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ACCESSION NUMBER RANGES

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

STAR (N-10000 Series) N80-22255 – N80-24258

IAA (A-10000 Series) A80-32627 – A80-36306

AERONAUTICAL ENGINEERING

A Continuing Bibliography

Supplement 125

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced in July 1980 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. Since that time, monthly supplements have been issued.

This supplement to *Aeronautical Engineering -- A Continuing Bibliography* (NASA SP-7037) lists 407 reports, journal articles, and other documents originally announced in July 1980 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*.

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

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

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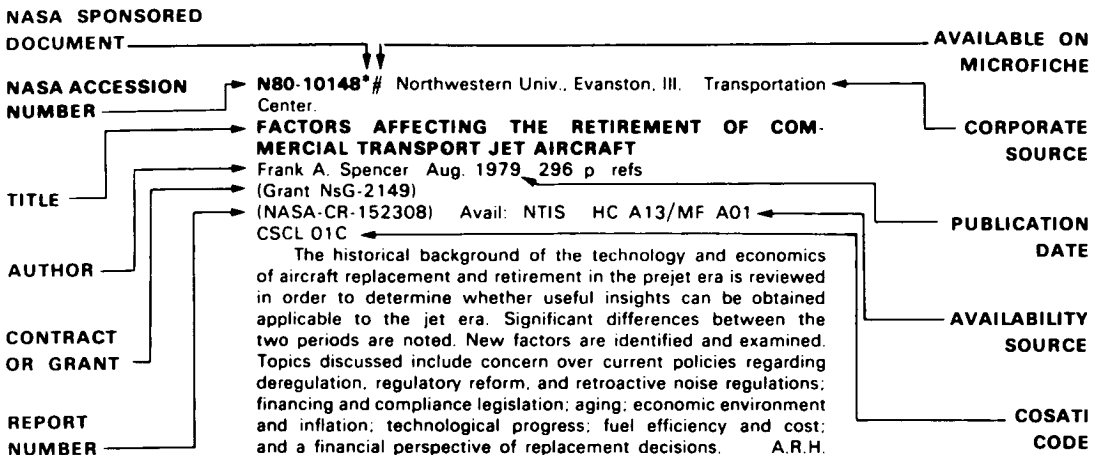
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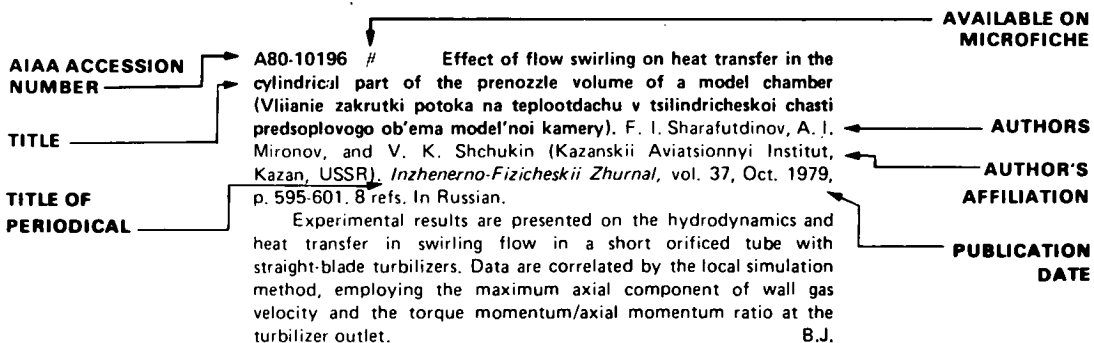
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TYPICAL CITATION AND ABSTRACT FROM IAA



AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 125)

AUGUST 1980

IAA ENTRIES

A80-32682 Predictive guidance for interceptors with time lag in acceleration. C. Hecht (Aerospace Corp., Guidance and Control Div., El Segundo, Calif.) and A. Troesch (Southern California, University, Los Angeles, Calif.). *IEEE Transactions on Automatic Control*, vol. AC-25, Apr. 1980, p. 270-274. 5 refs. Contract No. F4701-77-C-0078.

Predictive guidance equations for systems with time delays are developed using optimal control theory to obtain interceptor steering gains. The time response of the interceptor is approximated by a linear first-order time lag, and the optimal steering gain is evaluated using a quadratic penalty function. The optimal control for interception is determined to be a linear function of the predicted position error and the acceleration error. Computer simulations demonstrate a significant improvement of interceptor performance. (Author)

A80-32693 Flight control systems. VII. B. R. A. Burns (British Aerospace, WARTON Div., Preston, Lancs., England). *Air International*, vol. 18, May 1980, p. 229-232, 260.

The article traces the development of flight control systems and describes the various functions of flight control systems, leading to a modern full time fly-by-wire system. Attention is given to the need for a fuel system with power controls, as well as the topics of autostabilization and large authority autostabilization. Also discussed are electric signalling, fly-by-wire, and control configured flight. Finally, future control systems are examined. M.E.P.

A80-32759 Minimum sensitivity controllers with application to VTOL aircraft. V. Gourishankar (Alberta, University, Edmonton, Canada) and G. V. Zackowski (Department of National Defence, Ottawa, Canada). *IEEE Transactions on Aerospace and Electronic Systems*, vol. AES-16, Mar. 1980, p. 217-226. 7 refs. National Research Council of Canada Grant No. A-3322.

A technique is described for the design of a fixed-gain feedback controller for a vertical takeoff and landing (VTOL) aircraft, which minimizes the effect of arbitrary variations in the aircraft dynamics on aircraft performance over varying flight conditions. The design method involves the assignment of the eigenvalues of the aircraft model to prescribed locations in the complex plane and the minimization of their sensitivities to model parameter variations. This controller is shown to possess better tracking and regulating capabilities than another fixed-gain controller designed merely for assignment of eigenvalues using nominal parameter values, without any consideration of their sensitivity to plant parameter variations. (Author)

A80-32845 # Aircraft radio equipment adjustment and maintenance technology (Tekhnologiya remonta radiooborudovaniia letatel'nykh apparatov). Iu. N. Kalashnikov and L. M. Fedotov. Moscow, Izdatel'stvo Mashinostroenie, 1979. 248 p. 50 refs. In Russian.

This textbook deals essentially with the major aspects of training personnel to operate, maintain, and repair aircraft radio,

and electronic, and radar systems. The technology of system production, assembly, and installment is outlined. V.P.

A80-32860 # Advanced rotorcraft noise. H. Sternfeld, Jr. (Boeing Vertol Co., Philadelphia, Pa.). *American Institute of Aeronautics and Astronautics, International Meeting and Technical Display on Global Technology 2000, Baltimore, Md., May 6-8, 1980, Paper 80-0857*. 9 p. 21 refs.

The paper discusses improving helicopter rotor design to effect noise reduction. A review of the types and origins of helicopter rotor noise is presented, and the aerodynamic environment of the helicopter main rotor, fundamental principles of the rotary wing, and broadband noise sources are considered. Emphasis is placed on the fact that the main influence on rotor noise is tip speed: slowing the rotor would reduce noise, but will require wider chord blades and/or a larger number of blades per rotor, and, in effect, increased weight and reduced payload. Attention is given to the multispeed rotor, rotor blade airfoils, tip shapes, and sweep of the entire blade section rearward. In addition, tail rotor noise is considered, as is the tilt rotor and the blade-vortex separation of the tandem rotor helicopter. J.P.B.

A80-32861 * # Some unique characteristics of supersonic cruise vehicles and their effect on airport community noise. C. Driver and D. J. Maglieri (NASA, Langley Research Center, Hampton, Va.). *American Institute of Aeronautics and Astronautics, International Meeting and Technical Display on Global Technology 2000, Baltimore, Md., May 6-8, 1980, Paper 80-0859*. 10 p. 23 refs.

The paper examines the differences between the supersonic and subsonic commercial aircraft in terms of their configuration, aerodynamic characteristics, propulsion systems, and the manner of operation. The unique characteristics of supersonic cruise vehicles should provide improved airport-community noise exposures if the vehicle is permitted to operate at its most efficient and effective flight modes. It is concluded that noise exposure levels for supersonic cruise vehicles can be comparable to those of its equivalent subsonic counterpart of that time period. A.T.

A80-32876 # The future of civil turbo-fan engines. A. G. Newton and J. F. Coplin (Rolls-Royce, Ltd., Aero Div., Derby, England). *American Institute of Aeronautics and Astronautics, International Meeting and Technical Display on Global Technology 2000, Baltimore, Md., May 6-8, 1980, Paper 80-0893*. 11 p.

The paper describes the methods by which the current performance of civil turbo-fan engines has been achieved, with special emphasis on the work being undertaken for the future. The discussion covers the importance of fuel efficiency; optimization for low airline costs; the RB 211 3-shaft turbo-fan engine design objectives; the 3-shaft concept; modular development; engine fuel efficiency; historic trends in specific fuel consumption, specific weight and thrust; new engine designs; cost-effective and energy-efficient engine; hollow titanium fan; Kevlar containment; unshrouded HP turbine; LP/IP turbine module; core compressor technology; exhaust mixing; combustion technology; building blocks in the fuel-efficient engine technology program; low specific thrust for improved fuel consumption; prop-fan and related problems; small/

intermediate engines; and future fuel situation where worthwhile gains are achievable. S.D.

A80-32882 # Long range very large aircraft supply system for civil/military application with special emphasis on water-based aircraft. C. Dornier, Jr. (Dornier GmbH, Friedrichshafen, West Germany). *American Institute of Aeronautics and Astronautics, International Meeting and Technical Display on Global Technology 2000, Baltimore, Md., May 6-8, 1980, Paper 80-0903*. 11 p. 6 refs.

Very large transport aircraft appear to be indispensable for both civil and military use in the 1990s. The paper discusses parameters for the design of very large aircraft supply systems (VLASSs), for civil and military markets, concept of a VLASS, and project realization. The water-based aircraft has advantages over the land-based aircraft because it is, to a large extent, independent of an infrastructure. The kite configuration seems to be the best solution. VLASS with a takeoff weight of the order of 1000 t appear to be a future necessity, both for civil and military operations. Such a system could drastically reduce military deployment times and contribute to the credibility of deterrence. S.D.

A80-32887 * # Aeropropulsion in year 2000. R. J. Weber (NASA, Lewis Research Center, Cleveland, Ohio). *American Institute of Aeronautics and Astronautics, International Meeting and Technical Display on Global Technology 2000, Baltimore, Md., May 6-8, 1980, Paper 80-0914*. 11 p. 5 refs.

The paper demonstrates that many advances can be anticipated in propulsion systems for aircraft in the next 20 years. A survey is presented of probable future engine types, including convertible engines for helicopters, turboprops for fuel efficient airliners, and variable cycle engines for supersonic transports. Also examined is the use of rotary engines in general aviation aircraft. Finally, a review is given of related technology improvements in propellers, materials, noise suppression, and digital electronic controls. M.E.P.

A80-32888 # Technology requirements as derived from accident rate analysis. W. Graham (Questek, Inc., Centerport, N.Y.). *American Institute of Aeronautics and Astronautics, International Meeting and Technical Display on Global Technology 2000, Baltimore, Md., May 6-8, 1980, Paper 80-0918*. 11 p.

The paper deals with air carrier approach and landing accidents, general aviation safety, and near midair collision analysis. The exposure is unknown because no one attempts to keep track of the relevant conditions in uneventful flights in which there were no accidents. The accident can be calculated whenever the exposure can be estimated by direct or inferential methods. The estimated accident rates suggest many ways in which technological improvements can contribute to safety. S.D.

A80-32890 # Technology to increase airport capacity. R. M. Harris (Mitre Corp., Metrek Div., McLean, Va.). *American Institute of Aeronautics and Astronautics, International Meeting and Technical Display on Global Technology 2000, Baltimore, Md., May 6-8, 1980, Paper 80-0920*. 6 p. 15 refs. U.S. Department of Transportation Contract No. FA80WA-4370.

Technological approaches and operational procedures currently under development by the FAA to increase airport capacities and efficiencies are summarized. Consideration is given to runway configuration management systems, separate short runways for general aviation, dependent IFR runway operations, specialized MLS applications to such areas as missed approach situations, reductions in IFR final approach spacing and integrated flow management. It is concluded that more sophisticated levels of integrated flow management, starting from the current en route metering programs, will be required to obtain maximal terminal flow efficiency and system coordination. A.L.W.

A80-32897 * # Technology requirements and readiness for very large aircraft. D. W. Conner and J. C. Vaughan, III (NASA, Langley Research Center, Systems Analysis Branch, Hampton, Va.).

American Institute of Aeronautics and Astronautics, International Meeting and Technical Display on Global Technology 2000, Baltimore, Md., May 6-8, 1980, Paper 80-0935. 13 p. 20 refs.

The technology requirements for designing, manufacturing and operating any vehicle depend largely on the configuration of that vehicle. Under the general heading of Very Large Aircraft (VLA), configurations are many and varied, so, therefore, are the technology requirements. The present work is limited to technology requirements of particular interest to VLA. While many are of common interest, a few technology requirements critical to specific VLA types are also covered. Addressed in turn are common VLA concerns and how they influence configurations and technology; the methodology followed in selecting requirements and assessing readiness; the resultant technology requirements and readiness; and some overall observations regarding technology areas judged to be particularly critical. Over 50 technology requirements are identified as unique or particularly critical to VLA. However, none of the requirements is considered to have an excellent state of technology readiness. S.D.

A80-32898 # Advanced high speed commercial aircraft - 2000. R. L. Maxwell and L. V. Dickinson, Jr. (U.S. Congress, Office of Technology Assessment, Washington, D.C.). *American Institute of Aeronautics and Astronautics, International Meeting and Technical Display on Global Technology 2000, Baltimore, Md., May 6-8, 1980, Paper 80-0937*. 9 p. 10 refs.

The potential of introducing advanced high-speed commercial transports is examined on technological, energy, economics and environmental bases in the 2000 timeframe. Emphasis is placed on subsonic and supersonic aircraft for the transoceanic market. The most compelling argument for an advanced supersonic transport (AST) is improved aircraft productivity-seat-miles generated by an aircraft per unit time. Societal concerns about AST are also discussed. S.D.

A80-32899 # Air transportation 2000 - A challenge for new technology. R. Abraham (Deutsche Lufthansa AG, Frankfurt am Main, West Germany). *American Institute of Aeronautics and Astronautics, International Meeting and Technical Display on Global Technology 2000, Baltimore, Md., May 6-8, 1980, Paper 80-0945*. 12 p.

The next generation of air transportation is discussed in terms of fuel, technology and the air transportation infrastructure. The development of new fuel and combustion technologies are considered, as well as future progress from engine manufacturers regarding higher propulsive efficiency. Attention is given to the potential for aerodynamic improvements in winglets, increased aspect ratios and the provision of laminar flow by natural or artificial means. Also discussed are advanced flight avionics, the use of composite structures, and the improvements required in ground terminal installations. J.P.B.

A80-33105 # CLST's wing-in-ground effect vehicles (Ekranoloty CLST). S. T. Czerniawskij. *Technika Lotnicza i Astronautyczna*, vol. 35, Mar. 1980, p. 5-12. In Polish.

Experimental and conceptual designs of domestic and foreign wing-in-ground effect vehicles are reviewed. Comparisons of power versus speed and weight are made, and some conclusions are drawn concerning the future of wing-in-ground effect vehicle technology and its applications. V.P.

A80-33106 # Selective methods of determining the range of engine operation in aircraft crash investigations. I (Wybrane metody określenia zakresów pracy silnika podczas badania wypadków lotniczych. I). S. Andruszkiewicz, J. Borgon, and M. Stukonis. *Technika Lotnicza i Astronautyczna*, vol. 35, Mar. 1980, p. 16-18. In Polish.

The paper deals with methods of analyzing the state of an aircraft engine at the moment preceding a crash. The discussion covers means of analyzing onboard recordings, analyzing the color of oxide films at fracture surfaces, analyzing the state of blades and the

mechanical properties of the metal, etc. Metallographic, X-ray, spectral, and micrometric methods are examined. V.P.

A80-33107 # Numerical design and optimization of propellers. II (Numeryczne projektowanie i optymalizacja śmigiel. II). *Technika Lotnicza i Astronautyczna*, vol. 35, Mar. 1980, p. 25-28. In Polish.

The computer program under consideration incorporates two subroutines, one of which defines the propeller characteristics while the other uses a gradient technique to optimize these characteristics. For illustration, the program is applied to the optimization of NACA 4 propeller efficiency. V.P.

A80-33108 # Problems involved in the detection of aircraft defects (Problemy wykrywania usterek samolotow). A. Kiezelis. *Technika Lotnicza i Astronautyczna*, vol. 35, Mar. 1980, p. 29-31. In Polish.

The paper deals with methods of detecting faulty design features, manufacturing defects, and malfunctions resulting from such defects or from improper operational conditions. Some factors leading to defects are examined, and the influence of such factors as the number and intervals of inspection, aircraft service time, number of flight hours, and number of takeoffs and landings is examined. V.P.

A80-33121 Active control of rotor blade pitch for vibration reduction - A wind tunnel demonstration. J. Shaw and N. Albion (Boeing Vertol Co., Philadelphia, Pa.). *Vertica*, vol. 4, no. 1, 1980, p. 3-11. 8 refs.

A significant advance in the technology of helicopter rotor control has been demonstrated in the Boeing V/STOL Wind Tunnel. An automatic control system suppressed vibratory hub loads using only small amounts of oscillatory swashplate motion. The closed loop control system simultaneously suppressed up to 90% of the 4/rev vertical force, pitching moment, and rolling moment of a 3.05-m (10-ft) dia, four-bladed hingeless rotor. The system operated successfully in a wide range of flight conditions including transition and autorotation. Response time to cancel sudden changes of vibration level was very short, about two rotor revolutions. Thus the system will be able to suppress vibration of a flight vehicle even during maneuvers and gusty conditions. The system, although demonstrated on a hingeless rotor, is also applicable to articulated single and tandem rotor configurations. (Author)

A80-33122 Future of helicopter rotor control. M. Kretz and M. Larché (Giravions Dorand Industries, Suresnes, Hauts-de-Seine, France). (*Netherlands Association of Aeronautical Engineers and National Lucht- en Ruimtevaartlaboratorium, European Rotorcraft and Powered Lift Aircraft Forum, 5th, Amsterdam, Netherlands, Sept. 4-7, 1979.*) *Vertica*, vol. 4, no. 1, 1980, p. 13-22. 7 refs.

The projection into the future of past achievements in the field of rotor control shows an ever increasing use of feedback techniques to extend the helicopter flight envelope. Limitations of the present monocyclic swashplate will have to be overcome by the use of new types of control. The paper presents experimental and theoretical results of research directed towards the extensive use of active control. It discusses self-adaptive automatic systems for reducing vibration and stress levels at high load factors and high speeds. Tests on stall barrier feedback show the effectiveness of sensing the local pressure distribution over the blades of a rotor to remove stall from the normal working conditions of a rotor. Fast response action is used to absorb aerodynamic disturbances and gust effects. Rotor instabilities can be entirely eliminated. New types of control required by this technique result in the elimination of present swashplate and mechanical controls by the installation of fast-response electrohydraulic actuators on the rotating part of the rotor and by the introduction of electrical transmission of control signals. (Author)

A80-33123 * The promise of multicyclic control. J. L. McCloud, III (NASA, Ames Research Center, Moffett Field, Calif.).

Vertica, vol. 4, no. 1, 1980, p. 29-41. 17 refs.

The rough ride a helicopter endures is known to be self-generated. This roughness results in fatiguing blade loads and vibration which can be eliminated or greatly reduced by multicyclic control. Rotor performance may also be improved. Several types of rotors which have employed multicyclic control are reviewed and compared. Their differences are highlighted and their potential advantages and disadvantages are discussed. The flow field these rotors must operate in is discussed, and it is shown that simultaneous elimination of vibration and oscillatory blade loads is not an inherent solution to the roughness problem. The use of rotor blades and energy absorbers is proposed. Input-output relations are considered and a gain control for ROMULAN, a multicyclic controlling computer program, is introduced. Implications of the introduction of multicyclic systems into helicopters are also discussed. (Author)

A80-33135 Flight simulation techniques - The quest for realism. J. Rhea. *High Technology*, May 1980, p. 7-10.

Computer image generation (CIG) techniques for simulating flight situations in real time have been criticized for offering limited pictorial realism. The CIG techniques are reaching beyond flight simulation into maritime training and commercial animation. Their use has proven too expensive for automobile driver training and arcade games. Computer-generated images are accused of being too stylized, too cartoonish, too unnatural. Given that effective training can be achieved with the real system in the real environment, it follows that a simulation providing 100 percent realism would unquestionably provide effective training. New algorithms and improved hardware are complementing dynamic realism with textures, contours and shadows. S.D.

A80-33177 # Navigation for a group of aircraft /Automation of data processing and flight control procedures/ (Mezhsamoletnaia navigatsiia /Avtomatizatsiia zadach obrabotki dannykh i upravleniia poletom/). V. G. Tarasov. Moscow, Izdatel'stvo Mashinostroeniye, 1980. 184 p. 21 refs. In Russian.

In this book, the principles of designing group navigation systems and subsystems are discussed, along with the theory of system automation. Particular attention is given to the synthesis of optimal and suboptimal algorithms for processing statistical data, generated by the information sources of the system, and to algorithms of guidance and control within a formation. The dynamics of an aircraft formation is examined. V.P.

A80-33274 * # Modern fluid dynamics of subsonic and transonic flight. P. J. Bobbitt (NASA, Langley Research Center, Subsonic-Transonic Aerodynamics Div., Hampton, Va.). *American Institute of Aeronautics and Astronautics, International Meeting and Technical Display on Global Technology 2000, Baltimore, Md., May 6-8, 1980, Paper 80-0861.* 39 p. 65 refs.

The paper discusses a number of factors, termed research drivers, which are expected to provide much of the stimulus for research in the subsonic and transonic flight regimes in the coming decade. The research drivers discussed comprise the need for energy efficiency, new and improved facilities, better instrumentation, more capable and efficient computers, theoretical methodology refinements, increased use of optimization techniques, and military requirements. Illustrations of advances in aircraft aerodynamics at subsonic and transonic speeds are presented, along with a discussion of future research opportunities and trends. Particular attention is given to airfoil and basic fluids research designed to reduce skin-friction drag. S.D.

A80-33275 * # Modern fluid dynamics of supersonic and hypersonic flight. R. L. Trimpi (NASA, Langley Research Center, High-Speed Aerodynamics Div., Hampton, Va.). *American Institute of Aeronautics and Astronautics, International Meeting and Technical Display on Global Technology 2000, Baltimore, Md., May 6-8, 1980, Paper 80-0862.* 37 p. 85 refs.

Many aspects of fluid dynamics impacting supersonic and hypersonic flight are examined. Progress, current problem areas, and prognostications for the future are discussed, with special emphasis on those fluid dynamics facets which can be more directly tied to a potential end-product vehicle. Numerous illustrative examples are included. S.D.

A80-33276 # Theoretical investigation of the aerodynamics of double membrane sailing airfoil sections. H. Murai (Tohoku University, Sendai, Japan) and S. Maruyama. *Journal of Aircraft*, vol. 17, May 1980, p. 294-299. 11 refs.

The sailing has many special characteristics due to its flexible structure. In order to estimate the sailing performance theoretically, a numerical analysis method is presented for obtaining aerodynamic characteristics and profile forms of a sailing with a rounded leading edge and upper and lower individual surface shapes. The trailing edge is fixed and membranes are not stretched by tension although they have slackness. Through numerical examples, it is shown that a sailing of this type has a completely different pressure distribution from that of a single membrane sailing with a leading edge of the circular cylinder or oval type. The latter has shape peaks in the pressure distribution which may have undesirable effects on the sailing performance. These peaks in the pressure distribution can be removed by adopting a D-spar leading edge of some kind. (Author)

A80-33280 # Note on the yawing moment due to side slip for swept-back wings. B. N. Pamadi and T. G. Pai (Indian Institute of Technology, Bombay, India). *Journal of Aircraft*, vol. 17, May 1980, p. 378-380. 6 refs.

Babister (1961) has derived an expression for the yawing moment coefficient due to side slip for sweptback wings having no dihedral. The present note points out that the effect of the relative change in dynamic pressure over the wings due to side slipping flow should not be ignored, whereas Babister has disregarded it. This effect, demonstrated by a numerical example, can be quite large, particularly for highly sweptback wings. It is shown that the terms not considered by Babister are important and their contribution to wing yawing moment is quite significant. S.D.

A80-33282 # Experimental investigation of the two-dimensional asymmetrical turbulent wake behind a blade. M. A. Ghazi, K. A. Fathalah (King Abdulaziz University, Jeddah, Saudi Arabia), M. I. Rashed (Cairo, University, Cairo, Egypt), and R. M. El-Taher (King Abdulaziz University, Jeddah, Saudi Arabia; Cairo, University, Cairo, Egypt). *Journal of Aircraft*, vol. 17, May 1980, p. 382-384. NSF Grant No. OIP-74-21450.

Low-speed wind tunnel (working section 0.4 x 0.4 m) results are presented and discussed for turbulence measurements of the asymmetric turbulent 'near wake' of the cambered airfoil 10C4/30C50. Some important characteristics of the asymmetric wake flow behind a blade are identified. Major conclusions are that (1) the distribution of turbulence at any streamwise location is asymmetric and has two peaks at the upper and lower sides of the wake, which tend to be smoothed into one peak relatively far from the trailing edge; and (2) the actual turbulence intensity normalized by its maximum falls on two curves for the two regions of the wake having positive and negative static pressure gradient. S.D.

A80-33292 Emergency landings on a carpet of foam. L. Scheichl. *Airport Forum*, vol. 10, Apr. 1980, p. 35, 36, 39 (3 ff.). 5 refs.

Emergency landing by aircraft with faulty landing gear on carpets of foam laid out on a runway is studied. The theoretical and experimental fundamentals of foaming techniques are reviewed with attention given to the characteristics of the various types of foam. Foam equipment is discussed including runway foaming trailers and water trailers. V.T.

A80-33293 A matrix method for airport site evaluation. D. C. Koussios (Greek Air Force Academy, Athens, Greece). *Airport Forum*, vol. 10, Apr. 1980, p. 53-57.

The paper describes a site analysis procedure which can simplify the choice of an airport location. The primary factor of the analysis is an airport location checklist matrix which provides a systematic, mathematical evaluation of proposed sites. V.T.

A80-33294 The importance of runway capacity - An analytical approach. F. Collet (Service Technique des Bases Aériennes; Ecole Nationale de l'Aviation Civile, Paris, France). *Airport Forum*, vol. 10, Apr. 1980, p. 63-66. 15 refs.

The concept of runway capacity is discussed with emphasis placed on term definitions. Attention is given to time elements, average service and capacity times, and runway system configuration. V.T.

A80-33825 Gasdynamic analysis of gas-turbine combustion chambers with graduated air admission. G. N. Liubchik, V. A. Khristich, and V. P. Kuts (Kievskii Politeknicheskii Institut, Kiev, Ukrainian SSR). (*Energetika*, vol. 21, Mar. 1978, p. 68-74.) *Fluid Mechanics - Soviet Research*, vol. 8, July-Aug. 1979, p. 129-136. 7 refs. Translation.

The paper analyzes the effects of heat transfer and mass flowrate on the gas dynamics of air flow in the constant-cross-section chamber of a small gas-turbine power plant. The analysis is based on equations of continuity, state and heat and is valid for low values of supercharging. B.J.

A80-34154 Air Defense Ground environment - A case for automation. J. M. Tellez (Hughes Aircraft Co., Fullerton, Calif.). In: *Military Electronics Defence Expo '79; Proceedings of the Conference, Wiesbaden, West Germany, September 25-27, 1979.* Cointrin, Geneva, Switzerland, Interavia, S.A., 1979, p. 34-53.

The principal operations in a manual Air Defense Ground environment (ADGE) system are described as well as those in an automated ADGE system. The advantages to be obtained by automating the ground environment are summarized. The command and control functions which can derive significant benefits from computer aids are discussed. Trends in ADGE are outlined. V.T.

A80-34156 Survivable C3. D. Shore (RCA, Government Systems Div., Moorestown, N.J.). In: *Military Electronics Defence Expo '79; Proceedings of the Conference, Wiesbaden, West Germany, September 25-27, 1979.* Cointrin, Geneva, Switzerland, Interavia, S.A., 1979, p. 81-94.

The paper discusses the survivability problems of command, control, and communication (C3) centers. Consideration is given to versatile terminals, data processing, interior communications, and integration into a system. Sensors are briefly described and affordability and capability/flexibility payoffs are outlined. V.T.

A80-34157 IFF for air defence aircraft. D. G. Stewart (Cossor Electronics, Ltd., Harlow, Essex, England). In: *Military Electronics Defence Expo '79; Proceedings of the Conference, Wiesbaden, West Germany, September 25-27, 1979.* Cointrin, Geneva, Switzerland, Interavia, S.A., 1979, p. 109-124.

The operating principles and requirements of an Identification Friend or Foe (IFF) system are discussed. Consideration is given to an airborne IFF interrogator, primary radar, and secondary radar. Emphasis is placed on target resolution and aircraft system and problem areas including a radome effect, radar correlation, and feeder cables. Automatic code changing is outlined and flight trials are described. V.T.

A80-34158 The modular survivable radar. M. E. Davis (General Electric Co., Aircraft Equipment Div., Utica, N.Y.). In:

Military Electronics Defence Expo '79; Proceedings of the Conference, Wiesbaden, West Germany, September 25-27, 1979. Cointrin, Geneva, Switzerland, Interavia, S.A., 1979, p. 125-132.

A modular survivable radar concept based on LSI circuits and microwave integrated circuits technologies is discussed. To illustrate the applications of standard radar modules, two distinct systems have been examined. One has applications to tactical battlefield surveillance and includes eight auxiliary channels for ECCM cancellation. The other is a multimode air-to-air and air-to-ground radar for lightweight fighters. V.T.

A80-34159 Airborne radar coherent transmitters. A. Hainer (Telefonaktiebolaget L. M. Ericsson, Molndal, Sweden). In: Military Electronics Defence Expo '79; Proceedings of the Conference, Wiesbaden, West Germany, September 25-27, 1979. Cointrin, Geneva, Switzerland, Interavia, S.A., 1979, p. 133-145.

The L.M. Ericsson Wigen radar programs is described. The radar uses transmitters with coupled cavity traveling wave tubes. Consideration is given to the transmitter design including functional description and mechanical layout. High voltage technology employed and testing and field experience are outlined. V.T.

A80-34163 Experiences of a 50 MBPS video recording and processing system for FLIR images. B. Olsson (Telefonaktiebolaget L. M. Ericsson, Molndal, Sweden). In: Military Electronics Defence Expo '79; Proceedings of the Conference, Wiesbaden, West Germany, September 25-27, 1979. Cointrin, Geneva, Switzerland, Interavia, S.A., 1979, p. 220-235.

Operational experience obtained with a high-bit-rate airborne data acquisition and recording system and a ground-based data processing and evaluation system for forward-looking infrared radar (FLIR) data is reported. The airborne system, located on a strike aircraft, is a record-only system consisting of a data acquisition unit, a digital interface unit, a tape recorder and a remote control unit capable of recording a digital video signal, flight data and FLIR tests signals at a total rate of 50 Mbit/sec. The ground system, is comprised of a data recorder/reproducer, data recorder, a multi-purpose digital interface unit, FLIR and radar data control units, a minicomputer, graphic and video display systems and a digital image memory. In the course of about 70 flights, the airborne system exhibited 47 faults, only 11 of which lead to unsuccessful flights, and was found to meet the performance specifications. During the period of operation from May 1977 to July 1979, the ground system experienced 67 faults, predominantly in the first year of operation, and has performed well for quick-look and performance evaluations, although slowly in image processor simulations. A.L.W.

A80-34166 A broadband, circularly polarized, phase steered array. L. Josefsson (Telefonaktiebolaget L. M. Ericsson, Molndal, Sweden). In: Military Electronics Defence Expo '79; Proceedings of the Conference, Wiesbaden, West Germany, September 25-27, 1979. Cointrin, Geneva, Switzerland, Interavia, S.A., 1979, p. 273-284. 5 refs.

A broadband phased array antenna capable of + or - 60 deg beam steering developed for ECM jamming systems is reported. The antenna consists of an array of 16 waveguide radiators with linear polarization. This is transformed to circular polarization by a wire grid polarizer positioned in front of the array. V.T.

A80-34169 Electronically steered antennas. M. H. Carpenter (Thomson-CSF, Paris, France) and S. Drabowitch (Thomson-CSF, Bagneux, Hauts-de-Seine, France). In: Military Electronics Defence Expo '79; Proceedings of the Conference, Wiesbaden, West Germany, September 25-27, 1979. Cointrin, Geneva, Switzerland, Interavia, S.A., 1979, p. 391-400.

The use of computer-controlled electronically steered antennas is discussed, which are superior to mechanically steered antennas in that maximum energy can be sent in directions where jamming or

clutter is substantial and less energy in clear directions, as well as with regard to the permanent control of parasitic radiation. Attention is given to obtaining the radiation pattern of a given radiating array, and to phase control with or without spurious side-lobes. Problems from phase errors resulting from the quantization of phase are considered, such as loss in gain, error in angular measurement, and the production of parasitic radiation. A description of phased-array radar antennas is given, including the problem of coupling between adjacent radiating elements, phase shifters (diode or ferrite), and connecting the transmitter-receiver to the phased array. J.P.B.

A80-34174 Airborne FLIR - Experiences from flight tests. L.-G. Larsson (Telefonaktiebolaget L. M. Ericsson, Molndal, Sweden). In: Military Electronics Defence Expo '79; Proceedings of the Conference, Wiesbaden, West Germany, September 25-27, 1979. Cointrin, Geneva, Switzerland, Interavia, S.A., 1979, p. 479-486.

The paper is a follow-up to the MEDE '77 presentation and outlines some experiences from flight tests with the Ericsson second-generation FLIR. The flight test system is briefly described. A FLIR system can be used in an attack aircraft for the following purposes (besides target detection): low-altitude flying aid, navigation aid, aid for taxiing, and aid for takeoff and landing in darkness. The FLIR penetrates haze, smoke and visual camouflage; this means improved performance against ground targets day and night. The flight test experiences as regards field of view, spatial resolution, thermal resolution, target detector function, and display function are summarized. Also described is the FLIR equipment. S.D.

A80-34175 VLSI/VHSI device technology. D. D. Buss (Texas Instruments, Inc., Dallas, Tex.). In: Military Electronics Defence Expo '79; Proceedings of the Conference, Wiesbaden, West Germany, September 25-27, 1979. Cointrin, Geneva, Switzerland, Interavia, S.A., 1979, p. 489-493.

Problems associated with the military use of LSI technology are discussed, such as high costs, risk, and time delay inherent in the development of custom ICs, large inventory requirements, and special high-reliability military qualifications. It is recommended that one abandon low-volume custom military LSI and develop microprocessor-type Programmable System Components (PSCs) for military signal processing which will be programmable for a broad spectrum of military missions and will be produced in volume by semiconductor manufacturers. V.L.

A80-34178 Frequency independent sidelobe suppression and lobesharpening using broad beam antennas. A. Torby (Saab-Scania AB, Linköping, Sweden). In: Military Electronics Defence Expo '79; Proceedings of the Conference, Wiesbaden, West Germany, September 25-27, 1979. Cointrin, Geneva, Switzerland, Interavia, S.A., 1979, p. 559-565.

The performance of ESM and radar warning systems is largely dependent on the antenna subsystem configuration, particularly when localization of received signals is concerned. The paper discusses how to design an antenna subsystem with appropriate signal processing to estimate accurate bearing angles to unknown signal sources under some restricted conditions. These conditions take into account the problem of false bearing indications due to strong signals outside the sector of interest and how to eliminate these false signals or at least reduce them to a negligible extent. Good angular accuracy is important but is of no use unless false bearings are sufficiently suppressed. S.D.

A80-34179 Advanced digital data processing for onboard missile guidance and control. F. F. J. Kilger (Messerschmitt-Bölkow-Blohm GmbH, Ottobrunn, West Germany). In: Military Electronics Defence Expo '79; Proceedings of the Conference, Wiesbaden, West Germany, September 25-27, 1979. Cointrin, Geneva, Switzerland, Interavia, S.A., 1979, p. 575-596.

A digital data processing system MODUS developed for onboard missile guidance and control is described. Consideration is given to

long lifetime of system architecture, flexibility, reliability, and clear functional concept. Bus concept, bus implementation, fault-tolerant structures, and interfaces are outlined. It is noted that the MODUS concept permits direct information transfer from module to module, decentralized processing, and realization of the system with many autonomous modules (multiprocessing). V.T.

A80-34180 **Midcourse guidance for fire and forget missile - Modification of present homing missile.** H. Kuno, H. Nakajima, and Y. Ueno (Tokyo Shibaura Electric Co., Ltd., Kawasaki, Japan). In: Military Electronics Defence Expo '79; Proceedings of the Conference, Wiesbaden, West Germany, September 25-27, 1979.

Cointrin, Geneva, Switzerland, Interavia, S.A., 1979, p. 597-608, 7 refs.

The flight between firing and the seeker lock-on is termed the midcourse guidance. The increasing demand for fire-and-forget operation requires the modification of the present inventory to have midcourse guidance. The homing missile is fired after the target is locked on by the seeker, whereas the fire-and-forget missile is fired toward the collision point, and during that flight the seeker locks on the target. Midcourse flight path can have the shape of any curve, but the straight line is preferable for it gives the shortest flight time before lock-on, thereby minimizing the errors caused by dispersion bias and target maneuver. The paper describes lock-on probability and the details of a straight-line autopilot. This autopilot can be modified from the present inventory by replacing rate gyros with better static balance and the addition of integrating circuit to the rate gyro output. S.D.

A80-34185 **Aurora /CP-140/ aircraft operational software system.** L. D. Christie (Department of National Defence, Ottawa, Canada). In: Military Electronics Defence Expo '79; Proceedings of the Conference, Wiesbaden, West Germany, September 25-27, 1979.

Cointrin, Geneva, Switzerland, Interavia, S.A., 1979, p. 754-767, 7 refs.

The Aurora (CP-140) aircraft operational software system is presented, discussing in detail acquisition, costs, reliability, efficiency and testing. The aircraft is intended to gather information of a military and civilian nature required to support the commitments of the Government of Canada. This includes ASW, the ability to gather evidence on illegal maritime events off a coast of Canada and the ability to locate and help rescue persons or vehicles lost at sea or in any other area. The operational system includes separate routines operating on airborne and ground-based computers, noting hardware design avionics (acoustic and non-acoustic sensors), data storage (64 K words), interfaces, etc. The aircraft will be operational by 1981.

O.L.

A80-34187 **Laser Target Marker /designator/ and Ranger.** S. D. Lazenby (Ferranti, Ltd., Electro-Optics Group, Edinburgh, Scotland). In: Military Electronics Defence Expo '79; Proceedings of the Conference, Wiesbaden, West Germany, September 25-27, 1979.

Cointrin, Geneva, Switzerland, Interavia, S.A., 1979, p. 846-858.

The system is based on the use of a neodymium YAG laser capable of firing at pulse repetition frequencies of 10 or 20 pulses per second. The higher frequencies are especially useful for operation with laser guided weapons. The output of the laser is injected into the combined sighting and transmit telescope. The module is accurately interfaced with the tripod support which is essential if precise bearing information is to be made available for the artillery role of the equipment. The complete system, including a spare battery, weighs 28 kg and is normally transported by two men, often with vehicle or helicopter support. V.L.

A80-34188 **A microprocessor controlled system for determining the height of clouds.** K. A. Roider (D. Swarovski und Co., Wattens, Austria) and J. Riegl (Dr. Johannes Riegl, Industrieunternehmen für Radartechnik und Elektrooptik, Trafenreith, Austria). In: Military Electronics Defence Expo '79; Proceedings of the Conference, Wiesbaden, West Germany, September 25-27, 1979.

Cointrin, Geneva, Switzerland, Interavia, S.A., 1979, p. 859-866. Research supported by the Forschungsförderungsfonds der gewerblichen Wirtschaft.

The methods for measuring cloud base height are reviewed, emphasizing equipment based on the principle of electro-optic (laser pulses) range measurement. The equipment consists of two units: the measuring module and the data processing and display module which may be installed apart but communicating by telephone line under the control of two microprocessors. The block diagrams for the modules are given and the basic scheme for the optical system of the transmitting and receiving stages is shown. In addition, the basic specifications, including those for the laser diode, optical system, and detector are listed. O.L.

A80-34189 **Design considerations for an active laser seeker.** E. S. Faris, R. D. Waltram (USAF, Armament Laboratory, Eglin AFB, Fla.), and N. L. Andrade (McDonnell Douglas Astronautics Co., Huntington Beach, Calif.). In: Military Electronics Defence Expo '79; Proceedings of the Conference, Wiesbaden, West Germany, September 25-27, 1979.

Cointrin, Geneva, Switzerland, Interavia, S.A., 1979, p. 867-873.

It is noted that in a visual range air-to-air dogfight mission, an active laser seeker (ALS) offers many potential advantages. The primary design tradeoffs which must be made in synthesizing a workable seeker, are described. An analysis is made which shows that a neodymium:YAG laser is the best available device for a near-term ALS application. Further, using the performance provided by this laser and a silicon avalanche detector, laser parameters for a hypothetical seeker are derived. Finally, it is concluded that the current technology of laser and detector devices provides a capability which is within that needed for a successful ALS design. M.E.P.

A80-34190 **A solid state /CCD/ cockpit television system.** M. Vicars-Harris (Fairchild Camera and Instrument Corp., Syosset, N.Y.). In: Military Electronics Defence Expo '79; Proceedings of the Conference, Wiesbaden, West Germany, September 25-27, 1979.

Cointrin, Geneva, Switzerland, Interavia, S.A., 1979, p. 882-896. Contract No. F33657-78-C-0484.

The performance characteristics and capabilities of the Cockpit Television Sensor (CTVS) system are discussed. The system provides a monochrome videotape record of aircraft and instruments, records cockpit audio data, and offers instant postflight evaluation along with the option of real-time display for two-seat aircraft. Two displays, such as HUD and radar, are simultaneously recorded on a single tape using a CTVS split-screen mode. The video sensor head of the CCD TV camera with a volume under 100 cu cm and an f/2.8 auto-iris lens having a 5,000 to 1 dynamic range, is a candidate for many applications besides recording the HUD. The split-screen control unit is found to effectively double the capability of the airborne video cassette-tape recorder with a modest tradeoff in horizontal resolution. L.M.

A80-34216 **Big-fan engines - A new US generation.** B. Sweetman. *Interavia*, vol. 35, May 1980, p. 411-414.

The latest generation of improved big fan high-bypass-ratio powerplants is surveyed, noting that the market for such engines is dominated by two U.S. manufacturers. It is shown that both the CF-6-80 and JT9D-7R4 engine families offer a combination of better specific fuel consumption and lower costs per flight cycle compared with earlier engines. Attention is also given to the market position of the two manufacturers and their differing approaches to technological development such as P&W's more radical process of single-crystal blade casting. M.E.P.

A80-34217 **New developments in US military fighter engines.** D. Boyle. *Interavia*, vol. 35, May 1980, p. 415-417.

The latest development trends in the U.S. F100 and F101 military fighter engines are discussed. Attention is given to the high performance (7.6 to 1 thrust to weight ratio) of the F100 engine which has led to a number of problems in terms of reliability and durability. It is shown that the F101 engine with a thrust to weight ratio of 7.3 to 1 is being developed with a greater emphasis on

reliability and long service life at the expense of light weight construction. However, with an expected thrust of 26-29,000 lb., the F101 will still supply a better aircraft thrust to weight ratio than the F100 in spite of its greater weight. Finally, the continuing development of the F100 and the Component Improvement Program are examined. M.E.P.

A80-34218 The DC-8 re-engining program. J. McGowen (Cammacorp, El Segundo, Calif.). *Interavia*, vol. 35, May 1980, p. 419-421.

The new-generation high bypass ratio engine (the CFM56) for the DC-8 should not only solve the noise problem but should also provide very significant fuel savings and greatly improved takeoff thrust, range, and other performance characteristics. This paper discusses the DC-8 re-engining program with respect to program organization, contract agreements, DC-8 modifications, cost and performance, increased range, and future CFM56 applications. B.J.

A80-34223 * Release-rate calorimetry of multilayered materials for aircraft seats. L. L. Fewell, J. A. Parker (NASA, Ames Research Center, Moffett Field, Calif.), F. Duskin, H. Speith, and E. Trabold (Douglas Aircraft Co., Long Beach, Calif.). *SAMPE Quarterly*, vol. 11, Apr. 1980, p. 8-13.

Multilayered samples of contemporary and improved fire-resistant aircraft seat materials were evaluated for their rates of heat release and smoke generation. Top layers with glass-fiber block cushion were evaluated to determine which materials, based on their minimum contributions to the total heat release of the multilayered assembly, may be added or deleted. The smoke and heat release rates of multilayered seat materials were then measured at heat fluxes of 1.5 and 3.5 W/cm². Abrasion tests were conducted on the decorative fabric covering and slip sheet to ascertain service life and compatibility of layers. (Author)

A80-34226 The automatization of the detection of collision risks for French air traffic control (L'automatisation de la détection des risques de collision pour le contrôle du trafic aérien Français). A. Printemps (Centre d'Études de la Navigation Aérienne, Orly Aérogare, Val-de-Marne, France). (*Société des Electriciens, des Electroniciens et des Radioélectriciens and Institut Français de Navigation, Journée d'Études sur l'Anticollision, Gif-sur-Yvette, Essonne, France, Nov. 14, 1979.*) *Navigation (Paris)*, vol. 28, Apr. 1980, p. 161-171. In French.

