and Whitney Aircraft Group, East Hartford, CT). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0113.* 13 p. 20 refs.

A numerical simulation of the isothermal flow in the Wright Aeronautical Propulsion Laboratory diffusion-flame research combustor is carried out. An axisymmetric finite difference solution of the time-averaged, steady-state, elliptic form of the Reynolds equations is used with closure provided by a two-equation turbulence model. Although the simulation gives acceptable agreement with experimental data in many respects, it is deficient in predicting the recovery rate of a central near-wake region. Several possible explanations for this failure are explored and it is hypothesized that the most probable cause is an inability in the turbulence model to account for the effects on Reynolds stresses of streamwise curvature of the streamlines. (Author)

A82-17796 * # **An iterative finite element-integral technique for predicting sound radiation from turbofan inlets in steady flight.** S. J. Horowitz, R. K. Sigman, and B. T. Zinn (Georgia Institute of Technology, Atlanta, GA). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0124.* 9 p. 23 refs. Grant No. NsG-3036.

A new iterative solution technique for predicting the sound field radiated from a turbofan inlet in steady flight is presented. The sound field is divided into two regions: the sound field within and near the inlet which is computed using the finite element method and the radiation field beyond the inlet which is calculated using an integral solution technique. A continuous solution is obtained by matching the finite element and integral solutions at the interface between the two regions. The applicability of the iterative technique is demonstrated by comparison of experimental results with the theoretical results for several different inlet configurations with and without flow. These examples show that good agreement between experiment and theory is obtained within five iterations. (Author)

A82-17798 # **Unsteady flow patterns associated with spoiler control devices.** A. Ayoub, B. Satynarayana, K. Karamcheti (Stanford University, Stanford, CA), and H. C. Seetharam (Boeing Commercial Airplane Co., Seattle, WA). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0127.* 9 p.

The unsteady flow field past a Boeing research airfoil fitted with a spoiler has been examined using surface pressure measurements as well as a limited number of velocity measurements in and outside the boundary layer. Definite flow patterns associated with the process of vortex shedding were sought in an effort to establish some correlation with the performance of the spoiler as a lift control device. The flow patterns were found to be complex and not easily reconcilable with known notions about the flow in general. The flow details at two different Reynolds numbers (based on the chord), 2.82 x 10 to the 5th and 5.18 x 10 to the 5th, and three spoiler deflection angles are presented and discussed. (Author)

A82-17799 # **Trailing edge flap influence on leading edge vortex flap aerodynamics.** J. F. Marchman, III and A. C. Grantz (Virginia Polytechnic Institute and State University, Blacksburg, VA). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0128.* 7 p. 6 refs.

A study was conducted to explore the effects of trailing edge flaps (TEF) on leading edge vortex flap (LEVF) aerodynamics. A variety of LEVF and TEF configurations were tested on flat plate delta wings with leading edge sweep angles of 60 and 75 degrees. Results indicated that the well established vortex flowfield of the 75 degree wing was not substantially improved due to the deflection of trailing edge flaps. Significant changes were seen to occur to the marginal vortices of the 60 degree wing. For the 60 degree wing with inverted constant chord LEVFs the deflection of TEFs resulted in substantial increases in life coefficient at low angles of attack without sacrificing other performance parameters. Also shown was the capability for eliminating the adverse longitudinal characteristics of constant chord LEVFs. (Author)

A82-17800 # **Optimal subsonic diffuser wall design for arbitrary entry conditions.** J. L. Livesey and M. Heravi (Salford, University, Salford, Lancs., England). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0132.* 6 p.

Pressure gain in diffusers is basically limited by the flow separation. It is possible theoretically to determine the design of a diffuser with the limiting condition of flow separation occurring throughout. The cross-sectional variation as a function of location in the diffuser, in order to achieve optimal pressure gain, is thus determinable. An attempt has been made to predict, through an integral boundary layer method, the shape of a diffuser with optimal pressure gain. The entry condition is quite general (Reynolds number, Mach number, profile shape, momentum thickness and turbulence). The optimization in the present model is based on the assumption of constant profile shape (Hsep) and zero skin friction. The general effects of each individual entry parameters on the final design shape are discussed, and the general indications are that the pressure recovery of the present optimal diffusers are higher than those of conical diffusers of the same area ratios and that conical diffusers are comparable to the optimal shapes for high inlet Mach numbers. (Author)

A82-17814 # **Computational treatment of transonic canard-wing interactions.** V. Shankar and N. Malmuth (Rockwell International Science Center, Thousand Oaks, CA). *American Institute of*

Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0161. 9 p. 9 refs. Contract No. F44620-81-C-0044.

The transonic canard-wing interaction problem is simulated using modified small disturbance (MSD) transonic theory. The wing and the canard are treated in a sheared fine, grid system that is embedded in a global Cartesian crude grid. An appropriate far field and asymptotic expression for the velocity potential derived using Green's theorem is implemented. Results are presented for a few canard-wing configurations and compared with available experimental data. The weakening of the wing shock due to the presence of the canard downwash is illustrated in terms of contour plots. An empirical incidence correction for the wing leading edge vortex gives good agreement with experiment at low incidences. For higher angles of attack, the results indicate that a more sophisticated vortex roll-up and induction model is required. (Author)

A82-17815 # **A more-accurate transonic computational method for wing-body configurations.** L. T. Chen (McDonnell Douglas Research Laboratories, St. Louis, MO). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0162.* 10 p. 16 refs. Contract No. N000167-81-C-0057.

Second- and third-order, quasi-conservative and fully conservative schemes have been developed for computing inviscid flowfields about transonic wings. The fully conservative schemes are developed by modifying an existing finite-volume algorithm, while the quasi-conservative schemes are developed by solving a transformed full-potential equation with the addition of new second- or third-order artificial viscosities at supersonic points. A new shock-point operator is introduced, which adjusts the amount of nonconservative differencing at shock points and thus modifies the location and strength of captured shocks. Numerical results obtained using the second- and third-order schemes will be discussed and compared with experimental data. (Author)

A82-17816 * # **Transonic three-dimension viscous-inviscid interaction for wing-body configuration analysis.** E. G. Waggoner (Vought Corp., Dallas, TX). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0163.* 12 p. 16 refs. Contract No. NAS1-16055.

A three-dimensional small disturbance transonic analysis code has been coupled with a three-dimensional integral boundary layer code. A scheme was developed to interact the two codes through the use of a controlling module. The resulting hybrid code does not increase the costs or computer core requirements over that of the previous capabilities of the analysis code, which used a two-dimensional boundary layer analysis to model viscous effects. Several configurations have been analyzed and results compared against both experimental data and computational results using the two-dimensional viscous model. Results indicate good agreement with experimental data when using the three-dimensional interaction scheme, with the most marked improvement in the correlations observed for wing pressure coefficient predictions in the lower surface cusp region for supercritical wings. (Author)

A82-17820 # **Recent improvements in prediction techniques for supersonic weapon separation.** A. Cenko (Grumman Aerospace Corp., Bethpage, NY) and J. Waskiewicz (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, OH). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0170.* 9 p. 7 refs. Contract No. F33615-81-3011.

The Influence Function Method (IFM) considered in the investigation has been reported by Meyer et al. (1981). The principal assumption is that a store's normal force and moment in a nonuniform flow can be correlated with the angle-of-attack distribution along the store length. At supersonic speeds, the influence coefficients A and B can be determined by traversing a store through an oblique shock generated by a wedge and measuring the normal force and moment along the traverse. Theoretically determined weapon/store influence coefficients for four stores are shown to yield accurate IFM store force and moment predictions. Considering the geometric dissimilarity of the stores examined in the study, it would appear that the use of theoretically determined influence coefficients is a practical and cost-effective alternative to the use of experimental weapon calibrations for IFM applications at supersonic speeds. G.R.

A82-17827 # **Determination of Learjet Longhorn airplane horizontal tail load and hinge moment characteristics from flight data.** G. D. Park and M. H. Abla (Gates Learjet Corp., Wichita, KS). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0183.* 8 p. 21 refs.

Gates Learjet Corporation recently received the type certificate for the Model 55 Longhorn, its newest and largest business jet aircraft. During the certification effort, the aircraft flight characteristics, as well as the horizontal tail airloads and elevator hinge moments, were evaluated from inflight response data. The purpose of these analyses were to verify the design airloads used in the documentation required for FAA certification. Two parameter identification computer programs developed by NASA were used. One was developed by Taylor and Iliff in 1972. The other was developed by Maine and Iliff in 1980. (Author)

A82-17828 # **A binary matrix technique for aircraft collision threat recognition and avoidance.** M. N. Wagdi (Riyadh, University, Riyadh, Saudi Arabia). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0184.* 9 p.

A new technique is presented for aircraft collision threat recognition and avoidance. The lateral plane of the airspace in front of own aircraft is represented by a square binary matrix, whose central element coincides with the own aircraft body axes system. Each element of the binary matrix defines an airspace cell with known area. The elements representing the flight domains of own and threat aircraft have digits 1 while all other elements are zeros. The binary matrix approach enables one to project the three dimensional threat information onto a two dimensional indicator. This is done through the introduction of the threat signal intensity concept. A possible collision threat is recognized when the digit in one of the cells bounding the own aircraft domain changes from 0 to 1. The location of such cell in the binary matrix indicates the threat bearing angles. An evasive maneuver based on such information is thus initiated. (Author)

A82-17831 # **3 DOF gyro analysis from measured and derived rates.** G. T. Chrusciel and N. J. French (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0189.* 13 p. 5 refs.

Hypersonic three degree-of-freedom (3DOF) angular motion reentry simulation tests were performed using telemetry of onboard rate gyro signals for direct extraction of the aerodynamic moments. Conditions are described which produced high quality signals during one test entry and intermittant loss of signal for a subsequent test. Body fixed angular rate data were reconstructed from the 3DOF balance angular position results; these compared well with the gyro data. Feasibility of using the AEDC 3DOF gas bearing angular data for extraction of moments is demonstrated by good agreement of aerodynamic moments extracted using the derived rates and gyro rates. (Author)

A82-17833 * # **Development and operating characteristics of an advanced two-stage combustor.** W. Greene, S. Tanrikut (United Technologies Corp., Commercial Products Div., East Hartford, CT), and D. E. Sokolowski (NASA, Lewis Research Center, Cleveland, OH). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0191.* 14 p. 10 refs.

Results are presented from an experimental program aimed at optimizing the features of an advanced two-stage combustor that currently is being developed as part of the National Aeronautics and Space Administration/Pratt & Whitney Aircraft Energy Efficient Engine program. The combustor is designed to meet stringent goals for performance, emissions, durability and operational characteristics. An overview of the design selection process in light of these goals is discussed. Combustor rig test results, which highlight the techniques used to reduce emissions, development of the pilot and main power zone fuel injection systems, and methods of achieving efficient fuel staging, are presented. (Author)

A82-17836 * # **Water ingestion into jet engine axial compressors.** T. Tsuchiya and S. N. B. Murthy (Purdue University, West Lafayette, IN). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0196.* 11 p. 14 refs. Contract No. F33615-78-C-2401; Grant No. NAG3-62.

An axial flow compressor has been tested with water droplet ingestion under a variety of conditions. The results illustrate the manner in which the compressor pressure ratio, efficiency and surging characteristics are affected. A model for estimating the performance of a compressor during water ingestion has been developed and the predictions obtained compare favorably with the test results. It is then shown that with respect to five droplet-associated nonlinearly-interacting processes (namely, droplet-blade interactions, blade performance changes, centrifugal action, heat and mass transfer processes and droplet break-up), the initial water content and centrifugal action play the most dominant roles. (Author)

A82-17843 # **An experimental investigation of the influence of vertical wind shear on the aerodynamic characteristics of an airfoil.** F. M. Payne (Boeing Commercial Aircraft Co., Seattle, WA) and R. C. Nelson (Notre Dame, University, Notre Dame, IN). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0214.* 10 p. 17 refs. Research supported by the University of Notre Dame; U.S. Department of Transportation Contract No. RC-82010.

An experimental wind tunnel investigation was carried out to determine the influence of a vertical wind shear on the static longitudinal aerodynamic coefficients (i.e., the sectional drag, lift, and moment coefficients) of an airfoil. Force balance and surface pressure measurements were obtained from a NACA 0018 airfoil in a linear velocity gradient. The airfoil was tested in a Reynolds number range from 75,000 to 200,000, with endplates to simulate an infinite wing, and with the outboard endplate removed to simulate a finite wing. The effect of grit on the surface of the airfoil was also investigated. The influence of the velocity gradient on the aerodynamic characteristics of the airfoil was found to be small, especially in comparison to the effects of the grit. (Author)

A82-17844 * # **Simulation of phugoid excitation due to hazardous wind shear.** W. Frost (FWG Associates, Inc.; Tennessee, University, Space Institute, Tullahoma, TN), B. S. Turkel (Peachtree Dekalb Airport, Atlanta, GA), and J. McCarthy (National Center for Atmospheric Research, Boulder, CO). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0215.* 13 p. 11 refs. Contract No. NAS8-33458.

Computer and manned flight simulator studies of the effect of thunderstorm wind shear on the excitation of phugoid oscillations of commercial-type aircraft are reported. Previous studies have suggested that the characteristic scale of thunderstorm wind shear drives commercial-type aircraft at the critical phugoid frequency. To further investigate this phenomenon, aircraft performance in a hypothetical sinusoidal wind shear was investigated. Sinusoidal winds at the phugoid frequency and with frequencies above and below this value were studied both analytically and in manned flight simulators. Results indicate that excessive oscillations in flight path amplitude predicted by computer analyses were not fully collaborated by the manned flight simulator studies. Some resolution of this problem is given and additional research necessary to further identify the discrepancies between the flight simulator and the computer analysis is outlined. (Author)

A82-17855 * # **Three-dimensional flow studies on a slotted transonic wind tunnel wall.** J. M. Wu, F. G. Collins, and M. K. Bhat (Tennessee, University, Space Institute, Tullahoma, TN). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0230.* 12 p. 18 refs. Grant No. NsG-2379.

Three-dimensional flow field measurements were made near a transonic slotted wall. Field velocity vectors and static pressure distributions have been obtained. The boundary layer displacement thickness was found to vary in the transverse plane with its maximum at the slot center line but decreased with increasing suction rate through the slot. The boundary layer characteristics were sensitive to the mass transfer through the slot. The projection on the flow field velocity vectors on the transverse plane reveals a vortex-like flow formation. The center of this secondary flow was located nearly at the edge of the wall shear layer and decreased in strength with applied suction. The secondary vortex motion may be attributed to the mean flow skewing, inhomogeneous transverse plane boundary layer and the wall turbulence anisotropy. (Author)

A82-17856 * # **Vortex lift augmentation by suction on a 60 deg swept Gothic wing.** A. H. Taylor, L. R. Jackson, and J. K. Huffman (NASA, Langley Research Center, Hampton, VA). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0231.* 8 p. 12 refs.

An experimental investigation was conducted in the Langley high-speed 7- by 10-foot wind tunnel to determine the aerodynamic performance of suction applied near the wing tips above the trailing edge of a 60 deg swept Gothic wing. Moveable suction inlets were symmetrically mounted in the proximity of the trailing edge, and the amount of suction was varied to maximize wing lift. Tests were conducted at Mach 0.15, 0.30, and 0.45, and the angle of attack was varied from -4 to 50 deg. The suction augmentation increases the lift coefficient over the entire range of angle of attack. The lift improvement exceeds the unaugmented wing lift by over 20%. Moreover, the augmented lift exceeds the lift predicted by vortex lattice theory to 30 deg angle of attack. Suction augmentation is postulated to strengthen the vortex system by increasing its velocity and making it more concentrated. This causes the vortex breakdown to be delayed to a higher angle of attack. (Author)

A82-17858 * # **Recent sidewall boundary-layer investigations with suction in the Langley 0.3-m Transonic Cryogenic Tunnel.** A. V. Murthy, C. B. Johnson, E. J. Ray, and P. L. Lawing (NASA, Langley Research Center, Transonic Aerodynamics Div., Hampton, VA). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0234.* 12 p. 21 refs.

An experimental and theoretical study of the Langley 0.3-m Transonic Cryogenic Tunnel (TCT) sidewall boundary-layer with and without suction, has been made. Without suction, the boundary-layer displacement thickness at a station ahead of the model varied from about 1.6 mm to 1.3 mm over a Reynolds number range of 20 million to 200 million per m at Mach numbers from 0.30 to 0.76. Measured velocity profiles were correlated using the defect law of Hama. The boundary-layer displacement thickness decreased when suction was applied; however, after suction of about 2 percent of test section mass flow, the change in the thickness was small. A comparison of the measured suction effectiveness with finite difference and integral methods of boundary-layer calculation showed that both methods predicted the right trend over the range of suction velocities (up to a suction to free-stream velocity ratio of -0.02). (Author)

A82-17861 * # **Dynamic stability of a buoyant quad-rotor aircraft.** B. L. Nagabhushan and N. P. Tomlinson (Goodyear Aerospace Corp., Defense Systems Div., Akron, OH). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0242.* 10 p. 13 refs. Contract No. NAS2-10777.

Stability characteristics of a buoyant quad-rotor aircraft (BQRA) in hover and forward flight are examined by considering linear, state-variable, and nonlinear flight simulation models of such a configuration. The effects of carrying a sling load on the vehicle dynamics is predicted by considering a coupled model of the two bodies. Inherent stability characteristics of the vehicle are analyzed and compared with those of a helicopter and an airship in free flight. Typical operational conditions that could lead to vehicle instability are described in the flight envelope of interest. (Author)

A82-17862 * # **Bifurcation analysis of nonlinear stability of aircraft at high angles of attack.** W. H. Hui (Waterloo, University, Waterloo, Ontario, Canada) and M. Tobak (NASA, Ames Research Center, Moffett Field, CA). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0244.* 11 p. 13 refs. Grant No. NAGW-130.

The problem of stability of steady flight of an aircraft flying at

high angles of attack subject to finite-amplitude disturbances in pitch is studied using bifurcation theory, taking account of the interactions between the pitching motion and the unsteady flow. The aerodynamic responses to large-amplitude slow oscillations of the aircraft are obtained from that of infinitesimal amplitude case. Increasing the angle of attack past some critical angle for which the damping vanishes, the steady flight becomes unstable and Hopf bifurcation sets in, resulting in a periodic motion. A simple criterion in terms of the aerodynamic coefficients is given for determining the stability of the bifurcating period motion. For supersonic/hypersonic flat plate airfoils the bifurcating periodic motion is found to be unstable. This implies that when the angle of attack is increased past that of neutral damping, there will be drastic changes of the motion of the aircraft from its steady flight condition at the critical angle, including, e.g. hysteresis. (Author)

A82-17864 # **Aerodynamics of tactical weapons to Mach number 8 and angle-of-attack of 180 deg.** L. Devan, L. A. Mason, and F. G. Moore (U.S. Navy, Naval Surface Weapons Center, Dahlgren, VA). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0250.* 13 p. 14 refs. Army-sponsored research. Navy Task RF32-391-801; SEA Task SF32392-591; SEA Task SR02302.

The Naval Surface Weapons Center Aeroprediction Code has been extensively applied to the prediction of static and dynamic aerodynamics of missile configurations. Major extensions have recently been made to the code to extend its capability to freestream Mach number between 0 and 8 and angles of attack between 0 and 180 deg, and also to improve the transonic, inviscid, body-alone, static, aerodynamic predictions and the dynamic derivative predictions for all Mach numbers. The theoretical basis for the code extensions are outlined and previous methods are briefly reviewed. The code is evaluated through comparisons of computational examples with experiment for body-alone, body-tail and body-tail-canard configurations. The speed and accuracy of the code are ideal for use in preliminary design. (Author)

A82-17865 # **Relaxation solution for viscous transonic flow about fighter-type forebodies and afterbodies.** R. R. Cosner (McDonnell Aircraft Co., St. Louis, MO). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0252.* 10 p. 12 refs.

The velocity-splitting method for solving the Navier-Stokes equations has been formulated into a procedure to predict external 3-D flowfields at subsonic and transonic speeds. A wide range of geometry can be treated, including realistic fighter-type forebody and afterbody configurations. Accurate results for pressure and drag have been obtained for several configurations at transonic speeds, including cases in which the pressure field is modified substantially by boundary layer separation. The procedure has demonstrated the needed accuracy, versatility, reliability, and economy to be a practical engineering tool. (Author)

A82-17866 # **Performance calibration results for a Compact Multimission Aircraft Propulsion Simulator.** C. D. Wagenknecht, G. E. Hoff (General Electric Co., Cincinnati, OH), and T. J. Norbut (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0254.* 12 p. 9 refs.

Experimental performance data were obtained for a Compact Multimission Aircraft Propulsion Simulator configured with dry and reheat exhaust nozzles simulating a broad range of advanced multimission aircraft propulsion system cycles. Exhaust nozzles, pancake mixers, and circular arc venturi flow meters were calibrated over the expected range of operation prior to simulator testing. Agreement of the C-MAPS performance results with the calibration data are presented in order to assess methods for determining installed simulator inlet airflow. Installed operability considerations with regard to cycle simulation, model scaling, and aircraft integration are discussed. The C-MAPS test program demonstrated a 20 percent improvement in engine pressure ratio simulation capability relative to a prototype design. This was accomplished for the 1.65 lb/sec. C-MAPS in a compact size equivalent to a 36 percent overall length reduction and a 21 percent maximum diameter reduction. (Author)

A82-17867 # **Digital test pilot concept.** W. J. Bezdek (McDonnell Aircraft Co., St. Louis, MO) and R. T. Galloway (U.S. Navy, Naval Training Equipment Center, Orlando, FL). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0259.* 12 p. 9 refs.

A series of automated digital tests have been developed to verify the fidelity of aircraft systems, performance, and flying qualities for aircraft models developed for man-in-the-loop simulation. The aircraft digital tests include time to accelerate/decelerate, level turning performance, time to climb/descend, steady state trim, dynamic longitudinal stability, static and dynamic lateral-directional stability, lateral control effectiveness, and engine operation. The implementation of the test driver equations, verification of the test methods and comparisons with other validation methods are described. Examples using F-4J/S flight test data are used to demonstrate the concept. (Author)

A82-17868 * # **Real-time simulation of helicopter IFR approaches into major terminal areas using RNAV, MLS, and CDTI.** L. Tobias, H. Q. Lee, L. L. Peach (NASA, Ames Research Center, Moffett Field, CA), F. M. Willett, Jr., and P. J. O'Brien (FAA, Technical Center, Atlantic City, NJ). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0260.* 13 p. 11 refs.

Helicopter IFR routes at hub airports have been investigated in an air-traffic-control system simulation involving a piloted helicopter simulator, computer-generated air traffic, and air traffic controllers. Problems studied included: (1) pilot acceptance of the approach procedure and tracking accuracy; (2) ATC procedures for handling a mix of helicopter and fixed-wing traffic; and (3) utility of the Cockpit Display of Traffic Information (CDTI) for the helicopter. Results indicate that the helicopter routes were pilot acceptable and were noninterfering with fixed-wing traffic. Merging and spacing maneuvers using CDTI were successfully carried out by the pilots, but controllers had some reservations concerning CDTI. (Author)

A82-17874 # **Icing analysis of an unprotected aircraft radome.** J. Stone and R. Ross (Ross Aviation Associates, Sedgwick, KS). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0281.* 6 p.

Artificial icing tests were conducted to determine the rate of ice accretion on an unprotected aircraft radome. These data are correlated with accepted means of calculating water catch rate. The theoretical method of calculating water catch rate is subsequently modified to produce a more accurate prediction technique. A method is also developed to predict the thickness distribution of the accumulated ice on the radome. Since fully descriptive icing tunnel data does not exist for radome shapes, assumptions are made concerning the shape of the forward fuselage in the determination of the average collection efficiency. Other assumptions, such as ice density and the amount of water catch that freezes, are made to give the highest ice accumulation. (Author)

A82-17875 # **A Microwave Ice Accretion Measurement Instrument - MIAMI.** B. Magenheim and J. K. Rocks (Ideal Research, Inc., Rockville, MD). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0285.* 9 p.

A Microwave Ice Accretion Measurement Instrument (MIAMI), controlled by a microprocessor, has been developed that can: (1) detect the presence of ice and sound an alarm; (2) measure and digitally display the ice thickness and ice accretion rate; (3) plot the ice thickness and accretion rate on a pen recorder; (4) log and printout a permanent record of the ice thickness and ice accretion rate versus time; and (5) store data for delayed time statistical analysis and printout. The MIAMI was tested in the NASA Lewis Research Center's Icing Research Tunnel, demonstrating its ability to measure ice growth on a two-dimensional air foil. The MIAMI transducer is constructed from solid-state components, all of which have a low mass and are ruggedly built. The device may be mounted nonintrusively on any part of the aircraft skin, including the rotor blades and engine inlets. J.F.

A82-17894 * # **The NASA MERIT program - Developing new concepts for accurate flight planning.** R. Steinberg (NASA, Lewis

Research Center, Cleveland, OH). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0340.* 6 p.

It is noted that the rising cost of aviation fuel has necessitated the development of a new approach to upper air forecasting for flight planning. It is shown that the spatial resolution of the present weather forecast models used in fully automated computer flight planning is an important accuracy-limiting factor, and it is proposed that man be put back into the system, although not in the way he has been used in the past. A new approach is proposed which uses the application of man-computer interactive display techniques to upper air forecasting to retain the fine scale features of the atmosphere inherent in the present data base in order to provide a more accurate and cost effective flight plan. It is pointed out that, as a result of NASA research, the hardware required for this approach already exists. C.R.

A82-17895 # **Minimum cost atmospheric cruise control - Most efficient airspeed for a given wind component.** C. L. Chandler and C. J. Emmons (Delta Air Lines, Inc., Atlanta, GA). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0341.* 4 p.

Attention is called to the fact that many airlines overlook the effect of winds when setting the cruise speeds that will produce the most economical speed schedule for a flight. It is shown through calculations that as a headwind gets stronger the Mach number should be increased or at least maintained. Conversely, as the tailwinds increase in strength, the Mach number should be reduced. Another advantage of the method proposed is the improvement that would be seen in on-time performance by compensating for the winds with the wider use of Mach numbers. C.R.

A82-17896 * # **The influence of turbulence models on computer-simulated aircraft landing.** W. Frost (Tennessee, University, Tullahoma, TN), S.-T. Wang (FWG Associates, Inc., Tullahoma, TN), and D. W. Camp (NASA, Marshall Space Flight Center, Huntsville, AL). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0342.* 4 p. 9 refs. Contract No. NAS8-32692.

Three models of simulated atmospheric turbulence were used to determine their respective influence on a computer-simulated, DC-8 type, aircraft landing. Statistical results based on a sample of 20 simulated landings illustrate the influence of turbulence simulated by the different models. For the same spectrum function, a non-Gaussian turbulence model produces the higher degree of touchdown variability. When different spectrum functions are used the von Karman model induces a smaller standard deviation in position error than the Dryden model. The turbulence energy contained by the higher frequency fluctuation has little effect on the landing position. (Author)

A82-17900 * # **Computations of transonic flow over an oscillating airfoil with shock-induced separation.** W. J. Chyu and K. Kuwahara (NASA, Ames Research Center, Moffett Field, CA). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0350.* 11 p. 22 refs.

A numerical study is presented on unsteady transonic flow over an airfoil in pitching oscillation at a moderately high incidence. The study was focused on the effects of unsteady shock-wave/boundary-layer interactions and subsequent flow separations. An implicit finite-difference scheme was used to solve the full time-dependent compressible Navier-Stokes equations in conservation-law form. The algorithm adopted for this study is the Beam-Warming spatially factored scheme. It is, however, constructed in a body-fitted curvilinear coordinate system for efficient unsteady flow computations. The computational results are compared with experimental data measured in the Ames 11- by 11-Foot Transonic Wind Tunnel. (Author)

A82-17901 # **Instantaneous turbulence profiles in the wake of an oscillating airfoil.** J. De Ruyck and C. Hirsch (Brussel, Vrije Universiteit, Brussels, Belgium). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0353.* 13 p. 18 refs. Research supported by the Fonds National de la Recherche Scientifique; Grant No. DAJA37-80-C-0367.

Instantaneous velocity and turbulence profiles are measured in the wake of a NACA 0012 oscillating airfoil. All non-zero Reynolds stresses are determined using a single slanted rotating hot wire measurement technique. Data acquisition is performed through an on-line sampling, digitizing and recording facility. Measurements are made at 0.7, 2, 5, 10 and 20% chord downstream of the trailing edge. The frequency coefficient ranges from 0 to 1.23. Four mean incidences are considered corresponding to no stall, stall onset and light dynamic stall. Results are discussed and compared with steady state results. (Author)

A82-17902 # **Numerical computation of optimal atmospheric trajectories involving staged vehicles.** C. R. Hargraves (Boeing Co., Seattle, WA). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0360.* 6 p. 5 refs.

