

ACCESSION NUMBER RANGES

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

STAR (N-10000 Series) N81-12011 – N81-13913

IAA (A-10000 Series) A81-12785 – A81-16480

AERONAUTICAL ENGINEERING

A Continuing Bibliography

Supplement 133

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 February 1981 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 354 reports, journal articles, and other documents originally announced in February 1981 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*.

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

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

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

An annual cumulative index will be published.

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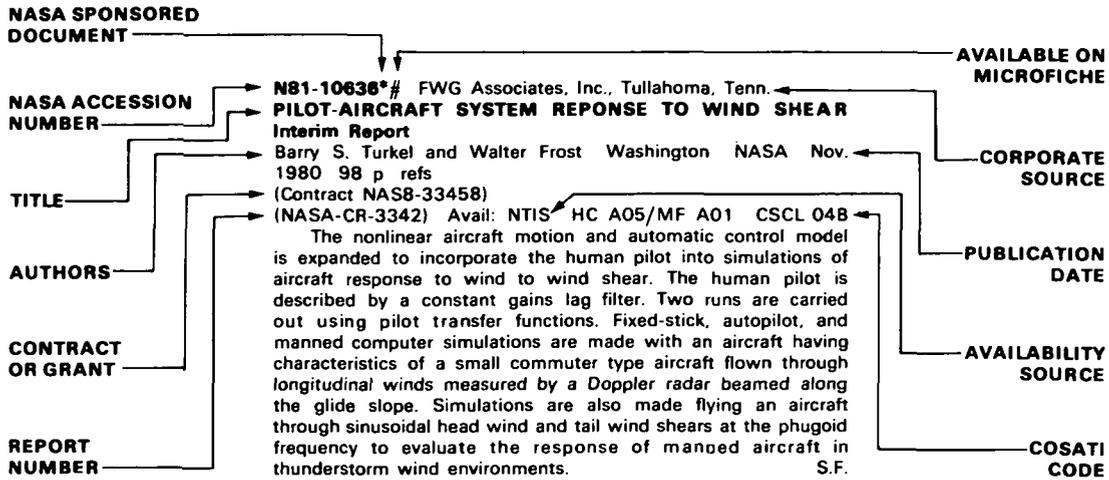
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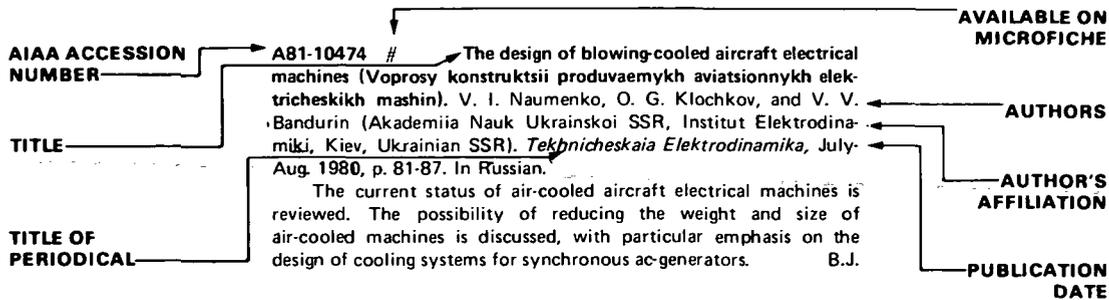
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TYPICAL CITATION AND ABSTRACT FROM IAA



AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 133)

MARCH 1981

IAA ENTRIES

A81-12793 **Computer generated radar images for navigation.** J. C. Holtzman, J. L. Abbott, V. H. Kaupp, and V. S. Frost (Kansas, University, Lawrence, Kan.). In: Military Electronics Exposition, Anaheim, Calif., November 14-16, 1978, Proceedings.

Chicago, Industrial and Scientific Conference Management, Inc., 1979, p. 233-244. 8 refs. Grants No. DAAG53-76-C-0154; No. DAAG29-77-0075.

A radar guidance technique is presented which derives guidance signals from an area correlation between a stored simulated image and real-time data sensed by an imaging Plan Position Indicator (PPI) radar mounted on the vehicle. A method of radar image simulation, the point scattering method, is summarized and its general implementation for PPI imaging radars is presented. Results of guidance image simulation for a real target scene are given. V.L.