The concept of the safeguarding net is discussed, which warns the air traffic controller of any imminent conflicts. Attention is given to studies made to develop the system, its characteristics, actual state of advancement, and impact on the control of aircraft circulation. Utilizing radar, the position of aircraft is to be determined two minutes in advance. The two principal processes of the system are considered: the rough sorting stage, wherein every 10 seconds the entire field of active aircraft over the control center is reviewed, and the fine sorting stage, whereby the movement of any two possibly conflicting aircraft is forecast. J.P.B.

A80-34227 Optimal integrated inertial navigation: An actual example - The R.P.A. aircraft carrier reference system (La navigation inertielle intégrée optimale: Un exemple de réalisation - Le système de référence porte-avions R.P.A.). L. Camberlein and M. de Crémiers (Société d'Applications Générales d'Electricité et de Mécanique, Paris, France). (*Symposium sur la Localisation en Mer, Brest, France, Oct. 1979.*) *Navigation (Paris)*, vol. 28, Apr. 1980, p. 172-187. 5 refs. In French.

The principles and objectives of integrated navigation are outlined, and the criteria for selecting navigation sensors are indicated. Particular attention is given to inertial navigation, and the use and advantages of Kalman filters are discussed. In addition, the R.P.A. reference aircraft carrier is described, as is the integrated inertial navigation system used in the Alidade method for aligning the Super-Étendard inertial system on aircraft carriers. The inertial

technology, Kalman filtration, and software of the R.P.A. are considered. J.P.B.

A80-34234 # New mathematical formula for the cropduster operational cycle (Nowa formula matematyczna agrolotniczego cyklu operacyjnego). B. Gajewski and J. Sienkiewicz (Akademia Rolnicza, Szczecin, Poland). *Technika Lotnicza i Astronautyczna*, vol. 35, Jan. 1980, p. 11-13. In Polish.

An improved formula is proposed which takes into account the numerous factors that affect the amount and quality of cropduster operation. The formula permits quantitative analysis of the amount and quality of cropduster performance, determination of the minimal economically tenable agricultural areas to be serviced by one cropduster, determination of optimal airfield locations and many other factors pertinent to the efficiency of cropduster operation. V.P.

A80-34235 # Investigation of the stress distribution in the surface layer of aircraft engine components (Badania rozkładu napreżeń w warstwie wierzchniej elementów silników lotniczych). J. Lunarski and M. Korzynski (Rzeszow, Politechnika, Rzeszow, Poland). *Technika Lotnicza i Astronautyczna*, vol. 35, Jan. 1980, p. 14-16. In Polish.

A technological procedure is proposed for determining the distribution of circumferential and axial stresses in surface layers of specimens removed by arc cutting from blades, shafts, and other engine components. The configurations of the test specimens, the etching procedure, the stress measurement circuits, and the formulas for calculating circumferential and axial stresses are given. V.P.

A80-34236 # Fuel consumption per units of transport work in airliner operation (Zużycie paliwa na jednostki pracy przewozowej w procesie eksploatacji dużych samolotów pasażerskich). K. Rzemek. *Technika Lotnicza i Astronautyczna*, vol. 35, Jan. 1980, p. 28, 29. In Polish.

A method is proposed for calculating indices of fuel consumption per ton-kilometer and passenger-kilometer for passenger aircraft, such as IL 62 and DC 10-30. Mathematical expressions for the mean fuel consumption functions are derived for each of the two indices. V.P.

A80-34237 # Combustion-gas temperature sensors for turbine and turbojet engines (Czujniki do pomiaru temperatury gazów spalinowych w silnikach turbinowych i turbodrzutowych). A. Lesiuk. *Technika Lotnicza i Astronautyczna*, vol. 35, Jan. 1980, p. 30-33. 9 refs. In Polish.

Some aspects of the application of thermoelectric sensors to in-flight exhaust-gas temperature measurements for turbojet and turbine engines are discussed. The reciprocal action of some metrological parameters is examined with particular reference to the dynamic properties, reliability, and stability of the sensors. V.P.

A80-34238 # Influence of external conditions on the generation and intensity of vortices at air-intakes (Wpływ warunków zewnętrznych na powstawanie i nateżenie wirów przedwlotowych). R. Szczepanik. *Technika Lotnicza i Astronautyczna*, vol. 35, Jan. 1980, p. 34, 35. In Polish.

The paper reviews the results of experiments carried out to study the influence of the meteorological conditions at the airport on generation and dynamics of vortices at air-intakes. The influence of the wind direction on vortex geometry and parameters is examined, along with the range of vortex displacement as a function of the wind parameters. V.P.

A80-34298 # Advanced research on helicopter blade airfoils. J.-J. Thibert (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France) and J. Gallot (Société Nationale Industrielle Aérospatiale, Marignane, Bouches-du-Rhône, France). (*European Rotorcraft and*

Powered Lift Aircraft Forum, 5th, Amsterdam, Netherlands, Sept. 4-7, 1979.) ONERA, TP no. 1979-120, 1979. 11 p. 7 refs.

ONERA and Aérospatiale have undertaken a joint program for defining advanced airfoils for helicopter rotor blades. Three airfoils with a thickness to chord ratio of 7 percent, 9 percent and 12 percent respectively have been defined to specifications suited to the position of the airfoil along the blade span. The characteristics and performance data determined from wind-tunnel testing are presented and compared with those of other known airfoils and with the figures expected from computation methods. Construction of model rotors has been decided for testing this new generation of airfoils; experiments carried out in S1 wind tunnel in Modane allowed confirmation of the expected gains. These tests were complemented by in-flight testing of a set of blades with the OA209 airfoil on Dauphin helicopter. The complete set of results has guided the optimization of blades intended for use on Dauphin or Ecureuil series. (Author)

A80-34351 A study of the stress-strain state of shaped hollow blades for radial superchargers. V. A. Pukhlii and V. K. Borisov (Tsentral'nyi Nauchno-Issledovatel'skii i Proektno-Eksperimental'nyi Institut Promyshlennykh Zdanii i Sooruzhenii, Moscow, USSR). (*Problemy Prochnosti*, Sept. 1979, p. 93-96.) *Strength of Materials*, vol. 11, no. 9, May 1980, p. 1040-1045. 6 refs. Translation.

The paper examines strength calculations of hollow shaped blades of radial superchargers. The analytical solution of the boundary value problem for a system of elliptic equations, which describe the stress-strain state of a blade, is constructed on the basis of the integral correlation method and the method of successive approximations. The calculated results were within 15 to 20% of strain gage measurements of an operating supercharger blade. A.T.

A80-34386 Aeroacoustics (Aeroakustika). Edited by A. V. Rimskii-Korsakov. Moscow, Izdatel'stvo Nauka, 1980. 144 p. In Russian.

The paper deals with the characteristics of aerodynamic noise and methods of suppressing it. The theoretical and experimental investigations described deal with the excitation and propagation of sound in air ducts with sound-absorbing liners; nonlinear interactions between flows and sound waves in air ducts; interactions between air and fan-generated flows, as sources of turbulent noise; and various means of suppressing oscillations in combustion chambers. Noise generated by airliners and supersonic transports is examined. V.P.

A80-34387 # Noise characteristics of supersonic passenger planes (Akusticheskie kharakteristiki sverkhzvukovykh passazhirskikh samoletov). A. G. Munin, G. A. Cheremukhin, and R. A. Shipov. In: *Aeroacoustics*. Moscow, Izdatel'stvo Nauka, 1980, p. 3-12. In Russian.

In the present paper, the noise characteristics of a supersonic transport are studied as a function of the craft's performance and specifications. The results of a parametric analysis of the influence of noise abatement measures on the parameters of the airplane are examined, showing that the noise-optimal cruising parameters differ appreciably from the fuel-optimal parameters. The noise-generating features of an SST and methods of reducing noise are discussed. It is shown that substantial noise abatement can be achieved by increasing the L/D ratio and by using variable-cycle engines. V.P.

A80-34388 # Propagation of acoustic waves in a nonuniformly heated medium (Rasprostraneniye akusticheskikh voln v neravnomerno nagretoi srede). V. I. Bashmakov, A. I. Maiorov, V. P. Panov, E. L. Spektor, and R. A. Shipov. In: *Aeroacoustics*. Moscow, Izdatel'stvo Nauka, 1980, p. 12-18. In Russian.

The paper deals with the influence of temperature gradients in the atmospheric boundary layer on the propagation of aircraft-generated sound waves. A numerical method for integrating a two-dimensional wave equation for an unbounded weakly inhomogeneous medium is proposed. Temperature gradients in a hydrostatically stable atmosphere are shown to have a very slight effect on the parameters of a sound field. V.P.

Temperature gradients in a hydrostatically stable atmosphere are shown to have a very slight effect on the parameters of a sound field. V.P.

A80-34396 # Determining the optimal fan silencer design of aircraft engines (Vybc. optimal'noi konstruktsii glushitelia shuma ventilatora silovoi ustanovki samoleta). E. G. Maslova and Z. N. Naumenko. In: *Aeroacoustics*. Moscow, Izdatel'stvo Nauka, 1980, p. 73-78. 5 refs. In Russian.

It is proposed to determine the geometrical parameters of an optimal silencer on the basis of models constructed from the given aeroacoustic characteristics of the source. Knowing the modeling scale, it is then possible to determine the modes of operation of the model fan stage for use in designing silencer versions. Expressing the experimental data in the form of relations between the attenuation of the various noise components of the fan and the input impedance of the silencer, the impedance value can be determined at which the reduction of fan noise for a given channel geometry is maximal. V.P.

A80-34398 # Experimental study of fan-noise silencers of aircraft turbojet engines (Eksperimental'noe issledovanie glushitelei shuma ventilatorov aviatsionnykh turboreaktivnykh dvigateli). A. A. Bezgreshnov, S. B. Bogomolov, M. N. Solov'eva, and Iu. D. Khaletskii. In: *Aeroacoustics*. Moscow, Izdatel'stvo Nauka, 1980, p. 93-100. In Russian.

A compressor test stand with silencing and reverberation chambers was used to test silencers of fan suction and exhaust noise, of the type used in turbojet engines. The honeycomb fillers of the silencers differed in their comb depth and the number and diameter of the perforations. The results obtained at suction Mach numbers ranging from 0.3 to 0.7 and exhaust Mach numbers from 0.1 to 0.3 are diagrammed and discussed. V.P.

A80-34399 # Experimental investigation of sound absorption in a flow-carrying channel with a sound-absorbing lining (Eksperimental'noe issledovanie pogloshcheniya zvuka v kanale so zvukopogloshchayushchei oblitsovkoj pri nalichii potoka). Iu. D. Khaletskii and R. A. Shipov. In: *Aeroacoustics*. Moscow, Izdatel'stvo Nauka, 1980, p. 101-108. 7 refs. In Russian.

A test facility incorporating a double reverberation chamber is described, using which the spectral characteristics of sound absorption in the intake and exhaust ducts of turbomachines can be determined by means of a strain energy method. The potentialities of the facility are illustrated by analyzing test data obtained with various aircraft silencers. V.P.

A80-34400 # Suppression of self-oscillations in combustion chambers by means of resonance sound absorbers (Podavlenie avtokolebaniy v kamere sgoraniya rezonansnymi zvukopoglotiteli). V. I. Kondrat'ev and A. L. Sushkov. In: *Aeroacoustics*. Moscow, Izdatel'stvo Nauka, 1980, p. 109-111. In Russian.

In the present experiment, resonance sound absorbers were studied using a jet-engine combustion chamber. It proved possible to develop Helmholtz-resonator absorbers capable of suppressing the lowest longitudinal-tangential mode of pressure fluctuations at frequencies of 3.2 kHz. Some effective means of suppressing self-oscillations are pointed out. V.P.

A80-34402 # Acoustic effects on the flow and the noise spectrum of supersonic jets (Akusticheskoe vozdeistvie na techeniye i spektr shuma sverkhzvukovykh strui). G. I. Eremin and V. I. Kondrat'ev. In: *Aeroacoustics*. Moscow, Izdatel'stvo Nauka, 1980, p. 119-123. In Russian.

The effect of sound oscillations on supersonic ($M = 1.2$ to 2.5) jets was studied experimentally at frequencies between 10 and 19.5 kHz and sound pressures ranging from 170 to 176 dB. The effect of sound oscillations is found to depend on the intensity of the external sound source, the excitation frequency, and the position of the excitation zone with respect to the nozzle exit section. It is shown that the acoustic effect on a supersonic jet increases when the

excitation zone is close to the nozzle and the frequency of the external sound source is low. V.P.

A80-34403 # Model studies of acoustic resonators (Model'nye issledovaniia akusticheskikh rezonatorov). A. L. Sushkov. In: *Aeroacoustics*. Moscow, Izdatel'stvo Nauka, 1980, p. 124-131. 7 refs. In Russian.

The experiments described were carried out to study means of improving the damping capacity of a Helmholtz resonator and of resonance sound absorbers employing Helmholtz resonators. The experiments were performed under conditions of vibrating combustion in a narrow tube in the presence of high-frequency longitudinal pressure fluctuations, and also in the combustion chamber of a gas generator with low-frequency tangential-longitudinal pressure fluctuations. The characteristics of an effective high-level noise absorber developed on the basis of the experimental data are discussed. V.P.

A80-34404 # Acoustic characteristics of jets issuing from ring-and-needle nozzles (Akusticheskie kharakteristiki strui, istekaiushchikh iz sopel s tsentral'nym teplom). V. P. Zhvalov, L. I. Sorokin, and M. N. Tolstosheev. In: *Aeroacoustics*. Moscow, Izdatel'stvo Nauka, 1980, p. 131-137. 5 refs. In Russian.

Empirical relations are derived for calculating the sound energy flux, the spectrum, and the directivity pattern of heated jets issuing from ring-and-needle nozzles. It is shown experimentally that jets produced in such nozzles are less noisy than those generated in converging nozzles. V.P.

A80-34588 # A pulsed radiography technique for studying the internal structure of fuel injection jets (Rentgenoimpul'snyi metod izucheniia vnutrennei struktury toplivnogo fakela). V. K. Baev, A. N. Bazhaikin, E. I. Bichenkov, A. A. Buzukov, R. L. Rabinovich, and B. P. Timoshenko. *PMTF - Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki*, Jan.-Feb. 1980, p. 105-111. 15 refs. In Russian.

The paper deals with the development and design of a portable X-ray apparatus and its application to studies of the internal structure of fuel jets injected from a diesel nozzle. The cumulative nature of the interaction between the jet head and the medium is demonstrated, along with the regular formation of liquid condensations in the body of the jet, the number of which in these cross sections exceeds by an order of magnitude their number in the rarefied portions of the jet. This phenomenon, observed only during the stage of increasing pressure in the fuel system, is attributed to the onset of hydrodynamic instability in jets with a positive longitudinal velocity gradient. V.P.

A80-34593 # Pitot-static system - Errors and calibrations. R. D. Michas (Canadian Armed Forces, Ottawa, Canada). *Canadian Aeronautics and Space Journal*, vol. 26, 1st Quarter, 1980, p. 20-26.

Accurate airspeed and altitude are required to inform the pilot on where he is in the flight envelope and to provide a reliable aid to air traffic control. The aircraft pitot-static system provides such information by measuring the static (outside ambient) and pitot (static plus impact) pressures. System errors, accuracy requirements, and tolerances and the calibration methods used by the Aerospace Engineering Test Establishment are discussed. Emphasis is laid on the importance of good maintenance and proper use of the pitot-static system to ensure that it fulfills its intended function. S.D.

A80-34594 # Jet flap impingement noise from a full-scale STOL EBF engine-wing system. R. G. Goldman (California, University, Santa Barbara, Calif.). *Canadian Aeronautics and Space Journal*, vol. 26, 1st Quarter, 1980, p. 28-40. 7 refs.

A full-scale section of a three-flap STOL wing was constructed in order to evaluate the noise levels generated by STOL aircraft under various conditions. The paper summarizes the results of the first full-scale acoustic and performance tests on a quieted, modern, high bypass ratio turbofan engine enclosed in an acoustically treated nacelle mounted to a section of a STOL wing. Tests are reported

which help determine the acoustic characteristics of a full-scale externally-blown-flap system utilizing a quieted, high bypass turbofan engine and a three-element flap STOL wing segment. S.D.

A80-34595 # Wake vortex trajectories of low flying spray aircraft. R. H. Wickens (National Research Council, Ottawa, Canada). *Canadian Aeronautics and Space Journal*, vol. 26, 1st Quarter, 1980, p. 41-45.

A80-34596 # Reduction of aerodynamic drag of external spray booms and nozzles used on DC-6 aircraft. R. H. Wickens (National Research Council, Ottawa, Canada). *Canadian Aeronautics and Space Journal*, vol. 26, 1st Quarter, 1980, p. 46-51.

An investigation into the aerodynamic drag of spray booms used on Conair DC-6 aircraft has shown that when flying at 200 kt an additional force of 1300 lb is exerted on the airframe, with a corresponding expenditure of 800 hp. A new boom profile and wing installation has been designed which reduces the parasite losses by 400 hp. Flight observations of the spray showed satisfactory patterns, and the new installation is now standard equipment on Conair's aircraft. Flight performance was also improved using these new profiles; estimates of best climb speed, and maneuver times during low-level turns indicated improvements of 10-15% over the original boom installation. (Author)

A80-34631 Aircraft gas turbine materials and processes. B. H. Kear and E. R. Thompson (United Technologies Research Center, East Hartford, Conn.). *Science*, vol. 208, May 23, 1980, p. 847-856. 26 refs.

Materials and processing innovations that have been incorporated into the manufacture of critical components for high-performance aircraft gas turbine engines are described. The materials of interest are the nickel- and cobalt-base superalloys for turbine and burner sections of the engine, and titanium alloys and composites for compressor and fan sections of the engine. Advanced processing methods considered include directional solidification, hot isostatic pressing, superplastic forging, directional recrystallization, and diffusion brazing. Future trends in gas turbine technology are discussed in terms of materials availability, substitution, and further advances in air-cooled hardware. (Author)

A80-34652 * Types of leeside flow over delta wings (Zur Systematik der Leeseiten-Strömung bei Deltaflügeln). J. Szodrich (NASA, Ames Research Center, Moffett Field, Calif.; Berlin, Technische Universität, Berlin, West Germany). *Zeitschrift für Flugwissenschaften und Weltraumforschung*, vol. 4, Mar.-Apr. 1980, p. 72-81. 19 refs. In German.

It is noted that so far most systematic investigations on the lee side flow over delta wings at supersonic speeds are concerned with flat upper surfaces. On the basis of these results, the paper makes an attempt to characterize the different types of flow over a wing with a delta-shaped upper surface by varying a number of parameters. It is concluded that the work should be considered a first step toward systematizing the flow over delta-shaped lee sides as well. M.E.P.

A80-34653 Study on the dynamics of small flight vehicles (Zur Dynamik kleiner Fluggeräte). R. Staufenberg (Aachen, Technische Hochschule, Aachen, West Germany). *Zeitschrift für Flugwissenschaften und Weltraumforschung*, vol. 4, Mar.-Apr. 1980, p. 81-93. 21 refs. In German.

It is noted that there is increasing interest in small flight vehicles, especially the use of RPVs. Attention is given to the influence of vehicle size on stability, loads and disturbances as well as on performance. Emphasis is placed on gust sensitivity and landing techniques of small vehicles with consideration given only to the longitudinal motion. M.E.P.

A80-34655 Possibilities for achieving trimmed minimum drag without sacrificing inherent stability (Realisierungsmöglichkei-

ten des getrimmten Minimalwiderstands ohne Verzicht auf natürliche Stabilität). G. Sachs (München, Hochschule der Bundeswehr, Neuburg, West Germany). *Zeitschrift für Flugwissenschaften und Weltraumforschung*, vol. 4, Mar.-Apr. 1980, p. 101-106. 18 refs. In German.

The paper deals with the relation between the inherent stability boundary and the drag optimum c.g. position which represents the c.g. position where trimmed drag is minimum. It is shown which are the factors significantly affecting this relation and which are the conditions where the drag optimum c.g. position is stable. The paper investigates the effects resulting from the aerodynamic configuration (wing body combination and tail) as well as from thrust moments.

(Author)

A80-34664 **Lightning damage mechanisms and simulation techniques.** E. H. Schulte (McDonnell Aircraft Co., St. Louis, Mo.). *Journal of Environmental Sciences*, vol. 23, May-June 1980, p. 13-17. 18 refs.

The paper describes the natural lightning phenomenon, showing how it relates to the need for aircraft protection. Laboratory simulations predicting the response of materials and structures to lightning and defining protective measures are considered. The tests account for the effect of swept stroke under which an aircraft becomes a part of the lightning arc. Simulations encompass such damage mechanisms as high-voltage ruptures and high-current spikes reaching 200,000 amperes in magnitude, during tens of microseconds. The simulation techniques proposed also treat high-charge transfer resulting in extreme heating, melting, and erosion of conductive materials and the effect of high-level signals induced in the electrical wiring systems and avionic circuits. O.L.

A80-34708 **Stationary flow past the lower surface of a piecewise planar delta wing with supersonic leading edges.** S. M. Ter-Minasiants. (*Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza*, Sept.-Oct. 1979, p. 80-90.) *Fluid Dynamics*, vol. 14, no. 5, Mar. 1980, p. 699-708. 18 refs. Translation.

The analysis deals with the supersonic flow over a wing surface composed of arbitrary flat triangular elements connected to each other at small angles along straight lines that intersect at a point on the leading edge. A three-dimensional shock wave is attached to the leading edge having the shape of a broken line. The pressure distribution over the wing span and the pressure at the center of the wing are calculated. V.P.

A80-34711 **Construction of a nonstationary nonlinear theory of helicopter rotors.** S. M. Belotserkovskii, V. A. Vasin, and B. E. Loktev. (*Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza*, Sept.-Oct. 1979, p. 107-113.) *Fluid Dynamics*, vol. 14, no. 5, Mar. 1980, p. 720-725. 8 refs. Translation.

The paper considers application of the discrete vortex method for construction of a nonlinear nonstationary propeller theory in an incompressible medium. The method allows modelling of propeller transition operations, and of conditions like the 'vortex ring' and 'vortex cushion'. The method is based on substitution of actual load bearing surfaces (propeller blades) with infinitely thin surfaces followed by substitution with a vortex sheet. The impermeability boundary condition is satisfied on the blade surfaces; velocity circulations along the closed fluid are constant with time, so that circulations of free vortices are also constant with time. The Chaplygin-Zhukovsky hypothesis on finiteness of velocities is realized during the take-off flow around the blade rear edges and on the side and front edges. Convergence of free vortices which occurs along the tangent to the propeller surface is assumed at these edges, concluding that the proposed method allows determination of nonstationary dispersed and combined aerodynamic characteristics, velocity fields, and vortex structures behind the propeller. A.T.

A80-34712 **Direct and inverse problems of flow over a wing of finite span in the linear formulation.** N. F. Vorob'ev.

(*Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza*, Sept.-Oct. 1979, p. 114-125.) *Fluid Dynamics*, vol. 14, no. 5, Mar. 1980, p. 726-735. 9 refs. Translation.

Correspondence of solutions of direct and inverse problems of the wing theory for a finite span wing is established in the framework of the linear theory based on the solution of the Volterra wave equation for supersonic flow, and the solution of the Laplace equation in the form of Green's formula for subsonic flow. For the direct problem in the supersonic case, a formula is derived for determining wing loading which most fully considers the wing geometry characteristics. For the inverse supersonic and subsonic flows, formulas are derived for determining wing geometry by specified wing loadings and the change in loading along the wing span. The solution of the inverse problem is presented in the form of integral convergence of internal points on the wing surface, with the wing surface representing a vortical surface of mutually orthogonal vertical lines. A.T.

A80-34765 **NDI policy and techniques for advanced composites.** R. M. Collins (Grumman Aerospace Co., Bethpage, N.Y.). In: *New horizons - Materials and processes for the eighties; Proceedings of the Eleventh National Conference*, Boston, Mass., November 13-15, 1979. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1979, p. 178-191.

An NDI policy that has provided the guidance necessary to assure the quality of primary structure is described. Critical defect types for NDI are defined. Designs for NDI standards, applicable to variable attenuative structures, are described. The effect of longitudinal ultrasonic waves propagating through the laminate thickness is discussed. The utility of NDI techniques for defect depth determination, per ply thickness measurement, detection of radii or edge defects, and the prediction of ultimate or residual strength of a structure are presented. (Author)

A80-34766 **Airworthiness certification of composite components for civil aircraft - The role of non-destructive evaluation.** P. R. Teagle (British Aerospace Materials Laboratory, Weybridge, Surrey, England). In: *New horizons - Materials and processes for the eighties; Proceedings of the Eleventh National Conference*, Boston, Mass., November 13-15, 1979. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1979, p. 192-210. 17 refs.

The paper describes the application of nondestructive evaluation to a first generation carbon fiber reinforced plastic civil airframe component. Attention is given to initial research, the development of production test techniques and quality control procedures. Finally, consideration is given to developments for applications to more complex components. M.E.P.

A80-34787 **Large-scale and small-scale flammability tests for airplane cabin materials.** J. M. Peterson and E. A. Tustin (Boeing Commercial Airplane Co., Seattle, Wash.). In: *New horizons - Materials and processes for the eighties; Proceedings of the Eleventh National Conference*, Boston, Mass., November 13-15, 1979.

Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1979, p. 531-550.

Flammability test methodology for passenger cabin materials is discussed with emphasis on correlation between small-scale test procedures and large-scale fire phenomena. Current aircraft interior materials were tested by simulated large-scale fire exposure and by selected laboratory tests. The laboratory methods investigated for measuring toxicant production did not consistently produce results which could be related to large-scale fire data. A testing technique is being developed, based on the Ohio State University release rate apparatus, with a view to obtaining direct correlation of laboratory results to the magnitude of the large-scale test heat and smoke data. V.L.

A80-34797 **Developments in ultrasonic welding for aircraft.** T. Renshaw, J. Curatola, and A. Sarrantonio (Fairchild

Republic Co., Farmingdale, N.Y.). In: *New horizons - Materials and processes for the eighties*; Proceedings of the Eleventh National Conference, Boston, Mass., November 13-15, 1979.

Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1979, p. 681-693. 5 refs.

The development of ultrasonic welding of aluminum for aircraft using a Sonobond fixed reed-wedge-transducer assembly and a hydraulically elevated high-power ultrasonic model is presented. The problem of tip sticking was overcome, and it was necessary to use large radii power tips for spotwelding alclad materials. Spot strength data were discussed, noting that restrictor blocks coated with Teflon had to be clamped to specimens to minimize the variables associated with peel action of overlapped pull specimens. Fatigue data were presented, and it was also shown that ultrasonic welding produces the effects of notch damage and/or section change, which leads to earlier failures than those of virgin panels. A.T.

A80-34805 **Comparison of surface treatments of aluminum and their influence on long term strength of metal bonds.** W. Brockmann and O. D. Hennmann (Institute für angewandte Materialforschung, Bremen, West Germany). In: *New horizons - Materials and processes for the eighties*; Proceedings of the Eleventh National Conference, Boston, Mass., November 13-15, 1979.

Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1979, p. 804-816. 5 refs.

The influence of different treatments of two aluminum alloys in bare and clad state on the strength and long term behavior of bonded joints is described. The alloys are 2024 T 3 bare and clad and 7075 T 6 bare and clad treated by FPL-etch European chromic-sulphuric-etch, phosphoric-acid-anodizing and chromic-acid-anodizing. Prior to bonding the surfaces were coated with primer BR 127, the adhesives were FM 123-5 and FM 73. (Author)

A80-34808 **A hybrid composite helicopter main rotor blade employing pneumatic lift control.** F. B. Clark and M. L. White (Kaman Aerospace Corp., Bloomfield, Conn.). In: *New horizons - Materials and processes for the eighties*; Proceedings of the Eleventh National Conference, Boston, Mass., November 13-15, 1979.

Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1979, p. 840-849. 8 refs.

A hybrid composite blade, utilizing interleaved S-glass/epoxy and graphite/epoxy laminae, has been developed as part of a program to study helicopter flight performance characteristics attainable with circulation control aerodynamics. Lift control of a Circulation Control Rotor (CCR) blade is accomplished by varying the flow of compressed air through a full-span trailing edge slot, rather than by pitch change. In addition to improved and simplified flight control, this concept promises lower maintenance, reduced vibration levels and enhanced aerodynamic efficiency versus conventional rotors. However, the CCR concept also introduces new blade design constraints arising from the internal air ducting requirements and trailing edge slot opening, and from compressor heating of the control air. Additionally, unique dynamic stability requirements dictate an unusually high blade torsional stiffness coupled with conventional bending mode natural frequencies. The great freedom, afforded by hybrid composite construction to tailor elastic, strength and thermal expansion properties contributed greatly to a successful design solution. Details of the design, fabrication and development testing of the blade are reported. (Author)

A80-34809 **Drilling composites with gun drills.** R. T. Beall (Lockheed Engineering Structural and Materials Laboratory, Marietta, Ga.). In: *New horizons - Materials and processes for the eighties*; Proceedings of the Eleventh National Conference, Boston, Mass., November 13-15, 1979. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1979, p. 850-856.

Gun drills have the ability to drill deep precision holes due to the provision for introducing a coolant to the drill tip which both cools and aids in removing chips and shavings. Lockheed has adapted

such drills to portable equipment for drilling close tolerance holes in aluminum, graphite/epoxy composites, fiberglass composites and combinations of these materials. Hole quality is equal to or superior to all competitive drilling procedures in diameter control and surface finish. Finished holes are completed in one step, eliminating any requirement for piloting, step drilling and reaming. (Author)

A80-34810 **Costs of graphite composite fabrication and repair.** T. J. Bettner (Northrop Corp., Aircraft Group, Hawthorne, Calif.). In: *New horizons - Materials and processes for the eighties*; Proceedings of the Eleventh National Conference, Boston, Mass., November 13-15, 1979. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1979, p. 857-869.

The paper presents a cost estimating methodology used for composite (graphite/epoxy) fabrication. The methodology can also be used for the identification of significant cost drivers encountered in the fabrication and repair of composite structures. V.T.

A80-34811 **Shock loading on reinforced splice joints of ultra high modulus graphite/epoxy cone frustum.** F. H. Koo (Martin Marietta Aerospace, Orlando, Fla.) and L. R. Aronin (U.S. Army, Army Materials and Mechanics Research Center, Watertown, Mass.). In: *New horizons - Materials and processes for the eighties*; Proceedings of the Eleventh National Conference, Boston, Mass., November 13-15, 1979. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1979, p. 882-899.

An ultra high modulus graphite/epoxy frustum reinforced with titanium shims at the splice joint was tested on the SM-1000 shock machine to determine its capability in absorbing peak shock levels in a shock spectrum. Test set up and procedures are discussed. The shock machine was calibrated to achieve the shock levels in increments. The test results in terms of strain gage data were evaluated to assess the structural response to the applied shock loads. (Author)

A80-34819 **Evaluation of coatings for wear and corrosion - Protection in air/fluid accumulators.** D. L. Behmke (U.S. Navy, Naval Air Engineering Center, Lakehurst, N.J.) and R. D. Brown (Southwest Research Institute, San Antonio, Tex.). In: *New horizons - Materials and processes for the eighties*; Proceedings of the Eleventh National Conference, Boston, Mass., November 13-15, 1979.

Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1979, p. 993-1004.

An evaluation of coatings for wear and corrosion protection in cylinders of catapult accumulators on Navy aircraft carriers is presented. Wear and corrosion damage of the inner surfaces is experienced particularly in the air space region and at the air fluid interface where the piston is at rest. The tests indicated that the Tribaloy 800 plasma-sprayed and sealed with epoxy and a Nedox coating consisting of electrodeposited porous nickel alloy infused with polytetrafluoroethylene were more corrosion resistant than the other coatings tested. It is concluded that the Tribaloy 800 coating will provide the best protection in the accumulator application. A.T.

A80-34840 * # **Current and projected use of carbon composites in United States aircraft.** R. W. Leonard (NASA, Langley Research Center, Hampton, Va.) and D. R. Mulville (U.S. Navy, Naval Air Systems Command, Washington, D.C.). *NATO, AGARD, Specialists Meeting on Electromagnetic Effects of Carbon Composite Materials upon Avionics Systems, Lisbon, Portugal, June 16-19, 1980, Paper.* 31 p. 19 refs.

It is noted that carbon composite materials are beginning to be used in commercial transports, general aviation aircraft, military fighter aircraft and helicopters due to demonstrated weight savings and potential manufacturing cost savings. Attention is given to current production applications of carbon composites which range from the secondary structures of new commercial transports to wing primary structures of fighters. Current development efforts are discussed that will lead to their future application to fuselages, as

well as whole airframes. Finally, laminate constructions which vary widely, and may be relevant to avionics system design, are examined.
M.E.P.

A80-34974 **Development of a structural overload warning system for modern high performance aircraft.** G. W. Venorsky (McDonnell Aircraft Co., St. Louis, Mo.). *Society of Flight Test Engineers, Journal*, vol. 2, May 1980, p. 19-26.

The development of an overload warning system (OWS), to provide F-15 pilots with a warning as allowable load factor limits are approached, is described. It is shown that the OWS microprocessor computes allowable load factor using inputs of fuel quantity, stores configuration, and control stick forces. The warning function is derived by comparing allowable load factor with actual load factor which is also a system input. In this manner, the prototype implementation accounts for changing fuel loads, some external store weights, and maneuver asymmetry, including rapidly increasing roll rate. Finally, it is noted that basic design concepts have been demonstrated and system development continues in active flight testing.
M.E.P.

A80-34975 **Measurement and correlation of structural response to inlet hammer shock phenomena on an F-14 airplane.** J. Auzins (Grumman Aerospace Corp., Calverton, N.Y.). *Society of Flight Test Engineers, Journal*, vol. 2, May 1980, p. 27-36.

Engine stalls in high speed jet aircraft can result in hammer shock and inlet buzz. When these phenomena do occur, they can impose significant air/inertia loads on the inlet structure and external stores. Although hammer shock and inlet buzz are part of the design criteria, flight tests are necessary to quantify these effects which result from the complex interaction of propulsive, aerodynamic, geometric and dynamic store response characteristics of the flight vehicle. This paper describes the tests and analytical methodology developed during the F-14A flight test program to assess the structural effects of engine stalls while maintaining the required structural margins.
(Author)

A80-34995 * # **A simple system for helicopter individual-blade-control and its application to gust alleviation.** N. D. Ham (MIT, Cambridge, Mass.). In: Structures, Structural Dynamics, and Materials Conference, 21st, Seattle, Wash., May 12-14, 1980, Technical Papers. Part 1. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 57-68. 8 refs. NASA-sponsored research. (AIAA 80-0666; AHS Paper 80-65)

A new, advanced type of active control for helicopters and its application to gust alleviation is described. Each blade is individually controlled in the rotating frame over a wide range of frequencies up to the sixth harmonic of rotor speed. Considerable system simplification is achieved by means of modal decomposition. It is shown both analytically and experimentally that by utilizing a tip-mounted accelerometer as a sensor in the feedback path, significant reductions in blade flapping response to a sinusoidal gust can be achieved at the gust excitation frequency as well as at super- and subharmonics of rotor speed.
(Author)

A80-34996 # **Vibration reduction with higher harmonic blade feathering for helicopters with two-bladed teetering and four-bladed hingeless rotors.** J. G. Yen (Bell Helicopter Textron, Fort Worth, Tex.). In: Structures, Structural Dynamics, and Materials Conference, 21st, Seattle, Wash., May 12-14, 1980, Technical Papers. Part 1. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 69-76. 15 refs. (AIAA 80-0670; AHS Paper 80-69)

Theoretical investigations have been conducted to compare higher harmonic blade pitch requirements for vibration reduction on helicopters with two-bladed teetering and four-bladed hingeless rotors in trimmed level flight. For the two-bladed teetering rotor, elimination of oscillatory two-per-rev hub vertical shear was studied. For the four-bladed hingeless rotor, higher-harmonic control (HHC) was used to minimize four-per-rev hub vertical shear, rolling and

pitching moments. Certain penalties in pitch-link loads and performance were predicted using higher-harmonic blade feathering. The penalties seem to be more serious for a two-bladed teetering rotor than those for a four-bladed hingeless rotor. Analyses were also performed to demonstrate that optimal HHC inputs for the multiple-input case are not simply a linear combination of optimal inputs for the respective single-input cases due to interharmonic coupling. Analytical results indicate that both amplitude and phase of HHC vary significantly with airspeed for the four-bladed hingeless rotor. For the two-bladed teetering rotor, the required pitch amplitude increases as airspeed increases with nearly invariant phase angle.
(Author)

A80-34997 * # **Multicyclic control for helicopters - Research in progress at Ames Research Center.** J. L. McCloud, III (NASA, Ames Research Center, Moffett Field, Calif.). In: Structures, Structural Dynamics, and Materials Conference, 21st, Seattle, Wash., May 12-14, 1980, Technical Papers. Part 1. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 77-81. 19 refs. (AIAA 80-0671; AHS Paper 80-70)

The term multicyclic control describes a blade pitch control technique used by helicopter designers to alleviate vibration in rotorcraft. Because rotor-induced vibrations are periodic, a multicyclic system, synchronized to the main rotor's azimuth position, is suitable. Many types of rotors - ranging from the jet-flap and circulation-control rotors to the conventional full-blade feathering rotors - have utilized multicyclic control. Multicyclic control systems may be designed to reduce blade-bending stresses, to reduce rotor-induced vibration, and to improve rotor performance. Rotor types are reviewed, primarily to highlight their differences. The increased use of composites in blade construction is seen to indicate that vibration alleviation will be the prime focus of multicyclic control. Adaptive feedback control systems, which also incorporate gust alleviation, are considered to be the ultimate application of multicyclic control.
(Author)

A80-34998 * # **Multicyclic control of a helicopter rotor considering the influence of vibration, loads, and control motion.** T. J. Brown and J. L. McCloud, III (NASA, Ames Research Center, Moffett Field, Calif.). In: Structures, Structural Dynamics, and Materials Conference, 21st, Seattle, Wash., May 12-14, 1980, Technical Papers. Part 1. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 82-100. 7 refs. (AIAA 80-0673; AHS Paper 80-72)

Weighted multiple linear regression is used to establish a transfer function matrix relationship between higher harmonic control inputs and transducer vibration outputs for a controllable twist rotor. Data used in the regression were taken from the test of a KAMAN controllable twist rotor conducted in the Ames Research Center's 40-by 80-Foot Wind Tunnel in June 1977. Optimal controls to minimize fixed system vibrational levels are calculated using linear quadratic regulatory theory with a control deflection penalty included in the performance criteria. Control sensitivity to changes in control travel, forward speed, and lift and propulsive forces is examined. It is found that the linear transfer matrix is a strong function of forward speed and a weak function of lift and propulsive force. An open-loop strategy is proposed for systems with limited control travel. (Author)

A80-35007 # **On experimental versus theoretical incipient buckling of narrow graphite/epoxy plates in compression.** E. E. Spier (General Dynamics Corp., Convair Div., San Diego, Calif.). In: Structures, Structural Dynamics, and Materials Conference, 21st, Seattle, Wash., May 12-14, 1980, Technical Papers. Part 1.

New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 187-193. 17 refs. (AIAA 80-0686)

Most stiffeners in aerospace structures are composed of narrow plate elements with the unloaded edges usually being either simply-supported or free. This paper is concerned with the difficulties encountered in attempting to predict the incipient buckling strength for narrow (low width to thickness ratio) angle-plyed

graphite/epoxy plates in compression. Numerous available test data was compared to analytical predictions. The tested plates were of two types: both unloaded edges supported by steel V-blocks (no-edge-free); one unloaded edge supported by a steel V-block and the other edge free (one-edge-free). Nondimensional plots for both types of tests are presented which can be used to predict incipient buckling strengths for plates with laminate configurations other than those tested. For completeness, nondimensional crippling plots are presented where the incipient (initial) buckling stress is employed in the nondimensional parameters. This approach is an interesting ramification of previously published crippling plots where the theoretical buckling stress was employed in the nondimensional parameters. (Author)

A80-35031 # The outside has to be bigger than the inside. H. W. Smith (Kansas, University, Lawrence, Kan.) and R. Burnham (Boeing Co., Seattle, Wash.). In: Structures, Structural Dynamics, and Materials Conference, 21st, Seattle, Wash., May 12-14, 1980, Technical Papers. Part 1. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 365-370. (AIAA 80-0726)

A method for calculating the volume requirements for an airplane, and a design procedure for distributing the volume is described. A not-too-obvious necessity for providing enough total volume to contain the payload fuel, structure and systems is presented as a logical design procedure. With outside mold lines being held at a minimum while the need to maximize internal space for seats, cargo and fuel capacity, a fundamental designer's dilemma is posed. Seat pitch, area ruling, fuel volume and structural depth are discussed. Two examples, a short haul transport and a supersonic fighter airplane are presented. Method versatility allows its use during preliminary, advanced, or production design phases. (Author)

A80-35036 # CAD produced aircraft drawings. M. D. Wehrman (Boeing Commercial Airplane Co., Seattle, Wash.). In: Structures, Structural Dynamics, and Materials Conference, 21st, Seattle, Wash., May 12-14, 1980, Technical Papers. Part 1. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 404-408. (AIAA 80-0732)

The use of computers to include the preparation of engineering drawings has been expanded. The system utilized is a combination of large host mainframes and minicomputers. This combination is tied together with a network called the CAD/CAM Integrated Information Network (CIIN) which allows data to be transferred between machines and also to be stored and retrieved from a common Geometric Data Base (GDB). Engineering drawings are produced using a combination of general and special batch APT (Automatically Programmed Tool) programs on the mainframes and then completed on the interactive computer graphics (ICG) system. (Author)

A80-35037 # Unsteady airloads on a harmonically pitching wing with external store. R. Roos (Nationaal Lucht- en Ruimtevaartlaboratorium, Amsterdam, Netherlands). In: Structures, Structural Dynamics, and Materials Conference, 21st, Seattle, Wash., May 12-14, 1980, Technical Papers. Part 1. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 409-416. 6 refs. Grant No. AF-AFOSR-77-3233. (AIAA 80-0733)

Results are presented of a wind-tunnel investigation carried out on a harmonically pitching fighter-type wing with and without an external store. In this test detailed steady and unsteady pressure distributions were measured on the wing, while also the aerodynamic loads on the store were obtained. The Mach number ranged from $Ma = 0.6$ to 1.35 , while frequencies up to 40 Hz were achieved. Three topics are covered in detail: (1) the influence of the store on the unsteady wing loading, (2) the behaviour of the unsteady store loads and (3) comparison with unsteady calculations. (Author)

A80-35038 * # Unsteady aerodynamics of conventional and supercritical airfoils. S. S. Davis and G. N. Malcolm (NASA, Ames

Research Center, Moffett Field, Calif.). In: Structures, Structural Dynamics, and Materials Conference, 21st, Seattle, Wash., May 12-14, 1980, Technical Papers. Part 1. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 417-433, 20 refs. (AIAA 80-0734)

The unsteady aerodynamics of a conventional and a supercritical airfoil are compared by examining measured chordwise unsteady pressure time-histories from four selected flow conditions. Although an oscillating supercritical airfoil excites more harmonics, the strength of the airfoil's shock wave is the more important parameter governing the complexity of the unsteady flow. Whether they are conventional or supercritical, airfoils that support weak shock waves induce unsteady loads that are qualitatively predictable with classical theories; flows with strong shock waves are sensitive to details of the shock-wave and boundary-layer interaction and cannot be adequately predicted. (Author)

A80-35044 # Composite wing/fuselage integral concept. A. Musicman (Rockwell International Corp., North American Aircraft Div., Los Angeles, Calif.) and H. Reinert (USAF, Materials Laboratory, Wright-Patterson AFB, Ohio). In: Structures, Structural Dynamics, and Materials Conference, 21st, Seattle, Wash., May 12-14, 1980, Technical Papers. Part 1. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 492-497. Contract No. F33615-77-C-5278. (AIAA 80-0744)

The integral composite wing/fuselage concept was evaluated for its performance, weight and cost. A full-scale component environmentally conditioned and tested met initial strength and weight projections and achieved cost savings up to 33% over aluminum and conventional built-up composite construction. Weight savings of 41% over aluminum and 18% over conventional composite constructions were also achieved. A.T.

A80-35045 # Built-up low-cost advanced titanium structures /BLATS/. W. L. Franklin (Rockwell International Corp., North American Aircraft Div., Los Angeles, Calif.) and C. R. Waitz (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, Ohio). In: Structures, Structural Dynamics, and Materials Conference, 21st, Seattle, Wash., May 12-14, 1980, Technical Papers. Part 1. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 498-503. (AIAA 80-0745)

Through the use of advanced-technology structures, a 50-percent cost and 30-percent weight advantage is projected over conventional aircraft structures. Advanced fabrication methods include superplastic forming (SPF) alone or concurrent with diffusion bonding (DB) of double- or multiple-sheet expanded sandwich panels which are joined together by welding, particularly plasma arc. Structural concepts were evaluated and tested from which the design of a full-size aircraft component, including the wing carry-through and a portion of the fuselage of a fighter plane, was developed. A demonstration article will be tested to validate cost, weight, and structural integrity. (Author)

A80-35046 # Economic life criteria for metallic airframes. S. D. Manning and V. D. Smith (General Dynamics Corp., Fort Worth, Tex.). In: Structures, Structural Dynamics, and Materials Conference, 21st, Seattle, Wash., May 12-14, 1980, Technical Papers. Part 1. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 504-511. 26 refs. Contract No. F33615-77-C-3123. (AIAA 80-0748)

Economic life criteria and guidelines are presented and discussed for implementing the U.S. Air Force's durability requirements for advanced metallic airframes at the design level. Economic life is quantified in terms of the probability of crack exceedance and/or maintenance cost. The number of structural details requiring repair after a specified service period is first determined. Maintenance costs can be estimated using this information. Essential elements of the proposed economic life criteria are described and practical applications are discussed. (Author)

A80-35047 # A quantitative assessment of the variables involved in crack propagation analysis for in-service aircraft. R. L. Circle and F. M. Conley (Lockheed-Georgia Co., Marietta, Ga.). In: Structures, Structural Dynamics, and Materials Conference, 21st, Seattle, Wash., May 12-14, 1980, Technical Papers. Part 1.