A trajectory optimization procedure is described which can solve practical problems involving staged vehicles or discontinuous equations of motion. It is an extension of a computer code called CTOP (Chebychev Trajectory Optimization Program) which was described by Hargraves et al. (1981). With CTOP, the state and control variables are described as functions of time by patched polynomials. A subset of the patch points (including initial and final time) may be designated as free parameters called events. It is pointed out that discontinuities may occur at events and that the payoff may depend on them. The values of the events are adjusted in order to achieve the desired optimum. Numerical examples are presented. C.R.

A82-17904 # **Constant L/D glide trajectories.** J. L. Raymond (Hughes Aircraft Co., Missile Systems Group, Canoga Park, CA). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0362.* 7 p.

The present paper reviews the phenomenon of constant L/D glide trajectories with the result that new, simple and accurate closed-form expressions are derived. They include relations between glide path angle, altitude, time, velocity, density, and dynamic pressure. Results obtained compare well with those obtained by a digital computer using step-by-step integration of the equations of motion for a point mass. The relations may be used for rapid preliminary design estimates of constant L/D trajectories. (Author)

A82-17905 # **Optimum configuration for a 10 passenger business turbofan jet airplane.** M. Aronson. *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0365.* 11 p. 7 refs.

The optimum external configuration for an airplane which will meet specific design and performance requirements is determined by use of an analytical method which considers systematic variations of wing sweep, thickness ratio, fuselage fineness ratio, cruising speed and design weight. Relationships between the various structural, weight and aerodynamic parameters used in the method are derived. Evaluation of the parameters is then based on limits imposed by current experience and assumptions. The specific design objective in this study was to minimize take-off weight and maximize the cruising speed for a specific range with a designated power plant. The optimum configuration resulting from this study has 36 deg wing sweep and 14.6% wing section thickness, a ramp weight of 21,575 pounds and a range of 2500 n. miles with 10 passengers. Besides providing an optimum design and an analytical method for its determination, the method and a number of the curves can be used to determine configurations which will meet other specific performance requirements. (Author)

A82-17906 # **Optimal trajectories in supersonic flight.** D.-F. Lin (Applied Dynamics International, Ann Arbor, MI). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0366.* 10 p. 5 refs.

A discussion emphasizing the analytic aspect of the theory of the optimal trajectories is presented, beginning with an overview of optimal trajectories in two dimensions. Solving the general problem of optimal trajectories in three dimensions is discussed in detail. Included here are the general properties of optimal trajectories consisting of the integrals of motion and the characteristic features in engine and aerodynamic controls. In addition, the optimality of

singular thrust control and the optimal junction of different subarcs are analyzed. It is noted that with the normalizing of the control variables, that is, the thrust-to-weight ratio, the bank angle, and the load factor, the results can be applied to any supersonic aircraft. C.R.

A82-17907 # **An application of invariance principle to pilot model for NT-33 aircraft with variable coefficients and delays.** A. S. C. Sinha (Purdue University, Indianapolis, IN). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0367.* 7 p. 13 refs. Contract No. F49620-79-C-0038.

A method is presented for analyzing pilot-induced oscillations (PIO) for the NT-33 closed-loop pilot model when retardations and coefficients are not constant. The variation of retardations and coefficients results from the effect of wind shear and the neuromuscular dynamics of the pilot reported in available data. Nonlinearities in the model are also considered. The method is based on the use of a new description of such systems in terms of convolution equations. Spectral factorization is applied to the entire functions of exponential order. The result is a criterion for the PIO-system with variable coefficients and variable delays. The criterion assumes continuity and boundedness of the coefficients and delays. A Lyapunov functional is constructed which gives a criterion on the roots of a certain 'quasi-polynomial,' i.e., a polynomial in a variable and the exponential of that variable. The largest domain of attraction is obtained from the Invariance Principle. (Author)

A82-17908 # **Flutter mode suppression using hyperstable feedback.** G. L. Slater (Cincinnati, University, Cincinnati, OH). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0368.* 11 p. 9 refs.

The stability properties of hyperstable systems are explained and a synthesis procedure for multivariable feedback control laws is formulated and applied to the flutter control problem. The feedback controller is determined by: (a) constructing a state variable feedback law using a simplified model of the actual system dynamics, and (b) constructing a Luenberger observer for this system where the observer gain matrix is determined based on the hyperstable criterion. The procedure is applied to two design cases, one which is open-loop stable and the second which is open loop unstable. Results indicate that the hyperstability conditions can be utilized conveniently to develop a stable, robust elastic mode suppression system. (Author)

A82-17909 * # **The residue-measure criterion for model reduction in the analysis of the NASA Space Shuttle's digital flight control system.** D. P. Gluch (Honeywell, Inc., Clearwater, FL). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0369.* 9 p. 8 refs. Research supported by the Honeywell, Inc., Rockwell International Corp., and NASA.

A residue-measure criterion model reduction technique is applied to the vehicle dynamics model used in the design and analysis of the NASA Space Shuttle's digital flight control system. As implemented in this study the residue-measure technique involved an a priori residue calculation with control system biasing. The predictions of the reduced model are compared to vehicle level dynamic stability test data. These comparisons show an excellent correlation of the dominant spectral and response features between the model and test data. In addition, the application of the reduction technique to various Shuttle mission flight phases is demonstrated. (Author)

A82-17910 # **Target acceleration modeling for tactical missile guidance.** P. L. Vergez (USAF, Armament Laboratory, Eglin AFB, FL). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0370.* 13 p. 8 refs.

This paper addresses the critical problem of estimating the missile-to-target position, velocity, and acceleration (required by the linear optimal guidance law) when only passive (angle only) seeker information is available on-board a highly maneuverable bank-to-turn missile concept. More specifically, the problem is how to model the target acceleration to achieve improved missile performance. Four target acceleration models coupled with an extended Kalman filter are presented and evaluated on a six degree-of-freedom missile simulation to determine their estimation effectiveness and their influence on missile guidance. (Author)

A82-17911 # **Performance considerations in the design of subsonic cruise missiles.** R. L. Hanson and M. H. Kiehle (Boeing Aerospace Co., Seattle, WA). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0371.* 11 p.

The recent introduction of advanced radar-controlled defenses to the territory of potential enemies has altered the requirements of both strategic and tactical cruise missiles, which have previously included only low specific fuel consumption and low vehicle weight. After a historical survey of cruise missile design practices, and an assessment of the capabilities of the current Harpoon, ALCM and Tomahawk systems, consideration is given to the impact of cruise missile radar cross section (RCS) and infrared signature in the emerging enemy defenses scenario. It is shown that the avoidance of fuselage, wing and control surface configurations with sharp points and tips that increase RCS leads to deltoid and saucer-like designs whose aerodynamic characteristics are not strictly in keeping with the efficient, high-speed cruise requirement. The construction of airframes from radar-absorbing materials is recommended. O.C.

A82-17912 # **An aerodynamic and signature shaping technique for developing advanced supersonic missile concepts.** R. J. Krieger (McDonnell Douglas Astronautics Co., St. Louis, MO). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0373.* 10 p. 13 refs.

A technique has been developed for optimizing the aerodynamic and signature characteristics of advanced, non-circular supersonic missile concepts. Sensitivity equations which guide configuration shaping are derived for the aerodynamic coefficients of axial force, normal force, pitching moment and lift-to-drag ratio; and for the signature characteristics of radar cross section and shadowing of surfaces. The implementation of the procedure in the computer aided design process is presented. Characteristics of the resulting shapes are verified by comparison with wind tunnel and high range resolution radar data. Applications are given for forebodies, boattail/base/nozzle integration and a complete configuration. (Author)

A82-17919 # **Viscous flow - Nemesis of the theoretician in pursuit of higher order accuracy.** L. E. Ericsson (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0389.* 13 p. 60 refs.

A review of viscous flow effects shows that the effects of large regions of separated flow on the vehicle dynamics cannot be mistaken for higher order inviscid flow effects because of their magnitude and nature. The effects of a thick boundary layer or of a small local separated flow region is less drastic; they may often be mistaken for a higher order inviscid flow effect. It is noted that because viscous effects are often large, even for attached hypersonic flow, great care is needed when comparing inviscid theory with experiment. An example is furnished by the effect of nose bluntness on slender cone unsteady aerodynamics. It is thought that for the foreseeable future the only practical means of obtaining the full scale unsteady viscous flow characteristics will be by the interactive use of experimental and theoretical results to obtain 'dynamic solution through analytic extrapolation'. C.R.

A82-17920 # **Evaluation of supersonic missile aerodynamic prediction techniques.** J. E. Williams (McDonnell Douglas Astronautics Co., St. Louis, MO). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0390.* 12 p. 30 refs.

Qualitative and quantitative analyses performed by comparing predictions with test data, and evaluating method accuracy according to a novel criterion, are presented for the case of ten methods used in the prediction of missile aerodynamic characteristics at supersonic speeds. It is found that: (1) while adequate predictions can be obtained for missile configurations in the conventional, airbreathing, and cruise missile classes, improvements are needed to address the lifting-body missile class; (2) of the two method categories considered, component-buildup and paneling techniques, that composed

of methods employing configuration component-buildup may be enhanced by existing techniques that would result in greater accuracy or capability; and (3) the Datcom, NSWC, Missile 2, Aerodyn, and S/HABP component-buildup methods are found useful in the complete longitudinal aerodynamic analysis of missiles. O.C.

A82-17928 # **The feasibility of turnback from a low altitude engine failure during the takeoff climb-out phase.** B. W. Jett (U.S. Naval Academy, Annapolis, MO). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0406.* 12 p.

A new procedure is proposed for responding to engine failures in single-engine aircraft that occur at a low altitude during the takeoff/climb-out phase of flight. The procedure involves a 180-deg turn back to the vicinity of the airfield. Here, the pilot must find the optimum bank angle and airspeed for the turn; this can be done by applying aerodynamic principles to a steady state power-off gliding turn. The feasibility of this maneuver is investigated here by testing a wide range of pilots under controlled conditions using a variable stability flight simulator. It is noted that the theoretical optimum bank angle and airspeed can also be verified experimentally. Data are acquired in real time during the test flights using an automated, computer-controlled data acquisition system. The combination of theoretical analysis and experimental data yields an optimum procedure for a turn back to the airfield and demonstrates that the maneuver is within the capability of a typical private pilot. C.R.

A82-17930 # **Experimental structural testing on a composite aircraft canard and its applications.** K. S. Caldwell, Jr. (Texas, University, Arlington, TX). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0409.* 9 p.

This paper presents the results and discussion of several structural tests performed on the canard of The University of Texas at Arlington's experimental aircraft, the Varieze. From various tests the influence and the c-cubed coefficients of the bending and twisting matrixes were obtained. From these results one can accurately determine the bending and twisting of the canard that will result for any force and moment applied. Applications of these coefficients to graphics computers and swept-wing design are discussed. Two canards that were failed to destruction due to an excess bending load are also discussed, documenting radical structural differences in the final homebuilt products when both canards employed the same amount of material and were constructed from the same set of plans. (Author)

A82-18831 # **High temperature in situ experimentation in HVEM instrumentation and application to materials science.** R. Valle, B. Genty, A. Marraud (CNRS and ONERA, Laboratoire de Microscopie THT, Châtillon-sous-Bagneux, Hauts-de-Seine, France), and J. Cadoz (CNRS, Laboratoire de Physique des Matériaux, Meudon, Hauts-de-Seine, France). *ONERA, TP* no. 1981-77, 1981. 5 p.

The design and construction of high temperature specimen holders for experimentation on superalloys and ceramics is discussed. A double tilting holder, a double tilting straining holder, and the composition and surface finishes are described. The holders can withstand up to 1500 K, using optically smooth tungsten jaws held in a golden molybdenum tip. Gold-coated shield, either tantalum or silica, have been chosen because of low emissivity when used as thermal shields, in addition to the mechanical property of remaining flat at elevated temperatures. A heating system has been devised comprising tungsten heating elements radiating in long holes machined directly in the jaws. Mention is made of experiments already performed on NiO single crystals at 1400 K. M.S.K.

A82-17932 # **Highlights of a design concept for a close ground support fighter.** D. J. Dacquino (Lockheed-California Co., Burbank, CA) and R. J. Raffaele (Arizona State University, Tucson, AZ). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0411.* 12 p. 9 refs.

The design concept makes use of recent technological developments in order to improve payload and endurance capabilities. The preliminary design is based on a study of gross weight, airfoil and wing design, weight and balance, and performance analysis. A computer simulation of such standard performance requirements as takeoff and initial climb, climb performance, and range and endurance indicates a successful integration of these techniques. C.R.

A82-17934 # **Pressure distribution on an ogee wing in supersonic flow.** M. E. Vaughn, Jr. (Auburn University, Auburn, AL). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0414.* 11 p. 22 refs. Research sponsored by Auburn University; Grant No. DAAG29-78-G-0036.

An approximate method is developed which extends pressure distribution theories for wings of constant sweep to wings with curvilinear leading edges. Two cases are considered. In the first case of a predominantly subsonic leading edge, and analogy is made to a wing in conical flow. In the second case of a supersonic/subsonic leading edge, physical reasoning is used to approximate the flow regions on the wing with line-source solutions. An application is made to a wing of ogee planform and comparisons with experimental data prove very favorable. Each case typically required under 7 seconds of computer time (IBM 3031). (Author)

A82-17936 * # **The effect of non-linear propagation in jet noise.** J. A. Gallagher. *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0416.* 9 p. 10 refs. Grant No. NAG1-10.

An experimental investigation of the nonlinear propagation effects which occur in the noise radiated from low and moderate Reynolds number supersonic jets has been performed. An array of three condenser microphones was used to measure the waveforms propagated by axisymmetric, cold model jets of Mach numbers 2.1 and 2.5. Relatively low Reynolds numbers were obtained by exhausting the jets into a low pressure anechoic test chamber. The results show that phenomena normally associated with nonlinear acoustic propagation, such as wave steepening, harmonic generation and wave merging, are measurable in the high speed model jets. (Author)

A82-17951 **Flight mechanics - Modern aircraft design and control concepts (Flugmechanik - Moderne Flugzeugentwurfs- und Steuerungskonzepte).** X. Hafer (Darmstadt, Technische Hochschule, Darmstadt, West Germany) and G. Sachs (München, Hochschule der Bundeswehr, Munich, West Germany). Berlin, Springer-Verlag, 1980. 282 p. 199 refs. In German. $34.25.

The state-of-the-art of aircraft design and control concepts are presented. Design features of aircraft of natural and artificial stability are discussed, with emphasis on the tail unit, trim drag and maximum lift, as well as the dynamics of unregulated, unstable aircraft. Various aspects of direct force control are then outlined: direct lift control, direct side force control, and direct drag control. Finally, other possible uses for active control technology are discussed, including artificial lateral stability, automatic maneuvering flaps, variable cambers, maneuver load control for large aircraft, gust load alleviation, and active flutter suppression. J.F.

A82-18021 # **Responses of oscillating wings in weak shear flow.** A. Sasaki (Mitsubishi Electric Co., Ltd., Amagasaki, Japan) and M. Kobayakawa (Kyoto University, Kyoto, Japan). *Japan Society for Aeronautical and Space Sciences, Transactions,* vol. 24, Nov. 1981, p. 139-151. 10 refs.

In this paper, a theory on wings which are oscillating in a weak shear flow is presented. The potential lifting surface theory is extended to the shear flow case by successive approximations. An integral equation is derived by the singularity method to the first order approximation, and it is solved numerically by the mode function method. For examples of calculations, oscillating wings with heaving and pitching modes in a shear flow are treated. Generalized forces which can easily be related with unsteady lift forces and moments are obtained. Results show that the shear flow decreases all forces in amplitudes, and moreover, a slight phase-lag and a phase-lead appear in heaving and pitching oscillations, respectively. (Author)

A82-18022 # ***A contribution to the hodograph method for* shock-free transonic airfoil sections.** T. Shigemi (National Aerospace Laboratory, Tokyo, Japan). *Japan Society for Aeronautical and Space Sciences, Transactions,* vol. 24, Nov. 1981, p. 152-168. 13 refs.

A simple method is developed for the design of transonic shock-free airfoil sections based on the analytical hodograph method. Traditional procedure is used in which a compressible flow is built up by transformation from an incompressible analog which is now called a model flow. In view of the defect in existing models such as a circular- or elliptic-cylinder, a new model, YC-profile, is introduced. (Author)

A82-18094 # ***Results of a Differential Omega experiment.*** T. M. Watt, L. E. Abrams, and F. G. Karkalik (Systems Control, Inc., Palo Alto, CA). In: Symposium on the Effect of the Ionosphere on Radiowave Systems, Washington, DC, April 14-16, 1981, Preprints. Washington, DC, U.S. Naval Research Laboratory, 1981. (4B-3). 12 p. 6 refs.

An experiment was performed to examine the utility of Differential Omega navigation for general aviation in Alaska and Northwest Canada, with emphasis on operational issues. The performance of a prototype Differential Omega system is evaluated for performance parameters such as maximum range of the data link, mean and variance of navigation error, and range decorrelation error. Mean error was observed to be about 0.5 NM, and the standard deviation error was about 0:25 NM. Ground tests yielded results that were consistent with results of earlier experiments, and random errors agreed well with the minimum range results. D.L.G.

A82-18117 **Introduction to V/STOL airplanes.** D. L. Kohlman (University of Kansas Center for Research, Inc., Lawrence, KS). Ames, Iowa State University Press, 1981. 242 p. 161 refs.

After a brief historical account of V/STOL aircraft requirements and experiments, consideration is given to (1) propulsion system devices, such as ducted propellers and augmenting ejectors, (2) operational problems, including ground effects and terminal area operations, (3) takeoff performance and equations for its description, (4) landing performance, relationships, equations and characteristics, and (5) the transition from hover to forward flight, including its equations of motion. Also covered are (6) blowing and suction boundary layer control and powered lift systems, such as jet flaps and blown flaps, propulsive wings and circulation-control airfoils, (7) stability and control in hover and handling qualities criteria, and (8) V/STOL propulsion considerations including number of engines and trends in speciafic fuel consumption and thrust-to-weight ratio. O.C.

A82-18126 **PLANS '80 - Position Location and Navigation Symposium, Atlantic City, NJ, December 8-11, 1980, Record.** Symposium sponsored by the Institute of Electrical and Electronics Engineers. New York, Institute of Electrical and Electronics Engineers, Inc., 1980. 511 p. Members, $25.; nonmembers, $37.50.

Aspects of satellite navigation are examined, taking into account the nonuniform GPS constellation, differential GPS navigation, navigation processing design for a low-cost GPS navigation system, an ionospheric refraction correction model for single-frequency Doppler navigation, a GPS receiver design for general aviation navigation, and geodetic positioning using a global positioning system of satellites. Questions of undersea navigation are investigated, giving attention to gravity gradiometry in a shipboard environment, stochastic and deterministic modeling of gravity gradiometer data, state-space models of gravity disturbance gradients, the astro-geodetic measurement of vertical deflection, the real-time estimation of vertical deflections using a gravimeter, and the laser gyro potential for long endurance marine navigation. Other topics discussed are related to time and frequency as applied to navigation systems, terrestrial-based radio navigation, self-contained navigation, integrated communications and navigation systems, the emerging civil navigation requirements and applications, the navigation of space vehicles, and mapping, charting, and geodesy for navigation systems. G.R.

A82-18132 **A GPS receiver design for general aviation navigation.** B. D. Elrod (Stanford Telecommunications, Inc., McLean, VA), H. A. Bustamante, and F. D. Natali (Stanford Telecommunications, Inc., Sunnyvale, CA). In: PLANS '80 - Position Location and Navigation Symposium, Atlantic City, NJ, December 8-11, 1980, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 33-41. 6 refs. U.S. Department of Transportation Contracts No. FA77WAI-757; No. FA78WA-4216.

The NAVSTAR Global Positioning System (GPS) will provide RF transmissions from a constellation of satellites for accurate position, velocity and/or time determination by suitably equipped users. An investigation by the FAA is conducted regarding the potential use of the GPS system for civil navigation to supplement or replace VOR/DME in the National Aerospace System. Of the nearly 200,000 civil aviation aircraft in use today, about 30% are equipped with 'low budget' navigation avionics. One of the objectives of the investigation is related to the development of low cost receiver designs for the navigation requirements of civil aviation. A description is presented of a GPS receiver design satisfying the needs of general aviation navigation. G.R.

A82-18139 **Maneuver dependent component error models and synchronized reset filters for inertial navigation systems.** W. H. Fincke and A. J. Kleinman (Dynamics Research Corp., Wilmington, MA). In: PLANS '80 - Position Location and Navigation Symposium, Atlantic City, NJ, December 8-11, 1980, Record.
New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 107-114.

In many inertial navigation systems (INS), external information in the form of position and/or velocity updates is used in conjunction with an estimation filter to make corrections to the INS to improve accuracy. Attention is given to a design of statistical estimation filters which has been found effective in improving accuracy when there are error sources that are sensitive to vehicle maneuvers. The errors may include reference velocity errors which are speed sensitive, or other errors that may be implemented as part of the navigation reset filter, or as a special prenavigate calibration sequence of vehicle maneuvers or platform rotations. G.R.

A82-18141 # **Selecting the post 1990 civil aviation radionavigation system.** J. C. Heurtley and J. W. Bradley (FAA, Office of Systems Engineering Management, Washington, DC). In: PLANS '80 - Position Location and Navigation Symposium, Atlantic City, NJ, December 8-11, 1980, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 177-181.

Investigations are being conducted which are to provide a basis for the selection of the radionavigation system or combination of systems which can best satisfy the requirements of the post 1990 time period. In 1983 the Department of Defense and the Department of Transportation are to make a joint recommendation on the navigation system mix for the post 1995 timeframe. The final area of consideration in selecting the post 1990 Civil Aviation Radionavigation System is the institutional issue. This issue encompasses international acceptance and standards, cost recovery policies, and in the case of NAVSTAR GPS the denial of accuracy, number of satellites, spare satellite policy, and military control of a system used for civil navigation. These issues are still to be resolved. G.R.

A82-18143 **A new end-fire ILS glide slope.** C. B. Watts, Jr. In: PLANS '80 - Position Location and Navigation Symposium, Atlantic City, NJ, December 8-11, 1980, Record.
New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 190-197. 8 refs.

The end-fire glide slope described here is a modification of standard ILS ground equipment designed to serve runways where it is not practical to install one of the present conventional systems. The antenna does not use a tower; an array of slotted cable elements is mounted on the runway shoulder, sufficiently low to clear wings and engine nacelles, and is frangible to avoid serious damage to an airplane which might run off the pavement. It is noted that savings in earth movement can amount to many times the cost of the antenna. End-fire development is traced from 1942. C.R.

A82-18144 **Solid-state VORTAC with remote maintenance and monitoring.** A. Lang (ITT Avionics Div., Nutley, NJ) and W. Hundley (Wilcox Electric, Inc., Kansas City, MO). In: PLANS '80 - Position Location and Navigation Symposium, Atlantic City, NJ, December 8-11, 1980, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 198-207.

Because of the widespread use and high capital investments in the VORTAC and VOR/DME system, there are indications that the U.S. and the ICAO will extend these services beyond 1995, the year that protection was to have expired. Owing to problems related to

maintenance and the replacement of parts, the FAA let a contract to industry to replace all the old tube-equipped VORs, VOR-DMEs, and VORTACs with a total system architecture that embodies modern technology. The system being produced for the FAA is described. Maintenance costs have been reduced as a result of four improvements: (1) improved reliability of an all solid-state design; (2) improved maintainability through modular construction with automatic fault isolation; (3) reduced maintenance by use of a solid-state and digital circuits; and (4) reduced routine trips by maintenance technicians to each facility, from one or two per week to once per 3 months, as a result of remote certification and maintenance testing. C.R.

A82-18145 MLS - A new generation landing guidance system is here. R. M. Cox and J. M. Shirey (Bendix Corp., Communications Div., Baltimore, MD). In: PLANS '80 - Position Location and Navigation Symposium, Atlantic City, NJ, December 8-11, 1980, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 208-215.

The Microwave Landing System (MLS), an air-derived system operating in the C-band, comprises azimuth guidance, elevation guidance, and ranging elements which provide continuous, accurate, three-dimensional position information within a wide coverage volume of the desired landing site. In the Time Reference Scanning Beam (TRSB) MLS, ground-based equipments provide signals to the airborne user from which position information is derived. An important difference between ILS and MLS is angular coverage; ILS is a VHF/UHF system which provides straight-in guidance only on a single fixed glide path. The MLS is a high-frequency microwave system operating at C-band (5031-5090 MHz), providing volumetric coverage over a sector of as much as + or - 60 deg in azimuth and 0-30 deg in elevation. It is noted that a precision DME (L-band, 978-1213 MHz) is available with the MLS to provide accurate range information and thus allow the aircraft to determine its exact position in the prescribed coverage volume. C.R.

A82-18146 The DME-based Azimuth System /DAS/. H. Vogel and W. Seith (Standard Elektrik Lorenz AG, Stuttgart, West Germany). In: PLANS '80 - Position Location and Navigation Symposium, Atlantic City, NJ, December 8-11, 1980, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 216-223. 5 refs.

In a competition organized by the ICAO to select a new precision approach and landing system, the DME-based Landing System (DLS) was submitted by the Federal Republic of Germany. Parts of this design were recommended for further development. These elements, which represent the DME-based Azimuth System (DAS), are the L-band precision DME and the 360-deg azimuth service utilizing DLS principles. The DME-based Azimuth System can be regarded as an improved Distance Measuring System (DME) with additional capabilities. The DAS has three essential characteristics: (1) in comparison with the conventional DME, where the measurement errors may amount to several hundred meters, the DAS distance measurement accuracy is considerably improved; (2) the DAS ground station determines with a high degree of accuracy the bearing to the interrogation aircraft and transmits this azimuth information to the airborne station; and (3) the DAS contains a ground-to-air data link. The frequency range is 962-1213 MHz; there are 20 DME frequencies with existing modes and 40 DME frequencies with additional co-channel modes. C.R.

A82-18147 Flight measurements of Area Navigation System performance using various combinations of ground aids and airborne sensors. R. A. Harlow (Royal Aircraft Establishment, Bedford, England). In: PLANS '80 - Position Location and Navigation Symposium, Atlantic City, NJ, December 8-11, 1980, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 228-235.

A description is given of flight trials undertaken to determine the accuracy of an Area Navigation (RNAV) System which uses currently available radio aids, and practical aspects of RNAV operation are discussed. Results show that, in an en-route environment, the position-fixing errors made by using Distance Measuring Equipment (DME)/DME navigation were less than half as many as those made in the course of VHF Omnidirectional Range (VOR)/DME navigation. In addition, DME/DME navigation proved to be more accurate than VOR/DME in a Terminal Maneuvering Area (TMA) environment, although the difference was less pronounced in the en-route situation because of the limited ground aids available in the trials area. The trials area was not representative of major European TMAs. The use of inertial velocity information rather than air data signals for the smoothing of RNAV aircraft position estimates was found to give significant accuracy improvements in VOR/DME guidance. O.C.

A82-18150 Laboratory and flight test of a new RLG strapdown INS. R. E. Ebner (Litton Systems, Inc., Woodland Hills, CA). In: PLANS '80 - Position Location and Navigation Symposium, Atlantic City, NJ, December 8-11, 1980, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 257-263.

A strapdown inertial navigation system using ring laser gyros is tested. Laboratory data are presented showing gyrocompass heading accuracy under differing gyro random walk disturbances, navigation during three-axis Scorsby motion, and navigation following a 180 deg turn. A dominant error source during the Scorsby motion is described, and test data for preliminary gyros which achieve a CEP of 1.4 nmi/h are presented. A new generation system with missile grade RLGs and a third series with higher performance instruments are tested, and the third series demonstrates a performance under 1 nmi/h with a 4 minute reaction time. D.L.G.

A82-18151 Position extrapolation quality calculation for inertial and Doppler-AHRS navigation systems. J. Yoh and R. Dunn (Intermetrics, Inc., Warminster, PA). In: PLANS '80 - Position Location and Navigation Symposium, Atlantic City, NJ, December 8-11, 1980, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 280-284.

The Position Extrapolation Quality (PEQ) is defined as the second mean of the second backward difference of the earth-referenced level position error read from the dead reckoner, sampled every thirty seconds. It is noted that because of truncation error in the outputs, this second difference is not available for all dead reckoners to the precision required. In this case, one takes the second mean of the second difference of the integral of the error in reported velocity. When the reporting interval is short, this quantity is equivalent to the other and is affected to a much lesser extent by truncation. Since certain of the underlying processes encountered in most dead reckoner types are not ergodic, it is not possible to evaluate this covariance matrix with a time average. It is necessary to either average over a number of runs with different equipment of the same type or to compute the PEQ using an established model for the type. It is shown here how it is possible to develop reasonable estimates for the PEQ of three types of dead reckoners from statistical models. C.R.