A81-12794 **Airborne countermeasures system AN/ALQ-161.** E. M. Drogin (Cutler-Hammer, AIL Div., Deer Park, N.Y.). In: Military Electronics Exposition, Anaheim, Calif., November 14-16, 1978, Proceedings. Chicago, Industrial and Scientific Conference Management, Inc., 1979, p. 276-285.

Originally designed as a fully integrated Radio Frequency Surveillance and Electronic Countermeasures System for the B-1 bomber, the AN/ALQ-161 is currently being installed on prototype B-1 aircraft No. 4 for flight tests early in 1979. The nonhomogeneous, federated, multicomputer network architecture providing fully power-managed jamming is reviewed with emphasis on the growth potential incorporated in the current design and its adaptability to other airframes. Specific features such as the 'servo-loop' data processor, 'closed-loop' amplitude set-on, and real-time 'receiver threshold' control are described. (Author)

A81-12795 **Low cost technology for expendable RPV applications.** J. H. Budiansky (E-Systems, Inc., Melpar Div., Falls Church, Va.). In: Military Electronics Exposition, Anaheim, Calif., November 14-16, 1978, Proceedings. Chicago, Industrial and Scientific Conference Management, Inc., 1979, p. 301-306.

Developments in expendable remotely piloted vehicles and related avionics equipment technology are reviewed with reference to navigation and flight control systems, autopilot flight status sensors and servos, propulsion technology based on commercial chain saw engines, and low-cost plastic airframe components. Manufacturing techniques and materials which are being used to meet required cost goals are also discussed. V.L.

A81-12796 * **A concept for dynamic control of RPV information system parameters.** R. F. Rice (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.). In: Military Electronics Exposition, Anaheim, Calif., November 14-16, 1978, Proceedings. Chicago, Industrial and Scientific Conference Management, Inc., 1979, p. 307-319. 5 refs. Army-sponsored research.

A globally adaptive image compression structure has been developed for use in the tactical environment of a remotely piloted vehicle. The control structure is based on an image compression algorithm RM2 but can be easily extended to standard algorithms. It is shown that this structure provides an operator with the flexibility to dynamically maximize the usefulness of a limited and changing bit rate and should significantly improve overall system performance in tactical environments. V.L.

A81-12797 **History and prospects for mini-RPVs and drones.** S. J. Colby (Lockheed Missiles and Space Co., Inc., Sunnyvale, Calif.). In: Military Electronics Exposition, Anaheim, Calif., November 14-16, 1978, Proceedings. Chicago, Industrial and Scientific Conference Management, Inc., 1979, p. 321-329.

Developments in mini-RPV (Remotely Piloted Vehicle) and drone technology and the status of mini-RPV/drone programs in the United States and Europe are reviewed. It is emphasized that uses of mini-RPVs for electronic warfare, counter-C3, and selective interdiction missions are most promising wherein the dense enemy air defenses, adverse weather, or the need to penetrate well into the enemy territory make it difficult for large manned aircraft. A list of U.S. and European mini-RPV and drones, both operational and under development, is presented. V.L.

A81-12967 # **The possibility of improving the lateral-directional characteristics of a twin-engine aircraft by spoilers in the case of sudden engine failure (Možnost zlepšení stranových charakteristik dvoumotorového letounu pomocí spoileru při náhle vyřazení pohonne jednotky).** J. Dedek. *Zpravodaj VZLU*, no. 3, 1980, p. 103-111. 6 refs. In Czech.

The paper considers airworthiness requirements with regard to single-engine failure in a twin-engine aircraft. The use of wing spoilers to improve the lateral-directional characteristics of such an aircraft is examined. An analog model is used to investigate the time dependence of these characteristics on the aerodynamic characteristics of the spoiler and on the time dependence of its deflection. The limits of rolling and yawing moment coefficients of the aircraft due to spoiler deflection are obtained. B.J.

A81-12968 # **Signal processing for a six-component strain-gate wind tunnel balance (Zpracování signálu šestikomponentních tenzometrických aerodynamických vah).** J. Subrt. *Zpravodaj VZLU*, no. 3, 1980, p. 113-118. In Czech.

Methods of signal processing for a six-component strain-gate wind tunnel balance are described. Particular attention is given to the

separation of balance signals from interferences of first and second orders. B.J.

A81-12970 # Damage tolerance concept for transport aircraft structures (Koncepte pripustneho poskozeni konstrukce draku dopravnihho letounu). V. Nejedly. *Zpravodaj VZLU*, no. 4, 1980, p. 147-161. 28 refs. In Czech.