New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 512-521. 12 refs. (AIAA 80-0752)

Results on the damage tolerance characteristics of airframe structures are presented. An in-depth assessment was made of the structural information required for design of a transport aircraft; determination of the sensitivity of the final analysis prediction was made to identify the variables requiring additional accuracy and attention. The results of this assessment are supported by test vs analytical comparisons using flight-by-flight test spectra developed from measured real-time history data from service aircraft. A.T.

A80-35048 # Analysis of cracks at attachment lugs. T. M. Hsu (Lockheed-Georgia Co., Advanced Structures Dept., Marietta, Ga.). In: Structures, Structural Dynamics, and Materials Conference, 21st, Seattle, Wash., May 12-14, 1980, Technical Papers. Part 1.

New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 522-528. 22 refs. (AIAA 80-0753)

An analytical procedure using the finite-element method with the inclusion of a high-order crack-tip singularity element was used to determine the pin-bearing pressure distributions and the stress intensity factors for cracks in both straight and tapered lugs. Other parameters evaluated include the crack length, the outer-to-inner radius ratio, and the relative rigidity of the pin and the lug. Based on this study, it is found that the pin-bearing pressure distribution changes with the change in crack length. In the presence of a crack, the pressure distributions change significantly compared with the uncracked case, and its associate stress intensity factor is sensitive to the pin-bearing pressure distributions, especially when the crack length is large or the outer-to-inner radius ratio is small. The effect of the relative rigidity of the pin and the lug on the stress intensity factor is negligible. (Author)

A80-35049 * # Preliminary design of composite wing-box structures for global damage tolerance. J. H. Starnes, Jr. (NASA, Langley Research Center, Structures and Dynamics Div., Hampton, Va.) and R. T. Haftka (Illinois Institute of Technology, Chicago, Ill.). In: Structures, Structural Dynamics, and Materials Conference, 21st, Seattle, Wash., May 12-14, 1980, Technical Papers. Part 2.

New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 529-538. 15 refs. Grant No. NAG1-5. (AIAA 80-0755)

A procedure is presented that incorporates the influence of potential global damage conditions into the design process for minimum-mass wing-box structures. The procedure is based on mathematical-programming optimization techniques. Material-strength, minimum-gage, and panel-buckling constraints are introduced by penalty functions, and Newton's method with approximate second derivatives of the penalty terms is used as the search algorithm to obtain minimum-mass designs. A potential global damage condition is represented by a structural model with the damaged components removed. Example minimum-mass designs are obtained that simultaneously satisfy the constraints of the damaged and undamaged configurations of both graphite-epoxy and aluminum wing-box structural models. These examples are designed with and without the influence of potential damage conditions, and results indicate that for equal mass cases the residual strength of a damaged structure is higher when the influence of potential damage is properly included in the design from the outset. Results of these examples also identify the minimum structural mass increase required to increase residual strength levels. (Author)

A80-35052 * # Release-rate calorimetry of multilayered materials for aircraft seats. L. L. Fewell, J. A. Parker (NASA, Ames Research Center, Moffett Field, Calif.), F. Duskin, H. Spieth, and E. Trabold (Douglas Aircraft, Co., Long Beach, Calif.). In: Structures, Structural Dynamics, and Materials Conference, 21st, Seattle, Wash.,

May 12-14, 1980, Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 555-564. (AIAA 80-0759)

Multilayered samples of contemporary and improved fire-resistant aircraft seat materials (foam cushion, decorative fabric, slip sheet, fire-blocking layer, and cushion-reinforcement layer) were evaluated for their rates of heat release and smoke generation. Top layers (decorative fabric, slip sheet, fire blocking, and cushion reinforcement) with glass-fiber block cushion were evaluated to determine which materials, based on their minimum contributions to the total heat release of the multilayered assembly, may be added or deleted. Top layers exhibiting desirable burning profiles were combined with foam cushion materials. The smoke and heat-release rate of multilayered seat materials were then measured at heat fluxes of 1.5 and 3.5 W/sq cm. Choices of contact and silicon adhesives for bonding multilayered assemblies were based on flammability, burn and smoke generation, animal toxicity tests, and thermal gravimetric analysis. (Author)

A80-35056 # Investigation of internal control laws for wing/store flutter suppression. T. E. Noll, L. J. Huttself, and D. E. Cooley (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). In: Structures, Structural Dynamics, and Materials Conference, 21st, Seattle, Wash., May 12-14, 1980, Technical Papers. Part 2.

New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 585-594. 10 refs. (AIAA 80-0764)

The design and evaluation of active flutter suppression technology using a common wind tunnel mode is discussed. The paper emphasizes analytical predictions and presents test data for correlation; control laws were evaluated using the FASTOP computer program and a modified Nyquist criterion. Although the design and tests were performed for a Mach number of 0.8, the analyses were made at several Mach numbers to determine system effectiveness at off-design conditions. A discussion of current USAF programs and future means of active flutter suppression are also presented. A.T.

A80-35057 # Active flutter suppression control law definition via least squares synthesis. E. H. Johnson (Northrop Corp., Aircraft Group, Hawthorne, Calif.). In: Structures, Structural Dynamics, and Materials Conference, 21st, Seattle, Wash., May 12-14, 1980, Technical Papers. Part 2.

New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 595-603. 6 refs. Contract No. F33615-78-C-3221. (AIAA 80-0765)

A technique is described whereby an arbitrary number of transfer functions of sensor outputs to a control surface input can be blended to form a feedback signal that is suitable for controlling a flutter mode. An attractive feature of the technique, which couples the concepts of the Nyquist criterion with a least squares fit procedure, is that it utilizes data which are readily measurable, thereby allowing for the rapid improvement of the control law once the empirical results are available. A theoretical description of the method is presented and its relationship to alternative methods is discussed. An analytical example is presented which depicts a 70 percent improvement in the flutter dynamic pressure of the YF-17 flutter model. Further results obtained during an analog simulation and a wind tunnel test of the same model are also presented. (Author)

A80-35058 * # Design for active flutter suppression and gust alleviation using state-space aeroelastic modeling. M. Karpel (Stanford University, Stanford, Calif.). In: Structures, Structural Dynamics, and Materials Conference, 21st, Seattle, Wash., May 12-14, 1980, Technical Papers. Part 2.

New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 604-611. 20 refs. Grant No. NGL-05-020-243. (AIAA 80-0766)

An analytical design technique for an active flutter-suppression and gust-alleviation control system is presented. It is based on a rational approximation of the unsteady aerodynamic loads in the entire Laplace domain, which yields matrix equations of motion with constant coefficients. Some existing rational approximation schemes are reviewed, and a new technique which yields a minimal number of

augmented states for a desired accuracy is presented. The state-space aeroelastic model is used to design a constant gain, partial-feedback control system, which simultaneously assures stability and optimizes any desired combination of gust response parameters throughout the entire flight envelope. (Author)

A80-35060 # F-16 flutter suppression system investigation. R. P. Peloubet, Jr., R. L. Haller, and R. M. Bolding (General Dynamics Corp., Fort Worth, Tex.). In: Structures, Structural Dynamics, and Materials Conference, 21st, Seattle, Wash., May 12-14, 1980, Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 620-634. 17 refs. Contract No. F33615-77-C-3081. (AIAA 80-0768)

A study was conducted to determine the feasibility of employing active controls on the F-16 to suppress wing/store flutter for several external store configurations. It was determined that the existing flaperons, with modifications to the integrated servoactuators, were effective in suppressing flutter. A separate analog computer study was conducted to examine the feasibility of measuring the flutter suppression system open-loop frequency response function (FRF). It was determined that the function could be successfully measured below the unaugmented flutter speed, where the feedback loop can be physically opened, and above the flutter speed, where it cannot. The F-16 flutter model was tested with active flaperons. Open-loop FRFs were successfully measured in the wind tunnel environment both with the feedback loop physically opened and with the loop closed. These measurements provided guidance in the selection of sensor locations and feedback control laws to suppress flutter. Control law variations were made to obtain the desired FRF characteristics. A 100% increase in dynamic pressure above the flutter dynamic pressure was demonstrated. (Author)

A80-35061 # Recent development of the YF-17 active flutter suppression system. C. Hwang, E. H. Johnson, and W. S. Pi (Northrop Corp., Aircraft Group, Hawthorne, Calif.). In: Structures, Structural Dynamics, and Materials Conference, 21st, Seattle, Wash., May 12-14, 1980, Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 635-648. 5 refs. Contract No. F33615-78-C-3221. (AIAA 80-0769)

Active wing/store flutter suppressing systems were demonstrated in 1977 in a series of wind tunnel tests on a YF-17 scale model. In order to substantially improve the suppression system performance, new control laws were developed based on multiple feedback loops, multiple control surfaces, or both. For test safety, a flutter sensing unit and a new store, functioning as a flutter stopper, were designed and fabricated. Test monitoring programs were organized on a Hewlett-Packard 5451C Fourier Analyzer that permitted a real time assessment of the control law effectiveness. One of the monitoring programs generated the aircraft open loop transfer function and Nyquist plots in the supersonic region while the flutter suppression loop was closed. In the tests performed in late 1979, the new control laws were applied to suppress a severe flutter condition to 70% above the uncontrolled flutter dynamic pressure. Postanalysis of the test data indicated the potential to increase the dynamic pressure to an even higher level. (Author)

A80-35062 * # Wind tunnel investigation of active controls technology applied to a DC-10 derivative. B. A. Winther, W. A. Shirley, and R. M. Heimbaugh (Douglas Aircraft Co., Long Beach, Calif.). In: Structures, Structural Dynamics, and Materials Conference, 21st, Seattle, Wash., May 12-14, 1980, Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 649-655. Contract No. NAS1-15327-02. (AIAA 80-0771)

Application of active controls technology to reduce aeroelastic response offers a potential for significant payoffs in terms of aerodynamic efficiency and structural weight. As part of the NASA Energy Efficient Transport program, the impact upon flutter and gust load characteristics has been investigated by means of analysis

and low-speed wind tunnel tests of a semispan model. The model represents a DC-10 derivative with increased wing span and an active aileron surface, responding to vertical acceleration at the wing tip. A control law satisfying both flutter and gust load constraints is presented and evaluated. In general, the beneficial effects predicted by analysis are in good agreement with experimental data. (Author)

A80-35065 # Advanced composite structure repair guide. C. E. Beck (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). In: Structures, Structural Dynamics, and Materials Conference, 21st, Seattle, Wash., May 12-14, 1980, Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 674-678. 13 refs. USAF-Navy-sponsored research. (AIAA 80-0774)

A need for composite repair technology is discussed. Consideration is given to composites used in helicopters, space and missile systems, and fixed-wing aircraft. The status of a federal government sponsored program which will result in the first edition of a repair guide is presented. V.T.

A80-35066 # Repair of advanced composite structures. S. H. Myhre and J. D. Labor (Northrop Corp., Hawthorne, Calif.). In: Structures, Structural Dynamics, and Materials Conference, 21st, Seattle, Wash., May 12-14, 1980, Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 679-686. 7 refs. Contract No. F33615-76-C-3017. (AIAA 80-0776)

A large-area composite structure program is reviewed. The objective of the program is to develop repair techniques which would restore as much as possible of the original material strength. Five large panels were repaired and subjected to static tests. The repair of a speedbrake damaged in service is described. V.T.

A80-35070 # Honeycomb sandwich joints for primary structure. U. Soudak (Israel Aircraft Industries, Ltd., Lod, Israel) and R. A. Hamm (Boeing Commercial Airplane Co., Seattle, Wash.). In: Structures, Structural Dynamics, and Materials Conference, 21st, Seattle, Wash., May 12-14, 1980, Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 706-711. (AIAA 80-0780)

Analysis methods and joint design details developed for adhesively bonded aluminum honeycomb in aircraft primary structure are described. Joint design details, which were tested for strength, durability and environmental resistance, provide a low cost design that is structurally efficient and durable. Weight and cost savings, producibility, and durability have been confirmed by five years of service experience on the YC-14 Empennage primary structure. The analysis considers the effect of the core on face sheet stress, the effect of face sheet eccentricity and also a failure analysis method for square edge panels; in addition, it allows strength/weight optimization procedures for honeycomb design. (Author)

A80-35072 # Damage tolerant design and test considerations in the engine structural integrity program. W. D. Cowie and T. A. Stein (USAF, Aeronautical Systems Div., Wright-Patterson AFB, Ohio). In: Structures, Structural Dynamics, and Materials Conference, 21st, Seattle, Wash., May 12-14, 1980, Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 723-728. (AIAA 80-0784)

Damage-tolerance philosophy and revised durability requirements incorporated into the engine structural integrity program (ENSIP) are discussed. Specific design and test criteria under consideration for the next revision of MIL-E-5007D are outlined. V.T.

A80-35073 # Experimental investigation of flutter in mid-stage compressor designs. R. R. Jutras (General Electric Co., Evendale, Ohio) and H. R. Bankhead (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, Ohio). In: Structures, Struc-

tural Dynamics, and Materials Conference, 21st, Seattle, Wash., May 12-14, 1980, Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 729-740. (AIAA 80-0786)

Blade instability related to compressor mid-stage-type rotor blades is studied with emphasis placed on negative incidence and choke flutter. Consideration is given to experimental data obtained to define blade instability boundaries for a quasi-continuous grid of blade geometries and aerodynamic environment conditions. V.T.

A80-35074 # An optimization method for the determination of the important flutter modes. E. Nissim and I. Lottati (Technion - Israel Institute of Technology, Haifa, Israel). In: Structures, Structural Dynamics, and Materials Conference, 21st, Seattle, Wash., May 12-14, 1980, Technical Papers. Part 2.

New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 741-747. 5 refs. (AIAA 80-0790)

Several methods proposed for the determination of the important aircraft flutter modes are briefly reviewed. A new method is developed which avoids the need to assume constant values for modal responses and systematic recomputations of the flutter speeds of large arrays of reduced-order systems. V.T.

A80-35075 * # Wing/store flutter with nonlinear pylon stiffness. R. N. Desmarais and W. H. Reed, III (NASA, Langley, Research Center, Structures and Dynamics Div., Hampton, Va.). In: Structures, Structural Dynamics, and Materials Conference, 21st, Seattle, Wash., May 12-14, 1980, Technical Papers. Part 2.

New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 748-753. 8 refs. (AIAA 80-0792)

Recent wind tunnel tests and analytical studies show that a store mounted on a pylon with 'soft' pitch stiffness provides substantial increase in flutter speed of fighter aircraft and reduces dependency of flutter on mass and inertia of the store. This concept, termed the decoupler pylon, utilizes a low-frequency control system to maintain pitch alignment of the store during maneuvers and changing flight conditions. Under rapidly changing transient loads, however, the alignment control system may allow the store to momentarily bottom against a relatively stiff backup structure in which case the pylon stiffness acts as a hardening nonlinear spring. Such structural nonlinearities are known to affect not only the flutter speed but also the basic behavior of the instability. This paper examines the influence of pylon stiffness nonlinearities on the flutter characteristics of wing-mounted external stores. (Author)

A80-35076 # Aeroelastic tailoring of a forward swept wing and comparisons with three equivalent aft swept wings. W. E. Triplett (McDonnell Aircraft Co., St. Louis, Mo.). In: Structures, Structural Dynamics, and Materials Conference, 21st, Seattle, Wash., May 12-14, 1980, Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 754-760. 9 refs. (AIAA 80-0794)

The structural feasibility of using aeroelastic tailoring of laminated composite material for a forward swept wing (FSW) on a high performance fighter aircraft has been analytically evaluated. An optimized design is obtained with zero weight penalty for static divergence by the use of a matrix dominated unbalanced composite ply layout. The optimized FSW is compared with three equivalent aft swept wings (ASWs) which are evaluated for the same design requirements. The FSW compares favorably with the ASWs in terms of flutter and aircraft roll rate for aileron deflections. The FSW requires more structural weight and has higher induced aerodynamic drag than the ASWs because of outboard air load buildup during high load factor maneuvers. (Author)

A80-35077 # Aeroelastic tailoring of forward swept composite wings. T. A. Weisshaar (Virginia Polytechnic Institute and State University, Blacksburg, Va.). In: Structures, Structural Dynamics, and Materials Conference, 21st, Seattle, Wash., May 12-14, 1980,

Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 761-770. 12 refs. Grant No. AF-AFOSR-77-3423D; Contract No. F33615-79-C-3224. (AIAA 80-0795)

A set of closed-form solutions to describe the effect of fibrous composite materials on the static aeroelastic characteristics of swept and unswept wings are presented. The aeroelastic characteristics considered are wing divergence, spanwise center of pressure location and flexible-to-rigid lift. Examples of the use of these expressions are presented. A simple, but accurate, matrix method for static aeroelastic analysis is also discussed, together with examples to illustrate the potential for aeroelastic tailoring of forward swept wings. (Author)

A80-35078 # A wind tunnel demonstration of the principle of aeroelastic tailoring applied to forward swept wings. V. C. Sherrer, T. J. Hertz, and M. H. Shirk (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). In: Structures, Structural Dynamics, and Materials Conference, 21st, Seattle, Wash., May 12-14, 1980, Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 771-780. 17 refs. (AIAA 80-0796)

The principle of aeroelastic tailoring with advanced composite materials to increase the divergence speed of a forward swept wing has been demonstrated through low speed wind tunnel tests. The approach was to perform a low cost, fairly simple wind tunnel test on a variable sweep cantilever wing model. Available analytical methods were shown to accurately predict the divergence speed of both aluminum and composite plate structures in the subsonic speed range. Methods were evaluated for predicting the onset of divergence using subcritical wind tunnel data. Results of the analyses and tests are presented in this report. (Author)

A80-35086 # Finite element analysis of F-16 aircraft canopy dynamic response to bird impact loading. R. E. McCarty (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). In: Structures, Structural Dynamics, and Materials Conference, 21st, Seattle, Wash., May 12-14, 1980, Technical Papers. Part 2.

New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 841-852. 23 refs. (AIAA 80-0804)

The finite element analysis of F-16 canopy response to bird impact is presented. The general requirements for nonlinear analysis of transparency bird impact is pointed out, and the results of such analyses for the F-16 canopy are given. The material nonlinearity, geometrical nonlinearity, and coupling between the impact loads and the resulting dynamic response are compared in regard to their relative importance; it is shown that coupling is the most significant of these factors. It is concluded that such analyses can be successful only if they can realistically simulate the effects of load-response coupling, although the nonlinear finite element computer program used here provided accurate and efficient results. A.T.

A80-35092 # Durability and consistency of composite components. A. C. Jackson (Lockheed-California Co., Burbank, Calif.). In: Structures, Structural Dynamics, and Materials Conference, 21st, Seattle, Wash., May 12-14, 1980, Technical Papers. Part 2.

New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 896-901. (AIAA 80-0811)

The paper discusses the Advanced Composite Vertical Fin program and the advanced manufacturing development of a composite empennage component for L-1011 aircraft. The tests demonstrate production qualities and static strength for graphite/epoxy components. Accelerated durability testing of coupons and subcomponents was made, but the evaluation of the effects of flight environments on a real-time basis takes many years. A program is underway to test components to demonstrate producibility and static strength of graphite/epoxy components; testing of components in a cyclic environment representative of flight and ground storage is being made which is expected to take 3-1/2 yrs to represent 20 yrs of service. A.T.

A80-35093 # Elevated temperature structural testing of advanced missiles. O. R. Otto and G. J. Inukai (McDonnell Douglas Astronautics Co., St. Louis, Mo.). In: Structures, Structural Dynamics, and Materials Conference, 21st, Seattle, Wash., May 12-14, 1980, Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 902-907. (AIAA 80-0812)

Structural tests at room and elevated temperature were conducted on a full-scale aft airframe section of the Advanced Strategic Air-Launched Missile (ASALM). Loads applied at room temperature represented conditions during captive carry and ejection. Test data are shown to agree well with theory. Loads applied at temperatures up to 1200 F represented conditions during ramjet flight. The high heating rates and temperature levels produced unanticipated and invalid response from some instrumentation. These events will be described and guidelines for high temperature testing will be presented. Although limited elevated-temperature test data were obtained, structural verification of the airframe was achieved.

(Author)

A80-35094 # Structural design loads for future airplanes. P. Milns (Boeing Military Airplane Co., Seattle, Wash.). In: Structures, Structural Dynamics, and Materials Conference, 21st, Seattle, Wash., May 12-14, 1980, Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 908-914. 10 refs. (AIAA 80-0813)

The paper demonstrates that many difficulties exist at the detail level in the interface between the stress analyst and the loads specialist. Additional work is required concerning the inclusion of viscous effects into the design loads and improvement of maneuver design criteria. The present and future static load generation techniques are discussed with examples of a tailless bomber and supersonic vehicles.

A.T.

A80-35096 # The Eccentuator - A new concept in actuation. R. G. Musgrove (Vought Corp., Dallas, Tex.). In: Structures, Structural Dynamics, and Materials Conference, 21st, Seattle, Wash., May 12-14, 1980, Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 933-937. (AIAA 80-0815)

The Eccentuator is a bent beam actuator that compensates for the lateral motion of the beam with an eccentric bearing on the support end of the beam. A unique indexing gear arrangement used with the bent beam and the eccentric bearing maintains the free end of the beam in a plane normal to the hinge line; the bent beam/eccentric bearing combination results in planar, arcuate motion. The arcuate motion is twice that achievable by rotating the bent beam alone. The supercritical contour in the region of the control surface hinge line is thinner than a conventional airfoil contour; the thin contours and large hinge moments coupled with an aerodynamic requirement to keep the upper and lower surfaces from protuberances produced a need for an actuation system which did not resolve the hinge moments with a force couple parallel to the surface reference plane. The actuator can be powered by hydraulic or mechanical inputs; applications of the Eccentuator are also discussed, including the actuation of variable camber surfaces on supercritical wings.

A.T.

A80-35097 # Review of nonstationary gust-responses of flight vehicles. G. H. Gaonkar (Indian Institute of Science, Bangalore, India). In: Structures, Structural Dynamics, and Materials Conference, 21st, Seattle, Wash., May 12-14, 1980, Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 938-956. 85 refs. (AIAA 80-0703)

The paper reviews nonstationary turbulence and its influence on aircraft, rotor, and propeller systems. A common nonstationary analytical approach is used, with emphasis on concepts instead of details. The necessity for this approach and its feasibility for predicting a complete set of gust and response statistics together with correlations using limited test data are appraised. It is concluded that due to extensive analytical background developed to date more experimental research is required. The research would verify the

validity of nonstationary gust models such as the transient gust-encounters, and answer questions, such as the possible inapplicability of the Taylor-von Karman turbulence theory near hovering modes.

A.T.

A80-35098 * # Integrated thermal-structural finite element analysis. E. A. Thornton, P. Decahamphai (Old Dominion University, Norfolk, Va.), and A. R. Wieting (NASA, Langley Research Center, Structures and Dynamics Div., Hampton, Va.). In: Structures, Structural Dynamics, and Materials Conference, 21st, Seattle, Wash., May 12-14, 1980, Technical Papers. Part 2.

New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 957-969. 19 refs. (AIAA 80-0717)

An integrated thermal-structural finite element approach for efficient coupling of thermal and structural analysis is presented. An integrated thermal-structural rod element is developed and used in four thermal-structural applications; the accuracy of this integrated approach is illustrated by comparisons with the customary approach of finite difference thermal-finite element structural analyses. Results show that integrated thermal-structural analysis of structures modeled with rod elements is more accurate than conventional analysis, and that its further development promises significant results.

A.T.

A80-35100 * # Practical design considerations for a flight-worthy higher harmonic control system. E. R. Wood and R. W. Powers (Hughes Helicopters, Culver City, Calif.). In: Structures, Structural Dynamics, and Materials Conference, 21st, Seattle, Wash., May 12-14, 1980, Technical Papers. Part 2.

New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 978-986. 11 refs. Contract No. NAS1-14552. (AIAA 80-0668; AHS Paper 80-67)

The paper discusses the design of a higher harmonic blade pitch control system for flight testing on an OH-6A helicopter. Alternative designs for both the mechanical and electronic subsystems are also presented. Among the recommendations set forth are: (1) use electronic analog methods instead of FFT software, delegating spectral analysis and self testing to an Electronic Control Unit; (2) use a digital rather than analog computer for increased flexibility in solution processing; and (3) locate HHC actuators in the nonrotating system and separate these actuators from the primary control system. It is concluded that a target weight for a prototype control system would be less than 1% of design gross weight and the production weight of the future HHC system may be 0.5 of the weight of the aircraft.

A.T.

A80-35101 * # Engine environmental effects on composite behavior. C. C. Chamis and G. T. Smith (NASA, Lewis Research Center, Cleveland, Ohio). In: Structures, Structural Dynamics, and Materials Conference, 21st, Seattle, Wash., May 12-14, 1980, Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 987-997. 7 refs. (AIAA 80-0695)

The effects of turbojet engine environmental saturation moisture and temperatures up to 300 F on composites were investigated. It was found that epoxy resin composites absorbed the most moisture (2 wt %), while polyimide resin composites absorbed 0.8%. High moisture and 250 F degraded the flexural and interlaminar shear properties, and the environmental and impact conditions severely damaged epoxy composites. The impact damage of fiber composites in moisture-temperature environments can be assessed with finite element and composite mechanics analyses. Engine operation environmental conditions of 0.8% moisture and 140 F had no discernible effect on the fatigue resistance of composite fan exit guide vanes, which can be designed to exceed engine operational requirements using composite materials.

A.T.

A80-35183 # Development and application concepts for trainer and combat-trainer versions of combat jet aircraft (Konceptcja rozwoju i zastosowania bojowych wersji odrzutowych samolotow szkolno-treningowych i szkolno-bojowych). E. Cichosz. *Technika Lotnicza i Astronautyczna*, vol. 35, Apr. 1980, p. 5-9. In Polish.

A method for classifying trainer and combat-trained jets is proposed, along with a method for comparing such aircraft. For illustration, the latter method is applied to a comparison of some representative British, French, German, and Italian trainer and combat aircraft. The historical development, specifications, and principal parameters of the foreign combat aircraft are examined.

V.P.

A80-35184 # Selected methods for defining engine operating ranges in the investigation of aircraft accidents. II (Wybrane metody okreslania zakresow pracy silnika podczas badania wypadkow lotniczych. II). S. Andruskiewicz, J. Borgon, and M. Stukonis. *Technika Lotnicza i Astronautyczna*, vol. 35, Apr. 1980, p. 10, 11. In Polish.

The determination of engine operating ranges is an important factor in aircraft accident investigations. The three methods examined in the present paper are based, respectively, on the use of the relationship between the rate of turbine blade cooling on the time elapsed after discontinuation of engine operation, the determination of the color of oxide films on blade fracture surfaces, and the basis of instrument readings.

V.P.

A80-35185 # Effects of electric fluctuations in electric power systems of flight vehicles (Skutki drgan elektrycznych w wezloch elektroenergetycznych obiektow latajacych). Z. Zmudzinski (Instytut Techniczny Wojsk Lotniczych, Warsaw, Poland). *Technika Lotnicza i Astronautyczna*, vol. 35, Apr. 1980, p. 12-14. In Polish.

The reasons for the premature wear of brushes observed in aircraft electric power systems of the GSR-3000 type are studied and are attributed to electric fluctuations in these power systems, due to faulty voltage control. Remedies to this situation are proposed.

V.P.

A80-35404 General aviation altimetry errors for collision avoidance systems. A. D. Mundra (Mitre Corp., McLean, Va.). *Navigation*, vol. 26, Winter 1979-1980, p. 267-274. 14 refs.

The present compilation of in-flight test data yields histograms of errors in automatically reported altitude and errors in indicated altitude for domestic general aviation aircraft. Two fully automatic collision avoidance systems, currently under consideration by the Federal Aviation Administration, are examined. These are the Automatic Traffic Advisory and Resolution Service system and the Beacon-based Collision Avoidance system. Furthermore, the automatically reported altitude is being increasingly used in the Air Traffic System, as exemplified by the implementation of Conflict Alert in the en route air space.

V.P.

A80-35498 * # Noise suppression due to annulus shaping of an inverted-velocity-profile coaxial nozzle. J. Goodykoontz and U. von Glahn (NASA, Lewis Research Center, Cleveland, Ohio). *Acoustical Society of America, Meeting, 99th, Atlanta, Ga., Apr. 21-25, 1980, Paper, 25 p. 8 refs.*

Previous studies have shown that an inverted-velocity-profile coaxial nozzle for use with supersonic cruise aircraft produces less jet noise than an equivalent conical nozzle. Furthermore, decreasing the annulus height (increasing radius ratio with constant flow) results in further noise reduction benefits. In the present model-scale study, the annulus shape, that is, height, was varied by an eccentric mounting of the annular nozzle with respect to a conical core nozzle. Acoustic measurements were made in the flyover plane below the narrowest portion of the annulus and at 90 deg and 180 deg from this point. The model-scale spectra are scaled up to engine size (1.07 m diameter) and the perceived noise levels for the eccentric and baseline concentric inverted-velocity-profile coaxial nozzles are compared over a range of operating conditions. The implications of the acoustic benefits derived with the eccentric nozzle to practical applications are discussed.

(Author)

A80-35771 # Technology of graphite-resin composite materials and their application in the aeronautical industry (Tecnologia dei materiali compositi grafite-resina e loro applicazioni nell'industria aeronautica). G. Romeo (Torino, Politecnico, Turin,

Italy). (AIAS, *Convegno Nazionale, 7th, Cagliari, Italy, Sept. 1979.*) *Ingegneria*, Mar.-Apr. 1980, p. 80-101. In Italian.

The use of advanced composite materials in aeronautical structures is discussed. Mechanical properties are given, and the production of carbon fibers is considered, including the pyrolysis of polyacrylonitrile and of rayon. The characteristics and high-temperature applications of epoxy resins and polyimide resins are examined. Attention is given to the process of polymerization of composite materials and to the process of realizing a multistrata laminate. With regard to methods of testing, the determination of the tensile strength and of the elastic modulus of a composite is discussed, including compression and bending tests; the determination of shear resistance is also considered.

J.P.B.

A80-35801 # Alkyl derivatives of resorcinol used as antioxidants in jet fuels (Alkilproizvodnye rezortsina v kachestve antiokisitel'nykh prisadok k reaktivnym toplivam). O. P. Lykov, T. P. Vishniakova, N. V. Tumar, E. P. Seregin, V. N. Prokudin, and I. A. Konishcheva (Moskovskii Institut Neftekhimicheskoi i Gazovoi Promyshlennosti, Moscow, USSR). *Khimiia i Tekhnologija Topliv i Masel*, no. 5, 1980, p. 18-21. 6 refs. In Russian.

Several alkylated resorcinols are examined with reference to their oxidation inhibiting properties when added, in concentrations of 0.003-0.01%, to hydrogenated jet fuels. The investigated alkylated resorcinols include: 5-methyl resorcinol, mono-tert-butyl resorcinol, di-tert-butyl resorcinol, 2,4,4-triethyl-5-methyl resorcinol, and tetraethyl resorcinol. These compounds are shown to improve antioxidation stability of the fuels without any detrimental effects on fuel performance.

V.L.

A80-35802 # Mannich base used as an antioxidant in jet fuels (Osnovanie Mannikha kak antiokisitel'naia prisadka k reaktivnym toplivam). T. P. Vishniakova, I. A. Golubeva, L. P. Gutnikova, E. P. Seregin, V. N. Prokudin, and V. M. Veseliaskaia (Moskovskii Institut Neftekhimicheskoi i Gazovoi Promyshlennosti, Moscow, USSR). *Khimiia i Tekhnologija Topliv i Masel*, no. 5, 1980, p. 39-42. In Russian.

The efficiency of 4-(N,N-dimethylaminomethylene)-2,6-di-tert-butyl phenol (Mannich base) as an oxidation inhibitor for jet fuels is investigated by successive heating techniques. The results of the experiments involving several hydrogenated fuels indicate that this additive, when used in a concentration of 0.003%, provides the same efficiency as ionol at a lower cost.

V.L.

A80-35898 * # The impact of fuels on aircraft technology through the year 2000. J. Grobman and G. M. Reck (NASA, Lewis Research Center, Cleveland, Ohio). *American Institute of Aeronautics and Astronautics, International Meeting and Technical Display on Global Technology 2000, Baltimore, Md., May 6-8, 1980, Paper 80-0896. 24 p. 29 refs.*

In the future, it may be necessary to use jet fuels with a broader range of properties in order to insure a more flexible and reliable supply and to minimize energy consumption and processing costs at the refinery. This paper describes research being conducted to (1) determine the potential range of properties for future jet fuels, (2) establish a data base of fuel property effects on propulsion system components, (3) evolve and evaluate advanced component technology that would permit the use of broader property fuels and (4) identify technical and economic trade-offs within the overall fuel production-air transportation system associated with variations in fuel properties.

(Author)

A80-35906 * # Status of NASA full-scale engine aeroelasticity research. J. F. Lubomski (NASA, Lewis Research Center, Cleveland, Ohio). In: Structures, Structural Dynamics, and Materials Conference, 21st, Seattle, Wash., May 12-14, 1980, Technical Papers. Conference sponsored by AIAA, ASME, ASCE, and AHS. New York, American Institute of Aeronautics and Astronautics, Inc., 1980. 18 p. 14 refs.

The paper presents data relevant to several types of aeroelastic instabilities which have been obtained using several types of turbojet and turbofan engines. Special attention is given to data relative to separated flow (stall) flutter, choke flutter, and system mode instabilities. The discussion covers the characteristics of these instabilities, and a number of correlations are presented that help identify the nature of the phenomena. M.E.P.

A80-35907 # Progress and trends in propeller/prop-fan noise technology. F. B. Metzger (United Technologies Corp., Hamilton Standard Div., Windsor Locks, Conn.). *American Institute of Aeronautics and Astronautics, International Meeting and Technical Display on Global Technology 2000, Baltimore, Md., May 6-8, 1980, Paper 80-0856.* 16 p. 53 refs.

The major contributions to the understanding and control of propeller noise that have occurred in the past 60 years are described. It is shown that early researchers recognized the propeller noise problem and attempted to model it mathematically, noting that this early research was hampered by lack of instrumentation. Attention is given to progress made in development of theoretically based noise prediction procedures and in systematically measuring propeller noise from 1945 until the dominance of jet propulsion in transport aircraft caused a decline of interest. Finally, it is shown that the recent interest in fuel efficient propulsion has caused a renewed interest in propeller aircraft, and that rapid progress is now being made in control of noise of all classes of propeller aircraft in the far field at locations around airports as well as in the cabins of transport aircraft. M.E.P.

A80-35912 # Experimental investigations on the vibration of blades due to a rotating stall. K. Ishihara (Kawasaki Heavy Industries, Ltd., Akashi, Japan) and M. Funakawa (Okayama, Science University, Okayama, Japan). *JSME, Bulletin*, vol. 23, Mar. 1980, p. 353-360.

The unsteady aerodynamic forces acting on blades due to a rotating stall are studied. Characteristics such as velocity, pressure fluctuations and blade vibration are measured and relations between them are studied by using a single stage compressor. It is found that the velocity and the width of the stall cell are significant factors governing the aerodynamic force. It is concluded that it is reasonable to regard the square wave of the velocity fluctuation as the aerodynamic force acting on the blade. M.E.P.

A80-35944 * # Transmission of high frequency sound waves through a slug flow jet. S. P. Parthasarathy and A. Vijayaraghavan (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 6th, Hartford, Conn., June 4-6, 1980, Paper 80-0969.* 12 p. 10 refs. Contract No. NAS7-100.

An analysis has been performed of sound waves which propagate in a pipe with gas flow. At the pipe exit these waves are partially reflected and the remainder are diffracted. The analysis is carried out by resolving the sound at the exit into its Fourier components and then continuing the solution, which is a combination of elementary plane waves, beyond the exit. These waves are of two types: homogeneous waves which propagate to infinity, and inhomogeneous waves with complex wave numbers which decay. The reflected waves are evaluated from the inhomogeneous waves. At the boundary of the jet, refraction of the elementary plane waves is accounted for and the far field sound is evaluated by the method of stationary phase. Comparisons of the theoretical calculations are made with experimental results and with calculations of other theories. (Author)

A80-35952 * # QCSEE fan exhaust bulk absorber treatment evaluation. H. E. Bloomer and N. E. Samanich (NASA, Lewis Research Center, Cleveland, Ohio). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 6th, Hartford, Conn., June 4-6, 1980, Paper 80-0987.* 11 p. 8 refs.

The purpose of the experimental program reported herein was to evaluate the acoustic suppression capability of bulk absorber

material designed for use in the fan exhaust duct walls of the QCSEE UTW (under-the-wing) engine and to compare it with other means of acoustic suppression. The paper includes comparison of the acoustic suppression to the original design for the QCSEE UTW engine fan duct which consisted of phased SDOF (single-degree-of-freedom) wall treatment and a splitter and also with the splitter removed. The method of approach consisted of mounting the UTW engine on the test stand of the Lewis Engine Noise Facility with an appropriate array of far-field microphones in order to measure the acoustic levels of the various configurations. Peak suppression was about as predicted with the bulk absorber configuration; however, the broadband characteristics were not attained. Post-test inspection revealed surface oil contamination on the bulk material which could have caused the loss in bandwidth suppression. (Author)

A80-35953 # Study and experimental tests of fibrous acoustic treatment for reduction of fan noise from XF3-1 turbofan engine. R. Sasaki (Japan Defense Agency, Technical Research and Development Institute, Tokyo, Japan), K. Ishizawa, and K. Higashi (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 6th, Hartford, Conn., June 4-6, 1980, Paper 80-0988.* 9 p.

The characteristics of an acoustic treatment employing fibrous material and its effect on fan noise reduction radiated from a turbofan engine have been studied. The predominant feature of the treatment is that it is composed of a fibrous layer backed with an air cavity, which facilitates the control of acoustic impedance of the treatment. This paper presents the design procedures for the treatment developed through this study and results of the tests which were done to investigate its mechanical and acoustic properties. As a result of acoustic tests using an XF3-1 turbofan engine, it is shown that not only fan discrete tones but also combination tones can be attenuated effectively by the treatment. (Author)

A80-35957 * # Experimental verification of propeller noise prediction. G. P. Succi (MIT, Cambridge, Mass.), D. H. Munro, and J. A. Zimmer. *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 6th, Hartford, Conn., June 4-6, 1980, Paper 80-0994.* 14 p. 12 refs. Contract No. NAS1-15154.

Results of experimental measurements of the sound fields of 1/4-scale general aviation propellers are presented and experimental wake surveys and pressure signatures obtained are compared with theoretical predictions. Experiments were performed primarily on a 1C160 propeller model mounted in front of a symmetric body in an anechoic wind tunnel, and measured the thrust and torque produced by propeller at different rotation speeds and tunnel velocities, wakes at three axial distances, and sound pressure at various azimuths and tip speeds with advance ratio or tunnel velocity constant. Aerodynamic calculations of blade loading were performed using airfoil section characteristics and a modified strip analysis procedure. The propeller was then modeled as an array of point sound sources with each point characterized by the force and volume of the corresponding propeller section in order to obtain the acoustic characteristics. Measurements are found to agree with predictions over a wide range of operating conditions, tip speeds and propeller nacelle combinations, without the use of adjustable constants. A.L.W.

A80-35958 * # Acoustic measurements of three Prop-Fan models. B. M. Brooks (United Technologies Corp., Hamilton Standard Div., Windsor Locks, Conn.). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 6th, Hartford, Conn., June 4-6, 1980, Paper 80-0995.* 13 p. 16 refs. Contract No. NAS3-20614.

Results of NASA sponsored acoustic tests of three 2 ft. diameter models of the Prop-Fan (a small diameter, highly loaded, many-bladed variable pitch advanced turboprop) are presented. The highly swept model designed for noise reduction produces substantially less near field noise at simulated 0.8 Mach number cruise conditions than the unswept or slightly swept models. It also produces less far field noise at conditions simulating takeoff and landing. The noise

reduction mechanism is discussed. Correlation between harmonic noise measurements and theoretical predictions and between measured and predicted acoustic pressure pulses is good. Shadowgraph measurements which show the location of blade associated wave patterns were obtained. Predicted and measured wave locations show good general agreement. Full scale near and far field noise is predicted. (Author)

A80-35959 * # A collection of formulas for calculation of rotating blade noise - Compact and noncompact source results. F. Farassat (NASA, Langley Research Center, Hampton, Va.). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 6th, Hartford, Conn., June 4-6, 1980, Paper 80-0996*. 14 p. 23 refs.

A unified approach is used to derive many of the current formulations for calculation of discrete frequency noise for helicopter rotors and propellers. Both compact and noncompact source formulations are derived. The compact formulations are obtained as the limit of noncompact source results. In particular, the linearized acoustic equations by Hawkins and Lowson, Farassat, Hanson, Woan and Gregorek, Succi, and Jou are derived in this paper. An interesting thickness noise formula by Isom and its recent extension to the near field by Ffowcs Williams are also presented. The paper includes some comparisons of measured and calculated acoustic pressure signatures and spectra for an advanced propeller. The theoretical results are obtained using a computer program developed by the author and P. A. Nystrom. (Author)

A80-35960 # Propeller light aircraft noise at discrete frequencies. C. Dahan, L. Avezard, G. Guillien, C. Malarmey, and J. Chombard (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 6th, Hartford, Conn., June 4-6, 1980, Paper 80-0997*. 11 p. 8 refs.

To study the acoustic field of propelled light aircraft, a method of in-flight measurements was implemented. The separation of noise sources is achieved by examination of the influence on the acoustic field of the relative set-up of the propeller and the engine. This shows that at high rotational speed, the propeller is the dominant source. Evaluating then the field due to steady/unsteady loading on the blades, one concludes that the former ones are the most acoustically efficient. The analysis fly-over noise measurements, using an original signal processing (Doppler effect compensation) makes the results obtained more complete. (Author)

A80-35961 * # Prediction of the interior noise levels of high-speed propeller-driven aircraft. D. C. Rennison, J. F. Wilby, and E. G. Wilby (Bolt Beranek and Newman, Inc., Canoga Park, Calif.). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 6th, Hartford, Conn., June 4-6, 1980, Paper 80-0998*. 12 p. 8 refs. Contract No. NAS1-15426.

The theoretical basis for an analytical model developed to predict the interior noise levels of high-speed propeller-driven airplanes is presented. Particular emphasis is given to modeling the transmission of discrete tones through a fuselage element into a cavity, estimates for the mean and standard deviation of the acoustic power flow, the coupling between a non-homogeneous excitation and the fuselage vibration response, and the prediction of maximum interior noise levels. The model allows for convenient examination of the various roles of the excitation and fuselage structural characteristics on the fuselage vibration response and the interior noise levels, as is required for the design of model or prototype noise control validation tests. (Author)

A80-35962 * # Noise control prediction for high-speed, propeller-driven aircraft. J. F. Wilby, D. C. Rennison, E. G. Wilby (Bolt Beranek and Newman, Inc., Canoga Park, Calif.), and A. H. Marsh (DyTec Engineering, Inc., Long Beach, Calif.). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 6th, Hartford, Conn., June 4-6, 1980, Paper 80-0999*. 11 p. 14 refs. Contract No. NAS1-15426.

An analytical study is described which explores add-on treat-

ments and advanced concepts for the reduction of noise levels in three high-speed aircraft driven by propellers. Noise reductions of 25 to 28 dB are required to achieve a goal of an A-weighted sound level not greater than 80 dB. It is found that only a double-wall system, with a limp inner wall or trim panel, can achieve the required noise reductions. Weight penalties are estimated for the double-wall treatments. These penalties are 0.75% to 1.51% of the aircraft takeoff weight for the particular baseline designs selected. (Author)

A80-35963 # An analytical model for study of interior noise control for high-speed, propeller-driven aircraft. J. D. Revell, F. J. Balena (Lockheed-California Co., Burbank, Calif.), and L. R. Koval (Missouri-Rolla, University, Rolla, Mo.). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 6th, Hartford, Conn., June 4-6, 1980, Paper 80-1000*. 11 p. 13 refs.

An analytical method is described for prediction of the interior noise levels for propeller-driven aircraft, given the exterior noise signature and its harmonic spectrum, and a description of the fuselage sidewall structure and various candidate 'add-on' noise-control elements. The structural response is described by the theory of Koval but simplified to consider the stiffeners as 'smeared' elements. The incremental transmission loss (TL) due to add-on noise-control elements is derived from the Beranek and Work method. Comparisons between experimental data and the theory are presented. The method is reasonably accurate below the ring frequency, but is somewhat conservative at normal incidence angle. This method is, however, expedient computationally, is economical and permits rapid comparisons of noise-control penalties for various treatment concepts. (Author)

A80-35964 # Analytical study of interior noise control by fuselage design techniques on high-speed propeller-driven aircraft. J. D. Revell, F. J. Balena (Lockheed-California Co., Burbank, Calif.), and L. R. Koval (Missouri-Rolla, University, Rolla, Mo.). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 6th, Hartford, Conn., June 4-6, 1980, Paper 80-1001*. 17 p. 11 refs.