A82-18152 JTIDS distributed TDMA /DTDMA/ terminal development results with emphasis on relative navigation performance. J. Rubin and S. Welt (ITT, ITT Avionics Div., Nutley, NJ). In: PLANS '80 - Position Location and Navigation Symposium, Atlantic City, NJ, December 8-11, 1980, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 285-299. Contract No. N62269-76-C-0105.

Laboratory testing has been completed for Advanced Development Model (ADM) terminals developed for the DOD Joint Tactical Information Distribution System (JTIDS) program. The terminals feature the JTIDS Phase II Distributed Time Division Multiple Access (TDMA) architecture, and include two Class 1 Command and Control terminals, two Class 2 Tactical Fighter terminals, and one JTIDS Environment Simulator. The JTIDS II/D-TDMA operates in Lx-band, from 960 to 1215 MHz, and provides a system that combines spread-spectrum multiple-access command and control functions with conventional TACAN navigation and IFF identification service. Attention is given the Relative Navigation (REL NAV) function of the system, which ties the operations of a tactical community of users to a common relative navigation grid, while optimally blending the fast-response and short-term accuracy of self-contained, dead reckoning navigation with JTIDS-derived position and status reports from multiple users. O.C.

A82-18153 JTIDS RELNAV network off-line simulation. J. B. Chadwick (Hughes Aircraft Co., Ground Systems Group, Fullerton, CA). In: PLANS '80 - Position Location and Navigation

Symposium, Atlantic City, NJ, December 8-11, 1980, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 300-302.

A description is presented of the Joint Tactical Information Distribution System (JTIDS) Relative Navigation (RELNAV) off-line simulator. The simulator was originally developed for use as an algorithm design test bed. This effort supported writing specifications for the RELNAV function software package addition to the Hughes Improved Terminal (HIT) operational computer program (OCP). After the design phase the simulator was modified to accommodate detailed step-by-step checkout of the subsequently developed RELNAV software by comparing the simulator's exact solutions with those of the OCP. The JTIDS RELNAV network off-line simulator is comprised of two distinct FORTRAN programs. One of the programs generates up to 12 arbitrary trajectories over a reference ellipsoid. The second simulation program is the RELNAV off-line simulator. Its main tasks are to generate and simulate at each JTIDS time slot real world events for up to 12 net numbers. G.R.

A82-18154 Post-flight assessment of the JTIDS Rel Nav. M. S. Greenberg (Dynamics Research Corp., Wilmington, MA) and L. Chin (U.S. Naval Material Command, Naval Air Development Center, Warminster, PA). In: PLANS '80 - Position Location and Navigation Symposium, Atlantic City, NJ, December 8-11, 1980, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 303-312. 5 refs.

Assessment of the Joint Tactical Information Distribution System (JTIDS) Relative Navigation (Rel Nav) function requires accurate and frequent precision navigation data to determine the position, velocity, and attitude errors of each JTIDS terminal under test. An approach was developed to create a synthetic reference for vehicle ground speed and attitude. A postflight Rel Nav data reduction program (RNDRP) was designed to filter the flight-recorded records of uncorrected inertial data at a 4 Hz rate and the asynchronously recorded radar tracking data at a 5-10 Hz rate. The RNDRP is also used to perform quick-look analysis of the Rel Nav function by bypassing the filter/smoother and simply differencing radar tracking data and Rel Nav position data. Attention is given to grid navigation, the Nav controller, grid translation and rotation, the Rel Nav figures-of-merit, the Rel Nav analysis approach, and aspects of RNDRP filter and inertial system integration. G.R.

A82-18155 A natural parameter-controller specification procedure for an integrated radio/dead reckoner navigation system. R. Dunn (Intermetrics, Inc., Warminster, PA). In: PLANS '80 - Position Location and Navigation Symposium, Atlantic City, NJ, December 8-11, 1980, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 313-317.

A natural parameter-controller specification procedure for an integrated radio/dead reckoner navigation system is presented. The technique is illustrated by computing an upper bound on the achievable performance of a nodeless relative navigation system, which is given in terms of position extrapolation quality and available position quality. This specification procedure furnishes a parametric specification, which is fair when the parameters indicate that the available source qualities, geometry, and supporting equipment are good. The technique also permits a specific graceful degradation as the parameters indicate a weakening of the environment. D.L.G.

A82-18156 A stable decentralized filtering implementation for JTIDS RelNav. T. H. Kerr (Intermetrics, Inc., Cambridge, MA) and L. Chin (U.S. Naval Material Command, Naval Air Development Center, Warminster, PA). In: PLANS '80 - Position Location and Navigation Symposium, Atlantic City, NJ, December 8-11, 1980, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 318-329. 45 refs.

Eight alternative decentralized linear estimation schemes are surveyed to find the mechanization most appropriate for stable community relative navigation in the JTIDS RelNav tactical scenario. Discrete-time mechanization equations for the sequentially partitioned algorithm (SPA) and the surely locally unbiased (SLU) filtering are presented, and an analytical proof of asymptotic stability for both SPA and SLU filters are estimated in terms of core memory requirements and operation counts. There are some indications that the RelNav algorithm exhibits some anomalous stability behavior. D.L.G.

A82-18157 PLRS engineering development testing - Early results. J. A. Kivett and F. L. Morse (Hughes Aircraft Co., Communications and Radar Div., Fullerton, CA). In: PLANS '80 - Position Location and Navigation Symposium, Atlantic City, NJ, December 8-11, 1980, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 330-334. Grant No. DAAB07-76-C-1750.

For all participants, the system (which operates beyond line-of-sight through integral relays) incorporates effective electronic counter-counter measures and provides cryptographically secure digital data communication. Each user has the capability of sending preassigned 2-character messages to furnish data to or request information from the system, as well as 12 character free text message exchanges. PLRS operates both ashore and afloat irrespective of visibility, weather, and terrain. Its configuration guarantees continuity of operation during the transitions of tactical headquarters and allows for survivability even if a major system element becomes inoperative. Full system performance is provided within a 47-km by 47-km primary operating area, and airborne users can be located and tracked (with slightly less accuracy) within a 300-km by 300-km extended operating area. C.R.

A82-18158 Coordinate transformation in PLRS. J. M. Lull, F. L. Morse, and R. Cook (Hughes Aircraft Co., Fullerton, CA). In: PLANS '80 - Position Location and Navigation Symposium, Atlantic City, NJ, December 8-11, 1980, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 335-338. Grant No. DAAB-07-76-C-1750.

A description is given of the primary coordinate transformation algorithm employed by the Position Location and Reporting System (PLRS), which operates between internal coordinates and the Universal Transverse Mercator (UTM) Military Grid Reference (MGR) coordinates. The PLRS coordinate transformation (1) operates over a 300 x 300 km area, with its given system center anywhere between 80 deg S and 84 deg N latitudes; (2) processes UTM grid zone boundaries, spheroid and datum boundaries, and irregularities in the MGR 100 km grid square identifications; (3) does not require large amounts of on-line storage; and (4) permits datum and MGR grid definitions to be changed easily. O.C.

A82-18159 Navigation system integrity and reliability for civil aviation. R. Braff, C. Shively (Mitre Corp., McLean, VA), and J. Bradley (FAA, Washington, DC). In: PLANS '80 - Position Location and Navigation Symposium, Atlantic City, NJ, December 8-11, 1980, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 367-374. 6 refs.

The integrity and reliability of the present primary civil air navigation system, VOR/DME, is discussed to identify and develop an understanding of the specific integrity and reliability performance factors that must be considered when evaluating alternative navigation systems. The identified performance factors are then used to define applicable technical analyses. Major issues relating to the integrity and reliability of the space segment of the Navstar Global Positioning system are discussed. V.L.

A82-18160 * # Evaluation of Loran-C enroute navigation and non-precision approaches within the State of Vermont. F. D. MacKenzie (U.S. Department of Transportation, Transportation Systems Center, Cambridge, MA) and C. D. Lytle (NASA, Langley Research Center, Hampton, VA). In: PLANS '80 - Position Location and Navigation Symposium, Atlantic City, NJ, December 8-11, 1980, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 375-380.

Results obtained in completing 257 nonprecision approaches and 44 data flights are discussed. The flights were initiated in the summer months and extended through four seasons and practically all weather conditions typical of the northeastern U.S. A preliminary assessment of the available data indicates that Loran-C signals are suitable as a means of navigation during enroute, terminal, and nonprecision approach operations and that the performance exceeds the minimum accuracy criteria specified by the applicable FAA advisory circular. Enroute operations are found to remain within + or - 0.75 nm of the desired track, compared with the requirement of + or - 2.5 nm. Terminal operations remained within + or - 0.65 nm of

the desired track, compared with the FAA circular's requirement of + or - 1.5 nm; the nonprecision final approach operations were within the limit of + or - 0.6 nm for all operations. C.R.

A82-18161 # **Helicopter decelerated steep approach and landing to confined areas under instrument meteorological conditions.** P. S. Demko (U.S. Army, Air Traffic Management Systems Div., Fort Monmouth, NJ). In: PLANS '80 - Position Location and Navigation Symposium, Atlantic City, NJ, December 8-11, 1980, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 381-388.

It is shown how small, portable microwave landing guidance systems, used with 4-cue decelerated steep approach and landing (DSAL) flight director systems designed especially for helicopters, can now overcome visibility barriers and provide a true all-visibility DSAL capability. The extension of the DSAL capabilities into the instrument meteorological conditions (IMC) realm is thought to be perhaps the greatest practical step which could be taken to expand the usefulness of helicopters. It is noted that technology has advanced sufficiently to provide the helicopter with IMC DSAL capability at the present time. C.R.

A82-18170 Status of the COSPAS-SARSAT project and its possible operation in conjunction with INMARSAT system. Y. G. Zurabov and V. A. Bogdanov (Vsesoiuznoe Ob'edinenie Morsviaz'-sputnik, Moscow, USSR). In: PLANS '80 - Position Location and Navigation Symposium, Atlantic City, NJ, December 8-11, 1980, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 459-467.

The status and main technical characteristics of the COSPAS-SARSAT project are considered, along with the possibility of its operation in conjunction with the INMARSAT system. The COSPAS-SARSAT project is an experimental satellite-aided project for the search and rescue of distressed vehicles, administered by U.S.S.R., U.S., French and Canadian agencies. Both the detection and location of distress signals will be undertaken, and the information facilities for completion of data processing and its further transmission to rescue services. The COSPAS and SARSAT projects interoperate at 121.5 and 406.0 MHz. Detailed block diagrams are given of the COSPAS system's spaceborne equipment and functions. O.C.

A82-18171 Enhanced noise immunity and error control in a fully integrated JTIDS/GPS receiver. H. J. Rome (Lowell, University, Lowell, MA), R. A. Reilly, and C. D. Ward (ITT, ITT Avionics Div., Nutley, NJ). In: PLANS '80 - Position Location and Navigation Symposium, Atlantic City, NJ, December 8-11, 1980, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 477-493. 13 refs.

The functional design of an integrated Joint Tactical Information Distribution System/Global Positioning System (JTIDS/GPS) receiving network, using data fragments from multiple sources to obtain dramatic improvement in positional reliability in an adverse signal environment, is described. It is shown that proper selection and synergistic use of data from both systems improve positional reliability under certain noise environments by up to four orders of magnitude. The higher the number of fully integrated terminals in the network, the greater the improvement in jam resistance; significant improvement, however, is attainable to an entire network by having even a limited number of integrated terminals. The key to the system is the use of 'smart' data source selection logic to properly weigh and choose the best current data available from JTIDS and GPS sources for navigation updating. C.R.

A82-18182 The electromagnetic theta gun and tubular projectiles. T. J. Burgess, E. C. Cnare, W. L. Oberkampf, S. G. Beard, and M. Cowan (Sandia National Laboratory, Albuquerque, NM). *(U.S. Army Armaments Research and Development Command and Defense Advanced Research Projects Agency, Conference on Electromagnetic Guns and Launchers, San Diego, CA, Nov. 4-6, 1980.) IEEE Transactions on Magnetics,* vol. MAG-18, Jan. 1982, p. 46-59. 15 refs. Research supported by the U.S. Department of Energy.

Unlike the better known rail gun, the theta gun applies the propelling force along the length of its projectile. This is shown to allow much greater acceleration of high fineness ratio projectiles for a given barrel pressure, allowing much shorter barrels for military applications. A computer code which simulates performance of the theta gun is described and experimental results from a few simple, low energy experiments show close agreement with code predictions. Trajectories and aerodynamic heating for three candidate military projectiles are calculated for vertical and horizontal atmospheric launches where initial velocity is as high as 5 km/s. The calculations indicate that in some cases a thin layer of heatshield (ablator) will be required to control projectile heating. (Author)

A82-18200 Helical rail glider launcher. P. Mongeau and F. Williams (MIT, Cambridge, MA). *(U.S. Army Armaments Research and Development Command and Defense Advanced Research Projects Agency, Conference on Electromagnetic Guns and Launchers, San Diego, CA, Nov. 4-6, 1980.) IEEE Transactions on Magnetics,* vol. MAG-18, Jan. 1982, p. 190-193. NSF-supported research; Grant No. DAAK10-79-C-0184.

The electromagnetic acceleration group at MIT has undertaken to build an electric glider launcher. The launcher features a mobile helical rail accelerator and power supply. It will launch a 6 foot radio-controlled glider for an overall range of several miles. This device is a prototype for a larger system that will provide a launch platform for munition and supply loaded gliders and a wide variety of RPV's. A 6 meter helical rail launcher has been constructed and is being tested. It is a twin boom device designed to accelerate a 5 kg glider to 100 m/s at 100 g's acceleration. (Author)

A82-18272 Data communications within the Air Navigation Services system. W. J. A. Vonk (Philips Telecommunicatie Industrie, Hilversum, Netherlands). *The Controller,* vol. 20, Dec. 1981, p. 17, 18.

A comparison is made between: (1) the Société Internationale des Telecommunications Aeronautique (SITA) communications network, which consists of 12,000 stations in 800 cities and employs land lines, radio links, and satellites for the transmission of passenger and cargo handling, averaging 3-sec in replying to information requests; and (2) the Aeronautical Fixed Telecommunication Network (AFTN), which is not suited to request/reply traffic, and supports the Air Navigation Services (ANS) system. Suggestions are made for the upgrading of the AFTN, based on a color graphics terminal that gives access to stored aeronautical information. Such a unit has been demonstrated in air traffic control roles, and presents through carefully selected function keys such information as airspace and route data, local regulations and weather data. O.C.

A82-18273 Modernizing the Egyptian A.T.C. system. R. Kahane. *The Controller,* vol. 20, Dec. 1981, p. 19, 20, 22, 23.

A description is given of plans for the modernization of the Egyptian ATC system, through the phased implementation of systems and services. The plan includes the modernization of: (1) the radar detection network; (2) radar data processing and display; (3) flight plan processing and display; (4) air-to-ground, and both domestic and international point-to-point communications networks, including telephonic and telegraphic links and HF, VHF and UHF radio and microwave links; also (5) the extension of navigation aids; and (6) the modernization of controller training programs. The installation of these systems throughout the country will, moreover, call for the construction of five building complexes, of which the largest is to be the Cairo Air Navigation Center (CANC), located at Heliopolis Airport. O.C.

A82-18274 # **'Integral Noise': An automatic calculation model for the prediction and control of fixed-wing aircraft noise. I - General considerations, theoretical bases and model analysis ('Integral Noise': Un modello di calcolo automatico per il controllo e la previsione del rumore degli aeromobili ad ala fissa. I - Considerazioni generali, fondamenti teorici ed analisi del modello).** F. Bossa (Consulenza Aeronautica, Mondovi, Italy) and R. Gualdi (Provincia di Milano, Laboratorio di Igiene e Profilassi, Milan, Italy). *Ingegneria,* Sept.-Oct. 1981, p. 257-265. 9 refs. In Italian.

A description is given of the INTNOI Integral Noise Program for advanced aircraft noise prediction and control. This computer model performs, on a modular basis, the analysis of both boundary layer aerodynamic noise and engine noise for the case of such turbofan-powered commercial aircraft as the 737. It also permits the prediction of noise levels due to engine and aerodynamic sources in the communities affected by approach and landing noise footprints. Attention is given to the effect on engine noise levels of low and high

fan bypass ratios, the noise components contributed by nacelles, slats, and flaps at various angles, and the specialized options offered by the modular-structure program. O.C.

A82-18321 **A short history of aviation gasoline development, 1903-1980.** A. R. Ogston. *(Society of Automotive Engineers, West Coast International Meeting, Seattle, WA, Aug. 3-6, 1981.) Aeronautical Journal,* vol. 85, Dec. 1981, p. 441-450. 9 refs.

An historical account is given of the development of gasoline for aircraft engines, in keeping with advances in reciprocating engine design and increasing performance requirements. Consideration is given to the capabilities of the oil refining industry at the time of the Wright brother's first powered flight in 1903, and the dependence between engine performance and fuel chemistry established shortly thereafter by the Wrights and other aviation pioneers. The cracking process, yielding gasolines with superior anti-knock properties, was not invented until 1913, and no official specifications for aviation gasoline existed before the First World War. The first systematic studies of the relation of detonation to fuel quality were made by Harry Ricardo in 1919, using a single-cylinder, variable-compression engine, and the first truly adequate, 100 octane gasolines became available in 1935. The 30% horsepower increase resulting from 100 octane gasoline's use was an essential element of the RAF's victory over the Luftwaffe in the Battle of Britain. The introduction of turboprop and turbojet airliners during the 1950s brought an end to the development of aviation gasoline. O.C.

A82-18322 **Design evolution of the Boeing 757.** P. M. Condit (Boeing Commercial Airplane Co., Renton, WA). *Aeronautical Journal,* vol. 85, Dec. 1981, p. 451-458.

An account is given of the development history of the 757-200 airliner, which is scheduled to enter service in January 1983. Attention is given the degree of structural commonality with the 727 aircraft that the 757 replaces, and the advanced flight management and hydraulic and electrical power systems shared by the 757 and wide-body 767 designs. The 757-200 may be fitted with 25-32% more seats than the 727, and incorporates RB211 engines whose specific fuel consumption is 26-31% lower than those used in the 727-300B program. The all-digital, two-pilot flight deck of the 757 provides flight path/energy management computation and display capabilities unavailable in current airliners, and can in addition display weather radar and optimum climb profiles and cruise altitudes. The energy efficiency gains estimated for the digital avionics are as high as 6%. O.C.

A82-18346 **F101DFE in Tomcat - Preliminary test results.** M. Gaines. *Flight International,* vol. 120, Dec. 19, 1981, p. 1826-1828.

System features and performance of the F101DFE engines in the F-14 Tomcat fighter are described. The two 29,000 lb thrust engines have a bypass ratio of 0.85, the core of the F101, and a scaled-up front end and nozzle from the F404 like in the F-18 Hornet. The engine components are detailed, and it is noted that the F101DFE can cross-start at ground idle. The new engines give a 62% combat radius increase, 34% longer patrol on-station, and 22% more energy for maneuvering. The Super Tomcat can climb at Mach 0.8, 30 deg pitch, with 8,000 lb of fuel and have power left at 40,000 ft, having taken off without afterburners from a carrier deck. The fuel is burned smokelessly, and combat maneuvering tests with F-5s showed that the F-5 pilots were unable to achieve either a gun or missile fix on the F101DFE aircraft, although a reticence to use full dual throttle capability was noted during test pilots' first flights. M.S.K.

A82-18347 **2037 - Pratt & Whitney tests new turbofan.** J. Moxon. *Flight International,* vol. 120, Dec. 19, 1981, p. 1832-1834.

The PW2037 turbofan, earmarked for use on the Boeing 757, is discussed. The engine provides 37,000 lb of thrust, spins 30% faster than the JT9D, and employs powdered metal nickel alloy discs. Other features are a 30:1 pressure ratio, single crystal blades, an inlet temperature of 1385 C, an electron beam welded drum, and digital engine control. Dual redundancy and three levels of self-test and fault isolation are included in the electronics, and active clearance control, abradable tip seals, and increased stiffness and concentricity result in a 2% added fuel efficiency. Flight testing aboard a 747 is scheduled for February 1983, with actual delivery for use on the 757 to begin in 1984. M.S.K.

A82-18348 **Lear Fan - The plastic aeroplane arrives.** R. Whitaker. *Flight International,* vol. 120, Dec. 26, 1981, p. 1896-1901.

The carbon reinforced plastic Lear rear-mounted turboprop aircraft is discussed. The design includes a 15,000 hr/15,000 cycle life, and high-strength areas where aluminum was used are indicated. The Kevlar radome is built to withstand a 4-lb birdstrike at 250 knots airspeed. The airfoils are computer optimized from the NACA 65 series and have Nomex honeycomb cores. A weight of 7200 lb and a wing area of 163 sq ft are mentioned for the Y-tailed plane. Centerline thrust is provided by independent dual engines, which are monitored by a metal chip detector to expand the operating safety margin. The engines have 850 shp and the cruise speed is 311 kt at 40,000 ft. It is noted that the propeller can operate at high Mach speeds and is also made of composites. Full certification is projected for 1983 with the addition of deicers. M.S.K.

A82-18349 **Boeing 757 - Introducing the big-fan narrow-body.** D. Velupillai and F. Munger. *Flight International,* vol. 121, Jan. 2, 1982, p. 12-20.

The Boeing 757, a 180 passenger turbofan powered aircraft intended for short haul airliner service, is described. Intended as a replacement for the 727, the 757 has a narrow-bodied fuselage with seating arranged six abreast, and offers fuel savings of 20% over previous turbofans. Many systems are interchangeable with the 767, and a cruise speed of Mach 0.8 is given for the 155 ft 3 in. long aircraft. Components of the body made of composites and advanced aluminum alloys have achieved significant weight savings and improved strength, in addition to increased range. The plane has a design range of 500 n.m. Emergency equipment is designed to operate automatically for the most part, and it is noted that the cockpit, with CRT displays, is the same cockpit used for the 767. M.S.K.

A82-18412 **Consideration of mechanical, physical, and chemical properties in bearing selection for landing gear of large transport aircraft.** H. E. Fewtrell (Lockheed-California Co., Burbank, CA). *American Society of Lubrication Engineers and American Society of Mechanical Engineers, Lubrication Conference, New Orleans, LA, Oct. 5-7, 1981, ASLE Preprint 81-LC-2B-3.* 4 p. Members, $2.00; nonmembers, $4.00.

A comparison of the performance of aluminum nickel bronze and beryllium copper under test and service conditions demonstrates that mechanical, physical and chemical properties must all be considered in the selection of bearing materials. These properties are related to specific performance requirements for the cases of (1) pin joints lubricated with diester grease and (2) shock strut pistons lubricated with MIL 5606 hydraulic oil, to show that the greater thermal diffusivity of beryllium copper can effectively prevent hot spotting under marginal lubrication conditions. In addition, data are presented which demonstrate how the chemical reactivity of beryllium copper, in the presence of the tricresyle phosphate of MIL 5606 hydraulic oil, can preclude the generation of ladder cracks in large transport landing gear pistons with chrome plating. O.C.

A82-18429 # **Four pad tilting pad bearing design and application for multistage axial compressors.** J. C. Nicholas and R. G. Kirk (Ingersoll-Rand Co., Turbo Machinery Div., Phillipsburg, NJ). *American Society of Mechanical Engineers and American Society of Lubrication Engineers, Joint Lubrication Conference, New Orleans, LA, Oct. 5-7, 1981, ASME Paper 81-Lub-12.* 7 p. 17 refs. Members, $2.00; nonmembers, $4.00.

Advantages of operating multistage axial compressors on 4 pad tilting pad bearings are discussed and compared to other fixed bore and tilting pad bearing designs. Advantages include operation free of subsynchronous vibrations, and placement of peak response speeds outside of the operating speed range with between pilot loading. Three axial groove and step journal bearings have asymmetric stiffness and damping properties, and therefore produce a split or double first critical speed. An axial compressor operating on three axial groove bearings may be subject to oil whirl and/or aerodynamic induced stabilities. Test results are in good agreement with theoretical analyses, and for the cases presented, the 4 pad tilting pad bearing is successful in removing the peak response from the operating speed range. D.L.G.

A82-18436 * # **Effects of ultra-clean and centrifugal filtration on rolling-element bearing life.** S. H. Loewenthal (NASA, Lewis Research Center, Cleveland, OH), D. W. Moyer (Tribon Bearing Co., Cleveland, OH), and W. M. Needelman (Pall Corp., Glen Cove, NY). *American Society of Mechanical Engineers and American Society of Lubrication Engineers, Joint Lubrication Conference, New Orleans, LA, Oct. 5-7, 1981, ASME Paper 81-Lub-35.* 9 p. 20 refs. Members, $2.00; nonmembers, $4.00.

Fatigue tests were conducted on groups of 65-mm bore diameter deep-groove ball bearings in a MIL-L-23699 lubricant under two levels of filtration to determine the upper limit in bearing life under the strictest possible lubricant cleanliness conditions. Bearing fatigue lives, surface distress and weight loss were compared to previous bearing fatigue tests in contaminated and noncontaminated oil filters having absolute removal ratings of 3, 30, 49, and 105 microns, with lubricant and sump temperatures maintained at 347 K. Ultra clean lubrication was found to produce bearing fatigue lives that were approximately twice that obtained in previous tests with contaminated oil using 3 micron absolute filtration. It was also observed that the centrifugal oil filter has the same effectiveness as a 30 micron absolute filter in preventing surface damage. D.L.G.

A82-18444 # **Inclusions and service induced cracks in a mature population of gas turbine engine bearings.** J. R. Barton, F. N. Kusenberger, and B. B. Baber (Southwest Research Institute, San Antonio, TX). *American Society of Mechanical Engineers and American Society of Lubrication Engineers, Joint Lubrication Conference, New Orleans, LA, Oct. 5-7, 1981, ASME Paper 81-Lub-48.* 9 p. 34 refs. Members, $2.00; nonmembers, $4.00. Contract No. F09603-74-C-5158.

The automated bearing inspection system called Critical Inspection of Bearings for Life Extension (CIBLE) was used to process NDE data acquired on approximately 1000 main shaft bearings used in the J57/TF33 gas turbine engine. Bearing service ranged from zero to about 13,000 hours, and both inclusions and service-induced cracks had been detected in a number of their components. In light of endurance testing that was conducted in addition to the metallurgical sectioning and scanning electron microscope investigations used in correlation analyses, a linear extrapolation of the total service population of the number 2 bearing position of the engine leads to the forecast of over 200 cracked bearings in the fleet of B52, KC135, C141, and E3A aircraft in which the J57/TF33 is installed. O.C.

A82-18452 # **Design and testing of a new double labyrinth seal.** J. S. Wyler (General Electric Co., Aircraft Instruments Dept., Wilmington, MA). *American Society of Mechanical Engineers and American Society of Lubrication Engineers, Joint Lubrication Conference, New Orleans, LA, Oct. 5-7, 1981, ASME Paper 81-Lub-58.* 6 p. 10 refs. Members, $2.00; nonmembers, $4.00.

A labyrinth seal that increases the fluid loss or fluid resistance through the leakage gap is presented. The design includes an inner member which can be slid axially into the outer member without interference. Losses are generated by the double labyrinth effect, and an analysis of loss measurement parameters is provided. Testing with a weight stand with JP4 jet fuel is described for the pressure drop across the seal. The results are noted to eliminate certain labyrinth designs from consideration for seal designs in a laminar region. The double labyrinth seal is, however, judged to be more effective than an equivalent annulus, although further tests on rotation are needed. Application of the results for improvements in the accuracy of fluid drive type angular momentum flowmeters are indicated. M.S.K.

A82-18479 † **Damage of turbine blades due to interaction with fuel resinification products (Razrushenie rabochikh lopatok turbiny v usloviiakh vzaimodeistviia s produktami osmoleniia topliva).** G. P. Pimenova, O. I. Marusii, I. A. Makovetskaia, and B. A. Griaznov (Akademiia Nauk Ukrainskoi SSR, Institut Problem Prochnosti, Kiev, Ukrainian SSR). *Problemy Prochnosti,* Dec. 1981, p. 27-32. 5 refs. In Russian.

The sulfide corrosion damage of the rotor blades of aircraft and stationary gas turbine engines have been studied after actual operation. Conditions leading to the formation of a corrosion layer containing films of nickel-nickel sulfide eutectics (35% S and 65% Ni) on ZhS6kp and EI826 alloy blading are identified. It is shown that such a layer reduces the fatigue strength of the blades by 50%. V.L.