Ways of achieving damage-tolerant aircraft structures are reviewed. The philosophy of airworthiness regulations for civil transport aircraft is discussed, and the future development of such regulations is assessed. Damage tolerance is discussed with reference to fatigue-life and safe-life testing; the application of fracture mechanics concepts to damage-tolerance testing is considered. The development of stiffened light-alloy panels is discussed. B.J.

A81-13167 Standardization in military avionics systems architecture; Proceedings of the Seminar, Dayton, Ohio, November 28, 1979. Seminar sponsored by the Institute of Electrical and Electronics Engineers. New York, Institute of Electrical and Electronics Engineers, Inc., 1979. 51 p. \$12.

The conference concentrates on the development, production, application, specification, procurement, and maintenance of digital avionics equipment and systems. Papers are presented on the military aircraft avionics in the 1980s, avionic standardization from a designer's perspective, and standardization in military system architecture. V.L.

A81-13168 Standardization in military system architecture. J. J. Kiernan and J. R. Sims (IBM Corp., Federal Systems Div., Owego, N.Y.). In: Standardization in military avionics systems architecture; Proceedings of the Seminar, Dayton, Ohio, November 28, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 7-13. 5 refs.

This paper reviews current approaches to standardization of modern weapon systems. Digital system architectures are reviewed and characterized with respect to the (1) reduced life-cycle cost; (2) reduced acquisition cost; (3) reduced software development and maintenance costs; and (4) ease of technology insertion. Commercial and military precedents and currently envisioned standardization programs are analyzed in terms of their influence on the stated objectives. Two independent issues, LSI application and procurement policy, are discussed in terms of their potential contribution to the objectives of the standardization programs. (Author)

A81-13169 Military aircraft avionics in the 1980's. J. H. Whiting (Boeing Military Airplane Co., Seattle, Wash.). In: Standardization in military avionics systems architecture; Proceedings of the Seminar, Dayton, Ohio, November 28, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 14-20.

Significant changes are anticipated in aircraft avionic designs and system architectures. By the middle of the 1980's, single-chip microprocessors with the processing capability of today's mini-computers will be widely used throughout the entire avionics system. These microcomputers will be interconnected using many data buses. This paper addresses some of the design issues from the perspective of a military aircraft prime contractor. Key issues regarding architectures, processing networks, distributed control and isolation of flight critical functions will be discussed in light of present and future military standards and technology advancements. (Author)

A81-13170 Avionic standardization from a designer's perspective. J. D. Engelland (General Dynamics Corp., Fort Worth, Tex.). In: Standardization in military avionics systems architecture; Proceedings of the Seminar, Dayton, Ohio, November 28, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 21-26. 6 refs.

The benefits of avionic standardization are discussed along with associated technical problems. The following steps to successful software standardization are emphasized: selection of standards that do not unduly impact system design options and have high payoff, establishment of a visible implementation schedule, early user involvement, and creation of a software exchange facility to provide a practical exchange library. V.L.

A81-13171 Avionic architectural standardization - Logistic support perspective. R. C. Mason and L. D. Parriott (TRW Defense and Space Systems Group, Redondo Beach, Calif.). In: Standardization in military avionics systems architecture; Proceedings of the Seminar, Dayton, Ohio, November 28, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 27-34.

The advent of digital technology, specifically embedded computer systems (ECS), has provided the impetus for rapid growth in the sophistication and complexity of airborne information processing functions. Along with the growth in avionic systems sophistication, there has been a corresponding increase in their costs and a proliferation of unique computer-embedded avionic systems and subsystems. This influx of embedded computer systems has introduced a new approach to the management and support of avionics systems at air logistics centers. This paper will describe this avionic support approach. This paper takes a closer look at the problem created by the rapid influx of embedded computer systems, each with their unique architectures, for current and planned ECS support systems and then reflects on several lessons learned and discusses where both avionic architectural standards and support facility standards can help reduce the proliferation of support systems. (Author)

A81-13172 # Promoting rational standardization. L. J. Urban (USAF, Aeronautical Systems Div., Wright-Patterson AFB, Ohio). In: Standardization in military avionics systems architecture; Proceedings of the Seminar, Dayton, Ohio, November 28, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 35-44.