This study defines acoustical treatment mass penalties required to achieve an interior noise level of 80 dBA for propfan-powered aircraft at 0.8 Mach number. The method, described in a companion paper combines Koval's theory for cylindrical shell noise transmission loss (TL) with the Beranek and Work methods for 'add-on' noise control element performance. Three different fuselage diameters are studied in connection with appropriate aircraft. Add-on mass penalties range from 1.7 to 2.4 percent of aircraft takeoff gross weight (TOGW). Advanced Noise Reduction Designs which permit structural modification reduce these penalties to 1.5 percent of TOGW for aluminum aircraft and 0.74 to 1.4 percent TOGW for fuselages constructed of composite materials. (Author)

A80-35965 * # Acoustic pressures on a prop-fan aircraft fuselage surface. B. Magliozzi (United Technologies Corp., Hamilton Standard Div., Windsor Locks, Conn.). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 6th, Hartford, Conn., June 4-6, 1980, Paper 80-1002*. 11 p. 9 refs. Contract No. NAS3-20614.

Acoustic pressure amplitude and phase distributions on the surface of a simulated fuselage (a rigid semi-cylinder) installed in an acoustically treated wind tunnel near a Prop-Fan model were measured. The test conditions simulated the relative tip Mach number and blade loading of a full scale Prop-Fan at high altitude 0.8 Mach number cruise. Measurements were also made at equivalent microphone locations without the semi-cylinder to establish the effects of the presence of a fuselage on the sound pressure amplitudes. These effects were found to be 6 dB at 90 degrees incidence, decreasing to no effect at grazing incidence. Comparison of measurements and calculations using a Hamilton Standard Prop-Fan noise calculation computer program showed good agreement in peak level and in phase distribution. Continuous recordings were also made of a Prop-Fan RPM sweep at constant simulated flight speed and a simulated flight speed sweep at constant Prop-Fan

RPM. These showed smooth variations in noise level over the tip Mach number range 0.878 to 1.143. (Author)

A80-35967 # A theoretical study of the coherence of jet noise. W. G. Richarz (Toronto, University, Toronto, Canada). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 6th, Hartford, Conn., June 4-6, 1980, Paper 80-1005*. 9 p. 18 refs. Research supported by the Natural Sciences and Engineering Research Council of Canada and University of Toronto.

Two point correlations and cross-spectra of jet noise are new tools available for jet noise diagnostics. They describe the temporal as well as the spatial coherence of the radiated sound field. Usually the coherence is limited to a relatively narrow 'beam', indicative of independent radiators. The theoretical description herein is a development of Ribner's self and shear noise formalism. Influences of source coherence, source strength distribution, and other parameters are illustrated with the aid of certain turbulent and mean flow models. Comparisons of predictions based on a 'realistic' source model with measurement show the two sets of data to be compatible. (Author)

A80-35968 * # A unique coannular plug nozzle jet noise prediction procedure. P. K. Bhutiani (General Electric Co., Evendale, Ohio). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 6th, Hartford, Conn., June 4-6, 1980, Paper 80-1007*. 11 p. 22 refs. Contract No. NAS3-20619.

The work presents a method for predicting jet mixing and shock noise spectra from coannular plug nozzles operated in the inverted velocity profile mode. It is shown that the jet mixing noise prediction method is based on the physics of the flow and its noise radiating characteristics, modeling the source spectrum, eddy convection, and fluid shrouding in a simplistic fashion. Further, the shock noise prediction procedure is described, noting that it is an extension of the Fisher-Harper-Bourne method for conical nozzles. Finally, it is concluded that the method has the potential of being extended to suppressors of complex geometries. M.E.P.

A80-35969 * # Noise from a vibrating propeller. H. L. Runyan (Joint Institute for Advancement of Flight Sciences, Hampton, Va.). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 6th, Hartford, Conn., June 4-6, 1980, Paper 80-1011*. 8 p. Contract No. NAS1-14605-13.

This paper is concerned with an analytical study of the noise from a vibrating propeller. The influence of airfoil thickness and of steady loading are also included to provide a basis for comparison. The analysis was based on the concept of distributing sources and doublets on the surface of the blade, which were multiplied by their appropriate strength factors. The noise in the plane of the propeller was dominated by the thickness noise. Moving the observer's position to the propeller axis, the thickness noise and loading noise were zero, and a pure sinusoidal noise was found, caused by the vibrations of the propeller. (Author)

A80-35970 # Helicopter rotor thickness noise. C. Dahan and E. Gratioux (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 6th, Hartford, Conn., June 4-6, 1980, Paper 80-1012*. 11 p. 11 refs.

The attention is focused on rotor blades thickness noise (flow subsonic everywhere). The solution of the wave equation is written in a closed form (frequency domain), which emphasizes the essential parameters for this field. On the other side, starting from an estimation of the loads on the rotor disk (lifting line theory), the acoustic emission due to loads is estimated in such a way that the acoustic efficiency of blade thickness and loads can be compared. To compare experimental results and predictions, an original signal processing method was designed, which compensates the Doppler effect due to the helicopter motion. (Author)

A80-35971 * # Model rotor low frequency broadband noise at moderate tip speeds. N. G. Humbad and W. L. Harris (MIT,

Cambridge, Mass.). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 6th, Hartford, Conn., June 4-6, 1980, Paper 80-1013*. 11 p. 10 refs. Grant No. NsG-1583.

The results of an experimental investigation of low frequency broadband noise (LFBN) radiated from model helicopter rotors are presented. The results are for a range of tip Mach numbers (Mt) up to 0.50. The effect of rotor blade loading, advance ratio, tip speed, number of blades and free stream turbulence on the sound pressure level (SPL) and the spectrum of LFBN have been investigated. The peak SPL of LFBN appears to follow an M(4) law if the effect of rms turbulence velocity is removed. The peak SPL of LFBN seems to saturate with increases in advance ratio and with blade loading, and is proportional to the square of the turbulence integral scale when the effect of rms turbulence velocity and Mt are removed. Also, a simple peak SPL scaling law for noise from a helicopter rotor in forward flight due to convected sinusoidal gust is developed. The trend predicted by this scaling law is found to be satisfactory for the variation of the peak SPL of LFBN with tip speed. (Author)

A80-35977 * # Fan noise caused by the ingestion of anisotropic turbulence - A model based on axisymmetric turbulence theory. E. J. Kerschen (GE Corporate Research and Development Center, Schenectady, N.Y.) and P. R. Glibe (General Electric Co., Aircraft Engine Business Group, Evendale, Ohio). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 6th, Hartford, Conn., June 4-6, 1980, Paper 80-1021*. 13 p. 23 refs. Contract No. NAS2-10002.

An analytical model of fan noise caused by inflow turbulence, a generalization of earlier work by Mani, is presented. Axisymmetric turbulence theory is used to develop a statistical representation of the inflow turbulence valid for a wide range of turbulence properties. Both the dipole source due to rotor blade unsteady forces and the quadrupole source resulting from the interaction of the turbulence with the rotor potential field are considered. The effects of variations in turbulence properties and fan operating conditions are evaluated. For turbulence axial integral length scales much larger than the blade spacing, the spectrum is shown to consist of sharp peaks at the blade passing frequency and its harmonics, with negligible broadband content. The analysis can then be simplified considerably and the total sound power contained within each spectrum peak becomes independent of axial length scale, while the width of the peak is inversely proportional to this parameter. Large axial length scales are characteristic of static fan test facilities, where the transverse contraction of the inlet flow produces highly anisotropic turbulence. In this situation, the rotor/turbulence interaction noise is mainly caused by the transverse component of turbulent velocity. (Author)

A80-35978 * # Analytical study of the effects of wind tunnel turbulence on turbofan rotor noise. P. R. Glibe (General Electric Co., Aircraft Engine Group, Cincinnati, Ohio). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 6th, Hartford, Conn., June 4-6, 1980, Paper 80-1022*. 13 p. 16 refs. Contract No. NAS2-10002.

An analytical study of the effects of wind tunnel turbulence on turbofan rotor noise was carried out to evaluate the effectiveness of the NASA Ames 40 by 80-foot wind tunnel in simulating flight levels of fan noise. A previously developed theory for predicting rotor/turbulence interaction noise, refined and extended to include first-order effects of inlet turbulence anisotropy, was employed to carry out a parametric study of the effects of fan size, blade number, and operating line for outdoor test stand, NASA Ames wind tunnel, and flight inlet turbulence conditions. A major result of this study is that although wind tunnel rotor/turbulence noise levels are not as low as flight levels, they are substantially lower than the outdoor test stand levels and do not mask other sources of fan noise. (Author)

A80-35979 # Impact of flight effects on multibyte suppressor design. J. P. Duponchel and P. Thomas (SNECMA, Paris, France). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 6th, Hartford, Conn., June 4-6, 1980, Paper 80-1029*. 16 p. 16 refs.

The paper presents the acoustical variation obtained from static and simulated flight tests with a multitube suppressor. A quantitative interpretation of these flight effects on multitube noise characteristics and a prediction method are proposed.

V.T.

A80-35980 # Simulation of high bypass ratio engine jet noise flight effects by model jet wind tunnel test. H. Y. Lu and S. K. Lanter (Boeing Commercial Airplane Co., Seattle, Wash.). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 6th, Hartford, Conn., June 4-6, 1980, Paper 80-1030*. 7 p. 5 refs.

A wind tunnel model test was conducted to simulate the in-flight noise of high bypass ratio jets. Model nozzles representative of JT9D and RB.211 engines were tested in a 9 by 9 foot wind tunnel where noise measurements were made on a two-foot sideline. These measurements were scaled and extrapolated to full scale flyover conditions using the multiple sideline technique based on static measurements. Good agreement was obtained with 747 flyover results in terms of absolute levels and static-to-flight effects where jet noise is dominant. The agreement is seen as a validation of this simulation technique for the in-flight jet noise of high bypass ratio jets.

(Author)

A80-35981 # Prediction of flyover noise from single and coannular jets. A. Michalke (Berlin, Technische Universität, Berlin, West Germany) and U. Michel, *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 6th, Hartford, Conn., June 4-6, 1980, Paper 80-1031*. 9 p. 24 refs.

A recently derived scaling law for predicting flyover jet noise from static experiments is presented and extended to the prediction of the noise from coannular jets in flight. The main differences from existing theories are the avoidance of a special turbulence model, the inclusion of the density terms of the source function and the consideration of a stretching of both the axial source and coherence length scales in flight. The flyover case at a specific jet and flight velocity proves to be related to that of a static jet. The corresponding static velocity depends on the emission angle and is lower in the rear arc and higher in the forward arc. The resulting equations are derived for low flight Mach numbers and for emission angles not too close to the jet axis. The influence of the boundary layer about the outside of the nozzle is neglected. The impressive agreement of the prediction with experimental results suggests that this might be valid for jet engines mounted in nacelles.

(Author)

A80-35982 * # Noise transmission and attenuation by stiffened panels. R. Vaicaitis, M. Slazak (Columbia University, New York, N.Y.), and M. T. Chang. *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 6th, Hartford, Conn., June 4-6, 1980, Paper 80-1034*. 12 p. 27 refs. Grant No. NSG-1450.

An analytical study of noise transmission into semi-cylindrical and rectangular acoustic enclosures due to turbulent boundary layer pressure and propeller noise (prop-fan) is presented. The structural noise transmission models include a single panel, discretely stiffened elastic panel and stiffened viscoelastic sandwich panel. Response characteristics of the stiffened panels are evaluated using a transfer matrix procedure. The interior noise field is determined by a Galerkin-like method. The effect on interior noise due to aerodynamic surface flow, cavity back-up pressure, pressurization, mass, stiffness, and damping addition to the structure is investigated. It is shown that stiffened viscoelastic sandwich panels, while providing the same stiffening benefits as an equivalent elastic panel, could significantly reduce vibration levels and subsequently give similar benefits for interior noise control.

(Author)

A80-35983 # Propeller signatures and their use. J. F. Johnston, R. E. Donham, and W. A. Guinn (Lockheed-California Co., Burbank, Calif.). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 6th, Hartford, Conn., June 4-6, 1980, Paper 80-1035*. 9 p.

The identification and use of the noise and vibration signatures of individual propellers, described herein, has provided a basis for rational advances in propeller-noise analysis and control. These

signatures, or influence vectors, were used for (1) determining analytically optimum synchrophase angles and (2) diagnosing the specific paths - airborne and structure-borne - of the noise into the cabin. A number of significant conclusions are drawn from flight experiments in a Navy P-3C patrol aircraft. The results and techniques from this work are applicable to improving the passenger and crew comfort as well as equipment life in propeller-powered aircraft.

(Author)

A80-35984 * # Noise transmission and control for a light, twin-engine aircraft. C. K. Barton and J. S. Mixson (NASA, Langley Research Center, Hampton, Va.). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 6th, Hartford, Conn., June 4-6, 1980, Paper 80-1036*. 8 p. 8 refs.

One of the dominant source-path combinations for cabin noise in light, twin-engine aircraft is propeller noise being transmitted through the fuselage sidewall. This source-path was investigated and candidate sidewall add-on treatment were installed and tested using both an external sound source and the propeller in a ground static runup. Results indicate that adding either mass or stiffness to the fuselage skin would improve sidewall attenuation and that the honeycomb stiffness treatment used generally provided more improvement than an equal amount of added mass. It is proposed that double-wall construction in conjunction with skin stiffening should provide a good weight efficient combination for the aircraft studied.

(Author)

A80-35991 # Static tests at model scale indicating rear-fuselage installation effects on engine exhaust noise. R. C. K. Stevens (National Gas Turbine Establishment, Farnborough, Hants., England). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 6th, Hartford, Conn., June 4-6, 1980, Paper 80-1046*. 11 p. 11 refs.

To investigate the increases in exhaust noise brought about by the rear-fuselage engine installation in an HS125 aircraft, tests have been conducted on a 1/9-scale model using a heated single-stream jet to simulate the engine exhaust flow and also a loudspeaker to generate internal noise simulating, to a limited extent, the engine core noise. Increases in the jet noise are observed particularly at low frequencies in the forward arc and these effects, attributed to tail-plane reflection, are not strongly dependent on the jet velocity. On the other hand, jet convection is shown to play a major role in determining the more complex installation effects observed with internally-generated noise.

(Author)

A80-35992 # Model tests demonstrating under-wing installation effects on engine exhaust noise. D. J. Way and B. A. Turner (National Gas Turbine Establishment, Farnborough, Hants., England). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 6th, Hartford, Conn., June 4-6, 1980, Paper 80-1048*. 15 p. 23 refs.

To investigate the increases in exhaust noise brought about by installing a turbo-fan engine under an aircraft wing, a short programme of experimental work has been conducted using a one-tenth scale co-axial nozzle positioned adjacent to a model wing. Although designed to represent the Tristar aircraft, results relevant to other similar aircraft designs have been obtained by repositioning the jet exhaust relative to the wing. Increases in the jet noise at both engine approach and take-off conditions are observed in the flyover plane and are attributed to wing reflection and jet-wing and jet-flap interactions. Tentative correlations of these effects have been made and the application of this work to project prediction is discussed.

(Author)

A80-35996 * # Prediction of noise constrained optimum take-off procedures. S. L. Padula (NASA, Langley Research Center, Hampton, Va.). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 6th, Hartford, Conn., June 4-6, 1980, Paper 80-1055*. 12 p. 10 refs.

An optimization method is used to predict safe, maximum-performance takeoff procedures which satisfy noise constraints at

multiple observer locations. The takeoff flight is represented by two-degree-of-freedom dynamical equations with aircraft angle-of-attack and engine power setting as control functions. The engine thrust, mass flow and noise source parameters are assumed to be given functions of the engine power setting and aircraft Mach number. Effective Perceived Noise Levels at the observers are treated as functionals of the control functions. The method is demonstrated by applying it to an Advanced Supersonic Transport aircraft design. The results indicate that automated takeoff procedures (continuously varying controls) can be used to significantly reduce community and certification noise without jeopardizing safety or degrading performance. (Author)

A80-35997 # Current problems and the future in advanced supersonic transport noise. J. V. O'Keefe, R. A. Mangiarotty, and N. Pickup (Boeing Commercial Airplane Co., Seattle, Wash.). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 6th, Hartford, Conn., June 4-6, 1980, Paper 80-1056.* 9 p. 9 refs.

Noise control technology developed during the past decade may enable the United States to resume development of an advanced supersonic transport (SST) that will give improved levels of noise. Such developments include coannular and nonconcentric nozzles, thermal acoustic shields, and mechanical suppressors to control jet noise, the primary source of SST noise. Advanced operational procedures during takeoff and landing will reduce SST community noise. However, because the success of noise suppression devices cannot be predicted with certainty, more noise-control technology must be developed and flight tested to ensure that SST jet and turbomachinery noise can meet community-noise standards of the future. (Author)

A80-35998 # Comparison of aircraft noise contour prediction programs. R. L. Chapkis, G. L. Blankenship, and A. H. Marsh (Dytec Engineering, Inc., Long Beach, Calif.). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 6th, Hartford, Conn., June 4-6, 1980, Paper 80-1057.* 10 p. 17 refs. Research sponsored by the U.S. Environmental Protection Agency.

A comparison was made of the FAA Integrated Noise Model (INM) and the USAF/NOISEMAP computer programs. Those programs are widely used to predict the location of aircraft noise contours around airports. Large differences between the programs were found in the noise data bases. There were also differences in the flight profile data bases, the ground attenuation factor, and in the way the change in noise duration is handled for curved flight paths. The two programs were used to calculate single-event noise level contours for various air-carrier and general aviation jets. The programs were also used to calculate contours of cumulative noise exposure level around a hypothetical average major intercontinental airport (AVPORT). Large differences in contour areas and shapes were found. (Author)

A80-36000 # Airframe self-noise studies on the Lockheed L 1011 TriStar aircraft. P. Fethney and A. H. Jelly (Royal Aircraft Establishment, Aerodynamics Dept., Farnborough, Hants., England). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 6th, Hartford, Conn., June 4-6, 1980, Paper 80-1061.* 14 p. 21 refs.

An experimental investigation into the level of airframe self-noise generated by the Lockheed L 1011 TriStar is reported. The aircraft was flown in several configurations, with its engines set at flight idle, over an extensive array of microphones arranged to measure the noise beneath the aircraft and at a number of sideline positions. Experimental techniques were employed to obviate ground reflection effects and increase the statistical accuracy of the data. The level, spectrum, and polar distribution of the noise generated by individual airframe components have been deduced from the flight measurements and are compared with the corresponding values obtained using Fink's prediction method. Moderate agreement has been demonstrated in terms of spectral content and amplitude of the noise at certain angles of propagation, but poor agreement with respect to source directivity. It has also been shown that the total

airframe noise at approach can be accurately evaluated from the sum of the component noise levels and that, when corrected to certification conditions, this corresponds to a value of about 6 EPN dB below the certificated level for the aircraft. (Author)

A80-36001 # Acoustic characteristics of the external upper surface blowing propulsive-lift configuration. M. Maita and T. Torisaki (National Aerospace Laboratory, Tokyo, Japan). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 6th, Hartford, Conn., June 4-6, 1980, Paper 80-1063.* 10 p. 19 refs.

Acoustic characteristics of the external upper surface blowing (USB) concept of propulsive-lift configuration were studied by full-scale model static experiment. Test components include FJR710 Turbo fan engine with acoustically treated nacelle and USB wing/flap assembly utilized in conjunction with ground verification testing of NAL Quiet STOL Research Aircraft's propulsive system. Results were compared with the previous 8%-scale cold flow model data. Aft-radiated turbofan engine noise shielding effect by wing/flap surface was also discussed and some attempts were made to reduce USB noise. (Author)

A80-36002 * # Upper surface blowing noise of the NASA-Ames quiet short-haul research aircraft. A. J. Bohn (Boeing Commercial Airplane Co., Seattle, Wash.) and M. D. Shovlin (NASA, Ames Research Center, Moffett Field, Calif.). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 6th, Hartford, Conn., June 4-6, 1980, Paper 80-1064.* 8 p. 7 refs.

An experimental study of the propulsive-lift noise of the NASA-Ames quiet short-haul research aircraft (QSRA) is described. Comparisons are made of measured QSRA flyover noise and model propulsive-lift noise data available in references. Developmental tests of trailing-edge treatments were conducted using sawtooth-shaped and porous USB flap trailing-edge extensions. Small scale parametric tests were conducted to determine noise reduction/design relationships. Full-scale static tests were conducted with the QSRA preparatory to the selection of edge treatment designs for flight testing. QSRA flight and published model propulsive-lift noise data have similar characteristics. Noise reductions of 2 to 3 dB were achieved over a wide range of frequency and directivity angles in static tests of the QSRA. These noise reductions are expected to be achieved or surpassed in flight tests planned by NASA in 1980. (Author)

A80-36019 New commutated Doppler microwave landing system. F. R. Connor (Cranfield Institute of Technology, Cranfield, Beds., England). *Electronics Letters*, vol. 16, May 9, 1980, p. 365-366.

A new design for a double sideband commutated Doppler system for landing aircraft is proposed. It is capable of providing angular information in elevation and azimuth by the measurement of a Doppler frequency. Furthermore, it offers the possibility of detecting and correcting any multipath error present in the Doppler signal. (Author)

A80-36076 Effect of some aircraft loading program modifications on the fatigue life of open hole specimens. A. Buch (Technion - Israel Institute of Technology, Haifa, Israel). *Engineering Fracture Mechanics*, vol. 13, no. 2, 1980, p. 237-256. 23 refs.

Flight simulation and program tests were carried out on different 2024-T3 sheet specimens containing a central hole. The effect of the peak-load frequency on the damage sum and flight number was investigated, and gust spectrum tests were compared with those of other authors. In the case of truncation levels $S_{max} = 1.84 \sigma(m)$ and $S_{max} = 1.685 \sigma(m)$ the investigated change of the frequency of stress cycles at the highest loading level had a weak effect on the damage sum, while the effect of decrease of the frequency of the lowest stress amplitude $\sigma(a) = 0.222 \sigma(m)$ (MiniTWIST instead of TWIST) was considerable in some cases. It was found that in some cases rare load peaks may have not only a

beneficial but also a detrimental effect on the number of simulated flights. B.J.

A80-36137 * # Laser-optical blade tip clearance measurement system. J. P. Barranger (NASA, Lewis Research Center, Cleveland, Ohio) and M. J. Ford (United Technologies Corp., Pratt and Whitney Aircraft Group, West Palm Beach, Fla.). In: Measurement methods in rotating components of turbomachinery; Proceedings of the Joint Fluids Engineering Gas Turbine Conference and Products Show, New Orleans, La., March 10-13, 1980. New York, American Society of Mechanical Engineers, 1980, p. 127-131.

The need for blade tip clearance instrumentation has been intensified recently by advances in technology of gas turbine engines. A new laser-optical measurement system has been developed to measure single blade tip clearances and average blade tip clearances between a rotor and its gas path seal in rotating component rigs and complete engines. The system is applicable to fan, compressor and turbine blade tip clearance measurements. The engine mounted probe is particularly suitable for operation in the extreme turbine environment. The measurement system consists of an optical subsystem, an electronic subsystem and a computing and graphic terminal. Bench tests and environmental tests were conducted to confirm operation at temperatures, pressures, and vibration levels typically encountered in an operating gas turbine engine. (Author)

A80-36138 # A laser-two-focus /L2F/ velocimeter for automatic flow vector measurements in the rotating components of turbomachines. R. Schödl (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Antriebstechnik, Cologne, West Germany). In: Measurement methods in rotating components of turbomachinery; Proceedings of the Joint Fluids Engineering Gas Turbine Conference and Products Show, New Orleans, La., March 10-13, 1980. New York, American Society of Mechanical Engineers, 1980, p. 139-147. 11 refs.

Measurement of blade wakes and shock wave systems in blade passages by means of the L2F velocimeter are time consuming; it takes about one hour to obtain 10 to 15 vector measurements. The technique described in the present paper reduces the measuring time by a factor of 10. Mathematical considerations of the L2F signal statistics have resulted in a modified computational model and a new measuring procedure. The optics, operational procedures, and electronics of the advanced flow measurement technique are discussed, and some experimental data are examined. V.P.

A80-36139 # Optical advances in laser transit anemometry. A. E. Smart, W. T. Mayo, Jr. (Spectron Development Laboratories, Inc., Costa Mesa, Calif.), and D. C. Wisler (General Electric Co., Aircraft Engine Group, Cincinnati, Ohio). In: Measurement methods in rotating components of turbomachinery; Proceedings of the Joint Fluids Engineering Gas Turbine Conference and Products Show, New Orleans, La., March 10-13, 1980. New York, American Society of Mechanical Engineers, 1980, p. 149-156. 16 refs.

The laser transit anemometer system described in the present paper will measure the velocity, flow angle, and turbulence in rotating machines. A novel design of the image rotator has resulted in a compact backscatter optical system, whose optimal alignment is not affected by rotation of the sensitive direction. Some unique features of the optical system are discussed, and flowfield measurements within the rotating blade row of a low-speed axial-flow compressor, made with the laser transit anemometer system, are examined. V.P.

A80-36141 * # Laser anemometer measurements in a transonic axial flow compressor rotor. A. J. Strazisar and J. A. Powell (NASA, Lewis Research Center, Cleveland, Ohio). In: Measurement methods in rotating components of turbomachinery; Proceedings of the Joint Fluids Engineering Gas Turbine Conference and Products Show, New Orleans, La., March 10-13, 1980.

New York, American Society of Mechanical Engineers, 1980, p. 165-176. 11 refs.

A laser anemometer system employing an efficient data acquisition technique has been used to make measurements upstream, within, and downstream of the compressor rotor. A fluorescent dye technique allowed measurements within endwall boundary layers. Adjustable laser beam orientation minimized shadowed regions and enabled radial velocity measurements outside of the blade row. The flow phenomena investigated include flow variations from passage to passage, the rotor shock system, three-dimensional flows in the blade wake, and the development of the outer endwall boundary layer. Laser anemometer measurements are compared to a numerical solution of the streamfunction equations and to measurements made with conventional instrumentation. (Author)

A80-36142 # Unsteady aerodynamic measurement techniques for turbomachinery research. F. O. Carta and R. L. O'Brien (United Technologies Research Center, East Hartford, Conn.). In: Measurement methods in rotating components of turbomachinery; Proceedings of the Joint Fluids Engineering Gas Turbine Conference and Products Show, New Orleans, La., March 10-13, 1980.

New York, American Society of Mechanical Engineers, 1980, p. 177-185. 18 refs.

The present paper deals with the application of digital data acquisition and FFT techniques to the reduction of on-rotor data and the study of rotating stall. Quick-response transducers, used in connection with digital data acquisition and reduction equipment, are shown to provide a powerful tool for studying unsteady processes in compressors, while on-rotor transducers are well suited for studying the dynamic response of the flow over the rotor blades. To obtain the dynamic changes in force on the rotor blade, extensive data averaging and calculations are required. Individual pressure readings on the rotor blade must be combined with an appropriate curve-fitting expression, and an integrating program must be used to obtain instantaneous force values for an entire rotor rotation. Digital computers, directly linked to the high-speed data acquisition equipment, are essential for such work. V.P.

A80-36143 # Unsteady pressure measurements and data analysis techniques in axial-flow compressors. W. F. O'Brien, Jr., W. T. Cousins (Virginia Polytechnic Institute and State University, Blacksburg, Va.), and M. R. Sexton (Virginia University, Charlottesville, Va.). In: Measurement methods in rotating components of turbomachinery; Proceedings of the Joint Fluids Engineering Gas Turbine Conference and Products Show, New Orleans, La., March 10-13, 1980. New York, American Society of Mechanical Engineers, 1980, p. 195-201. 12 refs. Project SQUID.

Methods for the collection and interpretation of unsteady pressure measurements in axial-flow compressors are described. Examples discussed include on-rotor data reduction and analysis for study of distorted inflow response, and rotating stall detection and measurement. Signals from high-response transducers were recorded and digitized. Data analysis techniques include signal averaging, curve fitting and integration for on-rotor pressure profiles, and application of FFT techniques. (Author)

A80-36144 # System to measure the pressure distribution on fan aerofoil surfaces during flutter conditions. J. W. H. Chivers (Rolls-Royce, Ltd., Electronics and Instrumentation Research Group, Derby, England). In: Measurement methods in rotating components of turbomachinery; Proceedings of the Joint Fluids Engineering Gas Turbine Conference and Products Show, New Orleans, La., March 10-13, 1980. New York, American Society of Mechanical Engineers, 1980, p. 203-207.

In order to assist in the understanding of high speed flutter, a series of tests have been conducted on a research fan in which the blade surface pressures have been measured by means of miniature silicon diaphragm pressure transducers embedded in selected fan blades. Prior to this investigation a programme of rig tests was conducted to examine the effects of centrifugal force and vibration on the transducer performance and a transducer mounting technique

was developed to minimize blade induced stress in the transducer. Instantaneous measurements of the tip stagger angles of the pressure instrumented fan blades have enabled a cross correlation to be performed on the blade surface pressure data and the blade tip angles. Some typical test results are shown. (Author)

A80-36145 * # Fluid and structural measurements to advance gas turbine technology. M. J. Hartmann (NASA, Lewis Research Center, Cleveland, Ohio). In: Measurement methods in rotating components of turbomachinery; Proceedings of the Joint Fluids Engineering Gas Turbine Conference and Products Show, New Orleans, La., March 10-13, 1980. New York, American Society of Mechanical Engineers, 1980, p. 209-213.

In the present paper, the current status of fluid and structural measurements is reviewed, and some potential improvements in gas turbine machinery, directly associated with the new measuring capability are discussed. Some considerations concerning the impact of the new capability on the methods and approaches that will be used in the further development of advanced technology, in general, and to aeropropulsion gas turbine machinery, in particular, are presented. V.P.

A80-36146 # Vibration measurements on turbomachine rotor blades with optical probes. H. Roth (Brown, Boveri et Cie., AG, Baden, Switzerland). In: Measurement methods in rotating components of turbomachinery; Proceedings of the Joint Fluids Engineering Gas Turbine Conference and Products Show, New Orleans, La., March 10-13, 1980. New York, American Society of Mechanical Engineers, 1980, p. 215-224.

The paper deals with a novel display device that will record simultaneously the vibrations of each blade in a row. The device is very similar to the Lewis system for detection of flutter (Nieberding, Pollack, 1977) but differs from it in that bright dots can be resolved in time. The introduction of this additional degree of freedom extends substantially the versatility of the device. Hard copies of several measurement records are presented. The derivation of the basic relations is given in an appendix. V.P.

A80-36149 # Processing and analysis of the data from a two spool gas turbine engine. N. K. Verma, K. Venkataraju, M. L. Abrol, and N. R. Raghuprasad (Gas Turbine Research Establishment, Bangalore, India). In: Measurement methods in rotating components of turbomachinery; Proceedings of the Joint Fluids Engineering Gas Turbine Conference and Products Show, New Orleans, La., March 10-13, 1980. New York, American Society of Mechanical Engineers, 1980, p. 241-246.

The paper deals with the measurement and analysis of a number of parameters essential for the development of a gas turbine engine. The first part of the paper describes a microprocessor based data processing system which has been developed for acquiring data from over 256 parameters. The salient features of this system are high accuracy of measurement, fast acquisition time and an on-line monitoring of a selected number of parameters on a bright CRT display. The data is presented in engineering units after suitable averaging. In the second part of the paper the analysis of the transients and time varying signals on a real time spectrum analyzer has been described. An attempt has been made to obtain a correlation between the mechanical and aerodynamic behavior of various components of the engine and the spectrum generated by them during the engine operation. (Author)

A80-36151 * # Digital system for dynamic turbine engine blade displacement measurements. L. J. Kiraly (NASA, Lewis Research Center, Cleveland, Ohio). In: Measurement methods in rotating components of turbomachinery; Proceedings of the Joint Fluids Engineering Gas Turbine Conference and Products Show, New Orleans, La., March 10-13, 1980. New York, American Society of Mechanical Engineers, 1980, p. 255-262.

The paper presents a technique for measuring blade tip displacements which employs optical probes and an array of microcomputers. A system directly digitizing a minimum of a

2048-point time-deflection history for each of the three measurement locations on each blade is described. V.T.

A80-36152 * # Preliminary measurements of aerodynamic damping of a transonic compressor rotor. E. F. Crawley, J. L. Kerrebrock, and J. Dugundji (MIT, Cambridge, Mass.). In: Measurement methods in rotating components of turbomachinery; Proceedings of the Joint Fluids Engineering Gas Turbine Conference and Products Show, New Orleans, La., March 10-13, 1980.

New York, American Society of Mechanical Engineers, 1980, p. 263-271. 9 refs. Grant No. N5G-3079.

The aeroelastic behavior of a transonic compressor rotor operated in the MIT Blowdown Compressor Facility has been examined by means of piezoelectric motion sensors at the base of each of the 23 blades. Excitation has been observed due to rotating stall, due to an incipient flutter, and due to the facility startup transient. A method has been found for determining the aerodynamic damping force by modal analysis of the blade motion. Application of this technique to the example of excitation by rotating stall has led to the conclusions that the blade loading decreases in the stall cell, and that the damping force on the blades in the clean flow is in phase with blade velocity but opposite it in sign, leading to a logarithmic decrement of 0.2. This method of force derivation has quite general applicability as it requires only blade motion data such as are routinely acquired with strain gages. It is argued that models are needed for aerodynamic damping which focus on the effects of near neighbors of a given blade, since flutter often results in large response of isolated blades or small groups of blades. (Author)

A80-36153 # Low profile strain gage applications telemetered from rotating machinery. R. D. DeRose (USAF, Aero Propulsion Laboratory, Wright-Patterson AFB, Ohio). In: Measurement methods in rotating components of turbomachinery; Proceedings of the Joint Fluids Engineering Gas Turbine Conference and Products Show, New Orleans, La., March 10-13, 1980.

New York, American Society of Mechanical Engineers, 1980, p. 273-277.

A strain gage lead out application using materials developed for flexible printed circuitry is described. This application technique is being tested along with axially mounted telemetry electronics transmitting signals from a high speed compressor test vehicle. The integrated system uses small pins and sockets interconnecting various electronic components to facilitate vehicle disassembly. The results from past tests along with a description of the next configuration to be tested are also given. The objective of this effort is to obtain a very low profile (0.08mm or less) application which will minimize aerodynamic disturbance when it is applied to airfoils operating at temperatures up to 585K (600 F). (Author)

A80-36154 # The design, development and operation of gas turbine radio telemetry systems. J. G. B. Worthy (Rolls-Royce, Ltd., Aero Div., Derby, England). In: Measurement methods in rotating components of turbomachinery; Proceedings of the Joint Fluids Engineering Gas Turbine Conference and Products Show, New Orleans, La., March 10-13, 1980. New York, American Society of Mechanical Engineers, 1980, p. 279-287. 8 refs.

The design and operation of gas turbine radio telemetry systems are examined. Measurements on the rotating components of aerogas turbines produce difficult instrumentation problems. This paper describes the Rolls-Royce approach to this problem and the design of over 30 radio telemetry systems manufactured by this company. Constraints on the measuring system, block diagrams of the telemetry system and transducer selection integrated circuit are discussed, and experience using dynamic and strain tests is analyzed. Finally, possible problems such as generation of spurious rotational frequency signals due to poor antenna design and the proximity of stator metal work are considered. A.T.

A80-36155 * # Impact of new instrumentation on advanced turbine research. R. W. Graham (NASA, Lewis Research Center, Cleveland, Ohio). In: Measurement methods in rotating components

of turbomachinery; Proceedings of the Joint Fluids Engineering Gas Turbine Conference and Products Show, New Orleans, La., March 10-13, 1980. New York, American Society of Mechanical Engineers, 1980, p. 289-302. 23 refs.

The progression of experimental programs is discussed from the simplest two-dimensional stationary geometry to the highly complex three-dimensional flow in a rotating blade row. Experimental methods and instrumentation techniques are described. Emphasis is placed on rotating blade row measurements. V.T.

A80-36156 # **Qualification of cooling systems design for high temperature on a turbine facility.** A. E. Cournot, M. Laroche (SNECMA, Moissy-Cramayel, Seine-et-Marne, France), Y. Le Bot, and P. J. Michard (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). In: Measurement methods in rotating components of turbomachinery; Proceedings of the Joint Fluids Engineering Gas Turbine Conference and Products Show, New Orleans, La., March 10-13, 1980. New York, American Society of Mechanical Engineers, 1980, p.303-317. 23 refs. (ONERA, TP no. 1980-15)

An advanced turbine test facility for predicting temperature distribution on airfoils and adjacent components is described. The turbine design program including static test rigs, engine tests, and measuring techniques are examined; aerodynamic properties of steam are characterized, including temperature distortion and aerodynamic turbulence, and measurement of heat exchange on blades and vanes. Finally, thermal characteristics of rotor blades and its application to the investigation of film-cooled blade thermal balance are considered. A.T.

A80-36157 * # **Temperature and pressure measurement techniques for an advanced turbine test facility.** F. G. Pollack and R. P. Cochran (NASA, Lewis Research Center, Cleveland, Ohio). In: Measurement methods in rotating components of turbomachinery; Proceedings of the Joint Fluids Engineering Gas Turbine Conference and Products Show, New Orleans, La., March 10-13, 1980. New York, American Society of Mechanical Engineers, 1980, p. 319-326. 13 refs.

A high pressure, high-temperature turbine test facility is being constructed at the NASA Lewis Research Center for use in turbine cooling research. Several recently developed temperature and pressure measuring techniques will be used in this facility. This paper describes these measurement techniques, their status, previous applications and some results. Noncontact surface temperature measurements will be made by optical methods. Radiation pyrometry principles combined with photoelectric scanning will be used for rotating components and infrared photography for stationary components. Contact (direct) temperature and pressure measurements on rotating components will be handled with an 80-channel rotary data package which mounts on and rotates with the turbine shaft at speeds up to 17,500 rpm. The data channels are time-division multiplexed and converted to digital words in the data package. A rotary transformer couples power and digital data to and from the shaft. (Author)

A80-36291 * **Air deployment of satellite-tracked drifters.** R. E. Cheney (NASA, Goddard Space Flight Center, Greenbelt, Md.), P. L. Richardson (Woods Hole Oceanographic Institution, Woods Hole, Mass.), and B. P. Blumenthal (U.S. Navy, Naval Oceanographic Office, Bay St. Louis, Mo.). *Journal of Geophysical Research*, vol. 85, May 20, 1980, p. 2773-2778. 7 refs. Contract No. N00014-74-C-0262. NR Project 083-004.

Six free-drifting buoys tracked by the Nimbus 6 satellite were successfully launched by C-130 aircraft in a series of deployments during 1977-1979. The buoys were launched in Gulf Stream rings which had been identified with airborne XBT surveys and satellite infrared images. This is the first operational test of these air-deployable buoys. (Author)

STAR ENTRIES

N80-22257# Sikorsky Aircraft, Stratford, Conn.
ANALYSIS OF HELICOPTER MAINTENANCE FAULT ISOLATION CRITERIA/TECHNIQUES Final Report, Oct. 1977 - Apr. 1979

Thomas N. Cook Oct. 1979 173 p refs
 (Contract DAAJ02-77-C-0071; DA Proj. 1L2-62209-AH-76)
 (AD-A080596; SER-510022; USARTL-TR-79-21) Avail: NTIS HC A08/MF A01 CSCL 01/3

The problems associated with fault isolation maintenance in Army aviation were investigated. The investigation included a detailed engineering analysis of historical maintenance data on the CH-54 helicopter and surveys of selected Army field activities throughout the United States. The investigation confirmed that fault isolation maintenance is a significant factor in the cost of operating Army helicopters. The most frequent criticism voiced by Army personnel in the field concerns the generally poor quality of troubleshooting data in current aircraft maintenance publications. In response to this problem, an improved approach to the development of fault isolation maintenance data for complex systems was developed. Called FIAT (Fault Isolation Analysis Technique), the proposed approach greatly facilitates the identification of symptom/cause relationships and the collection, processing and organization of data required for the preparation of maintenance manuals. GRA

N80-22260*# National Aeronautics and Space Administration, Washington, D. C.
TRANSONIC WING DFVLR-F4 AS EUROPEAN TEST MODEL

G. Redeker and Norbert Schmidt Jan. 1980 12 p Transl. into ENGLISH from Nachrichten-Tech. Z. (West Germany), Jun. 1979 p 36-39 Original language document announced as A79-41234 Transl. by Kanner (Leo) Associates, Redwood City, Calif. Original doc. prep. by DFVLR, Brunswick (Contract NASw-3199)
 (NASA-TM-75752) Avail: NTIS HC A02/MF A01 CSCL 01A

A transonic wing, the DFVLR-F4 was designed and tested as a model in European transonic wind tunnels and was found to give performance improvements over conventional wings. One reason for the improvement was the reduction of compression shocks in the transonic region as the result of improved wing design. E.D.K.

N80-22264*# North Carolina State Univ. at Raleigh, Center for Acoustical Studies.

EXPERIMENTAL STUDY OF AIRFOIL TRAILING EDGE NOISE: INSTRUMENTATION, METHODOLOGY AND INITIAL RESULTS M.S. Thesis

Mark B. Manley 1980 199 p refs
 (Grant NsG-1377)
 (NASA-CR-163007) Avail: NTIS HC A09/MF A01 CSCL 01A

The mechanisms of aerodynamic noise generation at the trailing edge of an airfoil is investigated. Instrumentation was designed, a miniature semiconductor strain-gauge pressure transducer and associated electronic amplifier circuitry were designed and tested and digital signal analysis techniques applied to gain insight into the relationship between the dynamic pressure close to the trailing edge and the sound in the acoustic far-field. Attempts are made to verify some trailing-edge noise generation characteristics as theoretically predicted by several contemporary acousticians. It is found that the noise detected in the far-field is comprised of the sum of many uncorrelated emissions radiating from the vicinity of the trailing edge. These

emissions appear to be the result of acoustic energy radiation which has been converted by the trailing-edge noise mechanism from the dynamic fluid energy of independent streamwise 'strips' of the turbulent boundary layer flow. A.R.H.

N80-22265*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

THEORETICAL PREDICTION OF NONLINEAR PROPAGATION EFFECTS ON NOISE SIGNATURES GENERATED BY SUBSONIC OR SUPERSONIC PROPELLER OR ROTOR-BLADE TIPS

Raymond L. Barger May 1980 18 p refs
 (NASA-TP-1660; L-13388) Avail: NTIS HC A02/MF A01 CSCL 01A

The nonlinear propagation equations for sound generated by a constant speed blade tip are presented. Propagation from a subsonic tip is treated as well as the various cases that can occur at supersonic speeds. Some computed examples indicate that the nonlinear theory correlates with experimental results better than linear theory for large amplitude waves. For swept tips that generate a wave with large amplitude leading expansion, the nonlinear theory predicts a cancellation effect that results in a significant reduction of both amplitude and impulse. Author

N80-22266*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

FULL-SCALE WIND TUNNEL INVESTIGATION OF THE ADVANCED TECHNOLOGY LIGHT TWIN-ENGINE AIRPLANE (ATLIT)

James L. Hassell, Jr., William A. Newsom, Jr., and Long P. Yip May 1980 212 p refs
 (NASA-TP-1591; L-13135) Avail: NTIS HC A10/MF A01 CSCL 01A

An investigation was conducted to evaluate the aerodynamic performance, stability, and control characteristics of the Advanced Technology Light Twin Engine airplane (ATLIT). Data were measured over an angle of attack range from -4 deg to 20 deg for various angles of sideslip between -5 deg and 15 deg at Reynolds numbers of 0.0000023 and 0.0000035 for various settings of power and flap deflection. Measurements were also made by means of special thrust torque balances to determine the installed propeller characteristics. Part of the investigation was devoted to drag cleanup of the basic airplane and to the evaluation of the effect of winglets on drag and stability. E.D.K.

N80-22267# Northrop Corp., Hawthorne, Calif. Aircraft Group.

TRANSONIC KERNEL FUNCTION METHOD FOR UNSTEADY FLOW CALCULATIONS USING A UNIFIED LINEAR PRESSURE PANEL PROCEDURE Final Report, 1 Mar. 1978 - 30 May 1979

D. D. Liu, W. S. Di, and M. T. Landahl Wright-Patterson AFB, Ohio AFFDL Oct. 1979 107 p refs
 (Contract F33615-78-C-3202)

(AD-A080227; NOR-79-52; AFFDL-TR-79-3085) Avail: NTIS HC A06/MF A01 CSCL 20/4

A transonic kernel function method for unsteady flow calculations was developed. A unified linear pressure panel procedure is established to solve for two-dimensional problems in the subsonic, transonic, and supersonic flow regimes; consequently, a TLP2D computer code was developed. Numerical results are presented for pitching or flapping airfoils in these linear and nonlinear flow regimes. The mixed kernel function procedure is applied to a pitching Guderley airfoil in sonic flow. Comparisons with other results and discussions are given. Additional analytical studies include Landahl's general formulation of the phase correction method and the kernel function formulation of the Eckhaus-Landahl shock-jump model. Finally, assessments of and recommendations for the present work are given. GRA

N80-22268# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio, School of Engineering.