A82-18484 † **Effect of the blading type on the aerodynamic damping of blade vibrations with allowance for the profile curvature (K voprosu o vliianii tipa reshetki na aerodinamicheskoe dempfirovanie kolebanii lopatok suchetom krivizny profilei).** N. Ia. Nastenko (Akademiia Nauk SSSR, Institut Problem Prochnosti, Kiev, Ukrainian SSR). *Problemy Prochnosti,* Dec. 1981, p. 66-70. 7 refs. In Russian.

The aerodynamic damping of blade vibrations has been studied experimentally as a function of the blading type, blade stagger angle, and blade curvature. It is shown that the effect of the adjacent blades on one another depends on the blading type and blade curvature. Experimental results are found to be in good qualitative agreement with the known theoretical studies; the quantitative deviation does not exceed 30-40%. V.L.

A82-18575 † **A mathematical model of a subsonic transport aircraft (O matematicheskoi modeli dozvukovogo transportnogo samoleta).** A. F. Latypov and B. N. Soroka (Akademiia Nauk SSSR, Institut Teoreticheskoi i Prikladnoi Mekhaniki, Novosibirsk, USSR). *Akademiia Nauk SSSR, Sibirskoe Otdelenie, Izvestiia, Seriia Tekhnicheskikh Nauk,* Oct. 1981, p. 83-88. In Russian.

A mathematical model of a subsonic turbojet-engine transport aircraft is developed which is based on the representation of the aerodynamic polar curve and the engine throttling characteristic in the form of generalized relationships. Also included are the necessary conditions for maximum flight range. Dimensionless parameters are incorporated into the model which reflect the characteristics of the airframe and power plant and make it possible to vary the optimum lift-drag ratio of the airframe and the thermodynamic efficiency of the power plant within wide limits. Examples are included of calculations carried out to determine the optimum dimensions of the power plant and to assess the effect of the dimensionless parameters on the aircraft's characteristics. C.R.

A82-18583 † **Determination of the trimmed drag of an aircraft (Opredelenie balansirovochnogo aerodinamicheskogo soprotivleniia samoleta).** V. A. Barinov and A. G. Obrubov. *TsAGI, Uchenye Zapiski,* vol. 12, no. 1, 1981, p. 78-84. 5 refs. In Russian.

It is shown that rake angles of flow from the wing near the horizontal tail surface calculated by the Glauert method agree well with experimentally measured angles. Formulas for calculating the drag of the horizontal tail surface are presented. An analysis is presented of the influence of the longitudinal static stability margin and longitudinal moment coefficient (at zero lift) on the lift-drag ratio under trim conditions. B.J.

A82-18584 † **Game-theoretical method for the synthesis of aircraft control during landing approach (Igrovoi podkhod k zadache sinteza upravleniia samoletom pri zakhode na posadku).** I. N. Titovskii. *TsAGI, Uchenye Zapiski,* vol. 12, no. 1, 1981, p. 85-92. In Russian.

The theory of differential games is used to consider the control of a nonmaneuvering aircraft in a longitudinal channel on a glide descent path under wind disturbances. An optimal control algorithm is obtained that ensures minimum deviation of the aircraft from glide, with allowance for constraints on the speed of control-surface reversal. Numerical results are presented. B.J.

A82-18588 † **Investigation of the stress-strain state of a rectangular wing section of variable thickness under concentrated loads and heating (Issledovanie napriazhenno-deformirovannogo priamougol'nogo kessona peremennoi tolshchiny pri sosredotochennykh nagruzkakh i nagreve).** S. N. Bulatov and P. N. Kurochka. *TsAGI, Uchenye Zapiski,* vol. 12, no. 1, 1981, p. 121-128. In Russian.

The Lagrange principle of virtual displacements is used to obtain a system of differential equations with variable coefficients. The solution of this system is used to determine the displacements of the arbitrary cross-section contour of a rectangular wing section under concentrated loads and an inhomogeneous temperature field. Displacements of contour points caused by warping are determined from the inhomogeneous Bessel equations. Computational results are presented. B.J.

A82-18589 † **Concerning the calculation of the aerodynamic characteristics of mechanized wings (K raschetu aerodinamicheskikh kharakteristik mekhanizirovannykh kryl'ev).** V. S. Savin. *TsAGI, Uchenye Zapiski,* vol. 12, no. 1, 1981, p. 129-133. In Russian.

The numerical method of discrete vortices is used for a comparative analysis of some results on the total and distributed aerodynamic characteristics of thin wings with control surfaces. Attention is given to the solution of the problem in the linear formulation and to the solution of the problem with allowance for the spatial distribution of vortices. B.J.

A82-18590 † Calculation of the unsteady loads on the surface of a moving wedge with an incident shock wave (Raschet nestatsionarnykh nagruzok, deistvuiushchikh na poverkhnost' dvizhushchegosia klina pri padenii na nego udarnoi volny). R. Ia. Tugazakov. *TsAGI, Uchenye Zapiski,* vol. 12, no. 1, 1981, p. 134-138. In Russian.

The maximum pressure on the surface of a moving wedge with an incident shock wave is calculated. Pressure on the body is determined as a function of the intensity of the incident wave and the angle of incidence when the intensity of the bow wave is equal to that of the incident wave. Hypersonic small-perturbation theory is used to study the influence of the contact discontinuity on the pressure distribution on the wedge surface. A decrease in the adiabatic exponent leads to an intensification of the unsteady effects. B.J.

A82-18591 † The effect of the cooling of the wing surface on laminar-to-turbulent boundary layer transition at supersonic flow velocities (Vliianie okhlazhdeniia poverkhnosti kryla na perekhod laminarnogo pogranichnogo sloia v turbulentnyi pri sverkhzvukovykh skorostiakh potoka). V. A. Kuz'minskii. *TsAGI, Uchenye Zapiski,* vol. 12, no. 1, 1981, p. 139-144. In Russian.

The influence of the cooling of a straight-wing model on the laminar-to-turbulent boundary layer transition was studied in a wind tunnel at Mach numbers of 1.8, 2.0, and 2.5, and Reynolds numbers (for one meter of length) in the ranges (11.7-16.9) x 10 to the 6th and (23.4-27.3) x 10 to the 6th. An analysis of experimental results shows that asymmetric cooling of the wing surface leads to an asymmetric development of the laminar-to-turbulent transition. B.J.

A82-18596 † A study of the effect of the flight vehicle body potential on the characteristics of ion attitude transmitters (Issledovanie vliianiia potentsiala korpusa letatel'nogo apparata na kharakteristiki ionnykh datchikov orientatsii). G. V. Eniutin, V. V. Skvortsov, and A. A. Uspenskii. *TsAGI, Uchenye Zapiski,* vol. 12, no. 1, 1981, p. 166-172. In Russian.

The effect of the flight vehicle body potential on the angular characteristics of ion attitude transmitters has been modeled experimentally in an ionized gas flow with parameters similar to those of the ionosphere. Possible ways to suppress this effect are examined, including the use of metal disks and screen grids in front of the transmitters. V.L.

A82-18612 † Application of the finite element method to the calculation of the modes and frequencies of natural vibrations of aircraft structures (Primenenie metoda konechnykh elementov k raschetu form i chastot sobstvennykh kolebanii aviatsionnykh konstruktsii). T. V. Snisarenko. *TsAGI, Uchenye Zapiski,* vol. 12, no. 1, 1981, p. 137-140. 6 refs. In Russian.

The paper develops a method for calculating the modes and frequencies of natural vibrations based on the finite-element modeling of the elastic and mass properties of the structure. An algorithm for solving the incomplete eigenvalue problem for a system of high-order equations is examined. The natural vibrations of a cylindrical shell are calculated as an example. B.J.

A82-18620 † Torsional vibrations of a wing carrying a concentrated load /asymptotic behavior/ (Krutil'nye kolebaniia kryla, nesushchego sosredotochennyi gruz /asimptotika/). Ia. M. Parkhomovskii. *TsAGI, Uchenye Zapiski,* vol. 12, no. 3, 1981, p. 69-82. In Russian.

Asymptotic formulas are obtained for the frequencies and modes of torsional vibrations of a wing carrying a concentrated load. These formulas are used to study the characteristics of the higher tones of the torsional vibrations. Results are presented for loads elastically and rigidly attached to the wing. B.J.

A82-18621 † Calculation of the stability of crosswise-reinforced cylindrical shells (K raschetu ustoichivosti karkasirovannykh tsilindvicheskikh obolochek). G. N. Zamula and K. M. Ierusalimskii. *TsAGI, Uchenye Zapiski,* vol. 12, no. 3, 1981, p. 83-94. 9 refs. In Russian.

General equations of stability and thermal stability are obtained for crosswise-reinforced noncircular cylindrical shells. The analysis takes into account nonuniform loading, variable stiffness, the anisotropy of the structure, and nonlinear effects. The equations make it possible to analyze the shell stability with allowance for the plastic state of the material and the buckling of the skin. The development of computational algorithms for this stability analysis is considered. B.J.

A82-18691 # Fluidics in aircraft engine controls. G. E. Davies (Plessey Aerospace, Ltd., Fareham, Hants., England). *ASME, Transactions, Journal of Dynamic Systems, Measurement, and Control,* vol. 103, Dec. 1981, p. 324-330. 6 refs.

Fluidics may be used to measure pressure ratio as a fundamental engine performance parameter using simple robust components, capable of withstanding high pressures and temperatures, and severe vibration. It improves the accuracy of measurement, and obviates the need of conventional systems to utilize nonoptimum, but easier to control parameters. A wide range of aircraft engine controls has been developed, including those for compressor inlet guide vanes, compressor bleed valves, engine fuel flow, and instrumentation. Total fluidic unit deliveries are now over 4200, and the civil operating hours exceed 13.5 million. A completely fluidic engine control is proposed with an electronic computer-controlled trim system for efficiency optimization. J.F.

A82-18726 Noise-Con 81; Proceedings of the National Conference on Noise Control Engineering, North Carolina State University, Raleigh, NC, June 8-10, 1981. Conference sponsored by the North Carolina State University and the Institute of Noise Control Engineering. Edited by L. H. Royster, F. D. Hart (North Carolina State University, Raleigh, NC), and N. D. Stewart (Acoustical Consultants, Inc., Gary, NC). Poughkeepsie, NY, Noise Control Foundation, 1981. 482 p. $42.

Topics discussed include noise control regulations and benefits, noise source identification, and the applications of damping materials. Papers are presented on Federal control technology initiatives in occupational noise, sound power measurement using the cross-spectral technique, low frequency noise reduction of acoustic enclosures, and the reflection and absorption of high-intensity sound at the surface of bulk porous materials. Attention is also given to nonacoustic design parameters for industrial mufflers, to educational programs for hearing conservation, and to a finite element analysis applied to open-end spinning noise. C.R.

A82-18727 Reduction of the acoustic environment in an F100-PW-100 engine test cell. V. R. Miller (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, OH). In: Noise-Con 81; Proceedings of the National Conference on Noise Control Engineering, Raleigh, NC, June 8-10, 1981. Poughkeepsie, NY, Noise Control Foundation, 1981, p. 257-260. 5 refs.

It is found that adding the acoustic treatment to the modification of the ejector tube lowers the acoustic environment in the test cell. The measured acoustic levels after modifications are below the design levels for engine structures as close as 40 inches ahead of the engine exhaust plane for maximum afterburner for the aft ejector tube position (AETP) and standard ejector tube position (SETP) configurations. The acoustic environment in the modified test cell is found to be lowest when the ejector tube is in the aft position (AETP). The measured acoustic levels exceed the design levels for engine structure with engine operation at the forward ejector tube position (FETP) configuration at maximum afterburner. C.R.

A82-18728 Development of a transmission loss test facility for light aircraft structures. C. K. Barton (Garrett Turbine Engine Co., Phoenix, AZ). In: Noise-Con 81; Proceedings of the National Conference on Noise Control Engineering, Raleigh, NC, June 8-10, 1981. Poughkeepsie, NY, Noise Control Foundation, 1981, p. 265-268.

The development of a transmission loss (TL) test facility designed specifically for light aircraft structures is described, and preliminary data obtained in the new facility are presented. The facility features automated control of the entire measurement

procedure through the use of a desk-top computer interfaced with digital relays and a one-third octave frequency analyzer. The computer is programmed to start and stop the sound sources, switch microphones for the analyzer, and operate the analyzer. C.R.

A82-18729 * **Acceleration response of fuselage sidewall panels on a twin-engine, light aircraft.** L. A. Roussos and J. S. Mixson (NASA, Langley Research Center, Hampton, VA). In: Noise-Con 81; Proceedings of the National Conference on Noise Control Engineering, Raleigh, NC, June 8-10, 1981. Poughkeepsie, NY, Noise Control Foundation, 1981, p. 291-294.

A response analysis is carried out to determine the predictability of sidewall accelerations in aircraft, to investigate whether it is necessary to model the exterior pressure as a traveling wave as opposed to a standing wave, and to determine the importance of parameters describing the exterior pressure and sidewall panel. Prediction of the acceleration response is found to be improved by including traveling wave and spatial variation effects of the exterior pressure in the model. Variations with propeller rpm are found to be important for the longer panel. C.R.

A82-18730 **Noise control plan for a new airplane manufacturing facility.** M. D. Lockleer and R. C. Klein (Boeing Commercial Airplane Co., Seattle, WA). In: Noise-Con 81; Proceedings of the National Conference on Noise Control Engineering, Raleigh, NC, June 8-10, 1981. Poughkeepsie, NY, Noise Control Foundation, 1981, p. 299-302.

The work done by a noise technology staff in designing a noise control treatment for a new factory that had already been designed and had an established floor plan is described. The staff also had the responsibility of estimating noise levels in the new factory before it was completed. The noise-estimating procedures were based on acquiring noise measurements in a similar manufacturing facility with comparable enclosed area dimensions, production activities, and room characteristics. Noise was measured along the periphery of each area by recording the dBA level for a period of one minute. These noise levels were then transferred onto the new factory floor layout, where they were adjusted to account for work cycle, density of work parts, and number of production workers per unit area. C.R.

A82-18731 **Noise monitoring in airport communities.** W. K. Connor (Tracor, Inc., Austin, TX). In: Noise-Con 81; Proceedings of the National Conference on Noise Control Engineering, Raleigh, NC, June 8-10, 1981. Poughkeepsie, NY, Noise Control Foundation, 1981, p. 401-406. 6 refs.

Current noise monitoring practices at airports are surveyed, with emphasis placed on extent, implementation, and rationale. It is noted that contemporary aircraft monitoring systems can perform a wide variety of functions in support of an airport noise abatement program. In establishing a system, the importance of developing the program before locating the stations and specifying functions is stressed. Among the basic design considerations are the location and type of the central station, the number and locations of the remote stations, the type of data output, the amount of data to be stored, and the operating costs. C.R.

A82-18732 * **Quantification of airport community noise impact in terms of noise levels, population density, and human subjective response.** R. DeLoach (NASA, Langley Research Center, Hampton, VA). In: Noise-Con 81; Proceedings of the National Conference on Noise Control Engineering, Raleigh, NC, June 8-10, 1981. Poughkeepsie, NY, Noise Control Foundation, 1981, p. 419-422. 7 refs.

The Fraction Impact Method (FIM), developed by the National Research Council (NRC) for assessing the amount and physiological effect of noise, is described. Here, the number of people exposed to a given level of noise is multiplied by a weighting factor that depends on noise level. It is pointed out that the Aircraft-noise Levels and Annoyance MOdel (ALAMO), recently developed at NASA Langley Research Center, can perform the NRC fractional impact calculations for given modes of operation at any U.S. airport. The sensitivity of these calculations to errors in estimates of population, noise level, and human subjective response is discussed. It is found that a change in source noise causes a substantially smaller change in contour area than would be predicted simply on the basis of inverse square law considerations. Another finding is that the impact calculations are generally less sensitive to source noise errors than to systematic errors in population or subjective response. C.R.

A82-18776 **The structure of a separating turbulent boundary layer. I - Mean flow and Reynolds stresses. II - Higher-order turbulence results.** R. L. Simpson, Y.-T. Chew, and B. G. Shivaprasad (Southern Methodist University, Dallas, TX). *Journal of Fluid Mechanics,* vol. 113, Dec. 1981, p. 23-51, 53-73. 60 refs. Navy-supported research. Project SQUID.

The structure of a separating turbulent boundary layer was studied experimentally for an airfoil-type flow. Reynolds stress and mean flow were determined, and results are provided for velocity probability distribution flatness and skewness factors for higher order turbulence. The flow was accelerated and decelerated until separation occurred, and measurements were made by hot-wire and laser anemometry. A small mean backflow in the separation is found to be supplied intermittently by large-scale structures passing through the separated flow. This mechanism is suggested to be dominant only when the thickness of the backflow region is small compared with the turbulent shear-layer thickness. M.S.K.

A82-18837 # **The application of bifurcation theory to the study of loss of control over combat aircraft (Application de la theorie des bifurcations à l'etude des pertes de controle sur avion de combat).** P. Guicheteau (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *(NATO, AGARD, Symposium on Combat Aircraft Maneuverability, Florence, Italy, Oct. 5-8, 1981.) ONERA, TP* no. 1981-100, 1981. 14 p. 8 refs. In French.

Nonlinear models of aircraft in spin and loss of control conditions are constructed using bifurcation theory. The cases of Riemann-Hugoniot catastrophe and Hopf bifurcation are considered, and bifurcation and the mechanics of flight are analyzed. A nonlinear model without hysteresis, with angles of attack ranging from -10 to 90 deg and slip angles from -40 to 40 deg is developed for combat aircraft with high wings and back empennage. Behavior at high angles of attack is discussed in terms of regaining control in movements transverse to the depth of the fixed position and in movements of pure depth. Areas of equilibrium of the flight envelope are defined for escaping from the hazardous situations. M.S.K.

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STAR ENTRIES

N82-14049*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
OPTIMIZATION AND PERFORMANCE CALCULATION OF DUAL-ROTATION PROPELLERS
Robert E. Davidson Dec. 1981 48 p refs
(NASA-TP-1948; L-14678) Avail: NTIS HC A03/MF A01 CSCL 01A

An analysis is given which enables the design of dual-rotation propellers. It relies on the use of a new tip loss factor deduced from T. Theodorsen's measurements coupled with the general methodology of C. N. H. Lock. In addition, it includes the effect of drag in optimizing. Some values for the tip loss factor are calculated for one advance ratio. Author

N82-14055*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
COMPARISON OF EXPERIMENTAL AND THEORETICAL TURBULENCE REDUCTION CHARACTERISTICS FOR SCREENS, HONEYCOMB, AND HONEYCOMB-SCREEN COMBINATIONS
James Scheiman Dec. 1981 55 p refs
(NASA-TP-1958; L-14628) Avail: NTIS HC A04/MF A01 CSCL 01A

Turbulence reduction research using screens, honeycomb, and combinations thereof was conducted in a half-scale model of a portion of the Langley 8-foot transonic pressure tunnel. It was found that screens alone reduce axial turbulence more than lateral turbulence; whereas, honeycomb alone reduces laterial turbulence more than axial turbulence. Because of this difference, the physical mechanism for decreasing turbulence for screens and honeycomb must be completely different. It is concluded that honeycomb with a downstream screen is an excellent combination for reducing turbulences. E.A.K.

N82-14056*# National Aeronautics and Space Administration, Washington, D. C.
SYSTEM FOR ACQUISITION AND ANALYSIS OF DYNAMIC TESTS ON AIR INTAKES
P. Perrier, B. Delahaye (SNECMA, Moissy-Cramayel, France), and G. Laruelle (ONERA, Paris) Dec. 1981 54 p refs Transl. into ENGLISH of "Systeme d'Acquisition et d'Analyse pour Essais Dynamiques d'Entees d'Air", Rept. ONERA-TP-1981-37 ONERA, France, 1981 15 p Presented at the AGARD Symp. on Aerodyn. of Power Plant Installation, Toulose, 11-14 May 1981 Original language document was announced as A81-39240 Transl. by Scientific Translation Service, Santa Barabara, Calif. Original doc. prep. by Avions Marcel Dassault-Brequet Aviation
(Contract NASw-3542)
(NASA-TM-76646) Avail: NTIS HC A04/MF A01 CSCL 01A

The problem of compatibility between the airflow developed through the aircraft's air intake ducting and its suitability to the jet engine are studied. A review of the various functions of the air intake is presented. A proposed solution to measure the various parameters is described. The specifications and details of the system permit measurements with a satisfactory reliability on the test bench, as well as in the wind tunnel or in flight. R.J.F.

N82-14057*# National Aeronautics and Space Administration, Washington, D. C.
EXPERIMENTAL INVESTIGATION OF A TRANSONIC POTENTIAL FLOW AROUND A SYMMETRIC AIRFOIL
W. J. Hiller and G. E. A. Meier Dec. 1981 26 p refs Transl. into ENGLISH from Rept. 10/1971 Max-Planck Inst. fuer Stroemungsforschung, Goettingen, W. Germany, Nov. 1971 22 p Original language document was announced as N72-19996 Transl. by Kanner (Leo) Associates, Redwood City, Calif.
(Contract NASw-3541)
(NASA-TM-76676; Rept-10/1971) Avail: NTIS HC A03/MF A01 CSCL 01A

Experimental flow investigations on smooth airfoils were done using numerical solutions for transonic airfoil streaming with shockless supersonic range. The experimental flow reproduced essential sections of the theoretically computed frictionless solution. Agreement is better in the expansion part of the of the flow than in the compression part. The flow was nearly stationary in the entire velocity range investigated. Author

N82-14058*# National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.
A FLIGHT INVESTIGATION OF BLADE-SECTION AERODYNAMICS FOR A HELICOPTER MAIN ROTOR HAVING 10-64C AIRFOIL SECTIONS
Charles E. K. Morris, Jr. Nov. 1981 181 p refs
(NASA-TM-83226) Avail: NTIS HC A09/MF A01 CSCL 01A

Pressure data at 90 percent blade radius were obtained for a helicopter main rotor with 10-64C blade sections during flight. Concurrent measurements were made of vehicle flight state, performance and some rotor loads. The test envelope included hover, level flight from about 65 to 162 knots, climb and descent, and collective fixed maneuvers. Good agreement is shown between some sets of airfoil pressure distributions obtained in flight and those from two-dimensional wind-tunnel tests or theoretical calculations. A.R.H.

N82-14059*# Low Energy Transport Systems, Capistrano Beach, Calif.
LOW REYNOLDS NUMBER AIRFOIL SURVEY, VOLUME 1 Final Report
B. H. Carmichael Nov. 1981 106 p refs
(NASA Order L-40598)
(NASA-CR-165803-Vol-1) Avail: NTIS HC A06/MF A01 CSCL 10A

The differences in flow behavior two dimensional airfoils in the critical chordlength Reynolds number compared with lower and higher Reynolds number are discussed. The large laminar separation bubble is discussed in view of its important influence on critical Reynolds number airfoil behavior. The shortcomings of application of theoretical boundary layer computations which are successful at higher Reynolds numbers to the critical regime are discussed. The large variation in experimental aerodynamic characteristic measurement due to small changes in ambient turbulence, vibration, and sound level is illustrated. The difficulties in obtaining accurate detailed measurements in free flight and dramatic performance improvements at critical Reynolds number, achieved with various types of boundary layer tripping devices are discussed. E.A.K.

N82-14060# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ACTA MECHANICA SINICA (SELECTED ARTICLES)
20 Oct. 1981 37 p refs Transl. into ENGLISH from Acta Mech. Sinica (Communist China), no. 3, 1980 p 217-231, 302-310
(AD-A107322; FTD-ID(RS)T-0709-81) Avail: NTIS HC A03/MF A01 CSCL 01/1

Simplified Navier-Stokes equations, their mathematical properties, and equations of flight mechanics used in analyzing the effects of wind and atmospheric turbulence on flight performance are presented. Lifting surface theory for wings in low frequency small amplitude yawing and side slipping oscillating motions at low speeds is also presented.

N82-14061# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
LIFTING SURFACE THEORY FOR WINGS IN LOW FREQUENCY SMALL AMPLITUDE YAWING AND SIDE SLIPPING OSCILLATING MOTIONS AT LOW SPEEDS
Huang Mingke *In its* Acta Mech. Sinica (Selected Articles) (FTD-ID(RS)T-0708-81) 20 Oct. 1981 p 1-15 refs Transl. into ENGLISH from Acta Mech. Sinica (Communist China), no. 3, 1980 p 217-231, 302-310

Avail: NTIS HC A03/MF A01 CSCL 01/1

The mathematical problem of flow at low speeds past a yawing oscillating wing set up by using a coordinate system fixed in the wing is discussed. The snake-like tail vortices behind

the wing are investigated in detail. In the case of low frequency oscillations, numerical solution is obtained by the non-steady vortex-lattice method which can be used to calculate the rolling moment aerodynamic derivatives of the wing due to yaw and side slip. Some of the computed results are compared with the experimental results. Author

N82-14071# Arinc Research Corp., Annapolis, Md.
THE USE OF FLIGHT MANAGEMENT COMPUTERS IN AIR CARRIER OPERATIONS IN THE 1980S Interim Report
I. Gershkoff Washington FAA Aug. 1981 113 p refs
(Contract DTFA01-80-C-10030)
(AD-A105621; Rept-1378-11-1-2482; FAA-EM-81-10) Avail: NTIS HC A06/MF A01 CSCL 09/2

The use of on-board flight management computers (FMCs) in air carrier operations has the potential for significant fuel savings. This report assesses the general capabilities of the FMCs currently available. From this information, economic benefits and rates at which aircraft would be equipped were developed. Minimum-cost flight profiles were analyzed for various common conditions to determine the problems associated with incorporating the capabilities of FMCs into a heavy traffic Air Traffic Control environment. GRA

N82-14072# Hamilton Standard, Windsor Locks, Conn.
ADVANCED CRASH SURVIVABLE FLIGHT DATA RECORDER AND ACCIDENT INFORMATION RETRIEVAL SYSTEM (AIRS) Final Report, Oct. 1978 - Dec. 1980
Henry R. Ask, Donald L. White, and Kent E. Berwick Fort Eustis, Va. Army Research and Technology Labs. Aug. 1981 166 p refs
(Contract DAAK51-78-C-0025; DA Proj. 1L1-62209-AH-76) (AD-A105510; ESP-8109; USAAVRADCOM-TR-81-D-20) Avail: NTIS HC A08/MF A01 CSCL 01/3

The Accident Information Retrieval System, (AIRS) development program consisted of four phases. Design concepts were formulated based on selection and definition of aircraft parameters to be monitored by the AIRS, selection of memory technology, circuit definitions for aircraft interfacing, and studies and tests related to the development of an armored module to protect the memory device. Brassboard electronics were fabricated and tested and software which proved the feasibility of data collection and storage in a solid-state memory device utilizing unique data compression techniques to reproduce critical aircraft flight information was developed and tested. Flight-worthiness assurance tests were performed on the AIRS brassbroad. The hardware was installed in a Sikorsky UH-60A BLACK HAWK helicopter. The system was reviewed for final configuration, risk areas, final size (207 cu. in. or less), weight (less than 9.3 lbs.), and life cost (greater than 10,000 hours MTBF). GRA

N82-14073# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugfuehrung.
ANALYSIS OF TWO AIR TRAFFIC SAMPLES IN THE TERMINAL AREA OF FRANKFURT/MAIN, AUGUST 4TH 1978
Uwe Voelckers, Manfred Schubert, and Albrecht Seyfried 1981 127 p refs In GERMAN
(DFVLR-Mitt-81-12) Avail: NTIS HC A07/MF A01

Two 'arrival peaks' are analyzed. Computer programs used to combine data recorded from several sources are discussed. Traffic analysis includes quantitative evaluation of traffic density, studies of air traffic distributions relating to space and time, investigation of air traffic control procedures, determination of the approach control planning strategies, and a basic investigation of traffic vectoring in the terminal area. The similarities and differences of the two traffic samples are discussed. N.W.

N82-14075*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
DESIGN AND IMPLEMENTATION OF A TELECOMMUNICATION INTERFACE FOR THE TAATM/TCV REAL-TIME EXPERIMENT
Joseph D. Nolan Dec. 1981 26 p refs
(NASA-TM-83231; L-15021) Avail: NTIS HC A03/MF A01 CSCL 17G

The traffic situation display experiment of the terminal configured vehicle (TCV) research program requires a bidirectional data communications tie line between an computer complex. The tie line is used in a real time environment on the CYBER 175 computer by the terminal area air traffic model (TAATM) simulation program. Aircraft position data are processed by TAATM with the resultant output sent to the facility for the generation of air traffic situation displays which are transmitted to a research aircraft. E.A.K.