The evolution in military avionics systems architecture over the past twenty years is briefly reviewed with reference to the avionics of fighters F-4, A-7, F-15, F-16, and F-18, fighter-bomber FB-111, and bomber B-1. The institution of the Integrated Digital Avionics program and the foundation of the Deputy for Avionics Control (DAC) are discussed, and the primary goals of DAC directorates are cited along with examples of current problems and prospects for rational standardization. (Author)

A81-13216 # Store separation trajectory analysis. A. R. Maddox (U.S. Naval Weapons Center, China Lake, Calif.). *Journal of Aircraft*, vol. 17, Nov. 1980, p. 769-773. 5 refs.

A series of store drops was made at moderate to high subsonic speeds with the same configuration on the center position of a triple-ejector rack (TER) on an F-4 inboard pylon. The data were compared with wind-tunnel and mathematical simulations. Both estimation techniques predicted the general nature of the motion, especially at low speeds, but failed to predict a minor collision observed at high speed. (Author)

A81-13217 * # Simple method for prediction of aircraft noise contours. E. C. Stewart and T. M. Carson (NASA, Ames Research Center, Moffett Field, Calif.). *Journal of Aircraft*, vol. 17, Nov. 1980, p. 828-830.

A method for generating noise contours more rapidly and more simply than previously used programs is discussed. The method gives the area, the noise contour, and its extremities for an arbitrarily complex flight path for both takeoffs and landings with relative ease. The analysis reveals the fundamental nature of the contours and how the various factors that influence its size and shape enter into the analysis. It is noted that the effects of ground attenuation and

shielding are omitted as they are important only on the initial portion of flight and are highly dependent upon aircraft configuration. However, the analysis shows that these effects could be included. It is emphasized the the single-event contour is an obvious choice for purposes of minimizing noise impact. S.S.

A81-13218 # Use of similitude in analyzing aircraft windshield anti-icing performance. R. Ross (Ross Aviation Associates, Sedgwick, Kan.). (*American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, New York, N.Y., Aug. 20-22, 1979, Paper 79-1822.*) *Journal of Aircraft*, vol. 17, Nov. 1980, p. 830-832.

The formulation of a prediction technique has been accomplished with the use of similitude. The method allows the prediction of windshield surface temperature, assuming that proper information about the aircraft conditions, weather conditions, and hot bleed air conditions is known. To testify the validity of the technique, the value of the windshield surface temperature based on known test conditions is calculated and compared with the corresponding measured value. The tests are conducted on a Gates Learjet M35. The hot anti-icing air is obtained as bleed from the engines and is supplied to the windshield on the aircraft through a duct. The average difference, obtained in the validity test on the basis of 45 test points, is about 5%. S.S.

A81-13250 Computer-aided methods for redesigning the stabilized pitch control system of a semi-active thermal homing missile. L. S. Shieh, M. Datta-Barua (Houston, University, Houston, Tex.), R. E. Yates, and J. P. Leonard (U.S. Army, Missile Research and Development Command, Redstone Arsenal, Ala.). *Computers and Electrical Engineering*, vol. 7, Sept. 1980, p. 185-200. 15 refs. Grants No. DAAG29-79-C-0178; No. DAAH01-80-C-0323.

An unstable pitch control system of a terminal homing missile was formerly stabilized using a high order stabilization filter that was realized using active elements. A new dominant-data matching method is presented to redesign the high-order stabilization filter for obtaining reduced-order filters. As a result, the implementation cost is reduced and the reliability increased. An algebraic method is also applied to improve the performance of the redesigned pitch control system. In addition, the proposed dominant-data matching method can be applied to determine a reduced-order model of a high-order system. Unlike most existing model reduction methods, the reduced-order model has the exact assigned frequency-domain specifications of the original system. Computer-aided design methods can also be applied to design general control systems. (Author)

A81-13285 A simple model of the threshold voltage of short and narrow channel MOSFETs. G. Merckel (Commissariat à l'Énergie Atomique, Laboratoire d'Électronique et de Technologie de l'Informatique, Grenoble, France). *Solid-State Electronics*, vol. 23, Dec. 1980, p. 1207-1213. 8 refs.

Simple but reasonably accurate equations are proposed which describe the behavior of threshold voltage for short and narrow-channel MOSFETs, for low drain-source voltages. It will be shown that good agreement is obtained between the model, experiment, and two dimensional calculations for channel lengths and widths as small as 1-2 microns. Moreover, by careful analysis of the model results, some new properties of the threshold voltage of small size devices can be derived. (Author)

A81-13310 The use of satellite systems for communication (Bisherige Anwendung von Satellitensystemen im Verkehr). F. Sender (Prakla Seismos GmbH, Hanover, West Germany). *Ortung und Navigation*, no. 2, 1980, p. 239-248. In German.