EVALUATION OF AN IMPROVED PARACHUTE TEST DATA ACQUISITION SYSTEM M.S. Thesis

Gary Alan Richardson Dec. 1979 109 p refs

(AD-A080240; AFIT/GCS/EE/79-13) Avail: NTIS
HC A06/MF A01 CSCL 14/3

This project confirms the feasibility of a sixteen channel, self-contained data acquisition system that would be suitable to store data obtained during a parachute performance evaluation drop. The overall system is discussed in modular fashion to allow generalization to other portable data acquisition systems that must accept data at high rates but over relatively short time intervals. The storage medium for the proposed system utilizes magnetic bubble memory devices. GRA

N80-22269# Avco Corp., Wilmington, Mass.
PROJECTILE/SABOT DISCARD AERODYNAMICS Final Report

David Siegelman and Peter Crimi Aberdeen Proving Ground, Md. BRL Dec. 1979 92 p refs
(Contract DAAK11-77-C-0080)
(AD-A080538; AD-E430367; ARBRL-CR-00410) Avail: NTIS
HC A05/MF A01 CSCL 19/1

An engineering analysis procedure which describes the sabot discard process for gun-launched projectiles has been modified in order to provide an improved tool for investigating the effects of sabot, projectile and launch parameters upon near field dispersive forces. Experimental test data generated by BRL has been used to formulate an improved engineering model of the interaction flow field which develops about the projectile/sabot petal package during the removal process. The experimental data indicated that individual compression wave intersections and reflections are present within the annular flow passage. In order to model this behavior, an integrated flow element approach utilizing local shock/expansion procedures has been evolved. GRA

N80-22272# European Space Agency, Paris (France).
CALCULATION OF THE INTERFERENCE EFFECTS BETWEEN THE ENGINE WING AND THE BASE WING OF A CIVIL AND MILITARY TRANSPORT AIRCRAFT BY THE VORTEX LATTICE METHOD

W. Schroeder Dec. 1978 101 p refs Transl. into ENGLISH of "Berechnung der Interferenzwirkung Zwischen Triebwerks- und Basisfluegel am Zivil-Militaerischen Transporter nach dem Wirbelleitverfahren". Rept. DLR-IB-151-77/19 DFVLR and VFW-Fokker G.m.b.H., Bremen, Dec. 1977 Original report in GERMAN previously announced as X79-71705
(ESA-TT-493; DLR-IB-151-77/19) Avail: NTIS
HC A06/MF A01

For incompressible symmetric flow, calculations of the interference between engine and basis wing of the VFW-Fokker 614 civil-military transport aircraft model were performed. The following parameters were used: angle of attack 0, 3, and 5 deg for three different engine wings each with -10%, 10%, 30% or 50% overlap between engine and basic wing. The results of the linear and nonlinear calculations are discussed. Author (ESA)

N80-22273# European Space Agency, Paris (France).
CALCULATION OF THE TURBULENT BOUNDARY LAYER ON AN INFINITE SWEEP WING USING A THREE-DIMENSIONAL MIXING LENGTH MODEL

Gert Reinhard Schneider Jul. 1979 70 p refs Transl. into ENGLISH of "Die Berechnung der Turbulenten Grenzschicht am Schiebenden Fluegel Unendlicher Spannweite Mittels eines Dreidimensionalen Mischungswegmodells". Rept. DLR-FB-77-73 DFVLR, Goettingen, West Germany, May 1978 Original report in GERMAN previously announced as X79-72041
(ESA-TT-534; DLR-FB-77-73) Avail: NTIS HC A04/MF A01;
DFVLR, Cologne DM 28,60

Experimental observations of three-dimensional turbulent boundary layers show that the direction of the shear stress is in general not parallel to the direction of the mean velocity gradient. Following this observation for the Reynolds shear stresses, a generalized mixing length model is developed based on a non-isotropically distributed eddy viscosity. The isotropic mixing length model currently used for three-dimensional flows is included as a special case. Calculations are carried out for the infinite swept wing situation of the VAN DEN BERG, ELSENAR and

BOELSMA experiment. The comparisons show an improvement of the prediction over the isotropic calculations. Author (ESA)

N80-22274# Office National d'Etudes et de Recherches Aeronautiques, Paris (France).

ACTIVITIES IN AEROSPACE RESEARCH Annual Report, 1978

1979 208 p refs Original contains color illustrations
Avail: NTIS HC A10/MF A01

Aerodynamics, wind tunnel testing, structures, propulsion, physics, and materials science are among the topics discussed. Applications of aerospace research in industry are covered. Patents and publications issued during the year are listed. Author (ESA)

N80-22275# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).

SUPERCritical WING DESIGN STUDIES FOR TRANSPORT AIRCRAFT. VOLUME 1: WING DESIGN AND WIND TUNNEL MEASUREMENTS Final Report

Guenter Binder, Hartmut Buers, and Hans-Joerg Proksch Bonn Bundesmin. fuer Forsch. u. Technol. Jul. 1979 94 p refs IN GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Forsch. u. Technol. 2 Vol.

(BMFT-FB-W-79-06-Vol-1) Avail: NTIS HC A05/MF A01

The design work and wind tunnel measurements for a supercritical wing for a transport aircraft to supplement the Airbus A 300 are described. Author (ESA)

N80-22276# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany). Theoretical Aerodynamics.

SUPERCritical WING DESIGN STUDIES FOR TRANSPORT AIRCRAFT. VOLUME 2: THEORETICAL STUDIES Final Report

Willy Fritz, Stefan Leicher, Wolfgang Schmidt, and Hans-Werner Stock Bonn Bundesmin. fuer Forsch. u. Technol. Jul. 1979 148 p refs IN GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Forsch. u. Technol. 2 Vol.

(BMFT-FB-W-79-07-Vol-2) Avail: NTIS HC A07/MF A01

The improvement of currently existing computer methods for the design of supersonic transport aircraft was studied. This was achieved by modifying both equation and boundary conditions. Wind tunnel wall effects were included as was viscous drag. The detailed comparisons document the present status of the different methods. Author (ESA)

N80-22278# Engineering Sciences Data Unit, London (England).
A COMPARISON OF VARIOUS NUMERICAL METHODS FOR CALCULATING SUPERCritical INVISCID ISENTROPIC FLOW OVER TWO-DIMENSIONAL AEROFOILS

R. H. Blockley Orpington, England Defense Res. Inform. Centre 1979 150 p refs

(Contract K/A72c/259/CB/A72c)

(S/T-Memo-4/75; BR47382) Avail: NTIS HC A07/MF A01

Numerical solutions of full potential flow equations are mutually compared with particular reference to the method of Garabedian and Korn. Comparisons of pressure distributions and aerodynamic force and moment coefficients for a small range of airfoils at Mach numbers for near-critical or supercritical flow are presented. Procedures for using the Garabedian and Korn program are recommended. An approximate method (transonic small perturbation method based on Krupp and Murman) is similarly compared with that of Garabedian and Korn. The airfoils studied are described. Author (ESA)

N80-22280# Royal Aircraft Establishment, Farnborough (England).

A COMMENT ON THE ORIGIN OF ENDWALL INTERFERENCE IN WIND TUNNEL TESTS OF AEROFOILS

K. G. Winter and J. H. B. Smith London HMSO 20 Aug. 1979 20 p refs

(RAE-TM-Aero-1816; BR70172)

Avail: NTIS HC A02/MF A01

The interference effects of an airfoil spanning the working section of a wind tunnel due to the presence of boundary layers on the walls are discussed. Tests reveal behavior different from

that predicted by theory. A qualitative assessment of the problem is made and it is suggested that the interference be explained in terms of changes in the displacement thickness of the boundary layers on the tunnel walls rather than in terms of induced effects from trailing vorticity. Author (ESA)

N80-22281# Royal Aircraft Establishment, Farnborough (England).

AERODYNAMIC CHARACTERISTICS OF MOVING TRAILING-EDGE CONTROLS AT SUBSONIC AND TRANSONIC SPEEDS

D. G. Mabey, D. M. McOwat, and B. L. Welsh London HMSO 25 Jun. 1979 27 p refs Presented at AGARD Fluid Dyn. Panel Meeting on the Aerodyn. Characteristics of Controls, May 1979 (RAE-TM-Struc-947; BR69932) Avail: NTIS HC A03/MF A01

Oscillatory pressures calculated and measured at high subsonic speeds for a swept back wing of aspect ratio 6 with a part span trailing-edge flap are compared. The flap was driven at frequencies of 1 Hz (quasi-steady) and 90 Hz at Mach numbers from 0.40 to 0.95 with both fixed and free transition over a range of Reynolds numbers from one to four million. The measured oscillatory pressures which depend strongly on the boundary layer displacement thickness at the hinge line, are presented. Tests with the flaps driven simultaneously at two frequencies (90 Hz and 131 Hz) at subsonic and transonic speeds are discussed. Author (ESA)

N80-22282# Aeronautical Research Inst. of Sweden, Stockholm. Aerodynamics Dept.

MEASUREMENT OF LOCAL SKIN FRICTION AND STATIC PRESSURE ON A SWEEPED WING IN FLIGHT Final Report

A. Bertelrud Jul. 1979 77 p refs Prepared in cooperation with Swedish Air Force, Stockholm (Contracts FMV-F-K-82223-76-001-21-001; FMV-F-K-82223-77-001-21-001; FMV-F-K-82223-77-116-21-001; FMV-F-K-82223-78-003-21-001) (FFA-AU-1370) Avail: NTIS HC A05/MF A01

A series of flight tests have been performed to explore the possibility of using multiple total head/static probes (modified Preston tubes) for the measurement of local skin friction and static pressure distribution in flight. The aircraft used in the experiment was a SAAB 32 A Lansen, which is a swept wing attack fighter. It is shown that the results obtained are reproducible and agree reasonably well with computations. Thin films (McCroskey gauges) mounted on the leading edge showed no deviations in resistance after 19 flights. This indicates that the gauges can be used for qualitative, and probably also quantitative measurements in flight. Author (ESA)

N80-22294# Army Safety Center, Fort Rucker, Ala. **SURVEY OF FORCED AND PRECAUTIONARY LANDING COSTS**

Emil Spezia, G. D. Kimel, and Thomas Neese Jul. 1979 24 p (AD-A080110; USASC-TR-79-4) Avail: NTIS HC A02/MF A01 CSDL 01/2

A questionnaire survey was conducted to learn the costs of forced landings (F/Ls) and precautionary landings (P/Ls). The questionnaire elicited cost data in respect to (1) the effect each mishap had on the mission assigned the mishap aircraft; (2) man-hours lost by the crew and passengers; (3) man-hours required to recover the crew, passengers, and aircraft; (4) time the mishap aircraft was unavailable for flight; (5) man-hours required to make the aircraft flyable; and (6) the components that malfunctioned to cause these mishaps. The broad and obscure costs revealed by the survey are sufficient to justify the initiation of a concerted effort to prevent the causes of these mishaps. Prevention of the causes of these mishaps will allow aviation units to operate more efficiently, i.e., allow them to maintain a higher state of combat readiness. GRA

N80-22295 Dayton Univ., Ohio. **OPTIMAL ESTIMATION APPLIED TO REDUNDANT**

STRAPPED DOWN INERTIAL SENSORS FOR NAVIGATION AND FLIGHT CONTROL Ph.D. Thesis

Jackie Wayne Bell 1979 213 p
Avail: Univ. Microfilms Order No. 8008430

The capability of various algorithms for improved estimation of the sensor true outputs from a strapped down inertial reference assembly is examined. A secondary factor is the optimum combination of the estimated outputs from a set of redundant inertial sensors to form an orthogonal triad inertial reference. The algorithms are based upon various levels of sensor modeling in Kalman or fixed-gain optimal filters. The algorithms range from a second-order to a fourth-order filter for each sensor. The redundant sensor estimated outputs are combined through a weighted least squares estimator which provides a statistical average of the estimated sensor outputs transformed into body coordinates. Dissert. Abstr.

N80-22297*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

A NEW ALGORITHM FOR HORIZONTAL CAPTURE TRAJECTORIES

John D. McLean Mar. 1980 21 p refs (NASA-TM-81186; A-8111) Avail: NTIS HC A02/MF A01 CSDL 17G

An algorithm which transfers an aircraft from an initial position and heading to a final position and heading was developed for onboard synthesis of horizontal flight paths. The algorithm finds all solutions possible, and selects the one with minimum path length. Degenerate conditions in which one or more of the basic segments is missing are handled without difficulty. The solution to this problem is derived, and a FORTRAN listing of the algorithm is provided. E.D.K.

N80-22303# National Aerospace Lab., Amsterdam (Netherlands). Flight Div.

COMPARISON OF THE MINILIR LOCATION SYSTEM AND THE NLR INERTIA MEASURING SYSTEM STALINS

A. J. L. Willekens 28 Jun. 1978 17 p (NLR-MP-78026-U) Avail: NTIS HC A02/MF A01

Aircraft trajectories were determined using the optical location system (MINILIR) and the inertial measuring system (STALINS). The optical tracking was controlled with a movie camera mounted on the MINILIR tracker. A known position in flight was obtained with a high precision fan marker system RASP. The accuracy of the position and velocity data obtained using both systems is discussed. Author (ESA)

N80-22304*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

PRELIMINARY INVESTIGATION OF MOTION REQUIREMENTS FOR THE SIMULATION OF HELICOPTER HOVER TASKS

Russell V. Parrish Apr. 1980 31 p refs (NASA-TM-81801) Avail: NTIS HC A03/MF A01 CSDL 01C

Data from a preliminary experiment are presented which attempted to define a helicopter hover task that would allow the detection of objectively-measured differences in fixed base/moving base simulator performance. The addition of heave, pitch, and roll movement of a ship at sea to the hover task, by means of an adaption of a simulator g-seat, potentially fulfills the desired definition. The feasibility of g-seat substitution for platform motion can be investigated utilizing this task. Author

N80-22305*# Science Applications, Inc., Los Angeles, Calif. Economic Analysis Div.

PARAMETRIC STUDY OF HELICOPTER AIRCRAFT SYSTEMS COSTS AND WEIGHTS

Michael N. Beltramo Jan. 1980 179 p refs (Contract NAS2-8703) (NASA-CR-152315) Avail: NTIS HC A09/MF A01 CSDL 01C

Weight estimating relationships (WERs) and recurring production cost estimating relationships (CERs) were developed for helicopters at the system level. The WERs estimate system

level weight based on performance or design characteristics which are available during concept formulation or the preliminary design phase. The CER (or CERs in some cases) for each system utilize weight (either actual or estimated using the appropriate WER) and production quantity as the key parameters. R.E.S.

N80-22306# National Aeronautics and Space Administration, Washington, D. C.

AERODYNAMICS OF THE NEW GENERATION OF COMBAT AIRCRAFT WITH DELTA WINGS

M. P. Bohn Mar. 1980 26 p Transl. into ENGLISH of "Aerodynamique de la Nouvelle Generation d'Avions de Combat a Aile Delta", Rept. AGARD-CP-241 AGARD, Paris, Jun. 1978 p 11-1-11-13 Presented at the Multi-Panel Symp. on Fighter Aircraft Design, Florence, 3-6 Oct. 1977 Translation was announced as N78-30106 Transl. by Scientific Translation Service, Santa Barbara, Calif.

(Contract NASw-3198)
(NASA-TM-75793; AGARD-CP-241) Avail: NTIS
HC A03/MF A01 CSCL 01C

The use of delta wing aerodynamic design for modern fighter aircraft is discussed. Various current French fighter airplanes are utilized for comparisons. E.D.K.

N80-22308# Naval Air Development Center, Warminster, Pa. Aircraft and Crew Systems Technology Directorate.

STATISTICAL REVIEW OF COUNTING ACCELEROMETER DATA FOR NAVY AND MARINE FLEET AIRCRAFT Semiannual Summary Report, 1 Jan. 1962 - 30 Jun. 1979

Warren J. Williams 1 Nov. 1979 159 p refs Revised
(AD-A080580; NADC-13920-2) Avail: NTIS
HC A08/MF A01 CSCL 01/3

This report is a specialized summary of normal acceleration data recorded by counting accelerometers. Data are separated by calendar time and mission category. Only data reported in the counting accelerometer program are included. This is a semi-annual progress report, and it presents a specialized summary of the data in the counting accelerometer program. Statistics describing Navy and Marine aircraft cumulative g-count exceedances are calculated and tabulated. These tabulations are separated by calendar time and into four major categories of fleet experience: Navy Training, Navy Combat, Marine Training, and Marine Combat. These data show that the load rate distributions (counts at 1000 hours) for most models and most g-levels have a non-normal distribution. Within a model (F-4N, F-8J, etc.) differences in the average load rates exist when data are separated by calendar time or mission category. GRA

N80-22309# Aeronautical Research Labs., Melbourne (Australia). **GENERATION OF A REPRESENTATIVE LOAD SEQUENCE FOR THE FATIGUE TESTING OF MACCHI MB 326H SPAR BOOMS**

L. R. Gratzler Jan. 1979 26 p refs
(AD-A074155; ARL/Struc-Note-450) Avail: NTIS
HC A03/MF A01 CSCL 01/3

Testing techniques have been developed to allow more realistic load sequences. To take advantage of this, the design of such test sequences must also be improved and for several years large scale tests at ARL have relied on loads obtained from flight histories transformed as little as possible. In this way the probability structure of flight sequences can be restored. Until now however, the design of test histories has been almost entirely manual. This note describes the generation of histories by use of automatic data processing techniques and linear programming. The example used in this note is the Macchi center section spar boom which is being tested under the design load history to supplement earlier data obtained under less realistic load sequences. GRA

N80-22310# Textron Bell Helicopter, Fort Worth, Tex. **IMPROVED MANEUVER CRITERIA EVALUATION PROGRAM Final report, Sep. 1976 - Jul 1979**

T. Wood and T. Waak Nov. 1979 79 p refs
(Contract DAAJ02-76-C-0064; DA Proj. 1F2-63211-D-157)
(AD-A080408; USARTL-TR-79-20) Avail: NTIS
HC A05/MF A01 CSCL 01/2

The Maneuver Criteria Evaluation Program (MCEP) is a digital computer program that solves the flight path equation of motion for a helicopter without auxiliary propulsion. The use of basic work, energy, and power relationships makes possible accurate representation of flight path trajectories. MCEP can be used to aid in the development of maneuver requirements that provide the necessary maneuver capability to perform the desired mission. The desired mission is simulated in MCEP by using individual flight controllers to 'fly' the helicopter through the mission profile. Key maneuver parameters are monitored throughout the flight profile to provide insight into the performance of the helicopter in achieving the desired flight trajectory. Three maneuvers have been modified to allow rotor rpm to be bled to use some of the rotor's stored energy. These maneuvers are a constant altitude acceleration maneuver, a collective pop-up maneuver, and a sideward acceleration maneuver. Correlation with flight test data is established to validate the bleed rpm maneuvers. The appendix to the report, the User's Guide, contains the detailed information necessary for setting up an input data deck for MCEP. GRA

N80-22311# Textron Bell Helicopter, Fort Worth, Tex. **AH-1S HIGH-SURVIVABLE TRANSMISSION SYSTEM Final Report, Oct. 1977 - Dec. 1978**

Gary A. Cope Oct. 1979 89 p ref
(Contract DAAJ02-76-C-0006; DA Proj. 1F2-63208-DB-52)
(AD-A080568; USAAVRADCOM-TR-79-43) Avail: NTIS
HC A05/MF A01 CSCL 01/3

The objective of the work performed on this program was to demonstrate that the AH-1S main transmission system, modified with internal component improvements but without an emergency lubrication system, could operate for 30 minutes following the loss of lubrication. The internal component improvements were based upon work done under this program and work done under a previous Eustis Directorate contract, both conducted by Bell Helicopter Textron. Six different modified versions of the AH-1S transmission configuration were tested under this program. Four of the six transmission configurations had been run to failure previously and the results reported in USAAMRDL-TR-77-30. The loss-of-lube testing for the final two transmission configurations was conducted at 680 input horsepower (60 percent of maximum continuous power rating of the AH-1S) and 6600 input rpm. The first transmission configuration tested ran 25 minutes under loss-of-lube conditions before failure of the lower planetary stage. The second transmission configuration ran 54 minutes before failure of the lower planetary stage. Thus, the 30-minute loss-of-lube capability has been demonstrated for all transmission components. GRA

N80-22312# Textron Bell Helicopter, Fort Worth, Tex. **ROTORCRAFT FLIGHT SIMULATION, COMPUTER PROGRAM C81. VOLUME 1: ENGINEER'S MANUAL Final Report, Nov. 1976 - Aug. 1977**

James R. VanGaasbeek, T. T. McLarty, and S. G. Sadler Oct. 1979 394 p refs Supersedes USAAMRDL-TR-76-41A 3 Vol.

(Contract DAAJ02-77-C-0003; DA Proj. 1L2-62209-AH-76)
(AD-A079631; BHT-699-099-062-Vol-1; USARTL-TR-77-54A; USSAMRDL-TR-76-41A) Avail: NTIS HC A17/MF A01 CSCL 01/3

This report consists of three volumes and documents the current version in the C81 family of rotorcraft flight simulation programs developed by Bell Helicopter Textron. This current version of the digital computer program is referred to as AGAJ77. The accompanying program for calculating fully coupled rotor blade mode shapes is called DNAM05, and the rotor wake program is called AR9102. The first volume, the Engineer's Manual, presents an overview of the computer program capabilities plus discussions for the background and development of the principal mathematical models in the program. The models discussed include all those currently in the program. GRA

N80-22313# Textron Bell Helicopter, Fort Worth, Tex. **ROTORCRAFT FLIGHT SIMULATION, COMPUTER PROGRAM C81. VOLUME 2: USER'S MANUAL Final Report, Nov. 1976 - Aug. 1977**

James R. VanGaasbeek Oct. 1979 511 p refs 3 Vol.

(Contract DAAJ02-77-C-0003; DA Proj. 1L2-62209-AH-76)
 (AD-A079632; BHT-699-099-062-Vol-2; USARTL-TR-77-54B;
 USAAMRDL-TR-76-41B) Avail: NTIS HC A22/MF A01 CSDL
 01/3

This report consists of three volumes and documents the current version in the C81 family of rotorcraft flight simulation programs developed by Bell Helicopter Textron. This current version of the digital computer program is referred to as AGAJ77. The accompanying program for calculating fully coupled rotor blade mode shapes is called DNAMO5, and the rotor wake program is called AR9102. Volume 2, the User's Manual, contains the detailed information necessary for setting up an input data deck and interpreting the computed data. Volume 3, the Programmer's Manual, includes a catalog of subroutines and a discussion of programming considerations. The source tapes and related software for the computer programs documented in this report are unpublished data on file at the Applied Technology Laboratory, U.S. Army Research and Technology Laboratories (AVRADCOM), Fort Eustis, Virginia. GRA

N80-22314# Naval Ship Research and Development Center, Bethesda, Md.

THE EFFECT OF SHAFT ANGLE ON PERFORMANCE OF A CIRCULATION CONTROL HIGH-SPEED ROTOR AT AN ADVANCE RATIO OF 0.7

Kenneth R. Reader Feb. 1980 42 p refs
 (AD-A080953; AERO-1262; DTNSRDC-80/015) Avail: NTIS
 HC A03/MF A01 CSDL 20/4

The performance of a high speed rotor model, designated the reverse blowing circulation control rotor (RBCCR), evaluated in a wind tunnel in the forward flight mode is discussed. The effects of rotor shaft angle of attack on rotor performance at the transition advance ratio of $\mu = 0.7$ are specifically examined. The test variables include rotor thrust, blade collective pitch angle, tip Mach number, and rotor shaft angle. The RBCCR model demonstrates both the lift and trim capabilities required in the transitional flight regime. The model also shows that rotor efficiency and power sharing between shaft power and compressor power can be controlled by rotor shaft angle at an advance ratio of 0.7. M.G.

N80-22315# European Space Agency, Paris (France).
INVESTIGATIONS INTO AN ACTIVE VIBRATION ISOLATION SYSTEM FOR HELICOPTERS WITH RIGID AND ELASTIC AIRFRAME MODELING

Jean Skudridakis 1979 73 p refs Transl. into ENGLISH of "Untersuchung zu Einen Aktiven Schwingungsisolationssystem fuer Hubschrauber bei Starrer und Elastischer Zellenmodellierung", Rept. DLR-IB-552-78-6 DFVLR, Brunswick, Jun. 1978
 (ESA-TT-531; DLR-IB-552/78-6) Avail: NTIS
 HC A04/MF A01

A system for active rotor isolation was investigated to compensate for blade number harmonic excitation of the rotor and limit the static relative movement of the rotor drive unit. Several sensor configurations were studied for the first completed regulator design of a single rigid function model with a modified Riccati design. This single axis computer model was reviewed and extended for the elastic helicopter airframe modeling (by means of a modified Riccati design). Computer results show that the active rotor isolation is superior in design to all known passive rotor isolation systems. The regulators designed for the single axis computer model show very good isolation of vibration at the 4- and 8- fold rotation frequencies of the rotor, in conjunction with rapid swinging. In addition, the separation between the rotor drive unit and the airframe was reduced with an additional load factor. Author (ESA)

N80-22316# Aeronautical Research Inst. of Sweden, Stockholm, Aerodynamics Dept.

A PRACTICAL METHOD FOR PREDICTING ROUGHNESS EFFECTS ON AIRCRAFT

A. Bertelrud Nov. 1978 54 p refs
 (Contract SWEDBTD-71.348-U-253)
 (FFA-AU-1413) Avail: NTIS HC A04/MF A01

A method for prediction of the extra drag due to surface roughness on aircraft is described. The method is based on use

of a number of working charts for flow parameters and includes charts for the drag increments due to different types of roughness. In the introductory part, the flow around wings is described with emphasis on the variation of flow characteristics with flight conditions. Author (ESA)

N80-22317# European Space Agency, Paris (France).
CIVIL COMPONENT PROGRAM WING SECTION. PREDI-MENSIONING OF A SUPERCRITICAL WING

Reinhard Arndt Jul. 1979 226 p refs Transl. into ENGLISH of "Ziviles Komponentenprogramm 'Flugelsektion' - Vordimensionierung eines Flügels mit Ueberkritischem Profil", Rept. BMFT-FB-W-77-38 DFVLR, Cologne and MBR G.m.b.H., Hamburg, Nov. 1977 Original report in GERMAN previously announced as X79-72062
 (ESA-TT-542; BMFT-FB-W-77-38) Avail: NTIS
 HC A11/MF A01; ZLDI, Munich DM 47.45

To achieve an optimal wing structure with respect to stringer and rib pitch and their cross-sectional shape, an estimated dimensioning of 700 mm rib pitch based upon the structure optimization program 'Dascha' for rigid load cases was written. The coordinates are calculated from the contour program 'Geolan', based on the wing profile MBB A1-725-146 and using the wing geometry of the ZKP basic design 3 (A 300 B 10 X-2). The dimensioning estimate was made in relation to rigid load cases. To obtain a minimum of structure, this estimation should be repeated with other pitches and cross-sectional shapes. The elastic load cases which result in greater sectional sizes can then be taken into consideration. Author (ESA)

N80-22318# Defence Research Information Centre, Orpington (England).

TRIALS TO COMPARE THE STOPPING PERFORMANCE OF THREE ANTI-SKID SYSTEMS AND TO DEMONSTRATE METHODS OF DETERMINING AIRCRAFT STOP DISTANCES ON THE STANDARD MILITARY REFERENCE WET SURFACE

I. Beaty (Mech. Eng. Res. and Develop.) and R. W. Sugg (Mech. Eng. Res. and Develop.) London HMSO Oct. 1979 64 p refs
 (S/T-Memo-3/79; BR70264) Avail: NTIS HC A04/MF A01

Tests were conducted to determine if there was any difference in the stop distance of a BAC 1-11 aircraft under wet runway conditions when fitted with three different modern anti-skid systems. By comparing the aircraft stop distances at the mu-meter reading of .6 it was concluded that although the two more modern systems appeared to give the shorter distance, the difference was small and based on insufficient data points to give a high degree of confidence. The aircraft Braking Force Coefficient versus speed and mu-meter reading from one of the runs was used to demonstrate the use a method to determine the stop distance on the standard military reference wet surface at the weight at which the aircraft was tested. A method of deciding on the suitability of a test runway for aircraft/mu-meter braking trials using National and NATO standards are presented as well as recommendations on how to conduct the trials and how to determine mu-meter speed/friction curves for the test surface. Author (ESA)

N80-22319# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugmechanik.

IN-FLIGHT HANDLING QUALITIES INVESTIGATION OF AIRBUS A 310 DLC. CONFIGURATIONS ON LANDING APPROACH USING THE DFVLR-HFB 320 VARIABLE STABILITY AIRCRAFT

Dietrich Hanke Feb. 1979 87 p refs In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-630)
 (DFVLR-FB-79-18) Avail: NTIS HC A05/MF A01; DFVLR, Cologne DM 17.30

In-flight simulation of the longitudinal and lateral/directional dynamics of the Airbus A 310 aircraft using the DFVLR-HFB 320 variable stability aircraft was studied. The evaluation of different spoiler direct lift controls (DLC) concepts for longitudinal control was stressed. The influence of these concepts handling qualities

and pilot-vehicle performance under real instrument landing systems (ILS) approach environmental conditions was determined. Sixty-three ILS approaches were flown by two pilots evaluating four aircraft/DLC configurations. The main handling quality parameter for DLC enhanced longitudinal control is the flight path to pitch attitude phase. A new general applicable flight path to pitch attitude phase criteria is proposed. Author (ESA)

N80-22320# Aeronautical Research Inst. of Sweden, Stockholm, Aerodynamics Dept.

ROUGHNESS EFFECTS ON FUEL CONSUMPTION FOR TWO COMMERCIAL AIRCRAFT: MCDONNELL DOUGLAS DC-9 AND DC-10 Final Report

A. Bertelrud Oct. 1979 48 p refs
(Contracts SWEDBTD-77-4869; SWEDBTD-78-5543)
(FFA-AU-1456) Avail: NTIS HC A03/MF A01

The effects of surface roughness on the fuel consumption of two typical passenger aircraft, McDonnell Douglas DC-9 and DC-10, are estimated. Typical cruise conditions and flights for the two aircraft types are considered. The roughness effects are estimated at two levels of sophistication; comprehensive and simplified. In the detailed approach the inviscid flow field around the wings is analyzed by means of a transonic, small perturbation code. The boundary layer is calculated with Bradshaw a straight-tapered swept wing code (with provision for distributed roughness). The simplified approach is basically a flat-plate analysis, which in many cases gave nearly the same results as the more sophisticated approach. Author, (ESA)

N80-22321# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

PILOT ASSESSMENT OF TWO COMPUTER-GENERATED DISPLAY FORMATS FOR HELICOPTER INSTRUMENT APPROACH

Frank R. Niessen, Perry L. Deal, and James M. Patton, Jr. May 1980 40 p refs
(NASA-TM-80151; L-13136) Avail: NTIS HC A03/MF A01
CSCL 01D

Two computer generated display formats were evaluated as primary displays by six research pilots in a fixed base simulator. One of the computer generated display formats was an electronic attitude director indicator (EADI) which featured three cue flight director, command information, superimposed on true perspective runway symbology. The other computer generated display format featured separate horizontal and vertical situation information with vector predictors. A baseline display, consisting of an electromechanical attitude director indicator (ADI) with a three cue flight director and a moving map, was used as a reference for the pilot evaluations. Author

N80-22323# Massachusetts Inst. of Tech., Cambridge, Aeroelastic and Structures Research Lab.

TWO-DIMENSIONAL FINITE-ELEMENT ANALYSES OF SIMULATED ROTOR-FRAGMENT IMPACTS AGAINST RINGS AND BEAMS COMPARED WITH EXPERIMENTS

Thomas R. Stagliano, Emmett A. Witmer, and Jose J. A. Rodal Dec. 1979 363 p refs
(Grant NGR-22-009-339)
(NASA-CR-159645; ASRL-TR-154-13) Avail: NTIS
HC A16/MF A01 CSCL 21E

Finite element modeling alternatives as well as the utility and limitations of the two dimensional structural response computer code CIVM-JET 4B for predicting the transient, large deflection, elastic plastic, structural responses of two dimensional beam and/or ring structures which are subjected to rigid fragment impact were investigated. The applicability of the CIVM-JET 4B analysis and code for the prediction of steel containment ring response to impact by complex deformable fragments from a trihub burst of a T58 turbine rotor was studied. Dimensional analysis considerations were used in a parametric examination of data from engine rotor burst containment experiments and data from sphere beam impact experiments. The use of the CIVM-JET 4B computer code for making parametric structural response studies on both fragment-containment structure and fragment-deflector structure was illustrated.

Modifications to the analysis/computation procedure were developed to alleviate restrictions. E.D.K.

N80-22324# Pratt and Whitney Aircraft Group, East Hartford, Conn.

PERFORMANCE DETERIORATION BASED ON EXISTING (HISTORICAL) DATA; JT9D JET ENGINE DIAGNOSTICS PROGRAM

G. Phil Sallee 20 Apr. 1978 228 p refs
(Contract NAS3-20632)
(NASA-CR-135448; PWA-5512-21) Avail: NTIS
HC A11/MF A01 CSCL 21E

The results of the collection and analysis of historical data pertaining to the deterioration of JT9D engine performance are presented. The results of analyses of preresearch and postrepair engine test stand performance data from a number of airlines to establish the individual as well as average losses in engine performance with respect to service use are included. Analysis of the changes in mechanical condition of parts, obtained by inspection of used gas-path parts of varying age, allowed preliminary assessments of component performance deterioration levels and identification of the causative factors. These component performance estimates, refined by data from special engine back-to-back testing related to module performance restoration, permitted the development of preliminary models of engine component/module performance deterioration with respect to usage. The preliminary assessment of the causes of module performance deterioration and the trends with usage are explained, along with the role each module plays in overall engine performance deterioration. Preliminary recommendations with respect to operating and maintenance practices which could be adopted to control the level of performance deterioration are presented. The needs for additional component sensitivity testing as well as outstanding issues are discussed. J.M.S.

N80-22326# Teledyne Continental Motors, Muskegon, Mich.
DESIGN STUDY: A 186 kW LIGHTWEIGHT DIESEL AIRCRAFT ENGINE Final Report

Alex P. Brouwers Apr. 1980 24 p
(Contract NAS3-20830)
(NASA-CR-3261) Avail: NTIS HC A02/MF A01 CSCL 21E

The design of an aircraft engine capable of developing 186 kW shaft power at a 7620 m altitude is described. The 186 kW design takes into account expected new developments in aircraft designs resulting in a reassessment of the power requirements at the cruise mode operation. Based on the results of this analysis a three phase technology development program is projected resulting in production dates of 1985, 1992, and 2000. R.E.S.

N80-22327# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

GENERAL AVIATION PROPULSION

Mar. 1980 437 p refs Conf. held in Cleveland, 28-29 Nov. 1979
(NASA-CP-2126; E-310) Avail: NTIS HC A19/MF A01 CSCL 21E

Programs exploring and demonstrating new technologies in general aviation propulsion are considered. These programs are the quiet, clean, general aviation turbofan (QCGAT) program; the general aviation turbine engine (GATE) study program; the general aviation propeller technology program; and the advanced rotary, diesel, and reciprocating engine programs.

N80-22328# AiResearch Mfg. Co., Phoenix, Ariz.
AIRESEARCH QCGAT ENGINE, AIRPLANE, AND NACELLE DESIGN FEATURES

Roger W. Heldenbrand *In* NASA, Lewis Res. Center Gen. Aviation Propulsion Mar. 1980 p 11-43

Avail: NTIS HC A19/MF A01 CSCL 21E

The quiet, clean, general aviation turbofan engine and nacelle system was designed and tested. The engine utilized the core of the AiResearch model TFE731-3 engine and incorporated several unique noise- and emissions-reduction features. Compo-

nents that were successfully adapted to this core include the fan, gearbox, combustor, low-pressure turbine, and associated structure. A highly versatile workhorse nacelle incorporating interchangeable acoustic and hardwall duct liners, showed that large-engine attenuation technology could be applied to small propulsion engines. The application of the mixer compound nozzle demonstrated both performance and noise advantages on the engine. Major performance, emissions, and noise goals were demonstrated. A.R.H.

N80-22329*# AiResearch Mfg. Co., Phoenix, Ariz.
AIRESEARCH QCGAT ENGINE PERFORMANCE AND EMISSIONS TESTS

William M. Norgren *In* NASA, Lewis Res. Center Gen. Aviation Propulsion Mar. 1980 p 45-64

Avail: NTIS HC A19/MF A01 CSCL 21E

Results of aerodynamic performance and emission tests, conducted on a specially designed QCGAT engine in the 17,793-N (4,000 lb) thrust class, are presented. Performance of the AiResearch QCGAT engine was excellent throughout all testing. No serious mechanical malfunctions were encountered, and no significant test time was lost due to engine-related problems. Emissions were drastically reduced over similar engines, and the engine exhibited good smoke performance. A.R.H.

N80-22330*# AiResearch Mfg. Co., Phoenix, Ariz.
AIRESEARCH QCGAT ENGINE: ACOUSTIC TEST RESULTS

Larry S. Kisner *In* NASA, Lewis Res. Center Gen. Aviation Propulsion Mar. 1980 p 65-100 refs

Avail: NTIS HC A19/MF A01 CSCL 21E

The noise levels of the quiet, general aviation turbofan (QCGAT) engine were measured in ground static noise tests. The static noise levels were found to be markedly lower than the demonstrably quiet AiResearch model TFE731 engine. The measured QCGAT noise levels were correlated with analytical noise source predictions to derive free-field component noise predictions. These component noise sources were used to predict the QCGAT flyover noise levels at FAR Part 36 conditions. The predicted flyover noise levels are about 10 decibels lower than the current quietest business jets. Author

N80-22331*# Avco Lycoming Div., Stratford, Conn.
QCGAT AIRCRAFT/ENGINE DESIGN FOR REDUCED NOISE AND EMISSIONS

Leonard Lanson and Kenneth M. Terrill *In* NASA, Lewis Res. Center Gen. Aviation Propulsion Mar. 1980 p 101-133

Avail: NTIS HC A19/MF A01 CSCL 21E

The high bypass ratio QCGAT engine played an important role in shaping the aircraft design. The aircraft which evolved is a sleek, advanced design, six-place aircraft with 3538 kg (7,800 lb) maximum gross weight. It offers a 2778 kilometer (1500 nautical mile) range with cruise speed of 0.5 Mach number and will take-off and land on the vast majority of general aviation airfields. Advanced features include broad application of composite materials and a supercritical wing design with winglets. Full-span fowler flaps were introduced to improve landing capability. Engines are fuselage-mounted with inlets over the wing to provide shielding of fan noise by the wing surfaces. The design objectives, noise, and emission considerations, engine cycle and engine description are discussed as well as specific design features. A.R.H.

N80-22332*# Avco Lycoming Div., Stratford, Conn.
AVCO LYCOMING QCGAT PROGRAM DESIGN CYCLE, DEMONSTRATED PERFORMANCE AND EMISSIONS

Phil Fogel and Angelo Koschier *In* NASA, Lewis Res. Center Gen. Aviation Propulsion Mar. 1980 p 135-154 refs

Avail: NTIS HC A19/MF A01 CSCL 21E

A high bypass ratio, twin spool turbofan engine of modular design which incorporates a front fan module driven by a modified LTS101 core engine was tested. The engine is housed in a

nacelle incorporating full length fan ducting with sound treatment in both the inlet and fan discharge flow paths. Design goals of components and results of component tests are presented together with full engine test results. The rationale behind the combustor design selected for the engine is presented as well as the emissions test results. Total system (engine and nacelle) test results are included. A.R.H.

N80-22333*# Avco Lycoming Div., Stratford, Conn.
AVCO LYCOMING QUIET CLEAN GENERAL AVIATION TURBOFAN ENGINE

Craig A. Wilson *In* NASA, Lewis Res. Center Gen. Aviation Propulsion Mar. 1980 p 155-187 refs

Avail: NTIS HC A19/MF A01 CSCL 21E

A fan module was developed using an existing turboshaft engine. The fan was designed using the latest in large engine noise control technology. A mixer was added to reduce the already low exhaust gas velocity. A nacelle incorporating sound treatment was provided for the test engine. A noise prediction model was used through the design process to evaluate the various design alternatives. Acoustic tests were then made to verify the prediction and identify the noise characteristics of the fan, core, jet, and sound treatment. Analysis of the recorded data yielded close agreement with the expected results. Core noise, as was expected, was the predominant source of noise for the quiet clean general aviation turbofan (QCGAT) engine. Flyover noise predictions were made which indicated that the Avco Lycoming QCGAT engine would meet the goals set for the QCGAT program. R.E.S.

N80-22335*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
NEW OPPORTUNITIES FOR FUTURE, SMALL, GENERAL-AVIATION TURBINE ENGINES (GATE)

William C. Strack *In its* Gen. Aviation Propulsion Mar. 1980 p 195-219 refs

Avail: NTIS HC A19/MF A01 CSCL 21E

The results of four independent contracted studies to explore the opportunities for future small turbine engines are summarized in a composite overview. Candidate advanced technologies are screened, various cycles and staging arrangements are parametrically evaluated, and optimum conceptual engines are identified for a range of 300 to 600 horsepower applications. Engine improvements of 20 percent in specific fuel consumption and 40 percent in engine cost were forecast using high risk technologies that could be technically demonstrated by 1988. The ensuing economic benefits are in the neighborhood of 20 to 30 percent for twin-engine aircraft currently powered by piston engines. Author

N80-22336*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
AN OVERVIEW OF NASA RESEARCH ON POSITIVE DISPLACEMENT GENERAL-AVIATION ENGINES

Erwin E. Kempke, Jr. *In its* Gen. Aviation Propulsion Mar. 1980 p 227-229

Avail: NTIS HC A19/MF A01 CSCL 21E

The research and technology program related to improved and advanced general aviation engines is described. Current research is directed at the near-term improvement of conventional air-cooled spark-ignition piston engines and at future alternative engine systems based on all-new spark-ignition piston engines, lightweight diesels, and rotary combustion engines that show potential for meeting program goals in the midterm and long-term future. The conventional piston engine activities involve efforts on applying existing technology to improve fuel economy, investigation of key processes to permit leaner operation and reduce drag, and the development of cost effective technology to permit flight at high-altitudes where fuel economy and safety are improved. The advanced engine concepts activities include engine conceptual design studies and enabling technology efforts on the critical or key technology items. R.E.S.

N80-22337*# Teledyne Continental Motors, Muskegon, Mich.
Aircraft Products Div.

THE SPARK-IGNITION AIRCRAFT PISTON ENGINE OF THE FUTURE

Kenneth J. Stuckas *In* NASA. Lewis Res. Center Gen. Aviation Propulsion Mar. 1980 p 231-245

(Contract NAS3-21272)

Avail: NTIS HC A19/MF A01 CSCL 21E

Areas of advanced technology appropriate to the design of a spark-ignition aircraft piston engine for the late 1980 time period were investigated and defined. Results of the study show that significant improvements in fuel economy, weight and size, safety, reliability, durability and performance may be achieved with a high degree of success, predicated on the continued development of advances in combustion systems, electronics, materials and control systems. R.E.S.

N80-22338*# Teledyne Continental Motors, Muskegon, Mich. General Products Div.

LIGHTWEIGHT DIESEL AIRCRAFT ENGINES FOR GENERAL AVIATION

Steven G. Berenyi and Alex P. Brouwers *In* NASA. Lewis Res. Center Gen. Aviation Propulsion Mar. 1980 p 247-285

Avail: NTIS HC A19/MF A01 CSCL 21E

A methodical design study was conducted to arrive at new diesel engine configurations and applicable advanced technologies. Two engines are discussed and the description of each engine includes concept drawings. A performance analysis, stress and weight prediction, and a cost study were also conducted. This information was then applied to two airplane concepts, a six-place twin and a four-place single engine aircraft. The aircraft study consisted of installation drawings, computer generated performance data, aircraft operating costs and drawings of the resulting airplanes. The performance data shows a vast improvement over current gasoline-powered aircraft. At the completion of this basic study, the program was expanded to evaluate a third engine configuration. This third engine incorporates the best features of the original two, and its design is currently in progress. Preliminary information on this engine is presented. R.E.S.

N80-22339*# Curtiss-Wright Corp., Wood-Ridge, N.J.

ADVANCED ROTARY ENGINE STUDIES

Charles Jones *In* NASA. Lewis Res. Center Gen. Aviation Propulsion Mar. 1980 p 287-311 refs

Avail: NTIS HC A19/MF A01 CSCL 21E

A review of rotary engine developments relevant to a stratified charge rotary aircraft engine is presented. Advantages in module size and weight, fuel efficiency, reliability, and multi-fuel capability are discussed along with developments in turbocharging, increased mean effective pressure, improved apex seal/trochoid wear surfacing materials, and high strength and temperature aluminum casting alloys. A carbureted prototype aircraft engine is also described. M.G.

N80-22340*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

POSITIVE DISPLACEMENT TYPE GENERAL-AVIATION ENGINES: SUMMARY AND CONCLUDING REMARKS

Erwin E. Kempke, Jr. *In its* Gen. Aviation Propulsion Mar. 1980 p 313-314

Avail: NTIS HC A19/MF A01 CSCL 21E

The activities of programs investigating various aspects of aircraft internal combustion engines are briefly described including developments in fuel injection technology, cooling systems and drag reduction, turbocharger technology, and stratified-charge rotary engines. M.G.

N80-22341*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

NASA PROPELLER TECHNOLOGY PROGRAM

Daniel C. Mikkelsen *In its* Gen. Aviation Propulsion Mar. 1980 p 315-325 refs

Avail: NTIS HC A19/MF A01 CSCL 21E

A program on propeller technology applicable to both low and high speed general aviation aircraft is summarized, and the overall program objectives and approach are outlined. M.G.

N80-22342*# Cessna Aircraft Co., Wichita, Kans. Accessory Div.

LOW SPEED PROPELLERS: IMPACT OF ADVANCED TECHNOLOGIES

Ira D. Keiter *In* NASA. Lewis Res. Center Gen. Aviation Propulsion Mar. 1980 p 327-343 refs

Avail: NTIS HC A19/MF A01 CSCL 21E

Sensitivity studies performed to evaluate the potential of several advanced technological elements on propeller performance, noise, weight, and cost for general aviation aircraft are discussed. Studies indicate that the application of advanced technologies to general aviation propellers can reduce fuel consumption in future aircraft an average of ten percent, meeting current regulatory noise limits. Through the use of composite blade construction, up to 25 percent propeller weight reduction can be achieved. This weight reduction in addition to seven percent propeller efficiency improvements through application of advanced technologies result in four percent reduction in direct operating costs, ten percent reduction in aircraft acquisition cost, and seven percent lower gross weight for general aviation aircraft. M.G.

N80-22343*# Hamilton Standard, Windsor Locks, Conn.