N82-14076# Federal Aviation Administration, Atlantic City, N.J.
IN-SERVICE TESTING OF THE PRECISION APPROACH PATH INDICATOR (PAPI) AT NEWARK INTERNATIONAL AIRPORT, NEW JERSEY Interim Report, Dec. 8, 1980 - Apr. 8, 1981
Bret B. Castle Dec. 1981 11 p
(DOT-081-502-510)
(DOT/FAA/RD-81/95; DOT/FAA/CT-81/79) Avail: NTIS HC A02/MF A01

The Precision Approach Path Indicator (PAPI) tests involving four months of inservice testing at Newark International Airport, New Jersey are presented. Basically, the PAPI was compared against the standard red/white Visual Approach Slope Indicator (VASI) system at a large airport and on a runway with an Instrument Landing System (ILS). The PAPI system was installed in a manner to take care of aircraft of all sizes; that is, different wheel to eye distances. Information was obtained from pilots of large commercial aircraft. Results show that under these conditions about 60 percent of the pilots prefer the PAPI over the VASI system. S.L.

N82-14078*# Ohio Univ., Athens. Avionics Engineering Center.
A PROTOTYPE INTERFACE UNIT FOR MICROPROCESSOR BASED LORAN-C RECEIVER
Stanley M. Novacki, III Nov. 1981 11 p refs
(Grant NGR-36-009-017)
(NASA-CR-164887; TM-82-NASA) Avail: NTIS HC A02/MF A01 CSCL 17G

An inexpensive data/command entry and CRT display system capable of alphanumeric and graphics moe operation and designed to operate in place of a separate ASCII terminal, is documented. The software to interface this unit to the 6502-based Loran C receiver is also described. The system simplifies receiver operations to a level typical of current avionics systems. N.W.

N82-14079# Mitre Corp., McLean, Va.
REQUIREMENTS FOR INSTRUMENT APPROACHES TO TRIPLE PARALLEL RUNWAYS
T. N. Shimi, W. J. Swedish, and L. C. Newman Jul. 1981 148 p refs
(Contract DTFA01-81-C-10001)
(AD-A105622; MTR-81W145; FAA-EM-81-12) Avail: NTIS HC A07/MF A01 CSCL 01/2

Current ATC procedures do not consider instrument approaches to more than two parallel runways. This document discusses the engineering results of an analysis that examined the technical feasibility of conducting triple parallel instrument approaches as a means of increasing the aircraft flow at congested airports. The technical criteria that were subjected to analysis include the physical characteristics of the airfield, airspace and aircraft mix, surveillance (the radar and display systems), and control (procedures for normal and abnormal operations. The expected performance in safety and capacity was estimated for alternative landing concepts. An analysis was conducted of blunders and evasion strategies. It was found that, for a given configuration, a single blunder recovery strategy could be specified that would produce acceptable separations between aircraft. Missed approaches on triple parallels and pilot acceptance of triple approaches are also discussed. Lastly, recommended requirements and control procedures for triple parallel instrument approaches are presented. Author (GRA)

N82-14080# Mitre Corp., McLean, Va.
REQUIREMENTS FOR INDEPENDENT AND DEPENDENT PARALLEL INSTRUMENT APPROACHES AT REDUCED RUNWAY SPACING
A. L. Haines and W. J. Swedish Washington FAA May 1981 182 p refs
(Contract DTFA01-81-C-10001)
(AD-A105673; MTR-81W15; FAA-EM-81-8) Avail: NTIS

HC A09/MF A01 CSCL 01/2

Independent parallel instrument approaches are conducted today only if the runway centerlines are 4300 ft apart or more. The rationale behind this criterion is reviewed, and the requirements for reducing the criterion to 3000 ft are evaluated. Although some benefit is derived from improvements in navigational accuracy, the performance of the surveillance system has the greatest impact on the required runway spacing. Dependent alternating instrument approaches to parallel runways are also evaluated. Currently such approaches require a runway spacing of 3000 ft or more. The effects of reducing this runway spacing are discussed, especially with regard to blunder recovery. Reducing the runway spacing required for these approaches could increase the arrival capacity and reduce delays at certain airports and would provide increased flexibility for planning new runways. Author (GRA)

N82-14082# Kaman Aerospace Corp., Bloomfield, Conn.

ADVANCED TECHNOLOGY LIGHTWEIGHT GONDOLA SYSTEM EXPERIMENTAL FABRICATION PROGRAM Final Report, Aug. 1979 - Mar. 1981

John D. Porterfield Jul. 1981 133 p refs

(Contract DAAK51-79-C-0036; DA Proj. 1L1-62209-AH-76) (AD-A104157; R-1630; USAAVRADCOM-TR-81-D-24) Avail: NTIS HC A07/MF A01 CSCL 01/3

Design concept verification hardware for the helicopter external gondola systems (HEGS) 10 and 20 modules, critical element and component fabrication and testing and full-scale HEGS 20 gondola assemblies were accomplished. The HEGS 20 module characteristics demonstrated during design, fabrication, and testing included (1) structural efficiency (2) impact resistance potential, (3) producibility, (4) repairability without post heat treatment, (5) maintenance, (6) functional and structural capabilities, (7) load and unload capabilities, (8) cargo tie-down capabilities, (9) compatibility with automated lifting devices and ground transport equipment, (10) suitability for loading and unloading on uneven terrain, and (11) low weight potential. Author

N82-14083# Army Armament Research and Development Command, Watervliet, N. Y. Geotechnical Lab.

C-5A OPERATIONAL UTILITY EVALUATION SOIL TESTS AND ANALYSIS Final Report, Jun. - Aug. 1980

Robert W. Grau Aug. 1981 74 p refs

(Contract MIPR-F7B13001430001)

(AD-A105555; WES-TR-GL-81-7) Avail: NTIS HC A04/MF A01 CSCL 08/13

The purpose of this report is to present the data collected concerning the ground flotation characteristics of the C-5A aircraft during the C-5A operational utility evaluation test program. This report gives a description of the three test sites selected for this program, a summary of all soil and surface distress measurements taken at each site during aircraft operations, and an analysis of the data. Results of this evaluation test program indicate that 3-in. ruts have little or no effect on the performance of the C-5A aircraft on unsurfaced areas. Author (GRA)

N82-14084# National Aerospace Lab., Amsterdam (Netherlands). Flight Div.

A METHOD FOR MEASURING TAKEOFF AND LANDING PERFORMANCE OF AIRCRAFT, USING AN INERTIAL SENSING SYSTEM

A. Pool, J. L. Simons, G. J. H. Wensink, and A. J. L. Willekens 25 Sep. 1980 10 p refs Presented at AGARD Flight Mech. Panel Symp. on Subsystem Testing and Flight Test Instrumentation, Geilo, Norway, 27-30 Oct. 1980

(NLR-MP-80036-U) Avail: NTIS HC A02/MF A01

An inertial sensing system, STALINS, used to provide trajectory data for takeoff and landing measurement instrument design, is presented. The system specifications based on certification requirements for civil transport aircraft are defined for continuous and rejected takeoff, minimum unstick speed, minimum control speed on the ground, and landing. Calculations are performed using a computer program supplemented by a manual check, giving horizontal distance and height measurements. Data are made available within 24 hours. The method is accurate and is suitable for tests at several airfields, since instrumentation is either onboard already, or easily transported by the aircraft. Author (ESA)

N82-14085*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

A GENERAL AVIATION SIMULATOR EVALUATION OF A RATE-ENHANCED INSTRUMENT LANDING SYSTEM DISPLAY

David A. Hinton Dec. 1981 44 p

(NASA-TP-1960; L-13911) Avail: NTIS HC A03/MF A01 CSCL 01D

A piloted-simulation study was conducted to evaluate the effect on instrument landing system tracking performance of integrating localizer-error rate with raw localizer and glide-slope error. The display was named the pseudocommand tracking indicator (PCTI) because it provides an indication of the change of heading required to track the localizer center line. Eight instrument-rated pilots each flew five instrument approaches with the PCTI and five instrument approaches with a conventional course deviation indicator. The results show good overall pilot acceptance of the display, a significant improvement in localizer tracking error, and no significant changes in glide-slope tracking error or pilot workload. B.W.

N82-14086 Royal Aircraft Establishment, Farnborough (England).

A TRUE AIR SPEED SENSOR FOR MINIATURE UNMANNED AIRCRAFT

J. A. C. Beattie Jun. 1981 11 p refs

(RAE-TM-SPACE-287; BR80019) Copyright. Avail: Issuing Activity

A prototype sensor with digital output is described. Vortex shedding principles are exploited by using a bluff body with end-plates to produce a stable set of vortices alternately from the edges of the body. Vortex production frequency is directly proportional to the speed of the fluid past the body. A pair of printed thick film thermistors detect the vortices. Tests show excellent linearity of response, although sensor geometry, and signal processing electronics can be improved. Author (ESA)

N82-14087# General Electric Co., Cincinnati, Ohio. Aircraft Equipment Div.

ELECTRONIC MASTER MONITOR AND ADVISORY DISPLAY SYSTEM, OPERATIONAL FUCTIONS REPORT Interim Report, Jun. 1979 - Oct. 1980

Oct. 1980 201 p refs

(Contract DAAK80-79-C-0270; DA Proj. 1L2-62202-AH-85) (AD-A105516; ACS-12-217; AVRADCOM-TR-79-0270-2; IR-2) Avail: NTIS HC A10/MF A01 CSCL 01/3

Basic system operating requirements for an Electronic Master Monitor and Advisory Display System (EMMADS), developed for use on U.S. Army helicopters to reduce crew workload by assuming responsibility for tasks associated with subsystem status monitoring, are described. A baseline for defining the requirements of the feasibility demonstration hardware is provided EMMADS functions described include examples related to the CH-47C helicopter, the aircraft selected as the basis for the EMMADS feasibility model. Author

N82-14088# Naval Air Development Center, Warminster, Pa.

INVESTIGATION OF FUNCTIONAL COMMONALITY OF AVIONICS SYSTEMS IN NAVAL AIRCRAFT Final Report, Jan. - Sep. 1981

John M. Cunningham 30 Sep. 1981 136 p refs

(W05720000)

(AD-A105503; NADC-81235-20) Avail: NTIS HC A07/MF A01 CSCL 09/3

This report presents the results of a study to determine general requirements for the development of core avionics equipment for common usage by Naval aircraft. The study addresses the core avionics architecture and the relationship between existing core avionics equipment and advanced subsystems under development. The report provides specific recommendations regarding: procurement policies; the application of standards to electronic interfaces; and the development of the basic architectural components. GRA

N82-14089# Southwest Research Inst., San Antonio, Tex.

HELICOPTER MODEL STUDIES FOR ON-BOARD ELECTROSTATIC SENSORS Final Report, 25 Sep. 1979 - 24 Jan. 1981

O. Tranbarger, B. M. Duff, and T. R. Owen Fort Eustis, Va. Army Research and Technology Labs. Sep. 1981 286 p refs

(Contract DAAK51-79-C-0060; DA Proj. 1L1-62209-AH-76)

(AD-A105511; SWRI-14-5863; USAAVRADCOM-TR-81-D-26) Avail: NTIS HC A13/MF A01 CSCL 13/12

Hovering helicopters accumulate excessive charge as a result of triboelectrification, surrounding space charge, and external electric fields that result in high electrostatic potentials on the aircraft. Electrostatic energy stored on the helicopter can cause electrical discharges to occur from the cargo hook when contact is made with the ground or ground personnel. Laboratory model studies were conducted under electrostatic conditions simulating hovering aircraft to show that on-board instrumentation capable of measuring electric field intensity and charge density can provide the basis for indirectly inferring the correct potential relative to ground of a spherical model test body. Potential of the model was inferred for three cases involving electrostatic instrumentation located (1) on the ground below the model, (2) installed at the south pole of the model, and (3) mounted at the end of the simulated cargo hook. Analysis of laboratory test data resulted in empirical derivations of unique electric field curves for each of the three cases studied. The first two cases were also studied analytically by solving Poisson's equation for a sphere between two parallel plates, and the mathematical expressions substantiated the laboratory results. Methodology for developing a full-scale helicopter electrostatic discharger system to eliminate hazardous potentials on helicopter aircraft is described.

Author (GRA)

N82-14090*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

GAS TURBINE CERAMIC-COATED-VANE CONCEPT WITH CONVECTION-COOLED POROUS METAL CORE

Albert F. Kascak (AVRADCOM Research and Technology Labs., Cleveland), Curt H. Liebert, Robert F. Handschuh, and Lawrence P. Ludwig Dec. 1981 14 p refs Sponsored in part by U.S. Army Aviation Research and Development Command, St. Louis (NASA-TP-1942; AVRADCOM-TR-81-C-7; E-732) Avail: NTIS HC A02/MF A01 CSCL 21E

Analysis and flow experiments on a ceramic-coated-porous-metal vane concept indicated the feasibility, from a heat transfer standpoint, of operating in a high-temperature (2500 F) gas turbine cascade facility. The heat transfer and pressure drop calculations provided a basis for selecting the ceramic layer thickness (to 0.08 in.), which was found to be the dominant factor in the overall heat transfer coefficient. Also an approximate analysis of the heat transfer in the vane trailing edge revealed that with trailing-edge ejection the ceramic thickness could be reduced to (0.01 in.) in this portion of the vane. B.W.

N82-14091*# National Aeronautics and Space Administration, Washington, D. C.

WIND TUNNEL TESTS OF ENGINE-EQUIPPED MODELS: COMPARISON OF TWO JET WASH SIMULATION METHODS

J. P. Becle and R. Perin Dec. 1981 43 p ref Transl. into ENGLISH of 'Essais en Soufflerie de Maquetter Motorisees. Comparison de Deux Methodes de Simulation des Jets des Reacteurs" rept. T.P. 1981-42, France, 1981 p 1-18 Presented at the AGARD/FDP Symp. Aerodynamics of Power Plant Installation, Toulouse, 11-14 May 1981 Original language document was announced as A81-39245 Transl. by Scientific Translation Service, Santa Barbara, Calif. Original doc. prep. by ONERA, Toulouse

(Contract NASw-3542)

(NASA-TM-76764; TP-1981-42) Avail: NTIS HC A03/MF A01 CSCL 21E

The optimization of performance factors in state of the art civil aircraft was studied by using powered models in wind tunnels. In cooperation with ONERA, two methods of cold simulation of jet engine washes were developed. The first, called 'blown jet', benefitted from the previously perfected test set-ups made for studies of the CONCORDE. The second, which utilized small air-turbines, were recently put into operation for the AIRBUS family of aircraft. The facilities, the measurement equipment and the methods of exploiting the results are described. The relative value of each of the methods of motorization is analyzed: complexity of equipment, duration, precision of measurements and comparison of results are also discussed. A.R.H.

N82-14094*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

THE USE OF OPTIMIZATION TECHNIQUES TO DESIGN CONTROLLED DIFFUSION COMPRESSOR BLADING

Nelson L. Sanger 1982 18 p refs Proposed for presentation at the 27th Ann. Intern. Gas Turbine Conf., London, Apr. 18-22, 1982; sponsored by ASME

(NASA-TM-82763; E-1084) Avail: NTIS HC A02/MF A01 CSCL 21E

A method for automating compressor blade design using numerical optimization, and applied to the design of a controlled diffusion stator blade row is presented. A general purpose optimization procedure is employed, based on conjugate directions for locally unconstrained problems and on feasible directions for locally constrained problems. Coupled to the optimizer is an analysis package consisting of three analysis programs which calculate blade geometry, inviscid flow, and blade surface boundary layers. The optimizing concepts and selection of design objective and constraints are described. The procedure for automating the design of a two dimensional blade section is discussed, and design results are presented. E.A.K.

N82-14095*# AiResearch Mfg. Co., Phoenix, Ariz.

POLLUTION REDUCTION TECHNOLOGY PROGRAM SMALL JET AIRCRAFT ENGINES, PHASE 3 Final Report

T. W. Bruce, F. G. Davis, T. E. Kuhn, and H. C. Mongia Dec. 1981 180 p refs

(Contract NAS3-20819)

(NASA-CR-165386; AiResearch-21-3615) Avail: NTIS HC A09/MF A01 CSCL 21E

A series of Model TFE731-2 engine tests were conducted with the Concept 2 variable geometry airblast fuel injector combustion system installed. The engine was tested to: (1) establish the emission levels over the selected points which comprise the Environmental Protection Agency Landing-Takeoff Cycle; (2) determine engine performance with the combustion system; and (3) evaulate the engine acceleration/deceleration characteristics. The hydrocarbon (HC), carbon monoxide (CO), and smoke goals were met. Oxides of nitrogen (NOx) were above the goal for the same configuration that met the other pollutant goals. The engine and combustor performance, as well as acceleration/deceleration characteristics, were acceptable. The Concept 3 staged combustor system was refined from earlier phase development and subjected to further rig refinement testing. The concept met all of the emissions goals. E.A.K.

N82-14096*# AiResearch Mfg. Co., Phoenix, Ariz.

ERBS FUEL ADDENDUM: POLLUTION REDUCTION TECHNOLOGY PROGRAM SMALL JET AIRCRAFT ENGINES, PHASE 3 Final Report

T. W. Bruce, F. G. Davis, T. E. Kuhn, and H. C. Mongia [1982] 47 p refs

(Contract NAS3-20819)

(NASA-CR-165387; AiResearch-21-3619) Avail: NTIS HC A03/MF A01 CSCL 21E

A Model TFE731-2 engine with a low emission, variable geometry combustion system was tested to compare the effects of operating the engine on Commercial Jet-A aviation turbine fuel and experimental referee broad specification (ERBS) fuels. Low power emission levels were essentially identical while the high power NOx emission indexes,were approximately 15% lower with the EBRS fuel. The exhaust smoke number was approximately 50% higher with ERBS at the takeoff thrust setting; however, both values were still below the EPA limit of 40 for the Model TFE731 engine. Primary zone liner wall temperature ran an average of 25 K higher with ERBS fuel than with Jet-A. The possible adoption of broadened proprties fuels for gas turbine applications is suggested. E.A.K.

N82-14097# Pratt and Whitney Aircraft Group, West Palm Beach, Fla. Government Products Div.

OPTIMIZATION OF COMPRESSOR VANE AND BLEED SETTINGS Final Report, May 1979 - May 1981

J. E. Garberoglio, J. O. Song, and W. L. Boudreaux Wright-Patterson AFB, Ohio AFWAL Jun. 1981 83 p refs

(Contract F33615-79-C-2018; AF Proj. 2307)

(AD-A106059; PWA-FR-14487; AFWAL-TR-81-2046) Avail: NTIS HC A05/MF A01 CSCL 21/5

This report evaluates optimization methods for their effectiveness in relating multistage axial compressor test data to the decision to vary a selected vane or bleed to reach a predetermined performance goal. Compressor simulations were used in a comparative evaluation and each method was judged on the basis of the number of tests required to achieve an optimum performance goal. The influence of measurement errors and finite

vane travel were also prime considerations. Based on this evaluation, the COPES/CONMIN approximate optimization technique was chosen most suitable. Author (GRA)

N82-14098# Naval Postgraduate School, Monterey, Calif.
FOREIGN OBJECT DAMAGE IN NAVAL AIRCRAFT ENGINES M.S. Thesis
Jack B. Mills Jun. 1981 138 p refs
(AD-A105787) Avail: NTIS HC A07/MF A01 CSCL 01/3

An investigation of historical data was conducted in an attempt to assign a specific cause to each foreign object damage incident reported during an eighteen month period. Interviews were conducted with engineers and fleet maintenance personnel in support of the above research. The impact of current FOD reporting procedures, the foreign objects, the ingestion process and the operating environment are discussed. Conclusions and recommendations are included. Author (GRA)

N82-14099# Pratt and Whitney Aircraft Group, West Palm Beach, Fla. Government Products Div.
CORROSION INHIBITING ENGINE OILS Final Interim Report, 4 Sep. 1979 - 1 Dec. 1980
G. C. Brown, R. J. Meehan, and P. A. Warner Wright-Patterson AFB, Ohio AFWAL Aug. 1981 73 p refs
(Contract F33615-79-C-5089)
(AD-A106127; PWA-FR-13908; AFWAL-TR-81-4028) Avail: NTIS HC A04/MF A01 CSCL 11/8

The Fluids, Lubricants, and Elastomers Branch of the Materials Laboratory, AFWAL, established the requirements for a MIL-L-7808H operational oil with corrosion inhibition characteristics at least equal to those of MIL-C-8188C. The new oil formulation is to provide corrosion inhibition under long-term storage conditions of the ALCM F107 turbine engine. During the initial fifteen-month effort, several approaches were evaluated as candidate methods for determining the effectiveness of corrosion inhibiting oil additives. A screening procedure was developed after preliminary modifications were made to the Corrosion Rate Evaluation Procedure (CREP). Using the CREP together with compatibility and miscibility screening of oil/inhibitor blends, a total of 67 candidate corrosion inhibitors (CCI) were evaluated. These included CCI obtained from Bray Oil Company, El Monte, California, as part of a subcontract to synthesize candidate corrosion inhibitors. Additional tests were completed on a preliminary physical and chemical property evaluation of the oil/inhibitor blends in regard to MIL-L-7808H and MIL-C-8188C specifications. GRA

N82-14101*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
MLS VERTICAL GUIDANCE AND NAVIGATION FOR A STOL AIRPLANE LANDING ON AN ELEVATED STOLPORT
David N. Warner, Jr. Nov. 1981 27 p refs
(NASA-TM-81338) Avail: NTIS HC A03/MF A01 CSCL 01C

In contrast to CTOL landing operations, STOL airplanes landing on short STOLport runways typically begin the flare maneuver before reaching the runway surface. Vertical guidance procedures were developed to allow an autoland flight control system for a STOL airplane to use Microwave Landing System (MLS) signals as altitude and sink rate references for flare initiation, with a transition to radar altimeter after the airplane is over the runway. The implementation has minimum impact on the control system and landing performance. Data are presented which show validation of the concepts in a simulator. Author

N82-14102 Royal Aircraft Establishment, Farnborough (England).
THE DESIGN OF A JET CATCHER
K. G. Winter and L. F. East Feb. 1981 11 p refs
(RAE-TM-AERO-1891; BR78582) Copyright. Avail: Issuing Activity

A device for catching and dissipating the kinetic energy of a jet used in a boundary layer tunnel to eliminate unwanted air currents is described. A dished front face and a large outlet catch the jet, avoiding spillage, and pass it through a screen set normal to the flow in order to reduce kinetic energy. The screen is inclined so as to take advantage of refraction. An additional muslin screen reduces noise. Final outlet velocity is 1/8 of the jet velocity, although there is slight spillage. Author (ESA)

N82-14103 Royal Aircraft Establishment, Farnborough (England).
AN AFTERBODY DRAG BALANCE
A. G. Kurn Mar. 1981 12 p ref
(RAE-TM-AERO-1897; BR78346) Copyright. Avail: Issuing Activity

A strain gage drag balance was made to fit into the jet blowing rig in a transonic wind tunnel. Differences in the drag of various axisymmetric boattailed afterbodies surrounding an engine exhaust nozzle were determined. Three sets of four flexures are spaced equally along the x axis, with strain gages on the middle set. The gages on the center flexures form bridges, compensated for thermal induced drift. Calibration shows that signals are linear with drag force. Output signals can be monitored from two separate strain gage circuits. The device can withstand components of force and moment that might be applied during model assembly. Drag values up to 20N can be measured. Author (ESA)

N82-14104# Grumman Aerospace Corp., Bethpage, N.Y.
STUDY OF FIBER OPTICS TO ENHANCE AN ENVIRONMENTAL LIGHTING LABORATORY Final Report, Nov. 1979 - Mar. 1981
J. Connelly Wright-Patterson AFB, Ohio AFWAL Aug. 1981 154 p Prepared in cooperation with Galileo Electro-Optics Corp., Strubridge, Mass.
(Contract F33615-79-C-3629; AF Proj. 2403)
(AD-A106117; AFWAL-TR-81-3098) Avail: NTIS HC A08/MF A01 CSCL 13/1

This report documents the results of an investigation to determine how fiber optic materials can be utilized to substantially increase the simulation capabilities of an Environmental Lighting Laboratory. This Laboratory must provide the capability to dynamically simulate the ambient environmental illumination conditions encountered in day, night and high threat/high risk aircraft missions. Three cockpit lighting simulator concepts were studied. Two of these concepts utilized a spherical lighting enclosure with a visual scene being projected at the inner surface via a remote projection input surface; fiber optics carry the image from input surface to output surface. In one concept, the pilot views a back-projected image on a translucent spherical screen via a spherical output surface with imbedded fiber optics. In the other concept, the pilot views the spherical fiber optic output surface directly. Both concepts were considered possible to implement; each concept having appropriate cost vs. performance tradeoffs. No useful solution was found using the third concept, a fiber optic input to mirrored ellipsoidal enclosure. It was found that the spherical enclosure concept with an internal translucent projection screen offers the best combination of illumination level and resolution; however, the cost of implementing this concept is substantial. GRA

N82-14312# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio. Fuels Branch.
DETERMINATION OF SELECTED DISTILLATE BLENDING SOLVENTS IN SIMPLE AND COMPLEX AIRCRAFT FUEL MATRICES VIA GLASS CAPILLARY GAS CHROMATOGRAPHY Final Report, Jan. - Dec. 1979
Paul C. Hayes, Jr. Jun. 1981 44 p refs
(AF Proj. 3048)
(AD-A105588; AFWAL-TR-80-2082) Avail: NTIS HC A03/MF A01 CSCL 07/4

A study was initiated to accurately determine the volume percent of various hydrocarbon distillate solvents present in blends with aircraft jet fuels JP-4 and JP-8. These modified fuels were an integral part of a combustion program to elucidate the effect altered fuel properties had on selected combustion parameters. A method of analysis was desired to check the accuracy of both in-house and contractual blending work. The effort was further expanded to even determine the amount of JP-4 present in the event of gross cross-contamination. Author (GRA)

N82-14313# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio. Fuels Branch.
DETERMINATION OF PYRIDINE IN MODIFIED JP-4 VIA HIGH PERFORMANCE LIQUID CHROMATOGRAPHY (HPLC) Final Report, Jun. - Jul. 1975
Paul C. Hayes, Jr. Apr. 1981 24 p refs
(AF Proj. 3048)
(AD-A105589; AFWAL-TR-80-2081) Avail: NTIS HC A02/MF A01 CSCL 07/4

A study was initiated to accurately determine the weight percent of pyridine present in pyridine-modified JP-4 used for contractual combustion studies. High Performance Liquid Chromatography (HPLC) was the method of choice. A chromatographic process was developed and systematic quantitative analses performed to substantiate the accuracy and precision of the new test method. A computing integrator interfaced with the HPLC system performed all data collection and calculations automatically, with the results printed on a teletype. Least square curve fitting accentuated the reliability for determining pyridine in the 0.5 to 5.0 weight percent concentration range. Author (GRA)

N82-14316# Naval Postgraduate School, Monterey, Calif.
COMBUSTION BEHAVIOR OF SOLID FUEL RAMJETS. VOLUME 1: CORRELATION OF REACTING AND NON-REACTING FLOW CHARACTERISTICS Final Report
Brian A. Binn, Winston E. Scott, and David W. Wetzer Jul. 1981 68 p refs
(AD-A106061; NPS67-81-010-Vol-1) Avail: NTIS HC A04/MF A01 CSCL 21/2

An experimental investigation was conducted to determine the relationship between the cold flow characteristics of velocity, pressure distribution, and turbulence intensity and the reacting flow performance and combustion characteristics of a solid fuel ramjet. The effects of configuration and air flow changes on the above characteristics were examined. Average regression rates and combustion efficiencies were not significantly affected by changes in configuration. These variations in test conditions significantly affected the centerline turbulence intensity but not the near-wall turbulence intensity in cold flow. Near-wall turbulence profiles in cold flow were found to correlate with the fuel regression profiles in reacting flows. The use of bypass resulted in decreases in regression rate and efficiencies for all cases. Author (GRA)

N82-14333*# Avco Lycoming Div., Stratford, Conn. Materials Lab.
DEVELOPMENT OF IMPROVED HIGH TEMPERATURE COATINGS FOR IN-792 + Hf Final Report
D. D. Profant and S. K. Naik Jun. 1981 95 p refs
(Contract NAS3-22371; DA Proj. 1L1-62209-AH-76)
(NASA-CR-165395) Avail: NTIS HC A05/MF A01 CSCL 11F

The development for t-55 l712 engine of high temperature for integral turbine nozzles with improved thermal fatigue resistance without sacrificing oxidation/corrosion protection is discussed. The program evaluated to coating systems which comprised one baseline plasma spray coating (12% Al-NiCoCrALY), three aluminide coatings including the baseline aluminide (701), two CoNiCrAly (6% Al) + aluminide systems and four NiCoCrY + aluminide coating were evaluated. The two-step coating processes were investigated since it offered the advantage of tailoring the composition as well as properly coating surfaces of an integral or segmented nozzle. Cyclic burner rig thermal fatigue and oxidation/corrosion tests were used to evaluate the candidate coating systems. The plasma sprayed 12% Al-NiCoCrAlY was rated the best coating in thermal fatigue resistance and outperformed all coatings by a factor between 1.4 to 2.5 in cycles to crack initiation. However, this coatings is not applicable to integral or segmented nozzles due to the line of sight limitation of the plasma spray process. The 6% Al-CoNiCrAlY + Mod. 701 aluminide (32 w/o Al) was rated the best coating in oxidation/corrosion resistance and was rated the second best in thermal fatigue resistance. J.D.H.