ADVANCED TURBOPROP POTENTIAL FOR HIGH SPEED

Bernard S. Gatzen *In* NASA. Lewis Res. Center Gen. Aviation Propulsion Mar. 1980 p 345-359

Avail: NTIS HC A19/MF A01 CSCL 21E

A turboprop propulsion system for general aviation aircraft, allowing high speed flight (to 0.8 Mach) is discussed. Design methodologies for aerodynamic and acoustic considerations and the performance and cost advantages of a prop-fan aircraft are presented. M.G.

N80-22344*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

HIGH-SPEED-PROPELLER WIND-TUNNEL AEROACOUSTIC RESULTS

Robert J. Racki and James H. Dittmar *In its* Gen. Aviation Propulsion Mar. 1980 p 361-374 refs

Avail: NTIS HC A19/MF A01 CSCL 21E

Some aerodynamic concepts are presented together with an explanation of how these concepts are applied to advanced propeller design. The unique features of this propulsion system are addressed with emphasis on the design concepts being considered for the high speed turboprop. More particular emphasis is given to the blade sweep, long blade chords, and the large number of blades. R.C.T.

N80-22345*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

ADVANCED PROPELLER AERODYNAMIC ANALYSIS

Lawrence J. Bober *In its* Gen. Aviation Propulsion Mar. 1980 p 375-385 refs

Avail: NTIS HC A19/MF A01 CSCL 21E

The analytical approaches as well as the capabilities of three advanced analyses for predicting propeller aerodynamic performance are presented. It is shown that two of these analyses use a lifting line representation for the propeller blades, and the third uses a lifting surface representation. R.C.T.

N80-22346*# Ohio State Univ., Columbus. Aeronautical and Astronautical Research Lab.

PROPELLER AEROACOUSTIC METHODOLOGIES

Kenneth D. Korkan and Gerald M. Gregorek *In* NASA. Lewis Res. Center Gen. Aviation Propulsion Mar. 1980 p 387-404 refs

(Grant Nsg-3247)

Avail: NTIS HC A19/MF A01 CSCL 21E

The aspects related to propeller performance by means of a review of propeller methodologies are addressed. Preliminary wind tunnel propeller performance data are presented and the predominant limitations of existing propeller performance methodologies are discussed. Airfoil developments appropriate for propeller applications are also reviewed. R.C.T.

N80-22347*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
NASA PROPELLER NOISE RESEARCH
 George C. Greene /In NASA, Lewis Res. Center Gen. Aviation Propulsion Mar. 1980 p 405-420

Avail: NTIS HC A19/MF A01 CSCL 21E

The research in propeller noise prediction, noise/performance optimization, and interior reduction is described. Selected results are presented to illustrate the status of the technology and the direction of future research. R.C.T.

N80-22348*# Pennsylvania State Univ., University Park.
PROPELLER DYNAMIC AND AEROELASTIC EFFECTS
 Barnes W. McCormick /In NASA, Lewis Res. Center Gen. Aviation Propulsion Mar. 1980 p 421-432 refs

(Grants NsG-1308; NsG-3304)

Avail: NTIS HC A19/MF A01 CSCL 21E

Various aspects of propeller blade dynamics are considered including those factors which are exciting the blades and the dynamic response of the blades to the excitations. Methods for treating this dynamic system are described and problems are discussed which may arise with advanced turboprop designs employing thin, swept blades. Author

N80-22350*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

PRELIMINARY STUDY OF ADVANCED TURBOPROP AND TURBOSHAFT ENGINES FOR LIGHT AIRCRAFT

G. Krip, R. M. Plencner, and J. D. Eisenberg Apr. 1980 62 p refs
 (NASA-TM-81467; E-397) Avail: NTIS HC A04/MF A01 CSCL 21E

The effects of engine configuration, advanced component technology, compressor pressure ratio and turbine rotor-inlet temperature on such figures of merit as vehicle gross weight, mission fuel, aircraft acquisition cost, operating, cost and life cycle cost are determined for three fixed- and two rotary-wing aircraft. Compared with a current production turboprop, an advanced technology (1988) engine results in a 23 percent decrease in specific fuel consumption. Depending on the figure of merit and the mission, turbine engine cost reductions required to achieve aircraft cost parity with a current spark ignition reciprocating (SIR) engine vary from 0 to 60 percent and from 6 to 74 percent with a hypothetical advanced SIR engine. Compared with a hypothetical turboshaft using currently available technology (1978), an advanced technology (1988) engine installed in a light twin-engine helicopter results in a 16 percent reduction in mission fuel and about 11 percent in most of the other figures of merit. A.R.H.

N80-22351# Naval Air Propulsion Test Center, Trenton, N.J. Propulsion Technology and Project Engineering Dept.

INVESTIGATION OF LUBRICANT CONCEPTS APPLICABLE TO FUTURE NAVY AIRCRAFT PROPULSION SYSTEMS

Final Report

A. J. Porazio, E. F. Pierce, and P. A. Karpovich Nov. 1979 51 p refs

(ZF54594001; WF54543300)

(AD-A079410; NAPC-PE-29) Avail: NTIS HC A04/MF A01 CSCL 11/8

Future lubrication requirements for Navy aircraft engines were estimated. Viable areas were evaluated to determine relative strengths and weaknesses of several systems. Among those areas investigated were ester lubricants, inserted ester lubricant systems, polyphenyl ethers and gas lubricated compliant bearings. GRA

N80-22352# Pratt and Whitney Aircraft Group, West Palm Beach, Fla. Government Products Div.

THERMAL RESPONSE TURBINE SHROUD STUDY Final Report, Aug. 1978 - May 1979

E. J. Kawecki Wright-Patterson AFB, Ohio AFAPL Jul. 1979 135 p

(Contract F33615-78-C-2022; AF Proj. 3066)

(AD-A080620; PWA-FR-11867; AFAPL-TR-79-2087) Avail: NTIS HC A07/MF A01 CSCL 21/5

The program objective was to evaluate active clearance controls (ACC) for future military fighter and transport aircraft/engines, rank the candidate schemes, and recommend a future course of action. Fifty-one potential ACC concepts were reduced to twelve: five mechanical, two pneumatic, and five thermal. The fighter and transport missions selected were the Advanced Tactical Fighter (ATF), and the C141X strategic aircraft. Three levels of controls for ACC were considered: simple on/off two-position; open loop infinitely variable; and feedback (requiring a clearance sensor). On/off systems were selected for study because the majority of the benefit is obtained during cruise/dash and the open and feedback systems have positioning and reliability uncertainties. The criteria selected to evaluate the different schemes were net Life Cycle Cost benefits, to the fleet over the life of the weapons system. These criteria were based on a new-engine/new-aircraft application where efficiency improvements due to ACC were used to reduce aircraft and engine size for a fixed mission (range, payload, etc.). The detailed operation and impact (cost, weight, reliability, maintainability) of the twelve final schemes were evaluated by adopting each of the candidate schemes to selected stages in the base engines. ACC showed a significant net benefit in the transport high pressure turbine. On the low pressure turbine some schemes showed a net savings, but the amount was small. For the fighter application, ACC showed a significant net benefit in the high pressure turbine only. GRA

N80-22353# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany). Inst. fuer Antriebstechnik.

DESIGN AND INVESTIGATION OF STATIC PRESSURE COMPRESSOR CASCADES BEHIND IMPULSE-ROTORS

Ph.D. Thesis - Technische Hochschule

Reinhold Fuchs Mar. 1979 119 p refs In GERMAN; ENGLISH summary Report will be also announced as translation (ESA-TT-629)

(DFVLR-FB-79-17) Avail: NTIS HC A06/MF A01; DFVLR, Cologne DM 21,30

The design, optimization, and wind tunnel testing for two dimensional cascades are described. The cascades decelerate the rotor outlet velocity of about $M = 2$ to subsonic stator outlet velocity by a multiple shock system realizing a high static pressure ratio. The multiple shock cascades with turning and without were tested in a cascade wind tunnel and compared with results of computations. Author (ESA)

N80-22355 Dayton Univ., Ohio.

DESIGN OF AN INTEGRATED FLIGHT/FIRE CONTROL SYSTEM INCLUDING MOVABLE GUN AND GIMBALED LINE OF SIGHT TRACKER Ph.D. Thesis

John Hazen Blakelock 1979 354 p

Avail: Univ. Microfilms Order No. 8008431

The design, analysis, and hybrid simulation of an integrated flight/fire control system (IFFC) including a movable gun and gimbaled line of sight tracker for the F-15 are discussed. The analysis includes a linear root locus analysis of the various control systems and a detailed discrete analysis of the sampled-data control system resulting from closing the outer control loops through the digital computer used to compute the prediction angle and to generate the inputs to the flight control systems. The capability of the IFFC system was tested against various target scenarios using a hybrid simulation. The results show that the IFFC with the movable gun is able to track a wide variety of target scenarios, including inverted flight to track an aircraft performing a split S, with the gun on track for a major portion of each run. Dissert. Abstr.

N80-22356*# Joint Inst. for Advancement of Flight Sciences, Hampton, Va.

EFFECT OF A FLEXIBLY MOUNTED STORE ON THE FLUTTER SPEED OF A WING Final Report

Harry L. Runyan NASA, Langley Res. Center. Apr. 1980 25 p refs

(Grant NsG-1438)

(NASA-CR-159245) Avail: NTIS HC A02/MF A01 CSDL 01C

A passive system proposed for increasing the flutter speed of a wing with heavy concentrated weights involves the concept of mounting the store on a pitch pivot having a very low pitch stiffness relative to the wing stiffness. This concept was investigated utilizing a two dimensional approach involving 4 degrees of freedom, namely, wing bending, wing torsion, store pitch and store vertical translation. This preliminary analysis was very encouraging and the results demonstrate that, if the uncoupled store pitch frequency was below the wing bending frequency, the flutter speed was greatly increased. A second more complete analysis was developed utilizing a three dimensional structure, but retaining the two dimensional, incompressible unsteady airforces of Theodorsen. The details of the analysis are included. A.R.H.

N80-22357*# Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.

THE DESIGN, TESTING AND EVALUATION OF THE MIT INDIVIDUAL-BLADE-CONTROL SYSTEM AS APPLIED TO GUST ALLEVIATION FOR HELICOPTERS Final Report

Robert Miller McKillip, Jr. Feb. 1980 92 p refs (Grant NsG-2266)

(NASA-CR-152352; ASRL-TR-196-1) Avail: NTIS HC A05/MF A01 CSDL 01C

A type of active control for helicopters was designed and tested on a four foot diameter model rotor. A single blade was individually controlled in pitch in the rotating frame over a wide range of frequencies by electromechanical means. By utilizing a tip mounted accelerometer as a sensor in the feedback path, significant reductions in blade flapping response to gust were achieved at the gust excitation frequency as well as at super and subharmonics of rotor speed. E.D.K.

N80-22358*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

DESCRIPTION OF AN EXPERIMENTAL (HYDROGEN PEROXIDE) ROCKET SYSTEM AND ITS USE IN MEASURING AILERON AND RUDDER EFFECTIVENESS OF A LIGHT AIRPLANE

Thomas C. OBryan, Maxwell W. Goode, Frederick D. Gregory, and Marna H. Mayo May 1980 42 p refs

(NASA-TP-1647; L-12494) Avail: NTIS HC A03/MF A01 CSDL 01C

A hydrogen peroxide fueled rocket system, which is to be used as a research tool in flight studies of stall and spin maneuvers, was installed on a light, four place general aviation airplane. The pilot controlled rocket system produces moments about either the roll or the yaw body axis to augment or oppose the aerodynamic forces and inertial moments acting on the airplane during various flight maneuvers, including the spin. These controlled moments of a known magnitude can be used in various ways to help analyze and interpret the importance of the various factors which influence airplane maneuvers. The rocket system and its installation in the airplane are described, and the results of flight tests used to measure rudder and aileron effectiveness at airspeeds above the stall are presented. These tests also serve to demonstrate the operational readiness of the rocket system for future research operations. E.D.K.

N80-22359*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

DECOUPLER PYLON: WING/STORE FLUTTER SUPPRESSOR Patent Application

Wilmer A. Reed, III, inventor (to NASA) Filed 28 Mar. 1980 18 p

(NASA-Case-LAR-12468-1; US-Patent-Appl-SN-135057) Avail: NTIS HC A02/MF A01 CSDL 01C

A device for suspending a store from a support such as an aircraft wing is described. It comprises soft-spring means whereby the store pitch mode is decoupled from support modes and a low frequency active control mechanism which maintains store alignment. In the described embodiment, a pneumatic suspension system both isolates the store in pitch and, under conditions of changing mean load, aligns the store with the wing to which it

is attached. The device allows the flutter speed of an aircraft flying with an attached store to be increased while reducing the sensitivity of flutter to changes in the pitch inertia and center of gravity location of the store. NASA

N80-22360# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

USING VERTICAL GUST ALLEVIATION TO IMPROVE THE TARGET TRACKING CAPABILITY OF THE CONTROL CONFIGURED YF-16 M.S. Thesis

Eric R. Molner Aug. 1979 278 p refs (AD-A080520; AFIT/GGC/EE/79-5)

Avail: NTIS HC A13/MF A01 CSDL 01/3

This thesis investigates the use of multiple aerodynamic control surfaces as a part of a flight control system configured to reduce aircraft pitch response to atmospheric disturbances. Coordinated deflection of two surfaces provides the desired gust alleviation with no decrease in system damping. At the same time, the commanded aircraft performance is improved relative to the performance of the baseline flight control system using a single control surface. The aircraft chosen for this analysis is the General Dynamics YF-16. This particular aircraft has a fly-by-wire electronic flight control system - an arrangement that permits the control surfaces to be electronically activated. A means of applying discrete vertical gusting to a modeled system is presented to permit evaluation of system performance. Using a simulation computer program, the YF-16 with baseline flight control system and Maneuver Enhancement augmentation are examined to determine gust response and pilot response characteristics. GRA

N80-22361# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

THE APPLICATION OF OUTPUT PREDICTIVE DIGITAL CONTROL TO WING FLUTTER SUPPRESSION AND TERRAIN FOLLOWING PROBLEMS M.S. Thesis

David E. Chaffin Dec. 1979 176 p refs

(AD-A080419; AFIT/GE/EE/79-9)

Avail: NTIS HC A09/MF A01 CSDL 01/3

This thesis is a study of a digital control technique known as Output Predictive Control (OPC) or Model Algorithmic Control (MAC). In OPC, the behavior of the system is predicted using its impulse response function and the desired response is characterized by a reference trajectory. Controls are computed iteratively to drive the system output along the desired trajectory. In an earlier study, the system was made to follow the reference trajectory exactly, but only at the control application time; there were large oscillations of the output between control changes. In this study, the control calculation is reformulated as a least squares curve fit problem, allowing some deviation from the desired trajectory. This approach is applied as a regulator for a very lightly damped fourth-order single-input/single-output system and as a pitch axis autopilot in a simplified terrain following problem. A qualitative discussion of the robustness properties is included. The design of the controller is difficult due to the interrelationships of the internal parameters; however, the results of the terrain following example indicate that this is a viable approach for this problem. GRA

N80-22362# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

ANALYSIS OF THE EFFECTS OF HIGHER ORDER CONTROL SYSTEMS ON AIRCRAFT APPROACH AND LANDING LONGITUDINAL HANDLING QUALITIES M.S. Thesis

Muhammad Anwar Pasha Dec. 1979 236 p refs

(AD-A080519; AFIT/GE/EE/79-27)

Avail: NTIS HC A11/MF A01 CSDL 05/8

The approach and landing longitudinal flying qualities data generated by Calspan using variable stability NT-33 aircraft combined with significant control system dynamics was analyzed. Three different approaches were used to determine the relationship between pilot ratings and the pilot workload, system sensitivity, and the system performance. An open-loop frequency response analysis showed that for a particular crossover frequency and phase margin (fixed performance), the phase angle (pilot workload) and slope of the phase curve (system sensitivity) at

the crossover frequency correlated well with the pilot ratings. An optimum pilot lead time for pitch tracking, flight path angle tracking, and both pitch and flight path angle tracking tasks is determined by a closed-loop analog simulation using integral error squared as a performance measure. A correlation is found between pilot ratings and performance. An attempt is made to explain the landing task as a closed-loop pitch and flight path angle tracking task. The open-loop impulse response of the pitch attitude showed that the initial delay and the transient behavior of the pitch response have a direct impact on the pilot ratings, pilot induced oscillations, and comments. GRA

N80-22363# European Space Agency, Paris (France).
CONTROL SYSTEM DESIGN USING VECTOR-VALUED PERFORMANCE CRITERIA WITH APPLICATION TO THE CONTROL RATE REDUCTION IN PARAMETER INSENSITIVE CONTROL SYSTEMS

Gerhard Kreisselmeier Dec. 1978 39 p refs Transl. into ENGLISH of "Reglerentwurf mit Vektoriellen Guetekriterien und Seine Praktische Anwendung zur Stellgeschwindigkeitsreduktion bei Parameterunempfindlichen Reglern", Rept. DLR-FB-77-55 DFVLR, Oberpfaffenhofen, Nov. 1977 Original report in GERMAN previously announced as X79-71736 (ESA-TT-512-Rev; DLR-FB-77-55-Rev) Avail: NTIS HC A03/MF A01; DFVLR, Cologne DM 17

A design strategy is suggested which uses for the optimization of the control system, a vector-valued performance-criterion such that a systematic step-by-step improvement of the performance vector is achieved, i.e., at each stage the performance of some components is improved without impairing that of the others, so that finally the optimal design is obtained. This technique is used to design a parameter-insensitive flight-path controller which, compared with earlier designs, has both a larger reduction in sensitivity and a considerable reduction in the maximal control rate. The design shows that a controller can have considerably reduced sensitivity without increasing the demands on the actuator system. This result is due primarily to the control rate being directly considered in the design. The controller-synthesis technique based on vector-valued performance-criteria as here suggested is feasible even when the number of design aspects is large. Author (ESA)

N80-22364# Office National d'Etudes et de Recherches Aeronautiques, Paris (France).

DEFINITION OF A TWO LEVEL CONTROL SYSTEM FOR NONLINEAR AIRCRAFT MOTION

Albert Kirszenblat 1979 34 p refs In FRENCH; ENGLISH summary Report will also be announced as translation (ESA-TT-614) (ONERA-NT-1979-7; ISSN-0078-3781) Avail: NTIS HC A03/MF A01

The utilization of fly by wire control systems is discussed in terms of the improvement of aircraft handling qualities. An approach to the problem of defining a control law well adapted to the whole flight envelope is presented. This system has a two level structure allowing a task oriented control and an augmentation of the aircraft stability. A nonlinear model of the aircraft dynamics is described incorporating the inertial coupling term, and the nonlinear aerodynamic effects. The model generates a trajectory, a reference control law vector, and an output vector which tracks a vector. This vector represents the maneuvering objectives assigned by the pilot at any time. A servo compensation which subordinates the aircraft motion to the model is also given. The control law is obtained by application of the optimal linear control theory to local linear models of the aircraft. Direct force control surfaces were easily incorporated in the computation of the control system. Author (ESA)

N80-22365# Naval Ship Research and Development Center, Bethesda, Md. Aviation and Surface Effects Dept.

DEVELOPMENT OF THE A-6/CIRCULATION CONTROL WING FLIGHT DEMONSTRATOR CONFIGURATION Final Report, Sep. 1975 - Jul. 1978

Robert J. Englar Jan. 1979 158 p refs (AD-A081241; DTNSRDC/ASED-79-01) Avail: NTIS HC A08/MF A01 CSCL 14/2

Wind tunnel investigations were conducted on a 1/8.5 scale model of the A-6/circulation control wing flight demonstrator aircraft in order to confirm the high lift capability of the concept, to improve lifting and control surfaces and to provide supporting data to assure safety of flight and adequate handling of the full-scale aircraft. The best configuration developed during these investigations produced a 2.2 fold increase in maximum coefficient of lift over the conventional A-6A high lift configuration. This circulation control wing configuration was compromised to simplify testbed aircraft modifications, reduce construction costs, and provide a larger range of parameters obtainable during flight testing, yet in the final configuration, still provided trimmed aerodynamic maximum coefficient of lift double that of the standard A-6A. A.R.H.

N80-22367*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

HIGH VOLTAGE SPARK CARBON FIBER DETECTION SYSTEM

Lien C. Yang 15 Apr. 1980 96 p refs (Contract NAS7-100)

(NASA-CR-162995; JPL-Pub-80-30) Avail: NTIS HC A05/MF A01 CSCL 14B

The pulse discharge technique was used to determine the length and density of carbon fibers released from fiber composite materials during a fire or aircraft accident. Specifications are given for the system which uses the ability of a carbon fiber to initiate spark discharge across a high voltage biased grid to achieve accurate counting and sizing of fibers. The design of the system was optimized, and prototype hardware proved satisfactory in laboratory and field tests. A.R.H.

N80-22368*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

MAGNETIC SUSPENSION AND BALANCE SYSTEM: A SELECTIVE ANNOTATED BIBLIOGRAPHY

Marie H. Tuttle, Robert A. Kilgore, and Richmond P. Boyden Apr. 1980 47 p

(NASA-TM-80225; L-13196) Avail: NTIS HC A03/MF A01 CSCL 14E

This bibliography, with abstracts, consists of 188 citations arranged in chronological order by dates of publication. Selection of the citations was made for their relevance to the problems involved in understanding, designing, and constructing magnetic suspension and balance systems for use in wind tunnels. Author

N80-22371# Defence Research Information Centre, Orpington (England).

A MEANS OF SPECIFYING A STANDARD REFERENCE WET SURFACE FOR MILITARY AIRCRAFT

R. W. Sugg (Mech. Eng. Res. and Develop.) London HMSO Oct. 1979 15 p refs

(S/T-Memo-1/79; BR70262) Avail: NTIS HC A02/MF A01

The British civil aircraft requirements (BCAR) method of aircraft certification under wet conditions and the correction of stopping distances to a standard using a friction trailer is studied. The method is also examined for military aircraft. The use of the standard to accident investigation procedures and NATO standards is discussed. A standard military reference wet surface and a way to correct aircraft performance to the standard are examined. Author (ESA)

N80-22372# Defence Research Information Centre, Orpington (England).

AN INVESTIGATION INTO MEASURING RUNWAY SURFACE TEXTURE BY THE GREASE PATCH AND OUTFLOW METER METHODS

R. W. Sugg (Mech. Eng. Res. and Develop.) London HMSO Oct. 1979 33 p refs

(S/T-Memo-2/79; BR70263) Avail: NTIS HC A03/MF A01

A measurement of surface texture was used by some organizations as a means of specifying runway friction for stop distance calculations and certification purposes in spite of the conclusion by the American Society for Testing and Materials (ASTM) that it should be discontinued. A method of using surface

texture to predict friction of ground vehicles at high speed was studied and it is concluded that within the limits found on runways it has only a very small effect on the prediction. It is recommended that where high speed prediction is necessary a more accurate method is to use equations based on test data. The difficulty in arriving at a single figure for surface texture was demonstrated by showing the variation that can occur along a runway and the large difference in readings between operators.
Author (ESA)

N80-22374# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Entwurfs-Aerodynamik.

GRAVIMETRIC INVESTIGATION OF THE PARTICLE NUMBER DENSITY DISTRIBUTION FUNCTION IN THE HIGH SPEED CASCADE WIND TUNNEL FOR LASER-ANEMOMETRY MEASUREMENTS

Harro Bessling and Torsten Hinz (Bundesforschungsanstalt fuer Landwirtschaft.) Jan. 1979 39 p refs In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-625)

(DFVLR-FB-79-12) Avail: NTIS HC A03/MF A01; DFVLR, Cologne DM 8,50

The conditions in high speed cascade wind tunnels were investigated to determine for the use of laser anemometers in measuring flow velocities. The natural particle number density present in the cascade wind tunnel was found insufficient for the application of the laser method. The effect of adding aerosols to increase the number of particles in the wind tunnel is discussed.
Author (ESA)

N80-22412*# National Aeronautics and Space Administration, Washington, D. C.

ECONOMICAL PROCESSING OF FIBER-REINFORCED COMPONENTS WITH THERMAL EXPANSION MOLDING

K. Schneider Dec. 1979 34 p Transl. into ENGLISH of conf. Paper-79-011 from DGLR Presented at the Symp. uber Wirtschaftliche Herstelltechniken, Cologne, 28 Mar. 1979 Original language document was announced as A79-32307 Transl. by Kanner (Leo) Associates, Redwood City, Calif.
(Contract NASW-3198)

(NASA-TM-75738; Paper-79-011) Avail: NTIS HC A03/MF A01 CSCL 11D

The concept of economical fabrication of fiber-reinforced structural components is illustrated with an example of a typical control surface (aileron). The concept provides for fabricating struts, ribs, and a cover plate as an integral structure in a hardening device and then joining the closure cover plate mechanically. Fabrication of the integral structure is achieved by the 'thermal expansion molding' technique. The hardening pressure is produced by silicone rubber cores which expand under the influence of temperature. Test results are presented for several rubber materials as well as for various structural pieces. The technique is demonstrated extensively for an aileron, consisting of five ribs, struts, and a cover plate. Economically, for a large scale technical production of an aileron, cost savings of twenty-five percent can be realized compared to those for a sheet metal structure.
J.M.S.

N80-22430*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

ULTRALEAN COMBUSTION IN GENERAL AVIATION PISTON ENGINES

J. E. Chirivella 1 Dec. 1979 246 p refs
(Contract NAS7-100)

(NASA-CR-163001; JPL-Pub-79-75) Avail: NTIS HC A11/MF A01 CSCL 21B

The role of ultralean combustion in achieving fuel economy in general aviation piston engines was investigated. The aircraft internal combustion engine was reviewed with regard to general aviation requirements, engine thermodynamics and systems. Factors affecting fuel economy such as those connected with an ideal leanout to near the gasoline lean flammability limit (ultralean operation) were analyzed. A Lycoming T10-541E engine was tested in that program (both in the test cell and in flight). Test results indicate that hydrogen addition is not necessary to

operate the engine ultralean. A 17 percent improvement in fuel economy was demonstrated in flight with the Beechcraft Duke B60 by simply leaning the engine at constant cruiser power and adjusting the ignition for best timing. No detonation was encountered, and a 25,000 ft ceiling was available. Engine roughness was shown to be the limiting factor in the leanout.
R.C.T.

N80-22432*# Little (Arthur D.), Inc., Cambridge, Mass.
ANALYSIS OF NASA JP-4 FIRE TESTS DATA AND DEVELOPMENT OF A SIMPLE FIRE MODEL

Phani Raj Apr. 1980 58 p refs
(Contract NAS1-15380)

(NASA-CR-159209; Rept-81857-6) Avail: NTIS HC A04/MF A01 CSCL 21B

The temperature, velocity and species concentration data obtained during the NASA fire tests (3m, 7.5m and 15m diameter JP-4 fires) were analyzed. Utilizing the data analysis, a simple theoretical model was formulated to predict the temperature and velocity profiles in JP-4 fires. The theoretical model, which does not take into account the detailed chemistry of combustion, is capable of predicting the extent of necking of the fire near its base.
Author

N80-22492*# Solar Turbines International, San Diego, Calif.
DEVELOPMENT OF FIRE-RESISTANT, LOW SMOKE GENERATING, THERMALLY STABLE END ITEMS FOR COMMERCIAL AIRCRAFT AND SPACECRAFT USING A BASIC POLYIMIDE RESIN Final Report, 15 Dec. 1977 - 15 Apr. 1980

J. Gagliani, R. Lee, U. A. K. Sorathia, and A. L. Wilcoxson
15 Apr. 1980 176 p refs

(Contract NAS9-15484)
(NASA-CR-160576; SR79-R-4674-38) Avail: NTIS HC A09/MF A01 CSCL 07C

A terpolyimide precursor was developed which can be foamed by microwave methods and yields foams possessing the best seating properties. A continuous process, based on spray drying techniques, permits production of polyimide powder precursors in large quantities. The constrained rise foaming process permits fabrication of rigid foam panels with improved mechanical properties and almost unlimited density characteristics. Polyimide foam core rigid panels were produced by this technique with woven fiberglass fabric bonded to each side of the panel in a one step microwave process. The fire resistance of polyimide foams was significantly improved by the addition of ceramic fibers to the powder precursors. Foams produced from these compositions are flexible, possess good acoustical attenuation and meet the minimum burnthrough requirements when impinged by high flux flame sources.
A.R.H.

N80-22723 Engineering Sciences Data Unit, London (England).
ENDURANCE OF RIVETED LAP JOINTS (ALUMINUM ALLOY SHEET AND RIVETS)

1979 21 p
(ESDU-79031; ISBN-0-85679-279-0; ISSN-0141-3996) For information on availability of series, sub-series, and other individual data items, write NTIS, Attn: ESDU, Springfield, Va. 22161 HC \$578.50

Fatigue endurance data is provided for riveted lap joints in aluminum alloy sheet. Life estimations of lightweight structures for aircraft, lightweight surface vessels, and other vehicles can be made from the data. The range of applicability is for aluminum alloy sheets and rivets where the geometrical ratios are in the ranges d/t 1.9 to 4.4, p/l 0.5 to 2.3 and p/d = 3.1 to 12.9.
ESDU (GRA)

N80-22734*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

NONLINEAR; THREE-DIMENSIONAL FINITE-ELEMENT ANALYSIS OF AIR-COOLED GAS TURBINE BLADES

Albert Kaufman and Raymond E. Gaugler Apr. 1980 22 p refs

(NASA-TP-1669; E-074) Avail: NTIS HC A02/MF A01 CSCL 21E

Cyclic stress-strain states in cooled turbine blades were calculated for a simulated mission of an advanced-technology commercial aircraft engine. The MARC, nonlinear, finite-element computer program was used for the analysis of impingement-cooled airfoils, with and without leading-edge film cooling. Creep was the predominant damage mode (ignoring hot corrosion), particularly around film-cooling holes. Radially angled holes exhibited less creep than holes with axes normal to the surface. Beam-theory analyses of all-impingement-cooled airfoils gave fair agreement with MARC results for initial creep. Author

N80-22737*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
APPLICATION OF TWO DESIGN METHODS FOR ACTIVE FLUTTER SUPPRESSION AND WIND-TUNNEL TEST RESULTS

Jerry R. Newsom, Irving Abel, and H. J. Dunn May 1980
 84 p refs
 (NASA-TP-1653; L-13177) Avail: NTIS HC A05/MF A01 CSCL 20L

The synthesis, implementation, and wind tunnel test of two flutter suppression control laws for an aeroelastic model equipped with a trailing edge control surface are presented. One control law is based on the aerodynamic energy method, and the other is based on results of optimal control theory. Analytical methods used to design the control laws and evaluate their performance are described. At Mach 0.6, 0.8, and 0.9, increases in flutter dynamic pressure were obtained but the full 44 percent increase was not achieved. However at Mach 0.95, the 44 percent increase was achieved with both control laws. Experimental results indicate that the performance of the systems is not so effective as that predicted by analysis, and that wind tunnel turbulence plays an important role in both control law synthesis and demonstration of system performance. E.D.K.

N80-22749# National Aerospace Lab., Amsterdam (Netherlands), Structures and Materials Div.

FATIGUE CRACK PROPAGATION IN ALUMINUM ALLOY SHEET MATERIALS UNDER MANEUVER SPECTRUM AND CONSTANT AMPLITUDE LOADING

R. J. H. Wanhill Jun. 1978 25 p refs Submitted for publication
 Sponsored in part by Royal Netherlands Air Force Directorate of Material
 (NLR-MP-78025-U) Avail: NTIS HC A02/MF A01

Aluminum alloy sheets were compared for fatigue crack propagation resistance under maneuver conditions and constant amplitude loading. Results of stress levels, crack growth rate, delta k value, and fracture toughness for each alloy are presented. Author (ESA)

N80-22753# National Aerospace Lab., Amsterdam (Netherlands), Structures and Materials Div.

THE INFLUENCE OF BENDING-TORSIONAL COUPLING ON THE BUCKLING LOAD OF GENERAL ORTHOTROPIC, MIDPLANE SYMMETRIC AND ELASTIC PLATES

J. F. M. Wiggenraad 1977 75 p refs
 (Contract NIVR-1808)

(NLR-TR-77126-U) Avail: NTIS HC A04/MF A01

The influence of bending-torsional coupling on the buckling load of general orthotropic, midplane symmetric and elastic plates was studied. This effect was analyzed for the case of infinitely long plate strips, resulting in approximate analytical solutions, which can be presented graphically for the entire range of the elastic constants. These solutions were obtained with the approximate method as applied by Thielemann. The results were compared with results for finite length panels as derived with the finite element method. The conclusion is drawn that buckling loads for plates with aspect ratio over 2 or 3, which demonstrate the bending-torsional coupling effect, can be estimated fairly well from the results for the infinitely long plate strip. Author (ESA)

N80-22758*# Computer Sciences Corp., Wallops Island, Va.
DETERMINING SEA-ICE BOUNDARIES AND ICE ROUGHNESS USING GEOS-3 ALTIMETER DATA

R. E. Dwyer and R. H. Godin (NOAA, Washington, D. C.) Wallops Island, Va. NASA Wallops Flight Center. Mar. 1980 49 p refs
 (NASA-CR-156862) Avail: NTIS HC A03/MF A01 CSCL 08L

The GEOS-3 satellite and radar altimeter instrumentation are described, detailing the ice boundary discrimination technique utilized and presenting an analyses of the GEOS-3 data with respect to satellite visual and IR imagery. A brief description of the GEOS-3 real time data system is also given. E.D.K.

N80-22778*# AiResearch Mfg. Co., Phoenix, Ariz.
CONCEPT DEFINITION STUDY OF SMALL BRAYTON CYCLE ENGINES FOR DISPERSED SOLAR ELECTRIC POWER SYSTEMS Final Report, Sep. 1978 - Jun. 1979

Lyle D. Six, Thomas L. Ashe, Frank X. Dobler, and Ron T. Elkins Jan. 1980 135 p refs
 (Contracts DEN3-69; EX-76-A-29-1060)
 (NASA-CR-159592; DOE/NASA/0069-79/1;
 AiResearch-31-3328) Avail: NTIS HC A07/MF A01 CSCL 10B

Three first-generation Brayton cycle engine types were studied for solar application: a near-term open cycle (configuration A), a near-term closed cycle (configuration B), and a longer-term open cycle (configuration C). A parametric performance analysis was carried out to select engine designs for the three configurations. The interface requirements for the Brayton cycle engine/generator and solar receivers were determined. A technology assessment was then carried out to define production costs, durability, and growth potential for the selected engine types. R.E.S.

N80-23008*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

VALIDATION METHODS RESEARCH FOR FAULT-TOLERANT AVIONICS AND CONTROL SYSTEMS: WORKING GROUP MEETING, 2

James W. Gault, ed., Kishor S. Trivedi, ed., and James B. Clary, ed. 1980 105 p Meeting held at Hampton, Va. 3-4 Oct. 1979

(NASA-CP-2130; L-13716) Avail: NTIS HC A06/MF A01 CSCL 12A

The validation process comprises the activities required to insure the agreement of system realization with system specification. A preliminary validation methodology for fault tolerant systems documented. A general framework for a validation methodology is presented along with a set of specific tasks intended for the validation of two specimen system, SIFT and FTMP. Two major areas of research are identified. First, are those activities required to support the ongoing development of the validation process itself, and second, are those activities required to support the design, development, and understanding of fault tolerant systems. E.D.K.

N80-23100*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

FORWARD ACOUSTIC PERFORMANCE OF A SHOCK-SWALLOWING HIGH-TIP-SPEED FAN (QF-13)

James G. Lucas, Richard P. Woodward, and Michael J. MacKinnon May 1980 20 p refs
 (NASA-TP-1668; E-202) Avail: NTIS HC A02/MF A01 CSCL 20A

Forward noise and overall aerodynamic performance data are presented for a high-tip-speed fan having rotor blade airfoils designed to alter the conventional leading-edge bow shocks to weak, oblique shocks which are swallowed within the interblade channels. It was anticipated that the swallowed shocks would minimize the generation of multiple-pure-tone noise. In the speed range where the shocks presumably were swallowed, the multiple-tone noise was lowered only about 3 decibels. Comparison with several high-speed fans on a thrust-corrected basis indicates that the present fan was the quietest in total forward noise at low speeds but offered no advantage at high speeds.

Author

N80-23104# European Space Agency, Paris (France).

NOISE GENERATION BY JET-ENGINE EXHAUST DEFLECTION

Burkhard Gehlar, Werner Dobrzynski, and Bernhard Fuhrken Jul. 1979 50 p refs Transl into ENGLISH of "Schallerzeugung durch Triebwerksstrahl-Deflexion", Rept. DFVLR-FB-78-21, DFVLR, Brunswick, Sep. 1978 Original report in GERMAN previously announced as X79-76750

(ESA-TT-553; DFVLR-FB-78-21) Avail: NTIS HC A03/MF A01; DFVLR, Cologne DM 23,30

Noise radiation by jet engine exhaust-flow-interaction with blast deflectors is investigated by means of model-experiments of scale 0.1. The investigations pertain to a specific deflector configuration. Noise spectra and directivity characteristics for various power-settings and configuration changes are determined and used for the prediction of noise generation by the full-scale configuration. The investigation shows that the particular deflector gives rise to higher noise levels than those of the corresponding engine noise alone when the distance between exhaust nozzle and deflector is less than 10 nozzle-diameters.

Author (ESA)

N80-23106# National Aerospace Lab., Amsterdam (Netherlands). Fluid Dynamics Div.

ON THE SOUND FIELD GENERATED BY A FAN IN A HARD-WALLED BAFFLED DUCT WITH UNIFORM FLOW

J. N. Laan and J. B. H. M. Schulten 22 Feb. 1978 67 p refs

(Contracts NIVR-1773; NIVR-1821)

(NLR-TR-78024-U) Avail: NTIS HC A04/MF A01

A method to calculate the generation, transmission and radiation of fan noise is described. A steady uniform flow is assumed in the whole field. A hard walled circular duct is considered which is terminated at the open end by an infinite baffle. It is shown that the source mechanism is the impingement of wakes from an upstream row giving rise to fluctuating blade forces: this force field drives the sound field. Author (ESA)

N80-23142# Human Engineering Labs., Aberdeen Proving Ground, Md.

THE VERIFICATION OF A COMPUTER MODEL OF INTERNAL LIGHT REFLECTIONS FOR HELICOPTER CANOPY DESIGN Final Report

Christopher C. Smyth and Harry R. Stowell Oct. 1979 58 p refs

(AD-A080473; HEL-TM-21-79) Avail: NTIS HC A04/MF A01 CSCL 01/3

The U.S. Army Human Engineering Laboratory (USAHEL) has experimentally verified a computer model for internal light reflections on the transparent surfaces of helicopter canopies. The model was verified using a mockup of the Model 209 AH-1S Helicopter with the flat plate canopy design. The transmittance and coordinates of the light images on the canopy surfaces were measured at various light source positions. A matched sample was computed for the source positions using the computer model. Pearson's correlation coefficients for a linear regression analysis of the matched measured and computed values are greater than 0.98, and the results are statistically significant at the .01 level. GRA

N80-23146# Naval Ocean Systems Center, San Diego, Calif. **EMP HARDENING OF AIRBORNE SYSTEMS THROUGH ELECTRO-OPTICAL TECHNIQUES DESIGN GUIDELINES Technical Report, Apr. - Aug. 1979**

R. A. Greenwell 15 Dec. 1979 55 p refs Sponsored by Defense Nuclear Agency (AD-A080650; NOSC/TR-469) Avail: NTIS HC A04/MF A01 CSCL 18/6

This report examines the utilization of fiber optics technology as an alternative to system EMP hardening and provides design guidelines for airborne system applications. It also examines potential EMP vulnerabilities of the overall fiber optic data subsystems, defines and quantifies methods of protection against the EMP threat, and compares vulnerabilities with those of hard-wired data systems. GRA

N80-23196 George Washington Univ., Washington, D. C. **SYNTHESIS OF A THEORETICAL APPROACH FOR EMPLOYING ADAPTIVE CONFIGURATION MANAGEMENT IN AERONAUTICAL WEAPON SYSTEM PROGRAMS Ph.D. Thesis**

Angelo John DiMascio 1979 426 p Avail: Univ. Microfilms Order No. 8008364

A unified systems approach for managing aeronautical weapon system acquisition and life cycle support is discussed. The proposed holistic model provides a structured framework for integration of all of the technical and administrative elements associated with effective life cycle management. The primary integrative mechanism, which is used as the foundation module, is an expanded configuration management discipline. An adaptive configuration baseline management concept, when logically combined with basic integrated logistics management and research and development processes by a tailored system engineering methodology, is required to mitigate the acquisition and support problems attendant to technology turnover. The adaptive characteristics and the tailoring emphasis are required not only to deal with the volatile state of technology but also to accommodate the continuously decreasing influence of the military markets on the components industries. Dissert. Abstr.

N80-23249* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

CONCEPTUAL STUDIES OF A LONG-RANGE TRANSPORT WITH AN UPPER SURFACE BLOWING PROPULSIVE LIFT SYSTEM

John A. Cochrane May 1980 24 p (NASA-TM-81196; A-8169) Avail: NASA. Ames Res. Center, Moffett Field, Calif. 94035 CSCL 01C

The application of propulsive lift technology to the long range, heavy lift transport mission was studied. The level of propulsive lift technology studied was that which is represented by the Quiet Short-Haul Research Aircraft (QSRA). This technology uses the upper surface blowing technique (USB) to develop high lift coefficients. Results indicate that field lengths of less than 3000 ft are feasible at landing gross weights and that even at maximum takeoff gross weight, a reduction in field length is available as compared to a conventional aircraft. Further study of the concept is recommended. J.M.S.

N80-23250*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

LEEWARD FLOW OVER DELTA WINGS AT SUPERSONIC SPEEDS

Joachim G. Szodrach Apr. 1980 49 p refs (NASA-TM-81187; A-8117) Avail: NTIS HC A03/MF A01 CSCL 01A

A survey was made of the parameters affecting the development of the leeward symmetric separated flow over slender delta wings immersed in a supersonic stream. The parameters included Mach number, Reynolds number, angle of attack, leading-edge sweep angle, and body cross-sectional shape, such that subsonic and supersonic leading-edge flows are encountered. It was seen that the boundaries between the various flow regimes existing about the leeward surface may conveniently be represented on a diagram with the components of angle of attack and Mach number normal to the leading edge as governing parameters. R.E.S.

N80-23251*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

A STUDY OF PANEL LOADS AND CENTERS OF PRESSURE OF THREE DIFFERENT CRUCIFORM AFT-TAIL CONTROL SURFACES OF A WINGLESS MISSILE FROM MACH 1.60 TO 3.70

Milton Lamb and Charles D. Trescot, Jr. May 1980 112 p refs (NASA-TM-81787; L-13501) Avail: NTIS HC A06/MF A01 CSCL 01A

An investigation was made of the forces and moments on the cruciform aft-tail control surfaces of a wingless missile model to determine the variation of panel load and center of pressure with angle of attack, tail deflection, model roll angle, and Mach

number. Also, a limited force-moment and surface-pressure investigation was made on a noncircular aft end. These investigations were made in a unitary plan wind tunnel at Mach numbers of 1.60, 2.36, and 3.70 and at a Reynolds number per meter of 6,600,000. The cruciform aft-tail results indicate very little variation in the center of pressure for the highly loaded windward tail. The noncircular aft-end test results indicate no significant effect of the fin unporting on the fin loads. R.E.S.

N80-23252*# Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.

SURFACE PRESSURE MEASUREMENTS AT TWO TIPS OF A MODEL HELICOPTER ROTOR IN HOVER Final Report R. B. Gray, H. M. McMahon, K. R. Shenoy, and M. L. Hammer May 1980 46 p refs

(Contract NAS1-15158; DA Proj. 1L1-61102-AH-45A) (NASA-CR-3281) Avail: NTIS HC A03/MF A01 CSCL 01A

Surface pressures were measured near the tip of a hovering single-bladed model helicopter rotor with two tip shapes. The rotor had a constant-chord, untwisted blade with a square, flat tip which could be modified to a body-of-revolution tip. Pressure measurements were made on the blade surface along the chordwise direction at six radial stations outboard of the 94 percent blade radius. Data for each blade tip configuration were taken at blade collective pitch angles of 0, 6.18 and 11.4 degrees at a Reynolds number of 736,000 and a Mach number of 0.25 both based on tip speed. Chordwise pressure distributions and constant surface pressure contours are presented and discussed. Author

N80-23253*# National Aeronautics and Space Administration, Washington, D. C.

LEE SIDE FLOW FOR SLENDER DELTA WINGS OF FINITE THICKNESS

Joachim G. Szodruch Mar. 1980 161 p refs Transl. into ENGLISH of "Leeseiten-Stromung Bei Schlanken DeltaFluegeln endlicher Dicke" Rept. ILR-23 Tech. Univ., Berlin, Inst. fuer Luft und Raumfahrt, 1977 150 p Trans. by Scientific Translation Service, Santa Barbara, Calif.

(Contract NASw-3198) (NASA-TM-75753; ILR-23) Avail: NTIS HC A08/MF A01 CSCL 01A

An experimental and theoretical investigation carried out to determine the lee side flow field over delta wings at supersonic speeds is presented. A theoretical method to described the flow field is described, where boundary conditions as a result of the experimental study are needed. The computed flow field with shock induced separation is satisfactory. M.G.

N80-23254# Nielsen Engineering and Research, Inc., Mountain View, Calif.