N82-14371*# United Technologies Research Center, East Hartford, Conn.
EXTERNAL FUEL VAPORIZATION STUDY Final Report
E. J. Szetela and J. A. TeVelde Nov. 1981 92 p refs
(NASA-CR-165513; UTRC-81-915326-15) HC A05/MF A01 CSCL 21D

The feasibility of external fuel vaporization in advanced aircraft gas turbine engines is addressed. Experiments were run to determine key fuel properties including boiling points, dew points, critical temperature, critical pressure, heat transfer coefficients, deposit formation rates, and deposit removal in a flowing system. Of particular concern were the heat transfer rate in the heat exchanger and the performance of the orifice used in the throttling process. Three fuels were utilized in the experiments including Jet-A, Experimental referee broad specification fuel, and a premium No. 2 diesel fuel. Engine conditions representing the NASA Energy Efficient Engine at sea level takeoff, cruise, and idle were simulated in the vaporization system and it was found that single phase flow was maintained in the heat exchanger and downstream of the throttle. Deposits encountered in the heat exchanger represented a thermal resistance as high as .0013 sq M K/watt and a deposit formation rate as high as 800 micro-gC/sq cm hr. These values are equivalent to a buildup of 0.055 cm of thickness in 36 hours resulting in a more severe fouling condition than originally anticipated. It was found that the deposit can be removed by cleaning with air at a temperature of 720 K for 10 minutes. R.J.F.

N82-14388# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
LA RECHERCHE AEROSPATIALE, BI-MONTHLY BULLETIN NO. 1981-2, MARCH - APRIL 1981
Claude Sevestre, ed. Sep. 1981 77 p refs Transl. into ENGLISH of La Rech. Aerospatiale, Bull. Bimensuel (Paris) No. 1981-2, Mar. - Apr. 1981
(ESA-TT-713) Avail: NTIS HC A05/MF A01; original FRENCH report available at ONERA, Paris FF 45

Research in aerodynamics is reported, including: thermal fatigue tests; cryogenic wind tunnels; plate buckling; subsonic flow; thin film transducers for temperature and heat flux measurements; and laser pumping by electron beam discharge.

N82-14394# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
RESEARCH ON AN INDUCTION DRIVEN CRYOGENIC WIND TUNNEL
Alain Blanchard, Jean-Bernard Dor, Andre Mignosi, and Jean-Francois Breil *In its* La Rech. Aerospatiale, Bi-monthly Bull. No. 1981-2, Mar. - Apr. 1981 (ESA-TT-713) Sep. 1981 p 63-77 refs Transl. into ENGLISH from La Rech. Aerospatiale, Bull. Bimensuel (Paris) No. 1981-2, Mar. - Apr. 1981

Avail: NTIS HC A05/MF A01; original FRENCH report available at ONERA, Paris FF 45

The cryogenitization of an induction driven transonic wind tunnel is discussed. Internal insulation and the design of a liquid nitrogen injection system are considered. A unit of 32 injectors is arranged at the periphery of the first diffuser in two rows. Each injector is controlled by a solenoid valve. Several elements can be brought together at the control point to form a 10 bit digital regulation unit. The nitrogen pulses are kept symmetrical by varying the response time of the solenoid valves. This induction system works well, since the increase in nozzle performance compensates increase of flow in the test, section due to the drop in temperature. It should be suitable with nitrogen gas. Composite and homogeneous insulating materials were repeatedly plunged into liquid nitrogen. All reveal defects when exposed to stress induced by differences in the expansion between their internal and external faces. Internal surfaces must be reinforced with polyurethane. Author (ESA)

N82-14424# ITT Avionics, Nutley, N.J.
MODULAR MULTI-FUNCTION MULTI-BAND AIRBORNE RADIO SYSTEM (MFBARS). VOLUME 2: DETAILED REPORT Final Technical Report, Mar. 1978 - Jun. 1980
R. A. Reilly, C. W. Ward, A. Lee, R. Schineller, A. Clemens, W. Robertson, and J. Rome (Lowell Univ.) Wright-Patterson AFB, Ohio AFWAL Jun. 1981 231 p 2 Vol.
(Contract F33615-78-C-1518; AF Proj. 2003)
(AD-A106052; AFWAL-TR-81-1077-Vol-2) Avail: NTIS HC A11/MF A01 CSCL 17/2

A top down, system oriented study of the selected system approach was conducted. System configuration details and performance parameters were refined. In addition, to minimize system development risk and to provide guidance on the best direction among which MFBARS should proceed, recommended plans were defined for development of the system and supporting technology. Emphasis is placed on the final recommended development plans. T.M.

N82-14447*# Virginia Polytechnic Inst. and State Univ., Blacksburg.
MODELING AND ANALYSIS OF POWER PROCESSING

SYSTEMS (MAPPS). VOLUME 1: TECHNICAL REPORT Final Technical Report, Oct. 1977 - Aug. 1980

F. C. Lee, S. Rahman, R. A. Carter, C. H. Wu, Yuang Yu (TRW Defense and Space Systems Group, Redondo Beach, Calif.), and R. Chang (TRW Defense and Space Systems Group, Redondo Beach, Calif.) Dec. 1980 335 p refs

(Contract NAS3-21051)

(NASA-CR-165538; TRW-32660-6001-RU-01) Avail: NTIS HC A15/MF A01 CSCL 09C

Computer aided design and analysis techniques were applied to power processing equipment. Topics covered include: (1) discrete time domain analysis of switching regulators for performance analysis; (2) design optimization of power converters using augmented Lagrangian penalty function technique; (3) investigation of current-injected multiloop controlled switching regulators; and (4) application of optimization for Navy VSTOL energy power system. The generation of the mathematical models and the development and application of computer aided design techniques to solve the different mathematical models are discussed. Recommendations are made for future work that would enhance the application of the computer aided design techniques for power processing systems. A.R.H.

N82-14454# Naval Research Lab., Washington, D. C. Combustion and Fuels Branch.

GENERATION OF ELECTROSTATIC CHARGE IN FUEL HANDLING SYSTEMS: A LITERATURE SURVEY Final Report, 1973 - 1980

J. T. Leonard 24 Sep. 1981 55 p refs

(AD-A106056; NRL-8484) Avail: NTIS HC A04/MF A01 CSCL 05/2

A review is presented on the status of research on the generation and dissipation of electrostatic charge by hydrocarbon liquids and fuels, with emphasis on the period 1973-1980. Both metallic and nonmetallic fuel handling systems are covered, including the special problems encountered in aircraft fuel tanks filled with polyurethane foam. The review stresses recent advances and presents opportunities for future research in some neglected, but nonetheless fundamentals areas affecting the charge generation process. Author (GRA)

N82-14527# Societe Nationale Industrielle Aerospatiale, Suresnes (France). Lab. Central.

CONTROL METHODOLOGY: NONDESTRUCTIVE TESTING IN THE AERONAUTICS INDUSTRY [METHODOLOGIE DE CONTROLE: CONTROLE NON DESTRUCTIF DOMAINE AERONAUTIQUE]

J. Odorico 12 Jun. 1980 39 p refs In FRENCH Presented at l'Ecole d'Ete Franco-Quebecoise Conf., Montreal, 14-23 Jul. 1980

(SNIAS-812-551-110) Avail: NTIS HC A03/MF A01

Quality control in aircraft production using nondestructive tests is considered. Training and administration are covered. Examples of procedures involving suppliers, constructors, and clients are given. Topics include: use of X-rays; holography; examination of alloys; and ultrasonic testing. The need for an integrated approach is stressed, involving client, inspectors, etc. Author (ESA)

N82-14529*# Flow Research, Inc., Kent, Wash.

DEVELOPMENT OF AN EFFICIENT PROCEDURE FOR CALCULATING THE AERODYNAMIC EFFECTS OF PLANFORM VARIATION Final Report

J. E. Mercer and E. W. Geller Washington NASA Dec. 1981 36 p refs

(Contract NAS1-15977)

(NASA-CR-3489; FLOW-RR-186) Avail: NTIS HC A03/MF A01 CSCL 20K

Numerical procedures to compute gradients in aerodynamic loading due to planform shape changes using panel method codes were studied. Two procedures were investigated: one computed the aerodynamic perturbation directly; the other computed the aerodynamic loading on the perturbed planform and on the base planform and then differenced these values to obtain the perturbation in loading. It is indicated that computing the perturbed values directly can not be done satisfactorily without proper aerodynamic representation of the pressure singularity at the leading edge of a thin wing. For the alternative procedure, a technique was developed which saves most of the time-consuming computations from a panel method calculation for the base planform. Using this procedure the perturbed loading can be calculated in about one-tenth the time of that for the base solution. Author

N82-14673*# National Aeronautics and Space Administration, Washington, D. C.

EFFECTS OF AIRCRAFT NOISE ON THE EQUILIBRIUM OF AIRPORT RESIDENTS: SUPPLEMENTARY ANALYSES TO THE STUDY CARRIED OUT AROUND ORLY

J. Francois Sep. 1981 43 p Transl. into ENGLISH of "Repercussion du bruit des avions sur l'equilibre des reverains des aeroports--Analyses complementaires de l'enquete realisee autour d'Orly" Aug. 1977 42 p Transl. by Scientific Translation Service, Santa Barbara, Calif. Original doc. prep. by Inst. Francais d'Opinion Publique, Paris

(Contract NASw-3542)

(NASA-TM-76627) Avail: NTIS HC A03/MF A01 CSCL 13B

The effects of aircraft noise on humans living near airports were studied. Two main questions were considered: do residents give evidence of psychological or physiological disturbances in unusually intense noise sectors; and do personality or health factors account for the high interindividual variability of annoyance? The methodology used and results obtained are presented. Samples of the survey questionnaires are included. E.A.K.

N82-14674*# National Aeronautics and Space Administration, Washington, D. C.

TAKING INTO ACCOUNT NIGHTTIME ANNOYANCE IN THE CALCULATION OF THE PSOPHIC INDEX

Jacques Francois May 1981 30 p ref Transl. into ENGLISH of "La Prise en Compte de la Gene Nocturne dans le Calcul de l'Indice Psophique" Rept., France, Feb. 1977 p 1-33 Transl. by Kanner (Leo) Associates, Redwood City, Calif. Original doc. prep. by Inst. Francaise d'Opinion Publique (IFOP), Paris

(Contract NASw-3199)

(NASA-TM-76580) Avail: NTIS HC A03/MF A01 CSCL 13B

The annoyance factor caused by air traffic noise on the residents of areas near airports is discussed. The psophic index is used to predict the level of overall annoyance suffered on the average by residents around airports. The calculation method differentiates between daytime and nighttime annoyance. E.A.K.

N82-14763# Air Force Geophysics Lab., Hanscom AFB, Mass. Mesoscale Forecasting Branch.

THE MODULAR AUTOMATED WEATHER SYSTEM (MAWS) CONCEPT

Donald A. Chisholm, Richard H. Lynch, and James C. Weyman *In* ESA Nowcasting: Mesoscale Observations and Short-Range Prediction Jun. 1981 p 303-307 refs

Avail: NTIS HC A19/MF A01; ESA, Paris FF 160 Member States, AU, CN and NO (+20% others)

A modular automated weather system (MAWS) which is a supervisory microprocessor that manages, disseminates and archives visibility, wind, temperature, and dew point measurements as well as outputs from ceilometers, transmissometers, digital alimeters, and digital clocks is discussed. Results are assessed for: (1) aviation weather elements and sensors suitable for automation; (2) sensor siting requirements for aviation critical weather elements; (3) performance potential of microprocessor components, display devices and communication systems; (4) the importance of met watch parameters in support of aviation operations; and (5) utility of short range forecast guidance based on simple statistical models. A microprocessor based MAWS system satisfies most automated observation requirements and provides an essential data base for the development of operational prototypes. Author (ESA)

N82-14817*# California State Univ., Fullerton. Dept. of Management Science.

REAL TIME SIMULATION OF COMPUTER-ASSISTED SEQUENCING OF TERMINAL AREA OPERATIONS Final Report, Jul. 1978 - Jan. 1981

Roger G. Dear 31 Jan. 1981 115 p refs

(Contract NCA2-OR253-801)

(NASA-CR-166195) Avail: NTIS HC A06/MF A01 CSCL 09B

A simulation was developed to investigate the utilization of computer assisted decision making for the task of sequencing and scheduling aircraft in a high density terminal area. The simulation incorporates a desision methodology termed Constrained Position Shifting. This methodology accounts for aircraft velocity profiles, routes, and weight classes in dynamically sequencing and scheduling arriving aircraft. A sample demonstration of Constrained Position Shifting is presented where six aircraft types (including both light and heavy aircraft) are sequenced to land at Denver's Stapleton International Airport. A graphical display is utilized and Constrained Position Shifting with a maximum shift of four positions (rearward or forward) is compared to first come, first serve with respect to arrival at the runway. The implementation of computer assisted sequencing and scheduling methodologies is investigated. A time based control concept will be required and design considerations for such a system are discussed. Author

N82-14829*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
RUGGEDIZED MINICOMPUTER HARDWARE AND SOFTWARE TOPICS, 1981: PROCEEDINGS OF THE 4TH ROLM MIL-SPEC COMPUTER USER'S GROUP CONFERENCE
Dec. 1981 214 p refs Conf. held in San Diego, Calif., 22-25 Feb. 1981
(NASA-CP-2206; L-14886) Avail: NTIS HC A11/MF A01 CSCL 09B

Presentations of a conference on the use of ruggedized minicomputers are summarized. The following topics are discussed: (1) the role of minicomputers in the development and/or certification of commercial or military airplanes in both the United States and Europe; (2) generalized software error detection techniques; (3) real time software development tools; (4) a redundancy management research tool for aircraft navigation/flight control sensors; (5) extended memory management techniques using a high order language; and (6) some comments on establishing a system maintenance scheme. Copies of presentation slides are also included.

N82-14830*# Boeing Commercial Airplane Co., Seattle, Wash.
AIRBORNE DATA ANALYSIS/MONITOR SYSTEM
Darryl B. Stephison *In* NASA. Langley Research Center Ruggedized Minicomputer Hardware and Software Topics, 1981 Dec. 1981 p 1-21

Avail: NTIS HC A11/MF A01 CSCL 09B

An Airborne Data Analysis/Monitor System (ADAMS), a ROLM 1666 computer based system installed onboard test airplanes used during experimental testing is evaluated. In addition to the 1666 computer, the ADAMS hardware includes a DDC System 90 fixed head disk and a Miltape DD400 floppy disk. Boeing designed a DMA interface to the data acquisition system and an intelligent terminal to reduce system overhead and simplify operator commands. The ADAMS software includes RMX/RTOS and both ROLM FORTRAN and assembly language are used. The ADAMS provides real time displays that enable onboard test engineers to make rapid decisions about test conduct thus reducing the cost and time required to certify new model airplanes, and improved the quality of data derived from the test, leading to more rapid development of improvements resulting in quieter, safer, and more efficient airplanes. The availability of airborne data processing removes most of the weather and geographical restrictions imposed by telemetered flight test data systems. A data base is maintained to describe the airplane, the data acquisition system, the type of testing, and the conditions under which the test is performed. M.D.K.

N82-14831*# Boeing Commercial Airplane Co., Seattle, Wash.
ADAMS EXECUTIVE AND OPERATING SYSTEM
W. D. Pittman *In* NASA. Langley Research Center Ruggedized Minicomputer Hardware and Software Topics, 1981 Dec. 1981 p 23-31
Avail: NTIS HC A11/MF A01 CSCL 09B

The ADAMS Executive and Operating System, a multitasking environment under which a variety of data reduction, display and utility programs are executed, a system which provides a high level of isolation between programs allowing them to be developed and modified independently, is described. The Airborne Data Analysis/Monitor System (ADAMS) was developed to provide a real time data monitoring and analysis capability onboard Boeing commercial airplanes during flight testing. It inputs sensor data from an airplane performance data by applying transforms to the collected sensor data, and presents this data to test personnel via various display media. Current utilization and future development are addressed. M.D.K.

N82-14833*# Societe Nationale Industrielle Aerospatiale, Toulouse (France). Flight Test Management Dept.
ON-BOARD COMPUTER PROGRESS IN DEVELOPMENT OF A 310 FLIGHT TESTING PROGRAM
Pierre Reau *In* NASA. Langley Research Center Ruggedized Minicomputer Hardware and Software Topics, 1981 Dec. 1981 p 47-57
Avail: NTIS HC A11/MF A01 CSCL 09B

Onboard computer progress in development of an Airbus A 310 flight testing program is described. Minicomputers were installed onboard three A 310 airplanes in 1979 in order to: (1) assure the flight safety by exercising a limit check of a given set of parameters; (2) improve the efficiency of flight tests and allow cost reduction; and (3) perform test analysis on an external basis by utilizing onboard flight types. The following program considerations are discussed: (1) conclusions based on simulation of an onboard computer system; (2) brief descriptions of A 310 airborne computer equipment, specifically the onboard universal calculator (CUB) consisting of a ROLM 1666 system and visualization system using an AFIGRAF CRT; (3) the ground system and flight information inputs; and (4) specifications and execution priorities for temporary and permanent programs. M.D.K.

N82-14839*# National Aerospace Lab., Amsterdam (Netherlands).
ROLM COMPUTERS IN THE FLIGHT TESTING OF THE FOKKER F29 AIRCRAFT
P. J. Manders *In* NASA. Langley Research Center Ruggedized Minicomputer Hardware and Software Topics, 1981 Dec. 1981 p 171-192
Avail: NTIS HC A11/MF A01 CSCL 09B

The design, development, installation, and operation of the test equipment (MRVS) is discussed. The main feature of the MRVS is continuous recording on an instrumentation recorder data of up to 1500 parameters with a total sample rate of up to 10,000 samples per second. In order to compress the evaluation and calibration time period, the following additional requirements were set for two test systems: (1) recording of selected parameters, time tagged on computer compatible tape (CCT); (2) recording of selected high bandwidth signals and ad hoc parameters on analog tape; (3) onboard presentation of calibrated parameter data, in engineering units, in numerical as well as graphical form for: system checkout during pre-, in- and post-flight, and quick look analysis during in-flight; (4) real time presentation on the ground by telemetry for: flight monitoring, takeoff and landing measurements, and noise measurements; and (5) data processing on the ground on the Fokker-NLR computer network. S.L.

N82-14842*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va. Flight Electronics Div.
DESCRIPTION OF A DUAL FAIL OPERATIONAL REDUNDANT STRAPDOWN INERTIAL MEASUREMENT UNIT FOR INTEGRATED AVIONICS SYSTEMS RESEARCH
W. H. Bryant and F. R. Morrell *In its* Ruggedized Minicomputer Hardware and Software Topics, 1981 Dec. 1981 p 209-217 refs
Avail: NTIS HC A11/MF A01 CSCL 09B

An experimental redundant strapdown inertial measurement unit (RSDIMU) is developed as a link to satisfy safety and reliability considerations in the integrated avionics concept. The unit includes four two degree-of-freedom tuned rotor gyros, and four accelerometers in a skewed and separable semioctahedral array. These sensors are coupled to four microprocessors which compensate sensor errors. These microprocessors are interfaced with two flight computers which process failure detection, isolation, redundancy management, and general flight control/navigation algorithms. Since the RSDIMU is a developmental unit, it is imperative that the flight computers provide special visibility and facility in algorithm modification. S.L.

N82-14849*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

APPLICATION OF INTEGRATION ALGORITHMS IN A PARALLEL PROCESSING ENVIRONMENT FOR THE SIMULATION OF JET ENGINES

Susan M. Krosel and Edward J. Milner 1982 25 p refs To be presented at the 15th Ann. Simulation Symp., Tampa, Fla., 17-19 Mar. 1982

(NASA-TM-82746; E-1059) Avail: NTIS HC A02/MF A01 CSCL 12A

The application of Predictor corrector integration algorithms developed for the digital parallel processing environment are investigated. The algorithms are implemented and evaluated through the use of a software simulator which provides an approximate representation of the parallel processing hardware. Test cases which focus on the use of the algorithms are presented and a specific application using a linear model of a turbofan engine is considered. Results are presented showing the effects of integration step size and the number of processors on simulation accuracy. Real time performance, interprocessor communication, and algorithm startup are also discussed. B.W.

N82-14880*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

PREDICTION OF FLYOVER JET NOISE SPECTRA FROM STATIC TESTS

Ulf Michel and Alfons Michalke (Technische Univ., Berlin) Dec. 1981 27 p refs Presented at the 100th Meeting of the Acoust. Soc. of Am., Los Angeles, Nov. 1980

(NASA-TM-83219; L-14953) Avail: NTIS HC A03/MF A01 CSCL 20A

A scaling law is derived for predicting the flyover noise spectra of a single-stream shock-free circular jet from static experiments. The theory is based on the Lighthill approach to jet noise. Density terms are retained to include the effects of jet heating. The influence of flight on the turbulent flow field is considered by an experimentally supported similarity assumption. The resulting scaling laws for the difference between one-third-octave spectra and the overall sound pressure level compare very well with flyover experiments with a jet engine and with wind tunnel experiments with a heated model jet.

Author

N82-15010# Societe Nationale Industrielle Aerospatiale, Suresnes (France). Lab. Central.

AERONAUTICAL APPLICATIONS OF BONDING [LES APPLICATIONS AERONAUTIQUES DU COLLAGE]

G. Briens 23 Jun. 1981 23 p In FRENCH Presented at Journee d'Information sur le Collage Organisee, Senlis, France, 17 Jun. 1981; sponsored by Federation des Industries Mecaniques et Transformatrices des Metaux and Centre Technique des Industries Mecaniques

(SNIAS-812-551-102; C.42-886) Avail: NTIS HC A02/MF A01

Adhesive bonding agents and techniques and their utilization in aircraft construction are reviewed. Adhesives are classified by their physical presentation, chemical nature, normal application, hardening temperature, and by service temperature and life. The principal structures in which adhesives are used include: honeycomb sandwich constructions, panel stiffeners, reinforcing backing, crack arresters, and laminates. Advantages in bonding assembly are mentioned. Mechanical limitations like shear strength, tensile strength, and resistance to peeling or cleaving, are discussed. The growing importance of bonding in the aerospace industry is emphasized. Author (ESA)

N82-15011# Societe Nationale Industrielle Aerospatiale, Suresnes (France). Lab. Central.

ADVANTAGES AND LIMITATIONS IN THE USE OF DIVERSE MATERIALS FOR AIRCRAFT CONSTRUCTION [ATOUTS ET LIMITES D'EMPLOIS DES DIVERS MATERIAUX UTILISES DANS LA CONSTRUCTION DES CELLULES]

G. Hilaire 1981 37 p In FRENCH Presented at 9th Colloq. Aciers et Alliages Speciaux dans les Ind. Aerospatiales, Le Bourget, France, 11 Jun. 1981

(SNIAS-811-551-104) Avail: NTIS HC A03/MF A01

The properties and applications of steels, light alloys, titanium, and carbon composites are compared. A percentage evaluation of their use in civil aircraft, military aircraft, helicopters, and spacecraft shows trends in airframe materials selection. Criteria for the choice of materials are discussed. Mechanical static characteristics, fatigue behavior, ruggedness, and cost are considered. A more widespread utilization of composites is indicated. Author (ESA)

N82-15013*# Cincinnati Univ., Ohio. Dept. of Aerospace Engineering and Applied Mechanics.

FLAG-LAG-TORSIONAL DYNAMICS OR EXTENSIONAL AND INEXTENSIONAL ROTOR BLADES IN HOVER AND IN FORWARD FLIGHT Semiannual Progress Report, Jul. - Dec 1981

M. R. M. CrespoDaSilva Dec. 1981 6 p refs

(Grant NAG2-38)

(NASA-CR-165078) Avail: NTIS HC A02/MF A01 CSCL 01A

The differential equations describing the flap-lag-torsional motion of a flexible rotor blade including third-order nonlinearities were derived for hover and forward flight. Making use of the two boundary conditions, those equations were reduced to a set of three integro partial differential equations written in terms of the flexural deflections and the torsional variable. L.F.M.

N82-15014*# Vigyan Research Associates, Inc., Hampton, Va.

SUBSONIC BALANCE AND PRESSURE INVESTIGATION OF A 60-DEG DELTA WING WITH LEADING-EDGE DEVICES (DATA REPORT)

Dhanvada M. Rao and Stephen A. Tingas (North Carolina State Univ., Raleigh) Hampton, Va. NASA. Langley Research Center Nov. 1981 126 p refs

(Contract NAS1-16259)

(NASA-CR-165806) Avail: NTIS HC A07/MF A01 CSCL 01A

The drag reduction potential of leading edge devices on a 60 degree delta wing at high lift was examined. Geometric variations of fences, chordwise slots, pylon type vortex generators, leading edge vortex flaps, and sharp leading edge extensions were tested individually and in specific combinations to improve high-alpha drag performance with a minimum of low-alpha drag penalty. The force, moment, and surface static pressure data for angles of attack up to 23 degrees, at Mach and Reynolds numbers of 0.16 and 3.85 x 10 to the 6th power per meter are documented. E.A.K.

N82-15015*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

LOW-SPEED AERODYNAMIC PERFORMANCE OF A HIGH-ASPECT-RATIO SUPERCRITICAL-WING TRANSPORT MODEL EQUIPPED WITH FULL-SPAN SLAT AND PART-SPAN DOUBLE-SLOTTED FLAPS

Harry L. Morgan, Jr. and John W. Paulson, Jr. Dec. 1979 145 p refs

(NASA-TP-1580; L-13201) Avail: NTIS HC A07/MF A01 CSCL 01A

An investigation was conducted in the Langley V/STOL tunnel to determine the static longitudinal and lateral-directional aerodynamic characteristics of an advanced high-aspect-ratio supercritical-wing transport model equipped with a full-span leading-edge slat and part-span double-slotted trailing-edge flaps. This wide-body transport model was also equipped with spoiler and aileron control surfaces, flow-through nacelles, landing gear, movable horizontal tails, and interchangeable wing tips with aspect ratios of 10 and 12. The model was tested with leading-edge slat and trailing-edge flap combinations representative of cruise, climb, takeoff, and landing wing configurations. The tests were conducted at free-stream conditions corresponding to Reynolds numbers (based on mean geometric chord) of 0.97 to 1.63 x 10 to the 6th power and corresponding Mach numbers of 0.12 to 0.20, through an angle-of-attack range of -2 deg to 24 deg and a sideslip-angle range of -10 deg to 5 deg. Author

N82-15017*# Boeing Commercial Airplane Co., Seattle, Wash. Preliminary Design Dept.

HIGH LIFT SELECTED CONCEPTS Final Report, Aug. 1977 - Jul. 1978

M. L. Henderson Hampton, Va. NASA Aug. 1979 108 p refs

(Contract NAS1-14742)

(NASA-CR-159093) Avail: NTIS HC A06/MF A01 CSCL 01A

The benefits to high lift system maximum life and, alternatively, to high lift system complexity, of applying analytic design and

analysis techniques to the design of high lift sections for flight conditions were determined and two high lift sections were designed to flight conditions. The influence of the high lift section on the sizing and economics of a specific energy efficient transport (EET) was clarified using a computerized sizing technique and an existing advanced airplane design data base. The impact of the best design resulting from the design applications studies on EET sizing and economics were evaluated. Flap technology trade studies, climb and descent studies, and augmented stability studies are included along with a description of the baseline high lift system geometry, a calculation of lift and pitching moment when separation is present, and an inverse boundary layer technique for pressure distribution synthesis and optimization. A.R.H.

N82-15018*# Boeing Commercial Airplane Co., Seattle, Wash. Preliminary Design Dept.
NATURAL LAMINAR FLOW AIRFOIL ANALYSIS AND TRADE STUDIES Final Report, Aug. 1977 - Jun. 1978
May 1979 86 p refs
(Contract NAS1-14742)
(NASA-CR-159029; B-7220) Avail: NTIS HC A05/MF A01 CSCL 01A

An analysis of an airfoil for a large commercial transport cruising at Mach 0.8 and the use of advanced computer techniques to perform the analysis are described. Incorporation of the airfoil into a natural laminar flow transport configuration is addressed and a comparison of fuel requirements and operating costs between the natural laminar flow transport and an equivalent turbulent flow transport is addressed. Author

N82-15025*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
NASA AVIATION SAFETY REPORTING SYSTEM Quarterly Report
Sep. 1981 57 p refs Prepared in cooperation with Battelle Columbus Labs., Mountain View, Calif.
(NASA-TM-81274; A-8504; QR-13) Avail: NTIS HC A04/MF A01 CSCL 01C

Aviation safety reports that relate to loss of control in flight, problems that occur as a result of similar sounding alphanumerics, and pilot incapacitation are presented. Problems related to the go around maneuver in air carrier operations, and bulletins (and FAA responses to them) that pertain to air traffic control systems and procedures are included. S.L.

N82-15026# Research Inst. of National Defence, Linkoeping (Sweden). Huvudavdelning 3.
DETECTION OF OBSTACLES BY LOW FLYING AIRCRAFT
Dietmar Letalick Aug. 1981 42 p refs
(FOA-C-30227-E1) Avail: NTIS HC A03/MF A01

A model which calculates reflection from cylindrical obstacle surfaces, e.g., power cables is presented. Measurements of reflection of 10.6 micron radiation from various types of wires, cables and framework are reported. The measurements were performed in the laboratory using a CO2 laser and direct detection, with the targets a few meters away. Detection at distances of 500 and 1100 m using a coherent laser was also performed. Calculations of detection range for typical situations indicate that detection at km distances is possible. Author (ESA)

N82-15027*# National Aeronautics and Space Administration. Wallops Flight Center, Wallops Island, Va.
AUTOMATED PILOT ADVISORY SYSTEM Final Report
John L. Parks, Jr. and James G. Haidt (Research Triangle Inst., N.C.) Nov. 1981 184 p refs
(NASA-TM-73296) Avail: NTIS HC A09/MF A01 CSCL 17G

An Automated Pilot Advisory System (APAS) was developed and operationally tested to demonstrate the concept that low cost automated systems can provide air traffic and aviation weather advisory information at high density uncontrolled airports. The system was designed to enhance the see and be seen rule of flight, and pilots who used the system preferred it over the self announcement system presently used at uncontrolled airports. S.L.

N82-15028# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Abt. Flugzeugsteuerung und -regelung.
ANALYSIS OF TWO AIR TRAFFIC SAMPLES IN THE TERMINAL AREA OF FRANKFURT AM MAIN, 3 AUGUST 1979
Manfred Schubert and Uwe Voelckers Jun. 1981 119 p refs In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-740)
(DFVLR-Mitt-81-17; ESA-TT-740) Avail: NTIS HC A06/MF A01; DFVLR, Cologne DM 26.50

The random deviation of air traffic arrivals in the terminal area, the different structure of standard arrival routes and a multitude of operational procedures affect the overall planning of arrival traffic. The necessary time-balance between arrivals can be established partly by coordination between approach control and enroute controller and by flight path planning within the terminal area. The effect of the applied control procedures on arrival distributions, traffic handling, traffic sequence, and traffic density in the terminal area are analyzed for the recorded air traffic periods on August 3rd, 1979. The findings are discussed in comparison with the results of a proceeding analysis of approach traffic on August 4th, 1978. Author

N82-15029# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Arteilung flugzeugsteuerung und -regelung.
ANALYSIS OF TWO AIR TRAFFIC SAMPLES IN THE TERMINAL AREA OF FRANKFURT AM MAIN, 4 AUGUST 1978
Uwe Voelckers, Manfred Schubert, and Albrecht Seyfried Jun. 1981 128 p refs In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-739)
(DFVLR-Mitt-81-12; ESA-TT-739) Avail: NTIS HC A07/MF A01; DFVLR, Cologne DM 28

Two 'arrival peaks' in the near terminal area of Frankfurt/Main were analyzed. Extensive computer-programs were used to combine the recorded data from seven different data-sources. The traffic analysis includes the quantitative evaluation of traffic density, studies of air traffic distributions relating to space and time, the investigation of air traffic control procedures, the determination of the approach control planning strategies and a basic investigation of traffic vectoring in the terminal area. The two traffic samples are discussed and compared. A.R.H.

N82-15030*# Boeing Vertol Co., Philadelphia, Pa.
XV-15 TILT ROTOR FLY-BY-WIRE COLLECTIVE CONTROL DEMONSTRATOR DEVELOPMENT SPECIFICATIONS Final Report, Mar. 1981
R. J. Meuleners Mar. 1981 34 p
(Contract NAS2-10160)
(NASA-CR-166262; D210-11819-1) Avail: NTIS HC A03/MF A01 CSCL 01C

A fly by wire system in the collective control system for XV-15 Tilt Rotor Research Aircraft was evaluated. The collective control system was selected because it requires a system tracking accuracy between right and left rotors of approximately 0.1%. The performance characteristics of the collectors axel provide typical axis control response data. The demonstrator is bread boarded as a dual system instead of the triplex system. E.A.K.

N82-15031*# Kansas Univ. Center for Research, Inc., Lawrence. Flight Research Lab.
A THEORETICAL INVESTIGATION OF WING ROCKING Semiannual Status Report, 1 Jul. - 31 Dec. 1981
C. Edward Lan and Chung-Hao Hsu 31 Dec. 1981 36 p refs
(Contract NAG1-134)
(NASA-CR-165058) Avail: NTIS HC A03/MF A01 CSCL 01A

A semiempirical method to predict vortex breakdown effects on aerodynamic characteristics of slender wings is described. The method is based on Polhamus' method of suction analogy. Both longitudinal and lateral directional characteristics are predicted. S.L.

N82-15032*# Connecticut Univ., Storrs.
STOCHASTIC CONTROL AND IDENTIFICATION OF HELICOPTER DYNAMIC MODES Semiannual Progress Report, 1 Jul. - 31 Dec. 1981
J. Molusis and Y. Bar-Shalom Dec. 1981 35 p refs
(Grant NAG2-72)

(NASA-CR-165057) Avail: NTIS HC A03/MF A01 CSCL 01C

Simulations of ground resonance model with constant and periodic coefficient measurement models were made. The extended Kalman filters, as an identification method, and it's convergence properties were reviewed. Free response data for identification of damping for ground resonance was used and the ground resonance parameter identification results for constant coefficient and periodic coefficient measurement models are presented. S.L.

N82-15033*# Boeing Co., Seattle, Wash.
SELECTED ADVANCED AERODYNAMIC AND ACTIVE CONTROL CONCEPTS DEVELOPMENT Summary Report, 10 Aug. 1977 - 9 Aug. 1979
Washington, D.C. NASA Jan. 1980 56 p refs
(Contract NAS1-14742)
(NASA-CR-3220; D6-46705) Avail: NTIS HC A04/MF A01 CSCL 01C

A summary is presented of results obtained during analysis, design and test activities on six selected technical tasks directed at exploratory improvement of fuel efficiency for new and derivative transports. The work included investigations into the potential offered by natural laminar flow, improved surface coatings and advanced high lift concepts. Similar investigations covering optimum low-energy flight path control, integrated application of active controls and evaluation of primary flight control systems reliability and maintenance are also summarized. Recommendations are included for future work needed to exploit potential advancements. Author

N82-15034*# Boeing Commercial Airplane Co., Seattle, Wash.
DEVELOPMENT OF INTEGRATED PROGRAMS FOR AEROSPACE-VEHICLE DESIGN (IPAD) - IPAD USER REQUIREMENTS Final Report
G. L. Anderton Mar. 1979 103 p
(Contract NAS1-14700)
(NASA-CR-2985; D6-IPAD-70013-D) Avail: NTIS HC A06/MF A01 CSCL 01C

Results of a requirements analysis task for Integrated Programs for Aerospace Vehicle Design (IPAD) are presented. User requirements which, in part, will shape the IPAD system design are given. Requirements considered were: generation, modification, storage, retrieval, communication, reporting, and protection of information. Data manipulation and controls on the system and the information were also considered. Specific needs relative to the product design process are also discussed. M.D.K.

N82-15035# Textron Bell Helicopter, Fort Worth, Tex.
HELICOPTER LANDING GEAR DESIGN AND TEST CRITERIA INVESTIGATION Final Report
David Crist and L. H. Symes Aug. 1981 192 p refs
(Contract DAAK51-79-C-8011; DA Proj. 1L1-62209-AH-76) (AD-A105512; BHT-699-099-026; USAAVRADCOM-TR-81-D-15) Avail: NTIS HC A09/MF A01 CSCL 01/3

This program was an investigation of the criteria relating to helicopter landing gears. A computerized literature search was conducted and a bibliography is included in this report. Existing criteria were reviewed and conflicts were identified. An analysis of survivable Army helicopter accidents was performed. The results were used to formulate a tentative criterion. A design study was conducted to evaluate the practicality of the tentative criteria. This investigation compared wheel and skid-type landing gears designed to the tentative criteria and to MIL-S-8698. A crashworthiness analysis of the tentative criteria tailwheel tricycle gear was performed. Weights and landing loads were calculated. A cost comparison was made between tailwheel tricycle gears designed to the two criteria. The gear designed to the new criteria was cost-effective. The results of the investigation were used to modify the tentative criteria and recommendations were made for a new helicopter landing gear military specification and for changes to the existing criteria. Author (GRA)

N82-15037# Vereinigte Flugtechnische Werke-Fokker G.m.b.H., Bremen (West Germany).
ESTIMATION METHODS FOR THE DETERMINATION OF DYNAMIC RESPONSES OF ELASTIC AIRCRAFT
S. Vogel Bonn Bundesministerium der Verteidigung 1981 123 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium der Verteidigung
(BMVg-FBWT-81-6) Avail: NTIS HC A06/MF A01; DOK-ZENTBw, Bonn DM 40

A method for establishing the dynamic response of an elastic aircraft structure to external excitation, such as random gusts or arbitrarily timed maneuver loads is presented. The solution is based on an analytic representation of the admittance functions by partical fractions. The time response frequency dependence of the aerodynamic forces induced by motion are approximated to allow analytical solutions which are shown to be as accurate, but more economical, than more elaborate numerical Fourier methods. Elasticity is introduced through eigenfrequencies and generalized masses. Several examples are shown which also include the influence of control systems and of elasticity on loads and accelerations. Depending on the quality of the structural and aerodynamical input, the method may be used as an estimation method or as an inexpensive approximation method for all dynamic problems in which elasticity, control systems and excitation time lag effects play a role. Author (ESA)

N82-15038# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Abteilung Flugzeugsteuerung und -regelung.
INTEGRATION OF A DIGITAL AIR DATA COMPUTER INTO THE TEST AIRCRAFT HFB-320
Rainer Dombrowsky and Volkmar Adam May 1981 62 p refs In GERMAN; ENGLISH summary
(DFVLR-Mitt-81-09) Avail: NTIS HC A04/MF A01; DFVLR, Cologne DM 16

The digital air data computer HG 280 D5 is presented with its essential characteristics, output signals, and failure test facilities. Integration with the measuring equipment of the test aircraft HFB 320 as well as the hard and software developed for the signal interface of the onboard computer are described. The system processes flight data, such as rate of climb and descent, and altitude. Author (ESA)

N82-15039*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPUTER PROGRAM FOR AERODYNAMIC AND BLADING DESIGN OF MULTISTAGE AXIAL-FLOW COMPRESSORS
James E. Crouse and William T. Gorrell Dec. 1981 105 p refs Prepared in cooperation with Army Aviation Research and Development Command, St. Louis, Mo.
(NASA-TP-1946; AVRADCOM-TR-80-C-21; E-280) Avail: NTIS HC A06/MF A01 CSCL 21E

A code for computing the aerodynamic design of a multistage axial-flow compressor and, if desired, the associated blading geometry input for internal flow analysis codes is presented. Compressible flow, which is assumed to be steady and axisymmetric, is the basis for a two-dimensional solution in the meridional plane with viscous effects modeled by pressure loss coefficients and boundary layer blockage. The radial equation of motion and the continuity equation are solved with the streamline curvature method on calculation stations outside the blade rows. The annulus profile, mass flow, pressure ratio, and rotative speed are input. A number of other input parameters specify and control the blade row aerodynamics and geometry. In particular, blade element centerlines and thicknesses can be specified with fourth degree polynomials for two segments. The output includes a detailed aerodynamic solution and, if desired, blading coordinates that can be used for internal flow analysis codes. Author

N82-15040*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF FUEL INJECTOR TYPE ON PERFORMANCE AND EMISSIONS OF REVERSE-FLOW COMBUSTOR
Carl T. Norgren and Stephen M. Riddlebaugh Dec. 1981 40 p refs
(NASA-TP-1945; E-556) Avail: NTIS HC A03/MF A01 CSCL 21E

The combustion process in a reverse-flow combustor suitable for a small gas turbine engine was investigated to evaluate the effect of fuel injector type on performance and emissions. Fuel injector configurations using pressure-atomizing, spill-flow, air blast, and air-assist techniques were compared and evaluated on the basis of performance obtained in a full-scale experimental combustor operated at inlet conditions corresponding to takeoff, cruise, low power, and idle and typical of a 16:1-pressure-ratio turbine engine. Major differences in combustor performance and

emissions characteristics were experienced with each injector type even though the aerodynamic configuration was common to most combustor models. Performance characteristics obtained with the various fuel injector types could not have been predicted from bench-test injector spray characteristics. The effect of the number of operating fuel injectors on performance and emissions is also presented. Author

N82-15041*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INTERACTIVE-GRAPHIC FLOWPATH PLOTTING FOR TURBINE ENGINES
Robert R. Corban Nov. 1981 51 p refs
(NASA-TM-82756; E-1074) Avail: NTIS HC A04/MF A01 CSCL 21E

An engine cycle program capable of simulating the design and off-design performance of arbitrary turbine engines, and a computer code which, when used in conjunction with the cycle code, can predict the weight of the engines are described. A graphics subroutine was added to the code to enable the engineer to visualize the designed engine with more clarity by producing an overall view of the designed engine for output on a graphics device using IBM-370 graphics subroutines. In addition, with the engine drawn on a graphics screen, the program allows for the interactive user to make changes to the inputs to the code for the engine to be redrawn and reweighed. These improvements allow better use of the code in conjunction with the engine program. T.M.

N82-15042 Ecole Polytechnique Federale de Lausanne (Switzerland). Inst. de Thermique Appliquee.
AEROELASTICITY IN TURBOMACHINES
P. Suter, ed. Zurich Juris-Verlag 1981 487 p refs Proc. of 2nd Intern. Symposium, Lausanne, Switzerland, 8-12 Sep. 1980
(EPFL-ITA-10; ISBN-3-260-04871-5) Avail: Issuing Activity

The understanding and prevention of failures in turbomachines caused by aeroelastic blade vibrations is considered. Calculation of subsonic cascades, cascade tests, vibration measurements and annular cascade tests, unsteady supersonic flow in cascades, and theoretical methods are discussed.

N82-15047 Tokyo Univ.,(Japan). Inst. of Space and Aeronautical Sciences.
AERODYNAMIC RESPONSE OF A BLADE IN PITCHING OSCILLATION WITH PARTIAL AND FULL SEPARATION
H. Tanaka, I. Fujimoto, and S. Ishii *In* Ecole Polytechnique de Lausanne Aeroelasticity in Turbomachines 1981 p 129-142 refs
Avail: Issuing Activity

The aerodynamic responses of a blade in pitching oscillation with separation bubble and trailing edge separation are analyzed, and the mechanism of energy transfer between the oscillating blade and the air flow is elucidated. In the state of partial separation and leading edge separation, the aerodynamic response of a Goe801 model airfoil vibrating in pitching motion around a midchord of the blade was observed in a blowdown low speed wind tunnel. The dynamic pressure distribution along the blade surface was measured. By considering physical phenomena on the blade surface, it is understood how the phase shift of the unsteady pressure on the blade surface is affected by the deformation of the pressure wave caused by the movement of the reattaching point of the separation bubble and the separation point of trailing edge separation. Author (ESA)

N82-15048 Ecole Polytechnique Federale de Lausanne (Switzerland).
DAMPING FOR TURBOMACHINE BLADE VARIATIONS IN SUBSONIC FLOW
G. S. Pisarenko, A. A. Kaminer, V. A. Balalayev, N. Y. Nastenko, A. L. Stelmach, and A. V. Dunayev *In its* Aeroelasticity in Turbomachinery 1981 p 151-161 refs

Avail: Issuing Activity

The reduction of dynamic stresses in turbomachine blades through an increase in aerodynamic damping of blade vibration is discussed. The influence of camber and stagger angle are investigated. An aeroelastic damping analysis for the case of stalled flow is presented. An experimental investigation of aerodynamic damping for planar bending and torsional vibrations of a flat cascade of model blades was carried out. In the range of camber variation from 0.025 to 1.0 dependence turns out not to be substantial; increased aerodynamic damping that never exceeds 10 to 15% accompanies an increase in camber. The influence of stagger angle on damping is also revealed to be relatively slight for angle variations from 0 to 60 deg. Author (ESA)

N82-15049 Toshiba Research and Development Center, Kawasaki (Japan). Research and Development Center.
SELF EXCITED FLOW OSCILLATION IN THE LOW PRESSURE STEAM TURBINE CASCADE
T. Araki, Y. Okamoto, and F. Ohtomo *In* Ecole Polytechnique de Lausanne Aeroelasticity in Turbomachines 1981 p 171-186 refs
Avail: Issuing Activity

The problem of unsteady flow in a turbine cascade with subsonic inlet and supersonic outlet flow was approached through experiments. The type of flow considered occurs at the tip of the last stages of low pressure steam turbine rotors. Experiments were made on a linear cascade over a range of outlet Mach numbers up to 1.8. The measurements included unsteady flow visualization by the Schlieren method and time traces of pressure on the blade surface by transducers on nonoscillating and oscillating blades. In addition, unsteady aerodynamic moments were measured. Results show that the transonic flow field at the tip section of the rotor blades of large steam turbines is steady, operating at rated conditions. Operating under partial load, the steady flow breaks down. Aerodynamic damping in pitching motion for unsteady flow conditions is negative, leading to the possibility that self excited vibration exists in the case of a free standing blade. Author (ESA)

N82-15050 Notre Dame Univ., Ind. Dept. of Aerospace and Mechanical Engineering.
STABILITY AND FLUTTER ANALYSIS OF TURBINE BLADES AT LOW SPEED
T. J. Akai and H. Atassi *In* Ecole Polytechnique de Lausanne Aeroelasticity in Turbomachines 1981 p 187-201 refs

(Contract F49620-76-C-0014)
Avail: Issuing Activity

An aeroelastic analysis for highly loaded turbine blades at low speed is carried out for various vibratory modes. These include pure bending and torsion as well as coupled oscillatory modes. The analysis is based on a complete aerodynamic theory which fully accounts for the blade geometry, flow conditions and cascade parameters. A damping coefficient simulating structural damping is also included. The results clearly show that classical flutter can occur for low speed turbine cascades at typical operating conditions. This is directly attributable to high blade loading and thickness. Author (ESA)

N82-15051 Akademiya Nauk SSSR, Novosibirsk. Inst. of Hydrodynamics.
CALCULATION OF QUASI-STATIONARY AERODYNAMIC FORCE ACTING ON A CASCADE OF OSCILLATING AIRFOILS IN SUBSONIC FLOW
V. B. Kurzin and V. P. Ryabchenko *In* Ecole Polytechnique de Lausanne Aeroelasticity of Turbomachines 1981 p 203-210 refs
Avail: Issuing Activity

Nonstationary aerodynamic characteristics of the cascade of thin airfoils in a subsonic gas flow are investigated showing that the influence of gas compressibility on their behavior can be characterized by two parameters: Mach number M and the wave number K. For the cascade of arbitrary airfoils, a theoretical statement of this problem for K tends to zero is considered; here nonstationary aerodynamic characteristics of the cascade are described well by their quasi-stationary approximation. A mathematical model of the nonstationary ideal gas flow at subsonic velocities through an arbitrary airfoil cascade in a quasi-stationary state is formulated. In accordance with the model, functions for the velocity potential wholly define the nonstationary gas flow through the cascade in a quasi-stationary approximation at any time moment. The determination problems for these functions are solved, using Chaplygin's approximation. Author (ESA)

N82-15052 Ecole Polytechnique Federale de Lausanne (Switzerland). Inst. de Thermique Appliquee.
NUMERICAL EXPERIMENTS ON UNSTEADY FLOWS

THROUGH VIBRATING CASCADES
Maurizio Pandolfi *In its* Aeroelasticity of Turbomachines 1981 p 211-228 refs
Avail: Issuing Activity

A numerical approach is presented for computing the inviscid compressible two-dimensional unsteady flow in a vibrating cascade. The full Euler equations are considered and no restrictive assumptions are required about geometry of the blading. The analysis is confined to subsonic flows. The modeling of the boundaries and the numerical methodology is described. Particular attention is paid to the explicit treatment of the wake behind the blade during the unsteady flow. Checks on the accuracy of the computations are made. Calculation results on the steady shockless transonic flow in an impulse cascade, where the exact solution is available, show acceptable agreement at least for the space-like discretization. Further evaluation of accuracy is hindered by a lack of benchmark solutions with which to compare. Author (ESA)

N82-15053 Ecole Polytechnique Federale de Lausanne (Switzerland).
COMPUTER AIDED INVESTIGATION OF TURBOMACHINE AERODYNAMICS AND AEROELASTICITY
S. M. Belotserkovskii, A. S. Volmir, V. V. Kuleshov, M. I. Nisht, G. U. Stepanov, and R. M. Ejodorov *In its* Aeroelasticity of Turbomachines 1981 p 229-249 refs

Avail: Issuing Activity

Computer aided solutions of aeroelasticity problems related to turbomachines are presented. A synthesis of numerical methods from nonstationary aerodynamics and elasticity theory are employed. Solutions derive from an understanding of general characteristics and aerodynamic loads acting on each turbomachine blade while taking into account the interference of the blades and blade rows. Aerodynamic stationary characteristics, aerodynamic derivatives at various values of the vibration frequencies, and aerodynamic characteristics with arbitrary dependence of the kinematic parameters on time were investigated. Elastic deformation of blade and blade/disk systems is explained. A flow chart for the computerized evaluation of these phenomena is shown, the results of which support a turbomachine aeroelasticity mathematical model. Author (ESA)

N82-15054 Mitsubishi Heavy-Industries Ltd., Nagasaki (Japan). Nagasaki Technical Inst.
ON THE NUMERICAL ANALYSIS OF STALL FLUTTER IN TURBINE CASCADES
S. Takahara, T. Adachi, and Y. Kadoya *In* Ecole Polytechnique de Lausanne Aerolasticity of Turbomachines 1981 p 251-262 refs
Avail: Issuing Activity

A numerical method using a triangular finite element mesh pattern is applied in order to solve the problem of unsteady stalled flow through a turbine cascade. The flow in the blade-to-blade plane is assumed to be viscous, and in addition, the friction drag on the blade surface is considered. The basic equations for two-dimensional compressible viscous flow are described. Boundary conditions and a vibration condition are also explained. Numerical results for low pressure end blades of a steam turbine are compared with flutter test data on aerodynamic damping and satisfactory agreement is obtained between calculation and experiment. Author (ESA)

N82-15055 Imperial Coll. of Science and Technology, London (England).
A METHOD FOR FORCE DETERMINATION FROM VIBRATION RESPONSE MEASUREMENTS
D. J. Ewins and B. Hillary *In* Ecole Polytechnique de Lausanne Aeroelasticity of Turbomachines 1981 p 263-283 refs Sponsored by Rolls Royce Ltd.

Avail: Issuing Activity

Dynamic force determination from response measurements was studied numerically and experimentally. Application to turbomachine blades undergoing steady or transient vibration is considered. In theory, the case of harmonic excitation and response is expressed as an inverse input/output equation. A cantilever beam and an isolated turbomachine blade were used as test pieces for the experimental study. Results show that application of the pseudoinverse force determination method is subject to a form of conditioning in the region of the fundamental mode. However, the results of tests on an actual compressor blade suggest that with very accurate dynamic modeling of the test structure and careful curve fitting this method is feasible, using current techniques and equipment. Author (ESA)

N82-15056 Brown, Boveri and Co., Ltd., Baden (Switzerland).
CONTROL OF VIBRATION IN AEROELASTIC CASCADE EXPERIMENTS
A. Krischner, B. Fosco, and E. Muller *In* Ecole Polytechnique de Lausanne Aeroelasticity of Turbomachines 1981 p 285-295 refs
Avail: Issuing Activity

The aeroelastic behavior of an annular, transonic turbine cascade with three degrees of freedom and an electromagnetic excitation system was investigated. Excitation and vibration control which allows measurement of effective damping in the stable operating domain of the cascade is discussed. The vibration control system demonstrates its capability to maintain preset vibration amplitudes and interblade phase angles throughout the resonance range if sufficient damping is present. Author (ESA)

N82-15057 New South Wales Univ., Kensington (Australia). School of Mechanical and Industrial Engineering.
STABILITY ANALYSIS OF THE TWIN MODE MODEL OF COUPLED FLEXION/TORSION VIBRATIONS IN TURBOFANS
R. A. J. Ford *In* Ecole Polytechnique de Lausanne Aeroelasticity of Turbomachines 1981 p 297-308 refs

Avail: Issuing Activity

The twin mode representation of coupled flexion/torsion vibrations in turbofans, a linear feedback system which depicts flutter as a system instability, is reviewed. An analysis which uses classical automatic control theory is presented. A stability analysis for zero phase lag on aerodynamic coupling is developed. A transfer function for the system is found, and determination of stability using Routh's criterion is explained. A more versatile characterization of flutter behavior for the twin orthogonal mode model results. Author (ESA)

N82-15058 Rolls-Royce Ltd., Derby (England). Aero Div.
AERODYNAMIC CONSIDERATIONS IN THE PREDICTION OF UNSTALLED SUPERSONIC FLUTTER IN TRANSONIC FANS
D. G. Halliwell *In* Ecole Polytechnique de Lausanne Aeroelasticity of Turbomachines 1981 p 309-322 refs

Avail: Issuing Activity

Two methods for the prediction of unsteady lift and moment coefficients for blades with supersonic entry flow pertaining to coupled flutter in turbofans are discussed. The first method uses a linearized supersonic model, with only weak pressure waves, while the second uses a strong normal shock model, however both are based on flat plate cascades. A basic problem in the application of the first model is discussed and a correction procedure to obtain a more rational solution is suggested. For the second model, although its shock structure is closer to the real case, overall comparison with experiment shows no improvement on the simpler model. However, results are qualitatively consistent with implied working line differences. Author (ESA)

N82-15059 Kyushu Univ., Fukuoka (Japan). Dept. of Aeronautical Engineering.
EFFECT OF MEAN BLADE LOADING ON SUPERSONIC CASCADE FLUTTER
M. Namba and R. Minami *In* Ecole Polytechnique de Lausanne Aeroelasticity of Turbomachines 1981 p 323-332 refs

Avail: Issuing Activity

A theory for supersonic cascade flutter with nonzero mean blade loadings was developed. An inviscid supersonic flow past a rectilinear two-dimensional cascade with subsonic leading edge locus was investigated. The theory allows for the effect of displacement of mass source and body force singular points which represent blades with nonzero thickness and mean lift force, but it neglects the effect of deviation of the local convection velocity and local speed of sound from the undisturbed uniform ones. The theory also predicts the occurrence of supersonic bending flutter at higher blade loadings. Author (ESA)

N82-15060 Technische Hochschule, Aachen (West Germany). Inst. fuer Strahlantriebe und Turboarbeitsmashinen.
A METHOD OF CHARACTERISTICS SOLUTION FOR A FINITE OSCILLATING SUPERSONIC CASCADE WITH THICKNESS EFFECTS
K. Vogeler *In* Ecole Polytechnique de Lausanne Aeroelasticity of Turbomachines 1981 p 333-347 refs

Avail: Issuing Activity

A method of characteristics approach to a nonlinear oscillating supersonic cascade is presented. The method is extended to a complete cascade computation for cascades with blades of nonzero thickness on the upper and lower sides. The flow field behind a single oscillating airfoil in a supersonic flow is treated and compared with an analytical flat plate solution. The technique is merged with an existing algorithm. The performance is compared with flat plate and slender blade solutions for infinite cascades. The effect of slender blades in comparison with flat plates on the unsteady aerodynamic response of an oscillating supersonic cascade are calculated for a nonlinear cascade in both the subresonant and superresonant region. Author (ESA)