ACTIVE CONTROL OF ASYMMETRIC VORTEX EFFECTS Final Technical Report, 20 Apr. 1978 - 20 Dec. 1979

John E. Fiddler Dec. 1979 55 p refs (Contract N60921-78-C-0073; WR02303003) (AD-A081648; NEAR-TR-212) Avail: NTIS HC A04/MF A01 CSCL 20/4

Active control of asymmetric vortex effects on a pointed, slender body at high angles of attack has been achieved by rotating portions of the body about the axis. The lee side asymmetric vortex patterns and their associated yaw-plane forces and moments have been varied in cyclic, repeatable fashion at rates up to 100 cycles per second. The variations occurred to rapidly that the average yaw-plane quantities were brought to small, steady values, or nulled out. The effect was obtained by rotating the nose, the nosetip and a band of the body surface just aft of the nose. GRA

N80-23255# McDonnell-Douglas Astronautics Co., St. Louis, Mo.

NUMERICAL FLOW FIELD PROGRAM FOR AERODYNAMIC HEATING ANALYSIS. VOLUME 1: EQUATIONS AND RESULTS Final Technical Report, Jun. 1977 - Sep. 1979 H. J. Fivel Wright-Patterson AFB, Ohio AFFDL Dec. 1979

125 p refs

(Contract F33165-77-C-3003; AF Proj. 2404) (AD-A081471; AFFDL-TR-79-3128-Vol-1) Avail: NTIS HC A06/MF A01 CSCL 20/4

This report documents a study to modify an existing computer program which provides an economical and easy to use analytic tool for aerodynamic heating to a wide variety of 3 dimensional vehicle configurations. This report also serves as a user's manual for the computer program plus two auxiliary programs written to analyze vehicle geometry, and presents program capabilities, input/output characteristics, and example problems. Core requirements have been minimized by the use of overlays. User oriented features of the program include minimized input requirements and various options for application flexibility. GRA

N80-23256# Kaman Avidyne, Burlington, Mass.

THE VIBRA-8 SUBSONIC AERODYNAMIC NUCLEAR GUST VULNERABILITY CODE Final Report, Jul. 1978 - Feb. 1979

Garabed Zartarian 1 May 1979 23 p refs (Contract DNA001-78-C-0317) (AD-A081722; AD-E300674; KA-TR-164; DNA-4966F) Avail: NTIS HC A02/MF A01 CSCL 20/4

This report describes certain modifications to the subsonic aerodynamic subroutine in the earlier versions of VIBRA to extend the applicability of the nuclear vulnerability code over broader ranges of Mach number, aspect ratio, and sweep angles. This modified version, designated as VIBRA-8, was developed in conjunction with a study of the nuclear vulnerability of an aeronautical system. A separate classified report has been issued to cover that study. GRA

N80-23257# Avco Systems Div., Wilmington, Mass.

HYPERSONIC HEAT TRANSFER TEST PROGRAM IN THE VKI LONGSHOT FACILITY Final Report, 1 Dec. 1978 - 30 Nov. 1979

Victor Dicristina 18 Dec. 1979 26 p (Contract F49620-79-C-0013; AF Proj. 2307) (AD-A081467; AVSD-0335-79-CR; K500-79-VD-32; AFOSR-80-0124TR) Avail: NTIS HC A03/MF A01 CSCL 20/13

A summary of test results is presented for local pressure and heat transfer distributions on a biconic body for a range of hypersonic Mach numbers, Reynolds number, and angle-of-attack. The model configuration approximated nosetip contours typical of low altitude turbulent ablated shapes. Instrumentation included a longitudinal row of ten pressure taps and, 180 degrees apart, a row of eleven smooth calorimeter discs. The tests were performed in the Longshot Facility of the von Karman Institute for Fluid Dynamics. GRA

N80-23258# Boeing Military Airplane Development, Seattle, Wash.

EASY-ACIS DYNAMIC ANALYSIS. USER'S MANUAL Final Report, 15 Apr. 1977 - 1 Jun. 1979

M. K. Wahi, G. S. Duleba, and P. R. Perkins Wright-Patterson AFB, Ohio AFFDL Sep. 1979 291 p refs (Contract F33615-77-C-3054; AF Proj. 2402) (AD-A081160; AFFDL-TR-79-3106) Avail: NTIS HC A13/MF A01 CSCL 09/2

This report contains a summary description of the command language used in the EASY dynamic analysis program. In addition, a description of the inputs and outputs for each standard component in the ACLS library is given. GRA

N80-23259# Calspan Advanced Technology Center, Buffalo, N.Y. Aerodynamic Research Dept.

ANALYSIS OF EXPERIMENTS ON THE EFFECTS OF JET PLUMES ON PRESSURE DISTRIBUTION OVER A CYLINDRICAL AFTERBODY AT TRANSONIC SPEEDS Final Report

Joseph P. Nenni Feb. 1980 51 p refs (Grant DAAG29-77-C-0008) (AD-A081647; CALSPAN-AA-4017-W-16; ARO-13797.1-E) Avail: NTIS HC A04/MF A01 CSCL 21/8

The objective of the present investigation was to obtain

experimentally, the effects of various jet plume parameters on afterbody pressure distributions and to partially validate the Korst modeling procedure. Analysis of the experimental results and supplemental calculations made by the method of characteristics show that the approximate theory used by Korst gives a good estimate of the plume shape for nozzle exit Mach number of 2.0 and below. For nozzle exit Mach numbers much in excess of 2.0, it appears desirable to include the effect of the nozzle wall boundary layer on plume shape. In addition, afterbody pressure distributions produced by a series of nozzles designed to produce the same plume shape, but with different values of the plume pliability parameter, have been compared with results from a solid plume simulator. In general, the solid plume simulator produces results that agree with the nozzles with the higher values of the plume pliability parameter at zero degrees angle of attack. The correlation deteriorates significantly, however, at five degrees angle of attack. Also, afterbody pressure distributions from model tests on the ZAP rocket motor are presented for future correlation with prototype results. GRA

N80-23260# McDonnell-Douglas Astronautics Co., St. Louis, Mo.

NUMERICAL FLOW FIELD PROGRAM FOR AERODYNAMIC HEATING ANALYSIS. VOLUME 2: USER'S MANUAL Final Technical Report, Jun. 1977 - Sep. 1979

H. J. Fivel Wright-Patterson AFB, Ohio AFFDL Dec. 1979 113 p refs Supersedes AFFDL-TR-79-3025 2 Vol.

(Contract F33615-77-C-3003; AF Proj. 2404)

(AD-A081472; AFFDL-TR-79-3128-Vol-2; AFFDL-TR-79-3025)

Avail: NTIS HC A06/MF A01 CSCL 20/4

This report documents a study to modify an existing computer program which provides an economical and easy to use analytic tool for aerodynamic heating to a wide variety of 3 dimensional vehicle configurations. This report also serves as a user's manual for the computer program plus two auxiliary programs written to analyze vehicle geometry, and presents program capabilities, input/output characteristics, and example problems. Core requirements have been minimized by the use of overlays. User oriented features of the program include minimized input requirements and various options for application flexibility. GRA

N80-23265# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Inst. fuer Theoretische Stroemungsmechanik.

LIFT, DRAG AND PITCHING MOMENT MEASUREMENTS ON A MISSILE BODY HAVING VARIOUS BOATTAILS AT SUBSONIC AND TRANSONIC VELOCITIES

Mauri Tanner Mar. 1979 86 p refs In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-628)

(DFVLR-FB-79-15) Avail: NTIS HC A05/MF A01; DFVLR, Cologne DM 13,60

The lift, drag, and pitching moment of a missile body with boattailing were measured at Mach numbers from 0.5 to 1.0 at a Reynolds number of 340,000 in a transonic wind tunnel. Lift, drag, and longitudinal stability of the body was found to decrease when the relative base diameter decreased. Author (ESA)

N80-23266# Rolls-Royce Ltd., Derby (England).

UNSTEADY AERODYNAMIC FORCES ON A SUBSONIC RECTILINEAR CASCADE OF BLADES

H. Loiseau and J. Nicolas 1979 28 p refs Transl. into ENGLISH of conf. paper "Forces Aerodynamiques Instationnaires en Grille Rectiligne d'Aubes Subsonique" ONERA, Paris, Oct. 1976 In ENGLISH and FRENCH Presented at the RFM Symp., Paris, Oct. 1976 p 105-114

(PNR-90007; Trans-14737) Avail: NTIS HC A03/MF A01

Tests performed on Pfenniger-Sulzer airfoils and NACA 65 A 006 airfoils, singly and in cascades in a subsonic wind tunnel to investigate aeroelastic phenomena in gas turbines are discussed. The simultaneous use of two measurement methods (forces extended from the variation in natural frequency and the damping of the rotating blade, and from pressures) is a certain means of checking the quality of the measurements. The choice of a vibrating configuration, where only one blade is subjected

to an oscillating movement, is found to be particularly effective in minimizing the effects of the horizontal walls. Agreement between the theoretical and experimental results is comparable to that obtained from a wing or an aircraft model between the results of flutter calculations and flutter measurements in a wind tunnel. However, although phases coincide well, the test amplitude are approximately 20 percent lower overall than the theoretical amplitudes. Author (ESA)

N80-23267# European Space Agency, Paris (France). **PRESSURE DISTRIBUTION MEASUREMENTS ON WEDGES AT SUBSONIC AND TRANSONIC VELOCITIES**

Mauri Tanner Nov. 1979 44 p refs Transl. into ENGLISH of "Druckverteilungsmessungen an Keilen bei Unterschall- und Transschallgeschwindigkeiten", Rept. DFVLR-FB-78-22 DFVLR, Cologne, Oct. 1978 Original report in GERMAN previously announced as N79-30156

(ESA-TT-554; DFVLR-FB-78-22) Avail: NTIS HC A03/MF A01; ZLDI, Munich 19,70

Measurements were performed in a wind tunnel on three wedges (apex angle of 8, 15, and 30 deg). Formulas are given for calculating pressure distributions and other characteristics associated with the wedge. Some comparisons are made with theoretically expected results. The pressure distribution on the wedge flank, the base pressure and the pressure drag vary considerably with Mach number and wedge angle. Author (ESA)

N80-23268# European Space Agency, Paris (France).

AFTERBODY DRAG AND BASE PRESSURE MEASUREMENTS ON A BODY OF REVOLUTION AT ANGLES OF INCIDENCE UP TO ALPHA = 25 DEG AT SUBSONIC AND TRANSONIC MACH NUMBERS

Mauri Tanner Nov. 1979 70 p refs Transl. into ENGLISH of "Heckwiderstands- und Basisdruckmessungen an einem fluckoerpererrumpf bei Anstellwinkeln bis Alphas = 25 deg im Unterschall und Transschallbereich", Rept. DFVLR-FB-78-14 DFVLR, Goettingen, West Germany, Jun. 1978 Original report in GERMAN previously announced as N79-30157

(ESA-TT-569; DFVLR-FB-78-14) Avail: NTIS HC A04/MF A01; ZLDI, Munich DM 26,90

Base pressure and afterbody drag measurements were performed in a wind tunnel. The Mach number had values from 0.5 to 1.0, the Reynolds number based on the model diameter was 340,000. Results show the influence of the boattail angle, the boattail length, and the relative base diameter on the base pressure and the afterbody drag at various angles of incidence. Author (ESA)

N80-23269# European Space Agency, Paris (France). **ON DISTURBANCE FIELDS OF MOVING SINGULARITIES IN AERODYNAMICS AND AEROACOUSTICS**

Arabino Das Dec. 1979 90 p refs Transl. into ENGLISH of "Ueber Stoerfelder Bewegter Singularitaeten in der Aerodynamische und Aeroakustik", Rept. DFVLR-FB-78-16 DFVLR, Brunswick, May 1978 Original report in GERMAN previously announced as N79-30158

(ESA-TT-570; DFVLR-FB-78-16) Avail: NTIS HC A05/MF A01; ZLDI, Munich DM 38,10

A unified method is presented in which arbitrary translatory motions of the disturbance sources, of the medium, and of the field point are admitted. The influence factors which arise from the kinematics of the disturbance field are derived and the physical processes involved are elucidated. The significance of the Lorentz transformation in problems of disturbance propagation from moving singularities is discussed. An evaluation of energy density and energy flux in disturbance fields is presented. Author (ESA)

N80-23270# European Space Agency, Paris (France).

THE HARMONICALLY OSCILLATING BODY IN SUBSONIC FLOW: EFFECT OF COMPRESSIBILITY

Wolfgang Geissler Nov. 1979 42 p refs Transl. into ENGLISH of "Der Harmonisch Schwingende Rumpf in Unterschallstroemung: Einfluss der Kompressibilitaet", Rept. DFVLR-FB-78-24 DFVLR,

Goettingen, West Germany, Nov. 1978 Original report in GERMAN previously announced as N79-30160 (ESA-TT-584; DFVLR-FB-78-24) Avail: NTIS HC A03/MF A01; ZLDI, Munich DM 20,20

The calculation of steady and unsteady airloads on harmonically oscillating bodies can be done by means of source and sink distributions on the real body surface. It is useful to do the calculation in a body fixed frame of reference. Pressures and forces on oscillating bodies were obtained for incompressible flow. The extension of this method to compressible subsonic flow is discussed. Numerical results are compared with other available methods for steady and unsteady flow about bodies.

Author (ESA)

N80-23273# National Aerospace Lab., Amsterdam (Netherlands). Fluid Dynamics Div.

SUMMARY OF DATA REQUIRED FOR THE AGARD SMP ACTIVITY STANDARD AEROELASTIC CONFIGURATIONS - TWO-DIMENSIONAL CONFIGURATIONS

R. J. Zwaan 30 Apr. 1979 26 p refs

(NLR-MP-79015-U) Avail: NTIS HC A03/MF A01

For the current AGARD structures and material panel (SMP) activity Standard Aeroelastic Configurations two airfoils were proposed for use in comparative calculations, one of which is the NLR 7301 airfoil. To facilitate reference to definitions of airfoil geometry and aerodynamic conditions and to experimental values, all relevant data are presented.

Author (ESA)

N80-23274# Bristol Univ. (England).

AN AEROELASTIC ANALYSIS OF THE SHERIFF WING B.S. Thesis

A. K. Fuan Jun. 1979 40 p refs

(BU-234) Avail: NTIS HC A03/MF A01

The aeroelastic behavior of the Sheriff wing, particularly the aileron dependent flutter characteristics was analyzed with the intention of minimizing the mass balance weight. Results are presented for wind divergence speed and control surface reversal. The mass and stiffness matrices and the associated eigenvalues and eigenvectors are discussed.

Author (ESA)

N80-23276# Bristol Univ. (England). Dept. of Aeronautical Engineering.

AN ASSESSMENT OF THE STABILITY AND OPENING CHARACTERISTICS OF CRUCIFORM PARACHUTES B.S. Thesis

M. D. Copcutt and P. L. Denner Jun. 1979 53 p ref

(BU-238) Avail: NTIS HC A04/MF A01

The stability of cruciform parachutes and the measurement of the forces which occurred during the inflationary phase were investigated. A number of cruciform parachutes, with arm ratios varying from 2 : 1 to 5 : 1, were constructed. Stability tests were performed by attaching the parachutes to a fixed point and observing their behavior in a wind tunnel. Force measurements were obtained by the horizontal deployment of the parachutes on a restraining cable. Cruciform parachutes were found to be more laterally stable than flat circular parachutes but they exhibit a spinning instability. Results indicate that the most promising arm ratios for parachute design are between two and a half to one and four to one.

Author (ESA)

N80-23277# Bristol Univ. (England). Dept. of Aeronautical Engineering.

WIND TUNNEL TESTS ON THE SHERIFF TWIN-ENGINE LIGHT AIRCRAFT B.S. Thesis

K. M. R. Walsh and S. Watkins Jun. 1979 76 p refs

(BU-241) Avail: NTIS HC A05/MF A01

The aerodynamics of the Sheriff twin-engine light aircraft were examined. Flow visualization experiments which gave evidence of a premature stall arising on the wing section between the nacelle and fuselage are described. A search for improvement was made using various high lift leading edge devices, fillets, and changes of nacelle geometry. Improved aerodynamic performance in the Sheriff by adopting pointed tail nacelles, leading edge cusps on the wing inboard of the nacelles, and fairings on the wing/fuselage junctions is discussed. Pressure readings taken

to assess the forces likely to be encountered on the canopy hatches are reported.

Author (ESA)

N80-23278# Crew Systems Consultants, Yellow Springs, Ohio. **CARBURETOR ICE: A REVIEW**

Richard L. Newman 1980 97 p refs Backup document for AIAA Synoptic, 'Carburetor ice flight testing: The use of an anti-icing fuel additive', scheduled for publication in Journal of Aircraft in Oct. or Nov. 1980

Avail: NTIS HC A05/MF A01

Carburetor ice formation, a cause of engine failure and resultant aircraft accidents, is investigated. Prevention techniques include antiicing fuel additives, such as ethylene glycol monomethyl ether, deicing procedures, pilot education, and engine design.

N80-23279# Crew Systems Consultants, Yellow Springs, Ohio. **CARBURETOR ICE: A REVIEW**

Richard L. Newman *In its Carburetor Ice* 1980 56 p refs

(TR-79-9) Avail: NTIS HC A05/MF A01

The effectiveness of 0.15 percent by volume of ethylene glycol monomethyl ether as an antiicing fuel additive was investigated in-flight using a PA-23 airplane equipped with O-320-A engines. Topics addressed include establishment of environmental conditions over which the carburetor is likely to form ice, rate of ice formation, and effectiveness of procedures for deicing a carburetor. The maximum amount of icing that can be safely tolerated was estimated.

E.D.K.

N80-23280# Crew Systems Consultants, Yellow Springs, Ohio. **CARBURETOR ICE: A REVIEW**

Richard L. Newman *In its Carburetor Ice* 1980 41 p refs

(TR-77-19) Avail: NTIS HC A05/MF A01

Records of aviation accidents due to carburetor icing are reviewed. Carburetor ice research, including formation and prevention techniques, is discussed. Possible solutions are presented with emphasis on fuel additives and a pilot education program.

E.D.K.

N80-23281# Mitre Corp., McLean, Va. **OPPORTUNITIES ANALYSIS OF POTENTIAL ADVANCED VORTEX SYSTEMS SEPARATION STANDARDS**

Dana L. Hall and Frank A. Amodeo Jul. 1979 73 p refs

(Contract DOT-FA79WA-4184)

(AD-A081479; MTR-79W00073; FAA-EM-79-17) Avail: NTIS HC A04/MF A01 CSCL 01/2

The benefits associated with conceptual Advanced Vortex Systems (AVS) are quantified from a delay reduction viewpoint. The findings are equally applicable to airborne vortex alleviation technology or to ground or air-based vortex avoidance systems. The delay consequences of three sets of successively closer interarrival standards are compared against the option of maintaining today's rules or a combination of today's and 3 nmi separations. The analysis was performed for only IFR weather conditions, since minimum required separation standards were selected as representative of possible AVS capabilities. Substantial delay savings are shown to be possible even with demand growth below that projected to occur across the 1985 through 1995 analysis time period. The benefits are sufficiently large as to warrant a substantial research and development investment into an AVS program.

A.R.H.

N80-23282*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

STORM HAZARDS '79: F-106B OPERATIONS SUMMARY

Bruce D. Fisher, Gerald L. Keyser, Jr., Perry L. Deal, Mitchel E. Thomas, and Felix L. Pitts Mar. 1980 64 p refs

(NASA-TM-81779) Avail: NTIS HC A04/MF A01 CSCL 01C

Preliminary flight tests with a F-106B aircraft were made on the periphery of isolated thunder cells using weather radar support. In addition to storm hazards correlation research, a direct-strike lightning measurement experiment and an atmospheric chemistry experiment were conducted. Two flights were

made to close proximity to lightning generating cumulonimbus clouds; however, no direct lightning strikes were experienced. Although no discernible lightning transients were recorded, many operational techniques were identified and established. R.E.S.

N80-23283*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
OUTLOOK FOR ADVANCED CONCEPTS IN TRANSPORT AIRCRAFT

D. William Conner Apr. 1980 21 p refs Presented at the 1980 Intern. Air Transportation Meeting, Cincinnati, 20-22 May 1980

(NASA-TM-81810; SAE-TP-800744) Avail: NTIS HC A02/MF A01 CSCL 01C

Air transportation demand trends, air transportation system goals, and air transportation system trends well into the 21st century were examined in detail. The outlook is for continued growth in both air passenger travel and air freight movements. The present system, with some improvements, is expected to continue to the turn of the century and to utilize technologically upgraded, derivative versions of today's aircraft, plus possibly some new aircraft for supersonic long haul, short haul, and high density commuter service. Severe constraints of the system, expected by early in the 21st century, should lead to innovations at the airport, away from the airport, and in the air. The innovations are illustrated by descriptions of three candidate systems involving advanced aircraft concepts. Advanced technologies and vehicles expected to impact the airport are illustrated by descriptions of laminar flow control aircraft, very large air freighters and cryogenically fueled transports. R.E.S.

N80-23284# National Aerospace Lab., Amsterdam (Netherlands), Structures Materials Dept.

FAILURE ANALYSIS IN AVIATION

E. A. B. deGraaf 14 Aug. 1978 48 p refs In DUTCH; ENGLISH summary

(NLR-MP-78028-U) Avail: NTIS HC A03/MF A01

The role of service failure analysis in defining new inspection procedures and the adoption of existing ones is illustrated. Examples include failures detected during inspections prescribed by the manufacturer, failures discovered after having learned of problems experienced by other operators of the same type of aircraft, and those found after an accident or by chance.

Author (ESA)

N80-23285# National Aerospace Lab., Amsterdam (Netherlands), Structures and Materials Dept.

THE FAILURE OF AIRCRAFT STRUCTURES

E. A. B. deGraaf 6 Dec. 1978 36 p refs In DUTCH; ENGLISH summary Presented at Bondsdag-Bond van Materialenkennis, Wageningen, Netherlands, 10 Nov. 1978

(NLR-MP-78040-U) Avail: NTIS HC A03/MF A01

A general discussion of aircraft structural failures and the design measures taken to prevent them are presented. Methods for determining static strength and stiffness, loads, and fatigue strength are surveyed. Modern design philosophies which take into account the possibility of initial defects, from which fatigue damage could originate are considered. Examples of structural failure are given and discussed. Author (ESA)

N80-23286# Logicon, Inc., San Pedro, Calif.
SOFTWARE IMPACT OF SELECTED EN ROUTE ATC COMPUTER REPLACEMENT STRATEGIES Final Report

W. D. Kandler, D. Weeton, and W. B. Cushing Dec. 1979 98 p refs

(Contract DOT-FA79WA-4313) (AD-A081478; FAA-EM-79-15; Rept-7941-03) Avail: NTIS HC A05/MF A01 CSCL 17/7

The impacts and software constraints associated with transitioning to an en route air traffic control system are examined. The functional splitting of existing major system functions (flight data processing and radar data processing) and the implementation of system enhancements (en route minimum safe altitude warning and flight plan conflict probe) in a new computer system attached to the existing IBM 9020 system via a selector channel are

described. The replacement of the IBM 9020 computer with an instruction-compatible computer system is also discussed. The required changes and predicted central processing unit and intersystem channel loading for each functional split are presented and implementation cost estimates provided. M.G.

N80-23287# Mitre Corp., McLean, Va. Metrek Div.
PROCEDURAL FEASIBILITY OF REDUCED SPACING UNDER WVAS OPERATION WITH APPLICATIONS TO ATLANTA AND O'HARE

Ronald G. Gados and Frank A. Amodeo Washington, D.C. FAA Aug. 1979 64 p refs

(Contract DOT-FA79WA-4184) (AD-A081480; MTR-79W00243; FAA-EM-79-18) Avail: NTIS HC A04/MF A01 CSCL 01/2

A Wake Vortex Avoidance System (WVAS) may provide increased airport capacity by allowing for reduced aircraft separation standards on final approach under certain meteorological conditions. Three sets of reduced separation standards were hypothesized in order to describe the operational characteristics of potential WVAS systems. The analyses developed several operational schemes which allow aircraft to transition to reduced separation standards when under WVAS coverage, while maintaining larger terminal area standards prior to intercepting that coverage. Specific applications of these schemes to Atlanta Hartsfield and Chicago O'Hare International Airports are described. Procedures for and dynamics of transitioning between different sets of separation standards were investigated. Capacity benefits corresponding to the utilization of the different sets of separation standards under various operational procedures are estimated for Chicago and Atlanta. R.E.S.

N80-23288# National Aviation Facilities Experimental Center, Atlantic City, N. J.

A FLIGHT INVESTIGATION OF SYSTEM ACCURACIES AND OPERATIONAL CAPABILITIES OF A GENERAL AVIATION/AIR TRANSPORT AREA NAVIGATION SYSTEM (RNAV) Final Report, Nov. 1977 - Mar. 1979

Jack Edmonds, John Gallagher, and Robert Pursel Feb. 1980 104 p

(FAA Proj. 975-310-001)

(AD-A081646; FAA-NA-79-25) Avail: NTIS HC A06/MF A01 CSCL 17/7

Flight tests were conducted using a general aviation/air transport type area navigation system (RNAV) to investigate area navigation system accuracies and resultant airspace requirements. The system used very high frequency omnidirectional radio/distance measuring equipment (VOR/DME) radio data for position determination. Data and operational capabilities were also investigated, and graphical data are presented for parallel offsets, delay fans, and turn anticipation. Author

N80-23293# Air Force Packaging Evaluation Agency, Wright-Patterson AFB, Ohio.

IMPROVED PACKAGING FOR THE LN-31 INERTIAL MEASUREMENT UNIT (F-15 AIRCRAFT)

Frank C. Jarvis Mar. 1980 14 p

(AD-A081745; PTPT-80-2) Avail: NTIS HC A02/MF A01 CSCL 17/7

The investigation of the current packaging for the F-15 Inertial Measurement Unit (LN-31 IMU) revealed that the pack will provide adequate shock and vibration protection for the item; however, it was anticipated that a less expensive pack could be developed at a cost savings of approximately 25% (PTPT Report 79-3, Packaging and Handling Analysis of the LN-31, 683420-14, Inertial Measurement Unit). A new improved pack was developed and evaluated. The estimated cost savings is 20% and the potential implementation date is scheduled for June 1980. GRA

N80-23295* National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.
OPERATIONS MANUAL: VERTICAL MOTION SIMULATOR (VMS) S.08

A. David Jones May 1980 70 p

(NASA-TM-81180; A-8095) Avail: Issuing Activity CSCL 14B

The Ames Research Center Vertical Motion Simulator (VMS) is described in terms useful to the researcher who intends to use it. A description of the VMS and its performance are presented together with the administrative policies governing its operation. The management controls over its use are detailed, including data requirements, user responsibilities, and scheduling procedures. This information is given in a form that should facilitate communication with the NASA operations group during initial simulator use. J.M.S.

N80-23296 Stanford Univ., Calif.
ESTIMATION OF WIND SHEAR AND THRUST LOSS DURING STOL AIRCRAFT LANDING APPROACH
 Ph.D. Thesis

Joseph Andrew Bossi 1980 125 p
 Avail: Univ. Microfilms Order No. 8011611

Techniques for designing constant gain estimators when uncertainties are present in the dynamic model were investigated. Modification of the steady state Kalman filter are described which provides a satisfactory estimator in such cases. Also, methods for predicting the performance sensitivity of estimator designs are described. The results of applying these techniques to the design of an estimator for wind shear and thrust loss on a STOL aircraft are presented. Estimator performance was verified using a digital flight simulation of the aircraft on final approach.

Dissert. Abstr.

N80-23297 Princeton Univ., N. J.
AN ANALYTICAL STUDY OF TILT PROPRTOR AIRCRAFT DYNAMICS IN AIRPLANE CRUISE CONFIGURATION INCLUDING THE EFFECTS OF FUSELAGE LONGITUDINAL RIGID BODY MOTION Ph.D. Thesis

Tatsuo Komatsuzaki 1980 430 p
 Avail: Univ. Microfilms Order No. 8011032

The dynamics of tilt proprotor aircraft in symmetric motion in airplane cruise configuration were examined with the effects of the fuselage longitudinal rigid body motion included. The reference values of the physical parameters were mainly based on those of the Bell XV-15, a tilt rotor research aircraft. The influence of the fuselage motion on the aeroelastic stability of the proprotor/wing system was investigated, as well as the influence of the proprotor/wing system dynamics on the stability and control characteristics of the vehicle. In addition, the effects of various feedbacks were examined with particular emphasis placed upon the feasibility of using relatively simple feedbacks to improve the dynamic stability characteristics of the proprotor/wing system. Prior to investigating the dynamics of the complete system, the dynamics of simplified models with reduced number of motion degrees of freedom was examined in some detail in order to obtain physical insights into the dynamics of the more complex system. Dissert. Abstr.

N80-23298# Decisions and Designs, Inc., McLean, Va.
DECISION ANALYSIS OF ADVANCED SCOUT HELICOPTER CANDIDATES Final Technical Report

Michael L. Donnell and Jacob W. Ulvila Jan. 1980 98 p ref (Contract DAAK50-79-C-0035)
 (AD-A081483; PR-80-1-307) Avail: NTIS HC A05/MF A01 CSDL 01/3

An analysis is described for thirteen Advanced Scout Helicopter (ASH) candidates and mixtures of those candidates. The analysis evaluates the candidates on the basis of their military worth; life cycle costs; attainability; force structure personnel impact; and rationalization, standardization and interoperability impact. The major portion of the report describes and explains the methodology used to evaluate the candidates, presents the results of the analysis, and illustrates several of the sensitivity analyses that were performed. Detailed assessments used in the analysis are reported in the appendices. GRA

N80-23299# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugmechanik.

INVESTIGATION OF LANDING FLARE IN PRESENCE OF WIND SHEAR

Knut Wilhelm and Martin Marchand Jun. 1979 55 p refs In

GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-631)
 (DFVLR-FB-79-20) Avail: NTIS HC A04/MF A01; DFVLR, Cologne DM 11,50

The effects of wind shear on the arrested landing of conventional and short take off aircraft were calculated. The aircraft trajectory during the landing maneuver is given in analytical form as a function of wind speed and pilot aircraft controls. Various examples are used to illustrate the effect, resulting in specific recommendations for pilot control during the aircraft landing. Author (ESA)

N80-23300# European Space Agency, Paris (France).
INVESTIGATIONS OF THE DESIGN OF ACTIVE VIBRATION ISOLATION SYSTEMS FOR HELICOPTERS WITH RIGID AND ELASTIC MODELING OF THE FUSELAGE

Gerd Schulz Nov. 1979 66 p refs Transl. into ENGLISH of "Untersuchungen zur Auslegung von Vollaktiven Schwingungsisolationssystemen fuer Hubschrauber bei Starrer und Elastischer Zellenmodellierung", Rept. DFVLR-FB-78-04 DFVLR, Oberpfaffenhofen, West Germany Original report in GERMAN previously announced as N79-30183
 (ESA-TT-556; DFVLR-FB-78-04) Avail: NTIS HC A04/MF A01; ZLDI, Munich DM 25,70

Different methods for the design of controllers for active vibration isolation on helicopters are investigated. Based on the special structure of the controller, compensation for the rotor blade harmonic disturbance vibrations is achieved, guaranteeing good trim behavior during maneuvers. For the first controller design, done for a rigid helicopter fuselage with a modified Riccati design, different sensor configurations are investigated. A possibility for sensitivity reduction for rotor speed variations is shown. For the second controller design for an elastic helicopter fuselage the modified Riccati design, the design by means of Nyquist plots and pole assignment are investigated, especially with respect to the applicability for higher order systems. Author (ESA)

N80-23301# Office National d'Etudes et de Recherches Aeronautiques, Paris (France).
FLIGHT SAFETY OF ROGALLO HANG GLIDERS. THEORETICAL AND EXPERIMENTAL STUDY OF THE FLIGHT ENVELOPE

Claudius LaBurthe and Simone Walden 1979 227 p refs In FRENCH; ENGLISH summary Report will also be announced as translation (ESA-TT-634)
 (ONERA-NT-1979-8) Avail: NTIS HC A11/MF A01

Two series of full scale wind tunnel tests were completed on 15 hang gliders. The results were used to calculate the basic performance and stability characteristics and to analyze the critical limitations. The problem of pitching stability is highlighted in the analysis. Implications of the results in areas such as take off, stall, dives, and settings are discussed. Author (ESA)

N80-23302# Bristol Univ. (England). Dept. of Aeronautical Engineering.

INVESTIGATION OF A FOAM SUPPORTED GLASS FIBER D-BOX FOR A RIGID WING HANG GLIDER B.S. Thesis
 N. A. Ruddick Jun. 1979 22 p refs
 (BU-240) Avail: NTIS HC A02/MF A01

A proposed design for a foam supported, glass fiber covered D-box for use as a wing primary structure in a rigid wing hang glider is investigated. An arrangement for bracing the wing was analyzed and the performance of the structure in bending was verified. The stability of the D-box walls in torsion was investigated. Author (ESA)

N80-23303# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).

THE IMPACT OF GLOBAL POSITIONING SYSTEM ON GUIDANCE AND CONTROLS SYSTEMS DESIGN OF MILITARY AIRCRAFT. VOLUME 2A: SPECIFIC APPLICATION STUDY NO. 1, CLOSE AIR SUPPORT

Louis J. Urban, ed. (ASD) Feb. 1980 70 p
 (AGARD-AR-147-Vol-2A; ISBN-92-835-1349-5) Avail: NTIS HC A04/MF A01

The application of NAVSTAR/Global Positioning System to Close Air Support is described. A currently available 'model' was selected, namely the F-4E aircraft equipped with the ARN-101 weapon delivery system. This was selected since it represents the current state-of-the-art for externally aided (LORAN) digital avionics system integrated into a reasonably modern fighter aircraft which is currently in the operational inventory of several NATO countries. R.E.S.

N80-23304*# National Aeronautics and Space Administration, Hugh L. Dryden Flight Research Center, Edwards, Calif.

WIND TUNNEL INVESTIGATION OF AN ALL FLUSH ORIFICE AIR DATA SYSTEM FOR A LARGE SUBSONIC AIRCRAFT

Terry J. Larson, Stuart G. Flechner, and Paul M. Siemers, III
May 1980 97 p refs
(NASA-TP-1642; H-1085) Avail: NTIS HC A05/MF A01 CSCL 01D

The results of a wind tunnel investigation on an all flush orifice air data system for use on a KC-135A aircraft are presented. The investigation was performed to determine the applicability of fixed all flush orifice air data systems that use only aircraft surfaces for orifices on the nose of the model (in a configuration similar to that of the shuttle entry air data system) provided the measurements required for the determination of stagnation pressure, angle of attack, and angle of sideslip. For the measurement of static pressure, additional flush orifices in positions on the sides of the fuselage corresponding to those in a standard pitot-static system were required. An acceptable but less accurate system, consisting of orifices only on the nose of the model, is defined and discussed. R.E.S.

N80-23305# Douglas Aircraft Co., Inc., Long Beach, Calif.
FLIGHT TEST EVALUATION OF AIRBORNE TIRE PRESSURE INDICATING SYSTEMS Final Report, Oct. 1978 - Aug. 1979

Ronald L. Suiter and Wilson W. Kwong Sep. 1979 114 p
(Contract DOT-FA77WA-4070)
(AD-A081598; FAA-RD-78-134-2) Avail: NTIS HC A06/MF A01

Six different cockpit tire pressure indicating systems were flight tested on two DC-10 aircraft: a seventh was tested on a DC-9. The systems evaluated include three analog tire pressure system concepts displaying actual tire pressure in the cockpit, two weight and balance systems measuring tire pressure indirectly via tire load and axle tilt, a go-no-go discrete pressure sensing system, and a wheel speed system that uses change in rolling radius to detect a low tire. A test evaluation for each of the systems and comments on the general merits of each system type are included. A recommendation is made that each system be subjected to airline service tests before entering fleet service. A.R.H.

N80-23306# McDonnell-Douglas Electronics Co., St. Charles, Mo.

VISUALLY COUPLED SYSTEM: COMPUTER GENERATED IMAGERY (VCS-CGI) ENGINEERING INTERFACE Final Report, Aug. 1977 - Mar. 1979

Shelton MacLeod and David B. Coblitz Wright-Patterson AFB, Ohio AMRL Nov. 1979 71 p refs
(Contract F33615-77-C-0524; AF Proj. 7184)
(AD-A080931; AMRL-TR-79-32) Avail: NTIS HC A04/MF A01 CSCL 14/2

The Visually-Coupled System Computer-Generated Imagery (VCS-CGI) Interface program had two main phases. The objective for the first phase was to successfully interface the various subcomponents (helmet-mounted sight, helmet-mounted displays, and advanced computer-generated image system) and demonstrate their compatibility and feasibility for use in wide field of view, air-to-ground visual simulation. The objective for the second phase was to conduct a systematic exploration and evaluation of various system parameters that could affect display quality. GRA

N80-23308 Pennsylvania State Univ., University Park.
AXIAL FLOW ROTOR UNSTEADY PERFORMANCE

Ph.D. Thesis

Edgar Perrin Bruce 1979 250 p
Avail: Univ. Microfilms Order No. 8010028

An existing two dimensional, nonviscous theory which employed a simplified vortex model in conjunction with the assumptions of thin airfoil theory to define cascade unsteady lift was modified and extended to include an expression for unsteady pitching moment. Computed theoretical results were compared with measured values of unsteady lift force and pitching moment coefficients and their phase angles and with the unsteady center-of-pressure position. In a large axial flow fan test facility, specially designed screens were employed to produce a variety of rotor inlet flows having a sinusoidally varying axial velocity component. Uncambered rotor response during operation in these harmonically varying inflows was determined by employing a strain-gaged sensing element on one rotor blade. The results show that, in general, the theory tends to overpredict the magnitude of the force and moment coefficients, that good agreement exists between the majority of the measured and predicted phase angle data, and that the validity of the theory in its present form should be restricted to values of reduced frequency greater than 0.8. Dissert. Abstr.

N80-23309*# General Electric Co., Cincinnati, Ohio.
CF6 JET ENGINE PERFORMANCE IMPROVEMENT: NEW FAN

W. A. Fasching May 1980 202 p
(Contract NAS3-20629)
(NASA-CR-159699; R79AEG413) Avail: NTIS HC A10/MF A01 CSCL 21E

As part of the NASA sponsored engine component improvement program, a fan package was developed to reduce fuel consumption in current CF6 turbofan aircraft engine. The new fan package consist of an improved fan blade, reduced fan tip clearance due to a fan case stiffener, and a smooth fan casing tip shroud. CF6 engine performance and acoustic tests demonstrated the predicted 1.8% improvement in cruise sfc without an increase in engine noise. Power management thrust/fan speed characteristics were defined. Mechanical and structural integrity was demonstrated in model fan rotor photoelastic stress tests, full-size fan blade bench fatigue tests, and CF6 engine bird ingestion, crosswind, and cyclic endurance tests. The fan was certified in the CF6-500c2/E2 engines and is in commercial service on the Boeing 747-200, Douglas DC-10-30, and Atrbus industrie A300B aircraft. A.R.H.

N80-23311*# Hamilton Standard, Windsor Locks, Conn.
ACOUSTIC TEST AND ANALYSES OF THREE ADVANCED TURBOPROP MODELS Final Report

Bennett M. Brooks and F. B. Metzger Jan. 1980 245 p refs
(Contract NAS3-20614)
(NASA-CR-159667) Avail: NTIS HC A11/MF A01 CSCL 21E

Results of acoustic tests of three 62.2 cm (24.5 inch) diameter models of the prop-fan (a small diameter, highly loaded, Multi-bladed variable pitch advanced turboprop) are presented. Results show that there is little difference in the noise produced by unswept and slightly swept designs. However, the model designed for noise reduction produces substantially less noise at test conditions simulating 0.8 Mach number cruise speed or at conditions simulating takeoff and landing. In the near field at cruise conditions the acoustically designed. In the far field at takeoff and landing conditions the acoustically designed model is 5 db quieter than unswept or slightly swept designs. Correlation between noise measurement and theoretical predictions as well as comparisons between measured and predicted acoustic pressure pulses generated by the prop-fan blades are discussed. The general characteristics of the pulses are predicted. Shadow-graph measurements were obtained which showed the location of bow and trailing waves. R.C.T.

N80-23312*# Pratt and Whitney Aircraft Group, East Hartford, Conn.

CORE COMPRESSOR EXIT STAGE STUDY, 2 Final Report
R. F. Behlke, E. A. Burdsall, E. Canal, Jr., and N. D. Korn Oct. 1979 90 p refs
(Contract NAS3-20578)

(NASA-CR-159812; PWA-5561-66) Avail: NTIS HC A05/MF A01 CSCL 21E

A total of two three-stage compressors were designed and tested to determine the effects of aspect ratio on compressor performance. The first compressor was designed with an aspect ratio of 0.81; the other, with an aspect ratio of 1.22. Both compressors had a hub-tip ratio of 0.915, representative of the rear stages of a core compressor, and both were designed to achieve a 15.0% surge margin at design pressure ratios of 1.357 and 1.324, respectively, at a mean wheel speed of 167 m/sec. At design speed the 0.81 aspect ratio compressor achieved a pressure ratio of 1.346 at a corrected flow of 4.28 kg/sec and an adiabatic efficiency of 86.1%. The 1.22 aspect ratio design achieved a pressure ratio of 1.314 at 4.35 kg/sec flow and 87.0% adiabatic efficiency. Surge margin to peak efficiency was 24.0% with the lower aspect ratio blading, compared with 12.4% with the higher aspect ratio blading.

R.C.T.

N80-23313*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

DEVELOPMENT OF IMPROVED-DURABILITY PLASMA SPRAYED CERAMIC COATINGS FOR GAS TURBINE ENGINES

Irving E. Sumner and Duane L. Ruckle (Pratt and Whitney Aircraft, East Hartford, Conn.) 1980 25 p refs Proposed for presentation at the 16th Joint Propulsion Conf., Hartford, 30 Jun. - 2 Jul. 1980; sponsored by AIAA, ASME and SAE (NASA-TM-81512; E-451) Avail: NTIS HC A02/MF A01 CSCL 21E

As part of a NASA program to reduce fuel consumption of current commercial aircraft engines, methods were investigated for improving the durability of plasma sprayed ceramic coatings for use on vane platforms in the JT9D turbofan engine. Increased durability concepts under evaluation include use of improved strain tolerant microstructures and control of the substrate temperature during coating application. Initial burner rig tests conducted at temperatures of 1010 C (1850 F) indicate that improvements in cyclic life greater than 20:1 over previous ceramic coating systems were achieved. Three plasma sprayed coating systems applied to first stage vane platforms in the high pressure turbine were subjected to a 100-cycle JT9D engine endurance test with only minor damage occurring to the coatings.

A.R.H.

N80-23314*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

OSCEE FAN EXHAUST BULK ABSORBER TREATMENT EVALUATION

H. E. Bloomer and Nick E. Samanich 1980 20 p refs Presented at 6th Aeroacoustics Conf., 4-6 June 1980; sponsored by AIAA (NASA-TM-81498; E-435) Avail: NTIS HC A02/MF A01 CSCL 21E

The acoustic suppression capability of bulk absorber material designed for use in the fan exhaust duct walls of the quiet clean short haul experiment engine (OCSEE UTW) was evaluated. The acoustic suppression to the original design for the engine fan duct which consisted of phased single degree-of-freedom wall treatment was tested with a splitter and also with the splitter removed. Peak suppression was about as predicted with the bulk absorber configuration, however, the broadband characteristics were not attained. Post test inspection revealed surface oil contamination on the bulk material which could have caused the loss in bandwidth suppression.

R.C.T.

N80-23316*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.

CF6-6D ENGINE SHORT-TERM PERFORMANCE DETERIORATION

W. H. Kramer, J. E. Paas, J. J. Smith, and R. H. Wulf Apr. 1980 154 p (Contract NAS3-20631) (NASA-CR-159830; R80AEG374) Avail: NTIS HC A08/MF A01

Studies conducted as part of the NASA-Lewis CF6 jet engine diagnostics program are summarized. An 82-engine sample of DC-10-10 aircraft engine checkout data that were gathered to define the extent and magnitude of CF6-6D short term performance deterioration were analyzed. These data are substantiated by the performance testing and analytical teardown of CF6-6D short term deterioration engine serial number (ESN) 451507.

R.C.T.

N80-23317*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

STATIC CALIBRATION OF A TWO-DIMENSIONAL WEDGE NOZZLE WITH THRUST VECTORING AND SPANWISE BLOWING

Michael J. Harris (Naval Ship Research and Development Center, Bethesda, Md.) and Michael D. Falarski Apr. 1980 38 p refs (NASA-TM-81161; A-8043) Avail: NTIS HC A03/MF A01 CSCL 21E

The results of a static calibration of the two dimensional wedge nozzles on a STOL configuration of a large-scale fighter model are reported. These nozzles internally turn the efflux produced by two turbojets down 25 degrees and exhaust it over the deflected trailing edge of the wing. This arrangement provides direct thrust lift, enhances wing lift by producing supercirculation, and provides thrust vectoring by varying the deflection of the wing's trailing edge. The thrust is vectored from 10 deg to 38 deg. This system was calibrated with spanwise blowing for augmentation of the leading-edge vortex. When 16% of the turbojet efflux is blown spanwise, the thrust recovered is 92% of the thrust produced when the total efflux is exhausted longitudinally.

E.D.K.

N80-23319# Naval Postgraduate School, Monterey, Calif.

A PRIMITIVE VARIABLE COMPUTER MODEL FOR COMBUSTION WITHIN SOLID FUEL RAMJETS Final Report

Charles A. Stevenson and David W. Netzer Oct. 1979 45 p refs Prepared for Naval Weapons Center, China Lake, Calif. (AD-A081081; NPS67-79-010) Avail: NTIS HC A03/MF A01 CSCL 21/5

An adaptation of a primitive variable, finite-difference computer program was accomplished in order to predict the reacting flow field in a solid fuel ramjet. The study compares the predictions of the primitive variable computer model with an earlier computer model and empirical data. It was found that the new model reasonably predicted the flow field and permitted calculations within the aft mixing chamber.

GRA

N80-23320# Solar Turbines International, San Diego, Calif.

APPLICATION OF CERAMIC NOZZLES TO 10 KW ENGINE Final Report

James C. Napier and A. G. Metcalfe Dec. 1978 263 p refs (Contract DAAK02-75-C-0138) (AD-A081184; SR80-R-4375-43; SO-6-4375-7) Avail: NTIS HC A12/MF A01 CSCL 21/5

Work on application of ceramics to the nozzle section of the small radial MERADCOM 10 KW gas turbine engine for meeting the two separate goals of improved erosion resistance and increased turbine inlet temperature is reported. Engine demonstrations of each of the two ceramic nozzle designs were completed. Efforts leading to engine demonstrations are documented and included; ceramic materials properties studies; design studies; engine simulator experiments for high temperature erosion; corrosion and thermal shock; and development of specialized relaxing glass adhesives for joining of ceramics. It was demonstrated that ceramics can offer from 10 to 100 times the erosion resistance at 1700 F to superalloys and have excellent corrosion and thermal shock properties.

GRA

N80-23321# Naval Postgraduate School, Monterey, Calif.

ATMOSPHERIC DISPERSION OF HIGH VELOCITY JETS Final Report

Jack V. Brendmoen and David W. Netzer Nov. 1979 84 p refs (ZF57572002)

(AD-A081612; NPS67-76-012) Avail: NTIS
HC A05/MF A01 CSCL 21/5

A neutrally stable atmospheric surface layer was simulated in a low speed wind tunnel by tripping the boundary layer with a fence and letting the turbulent flow develop over a length of roughness elements. Turbojet exhaust dispersion characteristics, simulated by a burner/nozzle system, were investigated by measuring the horizontal and vertical temperature profiles at axial stations downwind from the nozzle exit. Dispersion sensitivity to different nozzle exit conditions, angles of incidence to the wind, and nozzle surface blockage were investigated. The results were compared to dispersion methods used in the Air Quality Assessment Model (AQAM). It was found that (1) the experimental jet penetration length was much shorter than that assumed in AQAM; (2) the horizontal jet exhibited plume rise; (3) the initial dispersion coefficients were a function of wind direction; and (4) the plume spreading rate was more rapid than for the low velocity, elevated sources in neutrally stable atmospheric conditions. GRA

N80-23322# IIT Research Inst., Chicago, Ill.
PROPERTY SCREENING AND EVALUATION OF CERAMIC TURBINE ENGINE MATERIALS Final Report, 1 Jul. 1975 - 1 Aug. 1979

D. C. Larsen Wright-Patterson AFB, Ohio AFML Oct. 1979
152 p refs
(Contract F33615-75-C-519616)
(AD-A080963; AFML-TR-79-4188) Avail: NTIS
HC A08/MF A01 CSCL 11/2

An overview is presented of the pertinent thermal and mechanical properties of 26 structural silicon-base non-oxide ceramics that are candidates for advanced heat engine applications. Included are hot pressed, sintered and reaction sintered Si₃N₄ and SiC, and Sialon. Data are presented for flexure strength, elastic properties, strength degradation at long times due to subcritical crack growth, long term oxidation effects, creep resistance, fracture toughness, thermal expansion, thermal diffusivity, and thermal shock resistance. All materials are evaluated using the same test equipment so that valid comparisons can be made between materials. Emphasis is placed on predominant behavioral trends as related to material microstructure and purity, as determined by processing method. Structure-property relations are developed. GRA

N80-23323# Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio. Turbine Engine Div.

TURBOPROPULSION COMBUSTION TECHNOLOGY ASSESSMENT Technology Summary Report, Mar. 1978 - Oct. 1979

Robert E. Henderson, ed. and A. M. Mellor, ed. (Purdue Univ.)
Dec. 1979 31 p refs
(AF Proj. 3066)
(AD-A080748; AFAPL-TR-79-2115) Avail: NTIS
HC A03/MF A01 CSCL 21/2

This report summarizes the finding of an assessment. Section 1 provides a general introductory overview of the state-of-combustion-technology today and highlights some general projections and trends for the future. Section 2 gives a state-of-the-art review of the five special topic areas of interest covered during the assessment - main burners, afterburners, combustion modeling, structural and mechanical design, and alternative fuels. Sections 3 and 4 examine the advanced technology trends and projected technology needs, respectively, as related to each of the topic areas cited above. A five-year technology plan is outlined in section 5. Future aircraft propulsion requirements call for combustion systems capable of (1) accepting greater variations in compressor discharge pressure temperature and airflow; (2) producing heat release rates and temperature rises which will ultimately approach stoichiometric levels; and (3) providing high operational reliability and improved component durability, maintainability and repairability. In addition, the new requirements associated with exhaust emissions and fuel flexibility must be addressed. Consequently, as the combustor designer is confronted with the new requirements of the future, especially exhaust emissions and fuel flexibility, new design

concepts may be required to provide an acceptable solution. GRA

N80-23324# Motoren- und Turbinen-Union Muenchen G.m.b.H. (West Germany).

DEVELOPMENT OF HIGH TEMPERATURE RESISTANT CERAMIC PARTS FOR GAS TURBINES Final Report
Wolfgang Krueger, Bernd Kugenbuch, Walter-Hans Peschel, and Wilhelm Siebmanns Bonn Bundesmin. fuer Forsch. u. Technol. Jul. 1979 54 p refs In GERMAN; ENGLISH summary (Contract BMFT-NTS-19) (BMFT-FB-T-79-09) Avail: NTIS HC A04/MF A01; Fachinformationszentrum Energie, Phys., Math., Eggenstein-Leopoldshafen, West Germany DM 10,90

Ceramic materials were used to produce an automobile gas turbine engine which is capable of operating at temperatures of up to 1400 C. The flame tube, turbine inlet cone, and turbine nozzle assembly were fabricated entirely of ceramics. The turbine rotor consisted of ceramic blades and a metal disc. Extensive tests were performed under conditions similar to those expected in automobile applications. Author (ESA)

N80-23325# Office National d'Etudes et de Recherches Aeronautiques, Paris (France).

THREE DIMENSIONAL FLOW INVESTIGATION WITH A METHOD OF CHARACTERISTICS IN THE INLET REGION AND THE BLADE-TO-BLADE CHANNELS OF SUPERSONIC AXIAL COMPRESSORS Thesis - Paris VI Univ.
Jean Martinon 1979 205 p refs In FRENCH; ENGLISH summary Report will also be announced as translation (ESA-TT-637)

(ONERA-NT-1979-1; ISSN-0078-379X) Avail: NTIS
HC A10/MF A01

A three dimensional method of characteristics was developed for the calculation of the supersonic flow in the inlet region and the blade to blade channels of blade cascades and high transonic axial flow compressors with subsonic or supersonic axial velocity. The numerical scheme is described and example calculations on several linear or annular cascades and rotating blade rows are presented. Author (ESA)

N80-23326# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

NAVIGATION, GUIDANCE, AND CONTROL FOR HELICOPTER AUTOMATIC LANDINGS

James R. Kelly and Frank R. Niessen May 1980 58 p refs (NASA-TP-1649; L-13454) HC A04/MF A01 CSCL 01C

A navigation, guidance and control concept was developed for helicopter automatic approach and landings. The algorithms employed were implemented in an airborne digital computer installed on a CH-47B research helicopter. Data are presented to illustrate system performance during fully automatic approach and landings in a variety of wind conditions. A.W.H.

N80-23327# National Aeronautics and Space Administration, Hugh L. Dryden Flight Research Center, Edwards, Calif.

PRECISION CONTROLLABILITY OF THE YF-17 AIRPLANE
Thomas R. Sisk and Neil W. Mataeny May 1980 34 p refs (NASA-TP-1677; H-1089) Avail: NTIS HC A03/MF A01 CSCL 01C

A flying qualities evaluation conducted on the YF-17 airplane permitted assessment of its precision controllability in the transonic flight regime over the allowable angle of attack range. The precision controllability (tailchase tracking) study was conducted in constant-g and windup turn tracking maneuvers with the command augmentation system (CAS) on, automatic maneuver flaps, and the caged pipper gunsight depressed 70 mils. This study showed that the YF-17 airplane tracks essentially as well at 7 g's to 8 g's as earlier fighters did at 4 g's to 5 g's before they encountered wing rock. The pilots considered the YF-17 airplane one of the best tracking airplanes they had flown. Wing rock at the higher angles of attack degraded tracking precision, and lack of control harmony made precision controllability more difficult. The revised automatic maneuver flap schedule incorporated in the airplane at the time of the tests did not appear to be optimum.

The largest tracking errors and greatest pilot workload occurred at high normal load factors at low angles of attack. The pilots reported that the high-g maneuvers caused some tunnel vision and that they found it difficult to think clearly after repeated maneuvers.

Author

N80-23328*# Systems Technology, Inc., Hawthorne, Calif.
PRACTICAL OPTIMAL FLIGHT CONTROL SYSTEM DESIGN FOR HELICOPTER AIRCRAFT. VOLUME 1: TECHNICAL REPORT

L. G. Hofmann, Susan A. Riedel, and Duane McRuer May 1980 273 p refs
(Contract NAS2-9946)
(NASA-CR-3275; TR-1127-1-I) Avail: NTIS
HC A12/MF A01 CSCL 01C

A method by which modern and classical theory techniques may be integrated in a synergistic fashion and used in the design of practical flight control systems is presented. A general procedure is developed, and several illustrative examples are included. Emphasis is placed not only on the synthesis of the design, but on the assessment of the results as well.

R.C.T.

N80-23329# Army Missile and Munitions Center and School, Redstone Arsenal, Ala. Guidance and Control Directorate.
THEORY OF DISTURBANCE-UTILIZING CONTROL WITH APPLICATION TO MISSILE INTERCEPT PROBLEMS

William C. Kelly 12 Dec. 1979 327 p refs
(AD-A081110; DRSMI/RG-80-11) Avail: NTIS
HC A17/MF A01 CSCL 12/1

Control problems with disturbances which have waveform structure may be addressed by considering the maximum utilization mode of disturbance-accommodating control theory. It is shown in this work that the optimal utilization of disturbances can lead to significantly better performance than that of the 'optimal' linear-quadratic regulator. The conditions for the existence of a steady-state disturbance-utilizing control law are derived. It is shown that the steady-state control gains when they exist, are solutions of certain matrix algebraic equations. Steady-state gain expressions are derived for several first and second order plants. Results are presented for the cases of optimal disturbance-utilizing control of an air-defense interceptor missile and of a missile homing on a fixed target, which demonstrate performance superior to that obtained by a conventional 'optimal' linear-quadratic missile controller.

GRA

N80-23330# European Space Agency, Paris (France).
DEFINITION OF A TWO-LEVEL CONTROL SYSTEM FOR NONLINEAR MOTION OF AN AIRCRAFT

Albert Kirszenblat (Technion - Israel Inst. of Tech.) Feb. 1980 36 p refs Transl. into ENGLISH of "Calcul d'un Systeme de Commande a Deux Niveaux du Movement non Lineaire d'un Avion". Rept. ONERA-P-1979-7 ONERA, Paris, 1979 Original report in FRENCH previously announced as N80-22364
(ESA-TT-614; ONERA-P-1979-7) Avail: NTIS
HC A03/MF A01

An approach to the problem of defining a control law well adapted to the whole flight envelope is presented. This system has a two level structure allowing a task-oriented control and an augmentation of the aircraft stability. A nonlinear model of the aircraft dynamics incorporating the inertial coupling terms and the nonlinear aerodynamic effects constitute the first control level. The model generates a trajectory, a reference control law vector, and an output vector which follows a vector, representing the maneuvering objectives assigned by the pilot at any time. At the second level, a servo compensation subordinates the aircraft motion to the model. The control law is obtained by applying optimal linear control theory to local models of the aircraft. Direct force control surfaces may be easily incorporated into the computation of the control system. This system ensures an automatic and smooth coordination of the aircraft motions and of the deflection of the aerodynamic control surfaces along the pitch, roll and yaw axes, even under extreme flight conditions; it is particularly adapted to the case of high-performance fighter aircraft.

Author (ESA)

N80-23331# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).

DESIGN, DEVELOPMENT AND IMPLEMENTATION OF AN ACTIVE CONTROL SYSTEM FOR LOAD ALLEVIATION FOR A COMMERCIAL TRANSPORT AIRPLANE

R. F. O'Connell (Lockheed-California Co., Burbank) Feb. 1980 21 p refs Presented at the 49th Struct. and Mater. Panel Meetings, Porz-Wahn, West Germany, Oct. 1979
(AGARD-AR-683; ISBN92-835-1348-7) Avail: NTIS
HC A02/MF A01

An active control system for load alleviation was developed for a long range version of the Lockheed L-1011. This system which permits the use of an extended wing span for fuel conservation with minimum structural change, will be introduced into commercial service in early 1980. The system is described and the criteria to which it is of the system installed on the flight test data obtained from a prototype version of the system installed on the flight airplane are presented, and comparisons of these results with analytical predictions are shown. A basis for certification of such systems is presented, assuring a level of safety equivalent to that of a conventional design.

R.E.S.

N80-23332*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

TWINTAN: A PROGRAM FOR TRANSONIC WALL INTERFERENCE ASSESSMENT IN TWO-DIMENSIONAL WIND TUNNELS

William B. Kemp, Jr. May 1980 40 p refs
(NASA-TM-81819) Avail: NTIS HC A03/MF A01 CSCL 14B

A method for assessing the wall interference in transonic two dimensional wind tunnel test was developed and implemented in a computer program. The method involves three successive solutions of the transonic small disturbance potential equation to define the wind tunnel flow, the perturbation attributable to the model, and the equivalent free air flow around the model. Input includes pressure distributions on the model and along the top and bottom tunnel walls which are used as boundary conditions for the wind tunnel flow. The wall induced perturbation fields is determined as the difference between the perturbation in the tunnel flow solution and the perturbation attributable to the model. The methodology used in the program is described and detailed descriptions of the computer program input and output are presented. Input and output for a sample case are given.

J.M.S.

N80-23333*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

CRYOGENIC WIND TUNNELS: A SELECTED, ANNOTATED BIBLIOGRAPHY

Marie H. Tuttle and Robert A. Kilgore May 1980 15 p
(NASA-TM-80168) Avail: NTIS HC A02/MF A01 CSCL 14B

This annotated supplement updates the cryogenic wind tunnel bibliography. The entries continue the numbering begun in the first publication and run from 125 through 167.

R.E.S.

N80-23334# Air Force Human Resources Lab., Brooks AFB, Tex. Flying Training Div.

PLATFORM MOTION CONTRIBUTIONS TO SIMULATOR TRAINING EFFECTIVENESS. STUDY 3: INTERACTION OF MOTION WITH FIELD-OF-VIEW Final Report

Mark Nataupsky, Wayne L. Waag, Douglas C. Weyer, Robert W. McFadden, and Edward McDowell Nov. 1979 31 p refs (AF Proj. 1123)
(AD-A078426; AFHRL-TR-79-25) Avail: NTIS
HC A03/MF A01 CSCL 05/9

The objective was to determine the effects of platform motion cueing, visual field of view (FOV), and their interaction upon learning in the simulator and as subsequent transfer of training to the aircraft for basic contact maneuvers in the T-37 aircraft. A transfer of training study design was used in which student

pilots were initially trained in the Advanced Simulator for Pilot Training (ASPT) and subsequently evaluated on their first sortie in the T-37 aircraft. Each student received training under one of four simulator configurations: (1) full platform motion (six degrees-of-freedom), full FOV (300 degrees horizontal by 150 degrees vertical); (2) full platform motion, limited FOV (48 degrees by 36 degrees vertical); (3) no platform motion, full FOV; and (4) no platform motion, limited FOV. For the ASPT pretraining phase, scores from the automated performance measuring system and overall instructor pilot ratings were used for analysis. For the T-37 evaluation sorties, the overall instructor pilot ratings, as well as individually recorded flight parameters, were analyzed. These data provided no conclusive evidence of differential transfer effects resulting from platform motion cueing, size of the visual FOV, or their interaction. As such, these data provide support for previous findings that platform motion cueing does not significantly enhance the transfer of learning for basic contact tasks in the T-37 aircraft. It would seem that the impact of peripheral visual cues for initial acquisition is not critical. Furthermore, no convincing evidence was found indicating increased transfer using platform motion in conjunction with a narrow FOV visual scene. GRA

N80-23335# Naval Air Development Center, Warminster, Pa. Software and Computer Directorate.

NAVAIRDEVCCEN DYNAMIC FLIGHT SIMULATOR DESIGN AND MULTIPURPOSE CREW STATION CONCEPT DESIGN AND DEVELOPMENT PLAN Final Report

G. Terry Thomas 1 Nov. 1979 68 p refs
(AD-A081982; NADC-80019-50) Avail: NTIS
HC A04/MF A01 CSCL 14/2

Chemical reactions important in molecular lasers were studied with a special emphasis on atomic recombinations and on dissociation of diatomic molecules. The experiments involved flash photolysis and shock wave techniques. The results were explained in terms of 3-D trajectory calculations. GRA

N80-23336# Canyon Research Group, Inc., Westlake Village, Calif.

AIR COMBAT MANEUVERING PERFORMANCE MEASUREMENT

Michael J. Kelly, Lee Wooldridge, Robert T. Hennessy, Donald Vreula, and Steve F. Barnebey Sep. 1979 140 p refs
(Contract F33615-77-C-0079; AF Proj. 1123)
(AD-A077429; NAVTRAEQUIPC-IH-315; AFHRL-TR-79-3)
Avail: NTIS HC A07/MF A01 CSCL 05/9

A study was conducted to define measures of Air Combat Maneuvering (ACM) for one-versus-one (1v1) free engagements on the Simulator for Air-to-Air Combat (SAAC). The study found a small set of measures which were (1) sensitive to differences in pilot ACM skill level; (2) diagnostic of performance proficiencies and deficiencies; (3) usable by instructor pilots and compatible with their judgments; (4) capable of providing results immediately after the end of the engagement; and (5) compatible with current projected training measurement hardware. The study was conducted in three phases. Phase 1 was an analytical study of ACM tasks using information from training material and instructor pilots; 28 measures reflected subject matter experts opinion on the important elements of ACM. Pilot control, aircraft performance and engagement outcome variables were measured in phase 2 during 405 free engagements on the SAAC at Luke AFB using a total of 30 pilots with three different levels of experience. A computer analysis of the engagement data was conducted in phase 3 to (1) check methodological assumptions that the three pilot experience levels represented different ACM skill levels and (2) develop the smallest comprehensive measure set. GRA

N80-23337# Rolls-Royce Ltd., Derby (England).
INVESTIGATION INTO COMPRESSOR AEROELASTIC INSTABILITIES IN A WIND TUNNEL FOR A RECTILINEAR CASCADE OF BLADES

Edmond Szechenyi (ONERA, Paris), Henri Loiseau (ONERA, Paris), and Brigitte Maquennehan (ONERA, Paris) 1979 14 p refs
Transl. into ENGLISH of conf. paper "Etude des Instabilites Aeroelastiques des Compresseurs en Soufflerie de Grille Rectiligne

d'Aubes". Rept. AGARD-CP-248 AGARD In ENGLISH and FRENCH Presented at AGARD/PEP Symp.: Stresses, Vibration, Engine Integration and Engine Integrity, Cleveland, 23-27 Oct. 1978

(PNR-90011; Trans-14190; AGARD-CP-248) Avail: NTIS
HC A02/MF A01

The nature of the problems of aeroelastic stability in compressors is reviewed, and the wind tunnel for rectilinear cascades at ONERA is described. The installation simulates as closely as possible the conditions in the actual engines studied: compression ratio (or incidence), Mach number, and corrected frequency. The measurement methods are discussed, and test results presented which show the character of the aeroelastic instabilities in a subsonic and transonic flow. Author (ESA)

N80-23370*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

ENGINE ENVIRONMENTAL EFFECTS ON COMPOSITE BEHAVIOR

C. C. Chamis and G. T. Smith 1980 20 p refs Presented at the 21st Struct., Structural Dyn. and Mater. Conf., Seattle, 12-14 May 1980; sponsored by AIAA, ASME, ASCE, and AHS (NASA-TM-81508; E-446) Avail: NTIS HC A02/MF A01 CSCL 11D

A series of programs were conducted to investigate and develop the application of composite materials to turbojet engines. A significant part of that effort was directed to establishing the impact resistance and defect growth characteristics of composite materials over the wide range of environmental conditions found in commercial turbojet engine operations. Both analytical and empirical efforts were involved. The experimental programs and the analytical methodology development as well as an evaluation program for the use of composite materials as fan exit guide vanes are summarized. R.C.T.

N80-23371*# Lockheed-California Co., Burbank.

FLIGHT SERVICE EVALUATION OF KEVLAR-49 EPOXY COMPOSITE PANELS IN WIDE-BODIED COMMERCIAL TRANSPORT AIRCRAFT Annual Flight Service Report, Jan. - Dec. 1979

R. H. Stone Mar. 1980 43 p refs
(Contract NAS1-11621)
(NASA-CR-159231; AFSR-6) Avail: NTIS HC A03/MF A01
CSCL 11D

Kevlar-49 fairing panels, installed as flight service components on three L-1011s, were inspected after 6 years' service. The Kevlar-49 components were found to be performing satisfactorily in service with no major problems, or any condition requiring corrective action. The only defects noted were minor impact damage, and a minor degree of fastener hole fraying and elongation. These are for the most part comparable to damage noted on fiberglass fairings. R.C.T.

N80-23433# Naval Air Development Center, Warminster, Pa. Aircraft and Crew Systems Technology Directorate.

AIRCRAFT CARRIER EXPOSURE TESTS OF ALUMINUM ALLOYS Progress Report

E. J. Jankowsky, S. J. Ketcham, and V. S. Agarwala 1 Nov. 1979 36 p refs
(ZF61542001)
(AD-A081060; NADC-79251-60) Avail: NTIS
HC A03/MF A01 CSCL 11/6

An effort is underway to correlate results of accelerated laboratory corrosion tests with actual shipboard exposure of aircraft materials. This report describes the first of the series in which aluminum alloys with varying susceptibilities to exfoliation and stress corrosion were exposed on the flight deck of an aircraft carrier. Use of an electrochemical corrosion monitor to measure corrosivity of the environment is also described. GRA

N80-23444# Kloeckner-Humboldt-Deutz A.G., Oberursel (West Germany).

FATIGUE AT HIGH TEMPERATURES: EXAMINATION OF THE BEHAVIOR OF GASTURBINE CASTING MATERIALS ALSO IN SIMULTANEOUS TEMPERATURE AND STRAIN

CYCLES Final Report

Arnold Witt and Manfred Pucher Bonn Bundesmin. fuer Forsch. u. Technol. Jul. 1979 102 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Forsch. u. Technol. (BMFT-FB-T-79-26) Avail: NTIS HC A06/MF A01; Fachinformationszentrum Energie, Phys., Math., Eggenstein-Leopoldshafen, West Germany DM 21

Test equipment that allows an examination of the effects of low cycle fatigue of nickel based cast alloys is described. It is possible to simultaneously vary temperature and compression-tension strain cycles of precision cast alloy samples. A hollow cylindrical sample was investigated in terms of the number of cracks as a function of temperature, dwell times for tension and compression, cycle period, strain rate, and alteration of temperature and strain. Author (ESA)

N80-23449# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.

GUST SEVERITY EFFECTS ON FATIGUE CRACK PROPAGATION IN ALUMINUM ALLOY SHEET MATERIALS

R. J. H. Wanhill Dec. 1978 21 p refs Submitted for publication Sponsored by Netherlands Agency for Aerospace Programs and Dutch Civil Aviation Board (NLR-MP-78041-U) Avail: NTIS HC A02/MF A01

Flight simulation fatigue tests were conducted to investigate the effect of differing gust load experiences on fatigue crack propagation in 7075-T6 and the effect of gust load alleviation on 2024-T3. Two gust spectra were used: the Fokker F-27 spectrum and the reference spectrum TWIST. A large systematic effect of gust severity on crack propagation rates in 7075-T6 was correlated by the stress intensity factor for the rms of the gust amplitudes. Author (ESA)

N80-23472*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

THE IMPACT OF FUELS ON AIRCRAFT TECHNOLOGY THROUGH THE YEAR 2000

Jack Grobman and Gregory M. Reck 1980 26 p refs Presented at the Intern. Meeting and Tech. Display: Global Technol. 2000, Baltimore, 5-11 May 1980; sponsored by AIAA (NASA-TM-81492; E-429) Avail: NTIS HC A03/MF A01 CSCL 21D

The impact that the supply, quality, and processing costs of future fuels may have on aircraft technology is assessed. The potential range of properties for future jet fuels is discussed along with the establishment of a data base of fuel property effects on propulsion system components. Also, the evolution and evaluation of advanced component technology that would permit the use of broader property fuels and the identification of technical and economic trade-offs within the overall fuel production-air transportation system associated with variations in fuel properties are examined. M.G.

N80-23474# Suntech, Inc., Marcus Hook, Pa.

RESEARCH ON DIAMANTANE AND OTHER HIGH DENSITY HYDROCARBON FUELS

Final Report, 1 Jun. 1978 - 30 Jun. 1979

A. Schneider and H. K. Myers Wright-Patterson AFB, Ohio AFAPL Oct. 1979 93 p refs (Contract F33615-78-C-2037; AF Proj. 3048) (AD-A080749; AFAPL-TR-79-2080) Avail: NTIS HC A05/MF A01 CSCL 21/4

This report describes the preparation of (a) diamantane, (b) exo-tetrahydro-tricyclopentadiene, (c) the hydrogenated product of isomerized endo, endo-dinorbornadiene, and (d) some precursors of polyalkyldiamantanes. GRA

N80-23511*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

EMERGENCY IN-FLIGHT EGRESS OPENING FOR GENERAL AVIATION AIRCRAFT

Laurence J. Bement *In its Proc. of the 14th Aerospace Mech. Symp. May 1980 p 173-194 refs*

Avail: NTIS HC A15/MF A01 CSCL 01C

An emergency in-flight egress system was installed in a light general aviation airplane. The airplane had no provision for egress on the left side. To avoid a major structural redesign for a mechanical door, an add on 11.2 kg (24.6 lb) pyrotechnic-actuated system was developed to create an opening in the existing structure. The skin of the airplane was explosively severed around the side window, across a central stringer, and down to the floor, creating an opening of approximately 76 by 76 cm. The severed panel was jettisoned at an initial velocity of approximately 13.7 m/sec. System development included a total of 68 explosive severance tests on aluminum material using small samples, small and full scale flat panel aircraft structural mockups, and an actual aircraft fuselage. These tests proved explosive sizing/severance margins, explosive initiation, explosive product containment, and system dynamics. This technology is applicable to any aircraft of similar construction. R.C.T.

N80-23512*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

A SPIN-RECOVERY PARACHUTE SYSTEM FOR LIGHT GENERAL-AVIATION AIRPLANES

Charles F. Bradshaw *In its Proc. of the 14th Aerospace Mech. Symp. May 1980 p 195-209 refs*

Avail: NTIS HC A15/MF A01 CSCL 01C

A tail mounted spin recovery parachute system was designed and developed for use on light general aviation airplanes. The system was designed for use on typical airplane configurations, including low wing, high wing, single engine and twin engine designs. A mechanically triggered pyrotechnic slug gun is used to forcibly deploy a pilot parachute which extracts a bag that deploys a ring slot spin recovery parachute. The total system weighs 8.2 kg. System design factors included airplane wake effects on parachute deployment, prevention of premature parachute deployment, positive parachute jettison, compact size, low weight, system reliability, and pilot and ground crew safety. Extensive ground tests were conducted to qualify the system. The recovery parachute was used successfully in flight 17 times. R.C.T.

N80-23513*# Pratt and Whitney Aircraft, East Hartford, Conn. Government Products Div.

F100 EXHAUST NOZZLE AREA CONTROL

Joseph R. Kozlin *In NASA. Langley Res. Center Proc. of the 14th Aerospace Mech. Symp. May 1980 p 211-223*

Avail: NTIS HC A15/MF A01 CSCL 21E

The details of the F100 nozzle mechanism design are highlighted, placing particular emphasis upon the evolution of design constraints or drivers from initial concept through current operational deployment. A kinematic description of the area control mechanism is given, and several environmental constraints which complicate the normal mechanism design process are discussed. R.C.T.

N80-23514*# Boeing Commercial Airplane Co., Seattle, Wash. AIRPLANE WING LEADING EDGE VARIABLE CAMBER FLAP

James B. Cole *In NASA. Langley Res. Center Proc. of the 14th Aerospace Mech. Symp. May 1980 p 225-235*

Avail: NTIS HC A15/MF A01 CSCL 01C

The invention and design of an aerodynamic high lift device which provided a solution to an aircraft performance problem are described. The performance problem of converting a high speed cruise airfoil into a low speed aerodynamic shape that would provide landing and take-off characteristics superior to those available with contemporary high lift devices are addressed. The need for an improved wing leading edge device that would complement the high lift performance of a triple slotted trailing edge flap is examined. The mechanical and structural aspects of the variable camber flap are discussed and the aerodynamic performance aspects only as they relate to the invention and design of the device are presented. R.C.T.

N80-23530# National Aviation Facilities Experimental Center, Atlantic City, N. J.

MEASUREMENT OF INTERFERENCE-TO-NAVIGATION/COMMUNICATION AVIONICS FROM CABLE TELEVISION (CATV) SYSTEMS Final Report, Jan. - Sep. 1978

Edward M. Sawtelle and James G. Dong Dec. 1979 52 p refs

(FAA Proj. 213-662-810)

(AD-A081430; FAA-NA-79-7; FAA-RD-79-104) Avail: NTIS HC A04/MF A01 CSCL 20/14

Airborne measurements of cable television (CATV) leakage, made at selected cities to compile a representative sampling of interference effects are presented and discussed. Different altitudes were used in the flight-grid-type pattern. Ground measurements were also accomplished by the Federal Communications Commission (FCC) at the sites tested to determine any correlation between the ground and air measurements. The cities selected for discussion in this report were chosen to show various CATV effects detected by the data collection systems. A statistical analysis was performed on the data upon finding that direct airborne position correlation to strong ground leak points was not possible. The analysis provided the mean for each run of a grid and a comparison to determine if significant differences existed between runs. Where no significant differences were found, the condition was due to ambient noise exceeding signal level. Laboratory measurements were also made. Recommendations include maximum signal level for CATV leakage that may be tolerated in the communication and navigation bands. A further recommendation is made that the CATV industry use frequencies in the navigation band which are separated from Federal Aviation Administration navigation frequencies by 25 kilohertz. M.G.

N80-23536# Edgerton, Germeshausen and Grier, Inc., Albuquerque, N. Mex.

E-3A EMP EVALUATION PROGRAM Final Report, Nov. 1977 - Feb. 1979

J. R. Anderson Kirtland AFB, N. Mex. AFWL Oct. 1980 104 p

(Contract F29601-78-C-0013; AF Proj. 3763)

(AD-A081725; AD-E200458; EG/AG-1394; AFWL-TR-79-115) Avail: NTIS HC A06/MF A01 CSCL 20/14

This document is the final report of the E-3A EMP Evaluation Test Program conducted for the AFWL, at Kirtland Air Force Base. The report is divided into four sections: Test Planning, Test Procedures, Data Management and Test Activities. The Test Planning section emphasizes the importance of pretest activities, demonstrates what can happen if critical items (such as connectors) are not identified early, and makes recommendations for future tests. The Test Procedures section gives a step-by-step detailed explanation for performing an EMP test on a large test object. A great number of the problems the test crew encountered on this program are pointed out and solutions are recommended. A brief discussion on power-on testing and breakout box qualification tests are included at the end of the section. The most detailed section in the report is section 4, Data Management. Virtually every function of Data Management is covered in this section: examples of typical response data, 284 calibration data, Daset log sheets and Adset log sheets are given and explained. The final section, Test Activities, explains to the reader the mechanics of performing a test at the HPD facility. GRA

N80-23590# Oxford Univ. (England). Dept. of Engineering Science.

A SURVEY OF THE HIGH FREQUENCY EFFECTS ASSOCIATED WITH THE LIGHTNING DISCHARGE

N. S. J. Braithwaite and M. J. Cooke 1979 47 p refs (OUEL-1290/79) Avail: NTIS HC A03/MF A01

The literature on high frequency effects associated with the lightning discharge is reviewed, with emphasis on the possible hazards to aircraft from electromagnetic fields. Sources of fast field changes in the cloud discharge and in the discharge to ground are considered in detail, from experimental observations of the far radiation field. Radiation from the return stroke and from K changes is most important up to 10 MHz, and breakdown processes become important at higher frequencies. An overall amplitude frequency spectrum is given. Models of the return

stroke are briefly reviewed. Measurements at lightning current at ground are discussed, with the airborne survey of lightning fields conducted as part of TRIP-76. Author (ESA)

N80-23674# Laboratorium fuer Betriebsfestigkeit, Darmstadt (West Germany).

MATHEMATICAL MODEL FOR THE SEPARATION OF GUST AND MANOEUVRE LOADS OF CIVIL AIRCRAFT

J. Taylor 1979 28 p refs

(FB-141(1979); ICAF-1135) Avail: NTIS HC A03/MF A01

Ignoring the unsteady lift functions, the normal acceleration response of an aircraft at its centre of gravity to a simplified turbulence spectrum varying as frequency to the power $-5/3$ were studied. It is shown that the pitching influence usually reduces the response at long wavelengths from that produced by heaving alone. This influence was relatively small in piston-engined aircraft but has generally become greater as aircraft have developed. The increased response at long wavelengths in modern aircraft makes the problem of separating manoeuvres from gust response more difficult but it is attenuated somewhat by the pitching contributions to the response. Experimental studies on a T33, on a Concorde and on a Transall indicate that a band frequency exists where the manoeuvres and turbulence responses are both small so that a filter within this band should separate one type of response from the other. Author

N80-23678# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

STATUS OF NASA FULL-SCALE ENGINE AEROELASTICITY RESEARCH

Joseph F. Lubomski 1980 21 p refs Presented at the 21st Struct., Structural Dyn., and Mater. Conf., Seattle, 12-14 May 1980; sponsored by AIAA, ASME, ASCE and AHS (NASA-TM-81500; E-437) Avail: NTIS HC A02/MF A01 CSCL 20K

Data relevant to several types of aeroelastic instabilities were obtained using several types of turbojet and turbofan engines. In particular, data relative to separated flow (stall) flutter, choke flutter, and system mode instabilities are presented. The unique characteristics of these instabilities are discussed, and a number of correlations are presented that help identify the nature of the phenomena. R.E.S.

N80-23683# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

MINIMUM MASS SIZING OF A LARGE LOW-ASPECT RATIO AIRFRAME FOR FLUTTER-FREE PERFORMANCE

William H. Greene and Jaroslaw Sobieszczanski-Sobieski May 1980 40 p refs Presented at the 21st Struct., Structural Dyn., and Mater. Conf., Seattle, 12-14 May 1980; sponsored by AIAA, ASME, ASCE and AHS (NASA-TM-81818; AIAA-80-0724CP) Avail: NTIS HC A03/MF A01 CSCL 20K

A procedure for sizing an airframe for flutter-free performance is demonstrated on a large, flexible supersonic transport aircraft. The procedure is based on using a two level reduced basis or modal technique for reducing the computational cost of performing the repetitive flutter analyses. The supersonic transport aircraft exhibits complex dynamic behavior, has a well-known flutter problem and requires a large finite element model to predict the vibratory and flutter response. Flutter-free designs were produced with small mass increases relative to the wing structural weight and aircraft payload. R.E.S.

N80-23693# Naval Postgraduate School, Monterey, Calif.

AN INVESTIGATION OF RESIDUAL STRESSES IN SIMULATED WING PANELS OF 7075-T6 ALUMINUM M.S. Thesis

Edward C. Engle Dec. 1979 46 p refs

(AD-A080863) Avail: NTIS HC A03/MF A01 CSCL 11/6

The advent of onboard aircraft microprocessor fatigue monitoring systems will establish the opportunity to fully exploit residual stresses at stress-critical areas, including their effects on fatigue predictions. An experimental investigation was undertaken to more fully understand them by making photoelastic measurements of residual stresses at notches in simulated wing

panels of 7075-T6 aluminum and to establish the relationships between local stresses, residual stresses, and the far-field or applied stress. The stress concentration factors were found to decrease with increased plastic deformation while the strain concentration factors were found to remain constant. The residual stress levels were found to be immutable despite changes in fatigue loading conditions, notch geometry, or test duration. GRA

N80-23759# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. fuer Physik der Atmosphaere.

REMOTE SENSING METHODS FOR DETERMINATION OF SLANT RANGE VISIBILITY

Christian Werner Mar. 1979 49 p refs In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-627) (DFVLR-FB-79-14) Avail: NTIS HC A03/MF A01; DFVLR, Cologne DM 8,70

The various known methods for the determination of the slant visual range are reviewed and compared. Emphasis is placed on a discussion of laser radar systems for use in aircraft landing operations. Based on considerations related to accuracy and technical complexity, a measurement method is proposed for visibility distances of up to 1500 m and altitudes of 100 m.

Author (ESA)

N80-23781# National Mechanical Engineering Research Inst., Pretoria (South Africa). Aeromechanics Div.

THE AERODYNAMICS OF AXIAL FLOW WIND POWER TURBINES

W. J. VanderElst Jun. 1979 37 p refs (CSIR-ME-1619; ISBN-0-7988-1463-2) Avail: NTIS HC A03/MF A01

A general analysis of the aerodynamics of wind power turbines of the axial flow type is presented. The design parameters appear in nondimensional form and are presented graphically. The theory is applicable to any type of wind power generator, including slow running windmills normally used for powering water pumps as well as fast running machines which are suitable for the generation of electric power.

Author

N80-23845# West Virginia Univ., Morgantown. Dept. of Aerospace Engineering.

VERTICAL AXIS WIND TURBINE DEVELOPMENT: EXECUTIVE SUMMARY Final Report, 1 Mar. 1976 - 30 Jun. 1977

R. E. Walters, J. B. Fanucci, P. W. Hill, and P. G. Migliore Jul. 1979 26 p (Contract EY-76-C-05-5135) (ORO-5135-77-5-Summ) Avail: NTIS HC A03/MF A01

Information is presented concerning (1) the numerical solution of the aerodynamics of cross-flow wind turbines; (2) boundary layer considerations for a vertical axis wind turbine (VAWT); (3) VAWT outdoor test model; (4) low solidity blade tests; (5) high solidity blade design; (6) cost analysis of the VAWT test model; (7) structural parametric analysis of VAWT blades; and (8) DOE study of current wind energy conversion systems.

DOE

N80-23846# West Virginia Univ., Morgantown. Dept. of Aerospace Engineering.

VERTICAL AXIS WIND TURBINE DEVELOPMENT Final Report, 1 Mar. 1976 - 30 Jun. 1977

R. E. Walters, J. B. Fanucci, P. W. Hill, and P. G. Migliore Jul. 1979 243 p refs (Contract EY-76-C-05-5135) (ORO-5135-77-5) Avail: NTIS HC A11/MF A01

Theoretical and experimental research accomplished in evaluating an innovative concept for vertical axis wind turbines (VAWT) is described. The concept is that of using straight blades composed of circulation controlled airfoil sections. The theoretical analysis was developed to determine the unsteady lift and moment characteristics of multiple-blade cross-flow wind turbines. To determine the drag data needed as input to the theoretical analysis, an outdoor test model VAWT was constructed; design details,

instrumentation, calibration results, and initial test results are reported. Initial testing was with fixed pitch blades having cross-sections of conventional symmetrical airfoils. Costs of building the test model are included, as well as cost estimates for blades constructed with composite materials. These costs are compared with those of other types of wind turbines. DOE

N80-23862# Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.

DYNAMICS OF A FLEXIBLE ROTOR-TOWER SYSTEM

Lennart S. Hultgren and John Dugundji Stockholm Aeronautical Research Inst. of Sweden Aug. 1979 99 p refs (Contract SWEDBESD-5061.012) (ASRL-TR-194-1; FFA-AU-1499) Avail: NTIS HC A05/MF A01

The dynamics of a horizontal axis wind turbine were analyzed. Both the blades and the tower are taken to be flexible. The analysis is linear and modal. For a three bladed rotor, numerical results were obtained for free vibrations and forced oscillations due to static unbalance. Analytical solutions were constructed for forced vibrations due to gravity and wind shear.

Author (ESA)

N80-23874*# Virginia Univ., Charlottesville. Engineering Sciences Research Labs.

EVALUATING AND MINIMIZING NOISE IMPACT DUE TO AIRCRAFT FLYOVER Final Report

Ira D. Jacobson May 1980 78 p refs (Grant NsG-1509) (NASA-CR-153187; UVA/528166/MAE80/102) Avail: NTIS HC A05/MF A01

The results of a study on the evaluation and reduction of noise impact to a community due to aircraft landing and takeoff operations are presented. The case of multiple aircrafts flying on several trajectories, for either approach/landings or takeoffs was examined. An extremely realistic model of the flight path was developed. The annoyance criterion used was the noise impact index (NII). The algorithm was applied to Patrick Henry International Airport.

R.E.S.

N80-23887# Research Inst. for Environmental Hygiene, TNO, Delft (Netherlands). Afdel. Buitenlucht.

PROJECT FILTER HOLDER. TESTS ON 25 mm DUST FILTER HOLDERS [ONTWERP FILTERHOUDER. ONTWERP VAN NIEUWE FILTERHOUDER 25 mm EN HET TESTEN VAN DRIE TYPEN FILTERHOUDERS 25 mm]

W. C. Duba Apr. 1978 19 p In DUTCH (IG-TNO-F-1638) Avail: NTIS HC A02/MF A01

Designs are presented for dust filter holders suitable for use in air pollution monitoring equipment. Design principles were determined which overcome problems such as lateral filtration and leaks. Interchangeable parts permit different methods of sampling using the same basic equipment.

Author (ESA)

N80-24134# Office National d'Etudes et de Recherches Aeronautiques, Paris (France).

SPECTRAL ANALYSIS OF NON-STATIONARY RANDOM PROCESSES. APPLICATION TO NOISE OF FLYOVER TYPE Thesis - Paris-Sud Univ.

Max Ernout 1979 180 p refs In FRENCH; ENGLISH summary Report will also be announced as translation (ESA-TT-639) (ONERA-NT-1979-4) Avail: NTIS HC A09/MF A01

Nonstationary noise detected by fixed microphones was studied during the passage of a moving acoustic source (e.g., aircraft flyover noise), with the objectives of measuring the noise radiation pattern and characterizing the spatial distribution of the noise. A time frequency representation of the energy of nonstationary random processes and a series of charts which allows the adaptation of the spectral analysis processes to the treatment of nonstationary signals are presented. The characteristics pertaining to the nonstationarity of an aircraft noise determined in the far field, are discussed.

Author (ESA)

N80-24151*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

GLADSTONE-DALE CONSTANT FOR CF4

Alpheus W. Burner, Jr. and William K. Goad May 1980 18 p refs

(NASA-TM-80228; L-13551) Avail: NTIS HC A02/MF A01 CSCL 20F

The Gladstone-Dale constant, which relates the refractive index to density, was measured for CF₄ by counting fringes of a two-beam interferometer, one beam of which passes through a cell containing the test gas. The experimental approach and sources of systematic and imprecision errors are discussed. The constant for CF₄ was measured at several wavelengths in the visible region of the spectrum. A value of 0.122 cu cm/g with an uncertainty of plus or minus 0.001 cu cm/g was determined for use in the visible region. A procedure for noting the departure of the gas density from the ideal-gas law is discussed. A.R.H.

N80-24210# Committee on Commerce, Science, and Transportation (U. S. Senate).

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION AUTHORIZATION ACT, 1981

15 May 1980 20 p A bill referred to the Comm. on Com., Sci., and Transportation, 96th Congr., 2nd Sess., 30 Jan. 1980 (S-96-719) Avail: US Capitol, Senate Document Room

An amendment is presented to the text of a bill authorizing appropriations to the National Aeronautics and Space Administration for research and development, construction of facilities, and research and program development. A.R.H.

N80-24211# Committee on Science and Technology (U. S. House).

NASA AUTHORIZATION, 1981

Washington, D.C. GPO 1980 316 p refs Hearings before the Subcomm. on Transportation, Aviation and Commun. of the Comm. on Sci. and Technol., 96th Congr., 2nd Sess., no. 95, v. 3, 6-7 Feb. 1980

(GPO-59-528) Avail: Subcommittee on Transportation, Aviation and Communications

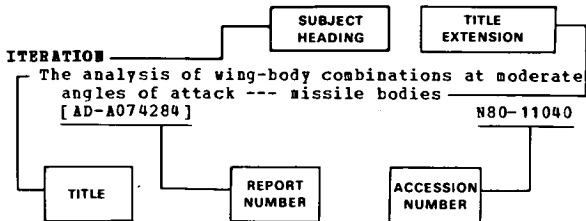
Specifics of NASA'S proposed aeronautics program are discussed with emphasis on research and technology development in aerodynamics, materials and structures propulsion, avionics, and human factors engineering. Benefits accrued from the ACEE program are examined and activities related to the defense program are summarized. A.R.H.

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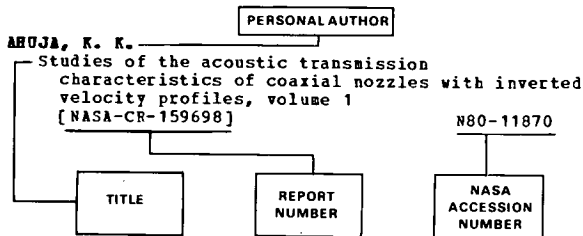
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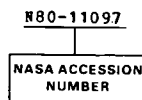
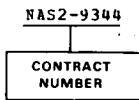
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