N82-15061 Akademiya Nauk SSSR, Novosibirsk. Inst. of Hydrodynamics.
CALCULATION OF NONSTATIONARY FORCE RATIOS ON BLADES OF A ROTATING ROW IN INCOMPRESSIBLE FLOW
V. P. Ryabchenko *In* Ecole Polytechnique de Lausanne Aeroelasticity of Turbomachines 1981 p 349-356 refs

Avail: Issuing Activity

A numerical solution to a three-dimensional problem of unsteady vortex-free (in the coordinate system coupled with the cascade) flow of ideal incompressible fluid past a rotating annular cascade, based on propeller vortex and finite wing span theory, is presented. The geometry of blade edge is modeled as an annular cascade whose blades are parts of helical surfaces. Aerodynamic force calculations are given only for a large number of blades since it is essential to this method. Analysis results also show the effect of flow three-dimensionality on aerodynamic forces acting on the annular cascade blade when their number is small. Author (ESA)

N82-15062 Tokyo Univ. (Japan). Dept. of Aeronautics.
THREE-DIMENSIONAL ANALYSIS OF CASCADE FLUTTER IN PARALLEL SHEAR FLOW
S. Kaji, H. Takata, and N. Niwa *In* Ecole Polytechnique de Lausanne Aeroelasticity of Turbomachines 1981 p 357-370 refs

Avail: Issuing Activity

The effect of spanwise nonuniformity of stream velocity as well as that of oscillation amplitude on flutter characteristics were studied. The main stream is assumed incompressible and to be a parallel shear flow with linear velocity profile. Flutter characteristics vary in spanwise direction in accordance with the variation of flow incidence and flow velocity. The cascade model of a semiactuator disk composed of a number of flat plate blades undergoing bending oscillation is used. It is indicated that the flow shear effect becomes noticeable in connection with oscillation modes. For uniform oscillation it is weak and for linear and quadratic modes it is significant. It is found that weak shear deteriorates aerodynamic damping and extends the unstable frequency range. Author (ESA)

N82-15063 Imperial Coll. of Science and Technology, London (England). Dept. of Aeronautics.
THE EFFECT OF ASPECT RATIO ON THE UNSTEADY AERODYNAMIC FORCES INDUCED BY VIBRATION OF A CASCADE BLADE
J. M. R. Graham and I. Kullar *In* Ecole Polytechnique de Lausanne Aeroelasticity of Turbomachines 1981 p 371-381 refs

Avail: Issuing Activity

A correction for three dimensionality made to strip theory when calculating the aerodynamic forces due to vibration of a cascade blade in incompressible flow is discussed. The three dimensional effects arise from the spanwise variation of unsteady velocity induced at the blade by the mode of vibration. Results are presented for simple cantilever type modes of vibration, using a three dimensional unsteady cascade theory for the Fourier transform of the spanwise upwash distribution. An integral equation is formulated which is solved numerically. The integral equation is also used to derive a perturbation solution for the correction terms as a series in inverse powers of the blade aspect ratio. The effect of three dimensionality on the critical reduced frequency for torsional flutter. Author (ESA)

N82-15065 Ecole Polytechnique Federale de Lausanne (Switzerland).
PRACTICAL EXPERIENCE WITH A NONCONTACT BLADE VIBRATION MEASURING SYSTEM IN INDUSTRIAL TURBOCOMPRESSORS
R. Jenny, C. Gremli, and H. B. Guemoes *In its* Aeroelasticity in Turbomachines 1981 p 419-428 refs

Avail: Issuing Activity

Blade vibration measurement with noncontact stationary probes in turbomachines is discussed. Due to the low sampling rate, the problem of nondefinite vibration reconstruction arises. This complicates vibration mode identification which is necessary for stress calculation. A method of probability analysis of the stress amplitude in connection with frequency analysis is presented. Two examples are given and blade flutter and rotating stall identification from turbocompressor measurements are shown. Author (ESA)

N82-15067 Tennessee Univ., Tullahoma. Space Inst.
LINEAR AND NONLINEAR ANALYSIS OF VORTEX WHISTLE: ANOTHER BLADE BUSTER
M. Kurosaka *In* Ecole Polytechnique de Lausanne Aeroelasticity of Turbomachines 1981 p 443-453 refs

Avail: Issuing Activity

A flow induced vibration problem in gas turbines, the vortex whistles, is discussed. The whistle is caused by high swirl flow and its characteristics are such that the frequency of fluctuation is discrete (a pure tone). The frequency becomes higher as the swirl or flow rate increases. An incident of vortex whistle is cited. Besides dynamic behavior of the flow field, the data reveal an unexpected change in the steady or time averaged flow field when the whistle is present. It is implicated that dynamic flow can affect even the steady flow field in turbomachinery, which causes damage. Author (ESA)

N82-15068 Mitsubishi Heavy-Industries Ltd., Takasago (Japan). Tagasago Technical Inst.
STUDY OF ACOUSTIC RESONANCE OF CASCADES
M. Honjo and T. Tominaga *In* Ecole Polytechnique de Lausanne Aeroelasticity of Turbomachines 1981 p 455-464 refs

Avail: Issuing Activity

The discrete sound generated by guide vanes was investigated experimentally. A two dimensional cascade test and a three dimensional duct guide vane model test were carried out. It is shown that the discrete noise generated by guide vanes is an acoustic resonance effect in the flow path of the vanes. The main excitation source which induces resonance is wake vortex shedding off the trailing edges of the vanes. Bubble vortices on the concave surfaces or leading edges are not excitation sources. Author (ESA)

N82-15070 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany).
TECHNICAL EVALUATION REPORT ON THE AEROELASTICITY IN TURBOMACHINES SYMPOSIUM
H. Foershing *In* Ecole Polytechnique de Lausanne Aeroelasticity in Turbomachines 1981 p 469-477 refs

Avail: Issuing Activity

Papers presented at the symposium on aeroelasticity in turbomachines are reviewed. Emphasis is on fluid mechanics of aeroelasticity in turbomachines, motion induced fluid dynamic forces, and unsteady fluid dynamic disturbance forces along with forced blade vibrations. Also covered are classic blade flutter, stalled flow, stall flutter and other unsteady phenomena. Author (ESA)

N82-15073# Motoren- und Turbinen-Union Muenchen G.m.b.H. (West Germany).
ADVANCED COMPRESSOR COMPONENTS. PHASE 1:

1978 TO 1979 Final Report, May 1980
Wolfgang Weiler, Franz Strasser, Eberhard Knodel, and Herbert Merz Bonn Bundesministerium fuer Forschung und Technologie Jul. 1981 250 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-W-81-025; ISSN-0170-1339) Avail: NTIS HC A11/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 42,50

An advanced 800 kW aero engine type compressor was developed. The design is of the axial centrifugal type where the cascades of the axial part have supercritical profiles. Detailed layouts are shown and the aerodynamic design and optimization techniques for the cascades are given. The application of fiber reinforced materials is actively investigated for both the compressor housing and its rotor and a detailed catalog of the various functions of and solicitations for such materials is appended.
Author (ESA)

N82-15074*# Calspan Advanced Technology Center, Buffalo, N.Y.
IN-FLIGHT INVESTIGATION OF THE EFFECTS OF PILOT LOCATION AND CONTROL SYSTEM DESIGN ON AIRPLANE FLYING QUALITIES FOR APPROACH AND LANDING Final Report
Norman C. Weingarten and Charles R. Chalk Jan. 1982 215 p refs Sponsored jointly by Dryden Flight Research Facility and USAF Flight Dynamis Labs.
(Contract F33615-79-C-3618)
(NASA-CR-163115; CALSPAN-6645-F-7) Avail: NTIS HC A10/MF A01 CSCL 01C

The handling qualities of large airplanes in the approach and landing flight phase were studied. The primary variables were relative pilot position with respect to center of rotation, command path time delays and phase shifts, augmentation schemes and levels of augmentation. It is indicated that the approach and landing task with large airplanes is a low bandwidth task. Low equivalent short period frequencies and relatively long time delays are tolerated only when the pilot is located at considerable distance forward of the center of rotation. The control problem experienced by the pilots, when seated behind the center of rotation, tended to occur at low altitude when they were using visual cues of rate of sink and altitude. A direct lift controller improved final flight path control of the shuttle like configurations.
E.A.K.

N82-15075*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
LONGITUDINAL AND LATERAL STATIC STABILITY AND CONTROL CHARACTERISTICS OF A 1/6-SCALE MODEL OF A REMOTELY PILOTED RESEARCH VEHICLE WITH A SUPERCRITICAL WING
Thomas A. Byrdsong and James B. Hallissy May 1979 118 p refs
(NASA-TP-1360; L-12059) Avail: NTIS HC A06/MF A01 CSCL 01C

An investigation was conducted in the Langley 8-foot transonic pressure tunnel to determine the longitudinal and lateral-directional static stability and control characteristics of a 1/6-scale force model of a remotely piloted research vehicle. The model was equipped with a supercritical wing and employed elevons for pitch and roll control. Test conditions were as follows: Reynolds number of about 6.6 x 10 to the 6th power per meter, variations of sideslip from -6 deg to 6 deg, elevon deflection angle (symmetrically and asymmetrically) from -9 deg to 3 deg, and rudder deflection angle from 0 deg to -10 deg. The model was longitudinally statically stable at angles of attack up to about 7 deg, which is significantly greater than the angle of attack for the cruise condition (approximately 4 deg). In the range of test Mach numbers, the model was directionally stable and had positive effective dihedral, sufficient pitch control, and positive effectiveness of roll and yaw control.
Author

N82-15076*# Lockheed-California Co., Burbank.
ACCELERATED DEVELOPMENT AND FLIGHT EVALUATION OF ACTIVE CONTROLS CONCEPTS FOR SUBSONIC TRANSPORT AIRCRAFT. VOLUME 1: LOAD ALLEVIATION/EXTENDED SPAN DEVELOPMENT AND FLIGHT TESTS Final Report
J. F. Johnston Sep. 1979 261 p refs
(Contract NAS1-14690)
(NASA-CR-159097; LR-29003-1-Vol-1) Avail: NTIS HC A12/MF A01 CSCL 01C

Active wing load alleviation to extend the wing span by 5.8 percent, giving a 3 percent reduction in cruise drag is covered. The active wing load alleviation used symmetric motions of the outboard ailerons for maneuver load control (MLC) and elastic mode suppression (EMS), and stabilizer motions for gust load alleviation (GLA). Slow maneuvers verified the MLC, and open and closed-loop flight frequency response tests verified the aircraft dynamic response to symmetric aileron and stabilizer drives as well as the active system performance. Flight tests in turbulence verified the effectiveness of the active controls in reducing gust-induced wing loads. It is concluded that active wing load alleviation/extended span is proven in the L-1011 and is ready for application to airline service; it is a very practical way to obtain the increased efficiency of a higher aspect ratio wing with minimum structural impact.
T.M.

N82-15077*# Lockheed-California Co., Burbank.
ACCELERATED DEVELOPMENT AND FLIGHT EVALUATION OF ACTIVE CONTROLS CONCEPTS FOR SUBSONIC TRANSPORT AIRCRAFT. VOLUME 2: AFT C.G. SIMULATION AND ANALYSIS Final Report
D. M. Urie Hampton, Va. NASA Sep. 1979 89 p
(Contract NAS1-14690)
(NASA-CR-159098; LR-29003-Vol-2) Avail: NTIS HC A05/MF A01 CSCL 01C

Relaxed static stability and stability augmentation with active controls were investigated for subsonic transport aircraft. Analytical and simulator evaluations were done using a contemporary wide body transport as a baseline. Criteria for augmentation system performance and unaugmented flying qualities were evaluated. Augmentation control laws were defined based on selected frequency response and time history criteria. Flying qualities evaluations were conducted by pilots using a moving base simulator with a transport cab. Static margin and air turbulence intensity were varied in test with and without augmentation. Suitability of a simple pitch control law was verified at neutral static margin in cruise and landing flight tasks. Neutral stability was found to be marginally acceptable in heavy turbulence in both cruise and landing conditions.
Author

N82-15078# *Deutsche Forschungs- und Versuchsanstalt fuer* Luft- und Raumfahrt, Brunswick (West Germany). Abt. Flugzeugsteuerung und -regelung.
AN OBSERVER APPROACH TO THE IDENTIFICATION AND ISOLATION OF SENSOR FAILURES IN FLIGHT CONTROL SYSTEMS Ph.D. Thesis - Tech. Univ., Carolo-Wilhelmina, West Germany
Norbert Stuckenberg Jul. 1981 140 p refs Report will also be announced as translation (ESA-TT-738)
(DFVLR-FB-81-26; ESA-TT-738) Avail: NTIS HC A07/MF A01; DFVLR, Cologne DM 32

A reliability concept for flight control sensors is presented providing a duplex sensor configuration with fail-operational capabilities by using analytical redundancy with deterministic observers. Without disregarding disturbances and plant parameter variations the identification performance is evaluated with respect to the failure signal properties. The concept is applied to a command and stability augmentation system for the lateral motion of the executive aircraft HFB 320.
Author

N82-15079*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.
NASA DRYDEN FLIGHT LOADS RESEARCH FACILITY
Walter J. Sefic Dec. 1981 43 p refs
(NASA-TM-81368) Avail: NTIS HC A03/MF A01 CSCL 14B

The Dryden Flight Loads Research Facility (NASA) and the associated equipment for simulating the loading and heating of aircraft or their components are described. Particular emphasis is placed on various fail-safe devices which are built into the equipment to minimize the possibility of damage to flight vehicles. The equipment described includes the ground vibration and moment of inertia equipment, the data acquisition system, and the instrumentation available in the facility for measuring load, position, strain, temperature, and acceleration.
R.J.F.

N82-15081# Institute for Perception RVO-TNO, Soesterberg (Netherlands).

OPTICAL PROPERTIES OF AIRFIELD LIGHTING FIXTURES OF THE ROYAL NETHERLANDS AIRFORCE. PART 1: COLOR MEASUREMENTS

P. Padmos and R. vanLeeuwen 1980 20 p In DUTCH; ENGLISH summary 2 Vol.
(Contract A78/KLu/085)
(IZF-1980-1-Vol-1; TDCK-73414) Avail: NTIS HC A02/MF A01

Airfield lighting fixtures in use in the Royal Netherlands' Airforce were sampled and used to measure to what extent the chromaticity coordinates are corresponding to the NATO-Standardization Agreements. For the yellow and red filters, especially, it is important to measure the chromaticity of the mounted lamp-filter combinations, because heating may cause a considerable shift in chromaticity. For each fixture the measurements were performed at nominal maximum luminous intensity. Moreover, for a number of representative colors, measurements were made at the reduced intensity settings normally in use. Conclusions regarding, rejecting, or accepting are tabulated.
Author

N82-15082# Institute for Perception RVO-TNO, Soesterberg (Netherlands).

OPTICAL PROPERTIES OF AIRFIELD LIGHTING FIXTURES OF THE ROYAL NETHERLANDS AIRFORCE. PART 2: INTENSITY MEASUREMENTS

P. Padmos and R. vanLeeuwen 1980 38 p In DUTCH; ENGLISH summary 2 Vol.
(Contract A78/KLu/085)
(IZF-1980-12-Vol-2; TDCK-75011) Avail: NTIS HC A03/MF A01

Most lighting fixtures did not fulfill NATO-Standardization requirements in one or another way. The most conspicuous error was found in a taxiway fixture, where the beam maximum appeared to be directed downwards. Many red filters have a deep red color, which lessens the light output. In most cases a considerable improvement in light output can be obtained by applying a more orange-red-color, for which the color requirements give room. It appears that for some red glass filters the transmission is lowered considerably by heating. Author

N82-15083# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany). Experimental Aerodynamics.

DEVELOPMENT AND TRIAL OF A ROTARY BALANCE FOR THE 3 m-LOW SPEED WIND TUNNELS IN THE FEDERAL REPUBLIC OF GERMANY Final Report, Dec. 1979

Bernd Schulze Bonn Bundesministerium fuer Forschung und Technologie Jul. 1981 70 p refs In GERMAN, ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-W-81-022; ISSN-0170-1339) Avail: NTIS HC A04/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 14,70

A rotary balance was developed for determining aerodynamic damping due to rolling by means of a stationary measuring procedure. Due to the uniform rotation around the wind tunnel axis, vortex relaxation effects that might result from oscillatory balances are avoided. Layout, instrumentation, and data processing are described. Results obtained by using the apparatus during different wind tunnel tests with a calibration model correlate well with existing reference data and flight test data. Dynamic stability derivates due to rolling can be measured for angles of attack up to 90 deg and for extreme angles of inclination.
Author (ESA)

N82-15111# Fraunhofer-Inst. fuer Naturwissenschaftlich-Technische Trendanalysen, Euskirchen (West Germany).

SENSOR FOOTPRINTS AND HOMING RANGE OF TERMINAL GUIDANCE MUNITION [SENSOR-FOOTPRINT UND NACHLENKBEREICH BEI ENDPHASENGELENKTER MUNITION]

K.-D. Leuthaeuser and H. Wessel Bonn Bundesministerium der Verteidigund 1981 56 p refs In GERMAN Sponsored by Bundesministerium der Verteidigung
(BMVg-FBWT-81-5) Avail: NTIS HC A04/MF A01; DOK-ZENTBw, Bonn DM 30

The footprints of terminal guidance projectiles were analyzed. These footprints, which correspond to the accessible target range on the surface, depend on the vision range of the sensor and on the homing range of the projectile. The sensor vision range is calculated as a function of trajectory parameters, sensor aperture, and sensor range. The extent of the homing range is determined for the special case of circular trajectories, i.e., proportional navigation, in dependence of flight height, angle of incidence, and maximal transverse acceleration. The resulting footprints are represented in overlay diagrams. Author (ESA)

N82-15277*# Old Dominion Univ., Norfolk, Va. Dept. of Electrical Engineering.

AIRBORNE ANTENNA PATTERN CALCULATIONS Final Report, 1 Nov. 1980 - 31 Oct. 1981

Timothy J. Knerr, Teri M. Owens, and Roland R. Mielke Dec. 1981 322 p refs
(Grant NsG-1655)
(NASA-CR-165059) Avail: NTIS HC A14/MF A01 CSCL 20N

Calculated principal-and off-principal plane patterns are presented for the following aircraft: de Havilland DHC-7, Rockwell Sabreliner 75A, Piper PA-31T Cheyenne, Lockheed Jet Star II, Piper PA-31-350 Navajo Chieftain, Beechcraft Duke B60, Rockwell Commander 700, Cessna Citation 3, Piper PA-31P Pressurized Navajo, Lear Jet, and Twin Otter DHC-6. Author

N82-15313*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

HIGH TEMPERATURE ELECTRONIC REQUIREMENTS IN AEROPROPULSION SYSTEMS

William C. Nieberding and J. Anthony Powell *In its* Proc. of The Conf. on High-Temp. Electron. 1981 p 13-16 refs

(E-708) Avail: NTIS HC A07/MF A01 CSCL 09C

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

N82-15359*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

RELATIONS FOR THE THERMODYNAMIC AND TRANSPORT PROPERTIES IN THE TESTING ENVIRONMENT OF THE LANGLEY HYPERSONIC CF4 TUNNEL

Kenneth Sutton Oct. 1981 40 p refs
(NASA-TM-83220) Avail: NTIS HC A03/MF A01 CSCL 20D

Thermodynamic and transport properties of gaseous CF4 that can be used in flow field computer codes and theoretical analyses for comparison of results with experimental data from the Langley Hypersonic CF4 Tunnel are presented. The thermodynamic relations which are based on thermally perfect but calorifically imperfect gas are adequate for the testing environment of the CF4 tunnel and are simpler to use than the imperfect gas relations required to define the complete expansion from the tunnel reservoir. Relations for the transport properties are based on the kinetic theory of gases in which published experimental data are used in the derivation of the relations. Extensive experimental data were located for viscosity and the derived relation should provide values for viscosity with errors of less than 1 percent. The experimental data for thermal conductivity were limited with significant disagreement between the various sources. The derived relation will probably provide values for the thermal conductivity with errors of no more than 5 percent which is within the accuracy of the experimental data. M.D.K.

N82-15498*# EG and G Washington Analytical Services Center, Inc., Pocomoke City, Md.

A GLOBAL ATLAS OF GEOS-3 SIGNIFICANT WAVEHEIGHT DATA AND COMPARISON OF THE DATA WITH NATIONAL BUOY DATA

J. D. McMillan Wallops Island, Va. NASA. Wallops Flight Center Nov. 1981 163 p refs

(Contract NAS6-2639)
(NASA-CR-156882) Avail: NTIS HC A08/MF A01 CSCL 08C

The accuracy of the GEOS-3 significant waveheight estimates compared with buoy measurements of significant waveheight were determined. A global atlas of the GEOS-3 significant waveheight estimates gathered is presented. The GEOS-3 significant waveheight estimation algorithm is derived by analyzing the return waveform characteristics of the altimeter. Convergence considerations are examined, the rationale for a smoothing technique is presented and the convergence characteristics of the smoothed estimate are discussed. The GEOS-3 data are selected for comparison with buoy measurements. The GEOS-3 significant waveheight estimates are assembled in the form of a global atlas of contour maps. Both high and low sea state contour maps are presented, and the data are displayed both by seasons and for the entire duration of the GEOS-3 mission. E.A.K.

N82-15596# Prins Maurits Lab. TNO, Rijswijk (Netherlands). Inst. voor Chemische en Technologische Research.
POLLUTION OF THE SOIL BY AVIATION GASOLINE
A. Verweij Aug. 1979 26 p ref In DUTCH; ENGLISH summary
(Contract A78/KL4/146)
(PML-1979-41; TDCK-73390) Avail: NTIS HC A03/MF A01

A literature search was conducted to determine the effects of aviation gasoline spills and more general oil spills on the environment and on the condition of oil storage tanks. Remedial measures are presented. Attention is given to natural restoration processes as well as to actions to speed up these processes.
Author

N82-15894*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
OPTICAL INFORMATION PROCESSING FOR AEROSPACE APPLICATIONS
Dec. 1981 347 p refs Conf. held in Hampton, Va., 18-19 Aug. 1981
(NASA-CP-2207; L-15018) Avail: NTIS HC A15/MF A01 CSCL 20F

Current research in optical processing is reviewed. Its role in future aerospace systems is determined. The development of optical devices and components demonstrates that system concepts can be implemented in practical aerospace configurations.

N82-15897*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ROLE OF OPTICAL COMPUTERS IN AERONAUTICAL CONTROL APPLICATIONS
Robert J. Baumbick *In* NASA. Langley Research Center Opt. Inform. Process. for Aerospace Appl. Dec. 1981 p 33-43
Avail: NTIS HC A15/MF A01 CSCL 30F

The role that optical computers play in aircraft control is determined. The optical computer has the potential high speed capability required, especially for matrix/matrix operations. The optical computer also has the potential for handling nonlinear simulations in real time. They are also more compatible with fiber optic signal transmission. Optics also permit the use of passive sensors to measure process variables. No electrical energy need be supplied to the sensor. Complex interfacing between optical sensors and the optical computer is avoided if the optical sensor outputs can be directly processed by the optical computer. S.L.

N82-15930# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Wesseling (West Germany). Inst. fuer Physik der Atmosphaere.
THE OPTICAL RECOGNITION OF SEA TARGETS AS A FUNCTION OF SURROUNDING AND OBSERVATION PARAMETERS IN AIR TO WATER OBSERVATIONS
Hans-Eberhard Hoffmann Bonn Bundesministerium der Verteidigung 1981 41 p refs In GERMAN; ENGLISH summary
(BMVG-FBWT-81-10) Avail: NTIS HC A03/MF A01; DOK-ZENTBW, Bonn DM 30

The influence of environmental and observation parameters on visibility ranges, maximum detection range, and maximum identification range were determined. The determination of the visibility ranges and the measurements of environmental parameters took place from helicopters. On the basis of the test results the influence of the following parameters on visibility ranges is shown: visual range, illumination, flight altitude, and environmental brightness as environmental parameters; and naked eye, light-intensifier, night goggles, limitation of field of view as observation parameters. T.M.

N82-15984# Dayton Univ., Ohio. Research Inst.
THE INFLUENCE OF AERONAUTICAL R&D EXPENDITURES UPON THE PRODUCTIVITY OF AIR TRANSPORTATION Final Report, 1926-1976
Ralph C. Lenz, John A. Machnic, and Anthony W. Elkins Jul. 1981 248 p refs
(Grant NSF SRS-79-10397)
(PB81-247140; UDR-TR-81-72; NSF/SIU-81-1) Avail: NTIS HC A11/MF A01 CSCL 05A

The impact which aeronautical R&D expenditures have had upon productivity growth in the air transportation industry over the 50-year period from 1926 to 1976 is examined. Quantitative analyses of the returns on U.S. investments in aeronautical R&D show that the net gains from such investments are very large in comparison with standard commercial opportunities during the same period. The gains were distributed primarily to the traveling public and, to a lesser extent, to the airline employees. Author

N82-15985* National Aeronautics and Space Administration, Washington, D. C.
INDEX TO NASA NEWS RELEASES AND SPEECHES, 1980
1981 131 p
Avail: NTIS HC A07/MF A01 CSCL 05B

A listing is provided of 201 news releases distributed by the Office of Public Affairs, NASA Headquarters and 10 selected speeches presented by Headquarters staff in 1980. Subject and name indexes are arranged alphabetically. Indexes to titles, news release numbers and accession numbers are arranged numerically. A.R.H.

N82-16008*# Helicopter Association of America, Washington, D. C.
COMMUNITY ROTORCRAFT AIR TRANSPORTATION BENEFITS AND OPPORTUNITIES Final Report, Dec. 1981
Glen A. Gilbert, Darral J. Freund, Robert M. Winick, Nicholas J. Cafarelli, Richard F. Hodgkins, Tirey K. Vickers et al Dec. 1981 181 p refs
(Contract NAS2-10798)
(NASA-CR-166266) Avail: NTIS HC A09/MF A01 CSCL 01C

Information about rotorcraft that will assist community planners in assessing and planning for the use of rotorcraft transportation in their communities is provided. Information useful to helicopter researchers, manufacturers, and operators concerning helicopter opportunities and benefits is also given. Three primary topics are discussed: the current status and future projections of rotorcraft technology, and the comparison of that technology with other transportation vehicles; the community benefits of promising rotorcraft transportation opportunities; and the integration and interfacing considerations between rotorcraft and other transportation vehicles. Helicopter applications in a number of business and public service fields are examined in various geographical settings. R.J.F.

N82-16022*# National Aeronautics and Space Administration, Washington, D. C.
AERONAUTICS AND SPACE REPORT OF THE PRESIDENT, 1980 ACTIVITIES
1981 108 p
(NASA-TM-84079) Avail: NTIS HC A06/MF A01 CSCL 05A

The year's achievements in the areas of communication, Earth resources, environment, space sciences, transportation, and space energy are summarized and current and planned activities in these areas at the various departments and agencies of the Federal Government are summarized. Tables show U.S. and world spacecraft records, spacecraft launchings for 1980, and scientific payload and probes launched 1975-1980. Budget data are included. A.R.H.

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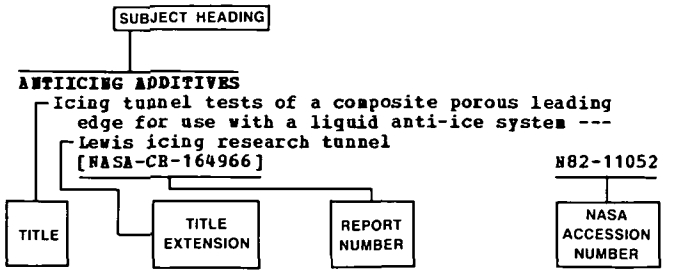

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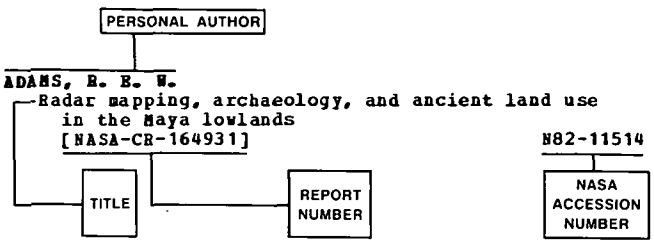

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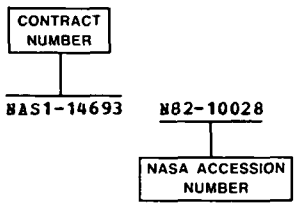

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1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
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AERONAUTICAL ENGINEERING A Continuing Bibliography (Supplement 147)	April 1982
	6. Performing Organization Code
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15. Supplementary Notes

16. Abstract

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17. Key Words (Suggested by Author(s))	18. Distribution Statement
Aerodynamics Aeronautical Engineering Aeronautics Bibliographies	Unclassified-Unlimited

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price*
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