The use of satellite systems with radio communication for global navigation is discussed. Operational statistics for the Transit and NAVSTAR/GPS navigation satellites are compared. Use of the

Transit system has increased from 600 stations in 1974 to a projected 10,000 in 1981. The Transit Improvement Program (TIP) is examined along with the Disturbance Compensation System (Discos) and other improvements. Project development for the NAVSTAR/GPS system is presented. By the third phase, 24 satellites will orbit in 3 different orbital planes displaced at 63 degrees to each other. Each satellite sends out signals concurrently in a Pseudo Random Noise (PRN) code, and time measurements in the nano-second region are possible. R.C.

A81-13311 The state of German involvement and future possibilities in the development of the DME-based landing system DLS (Stand der deutschen Aktivitäten und künftigen Möglichkeiten in der Weiterentwicklung des DME-based Landing System DLS). A. Becker (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Flugführung, Braunschweig, West Germany). *Ortung und Navigation*, no. 2, 1980, p. 256-261. In German.

The future development of the DME-based landing system for 360 degree azimuth occultation is examined. The system is used in conjunction with microwave landing systems such as the time reference scanning beam model. The organization of the DME-based Azimuth System (DAS) program is considered. The major concerns include hardware development and research activities. The construction of a high performance unit is discussed along with the determination of international standardization of the DAS. International cooperation in theoretical consideration is also taken into account. R.C.

A81-13312 The present state of the MLS (Derzeitiger Stand der MLS-Situation). Mr. Bohr (Bundesanstalt für Flugsicherung, Frankfurt am Main, West Germany). *Ortung und Navigation*, no. 2, 1980, p. 262-265. In German.

The standardization of the microwave landing system (MLS) by the All Weather Operations Panel of the ICAO is discussed. The agenda includes the determination of technical specification for the MLS and the precision DME. The development of a separate system in France with on board equipment is examined along with research in West Germany on DME components for the MLS. The production of information brochures by AWOP including characteristics on the MLS and the impact of the system at the airports and for flight safety is considered. The use of instrument landing systems (ILS) and the MLS during the next 20 years is investigated with emphasis on the transition from the ILS to the MLS. R.C.

A81-13313 The outfitting of regional airports in the future with radio assistance for approach and landing, with emphasis on landing site obstacles for general aviation (Zur zukünftigen Ausrüstung von Flugplätzen mit regionaler Bedeutung /Schwerpunkt-Landplätze der Allgemeinen Luftfahrt/ mit Funkhilfen für Anflug und Landung). M. Böhm (Standard Elektrik Lorenz AG, Stuttgart, West Germany). *Ortung und Navigation*, no. 2, 1980, p. 266-276. In German.

The increase in air traffic and the demand on the airports in West Germany are discussed. The improvement of flight safety, especially at regional airports is examined. The existing systems for communications, navigation and identification are presented along with the development of new systems. The TRSB (Time Reference Scanning Beam) is central to the Microwave Landing System. Operating at 5 GHz the system requires an on board directional antenna. The DAS program (DME-supported azimuth system) is also considered in conjunction with TRSB. The error in angle measurement lies below 0.1 degree for a standard installation and around 0.2 degree for a small installation. Plans for future development of the systems are presented. R.C.

A81-13314 Specifications for short instrument and precision approach path trajectories (Spezifikationen für kurze Instrumenten- und Präzisionslandebahnen). E. Böhme (Bundesministerium für Verkehr, Bonn, West Germany). *Ortung und Navigation*, no. 2, 1980, p. 278-286. In German.

A81-13315

Specifications for short instrument and precision approach paths as commissioned by the ICAO are presented. A path width of 30 m was determined for short precision approach paths independent of the length. This allows for an aperture angle of 5 degrees. The combination of a 75 m strip width and a 1 to 7 (14.3 degrees) inclination of the lateral transition level was chosen. The standard land track width is reduced from 210 to 140 m. R.C.

A81-13315 General aviation considerations on bad weather approaches at regional airports (Wünsche der Allgemeinen Luftfahrt für Schlechtwetteranflüge auf Flugplätzen von regionaler Bedeutung). K. Sensen (Verband der allgemeinen Luftfahrt, Egelsbach, West Germany). *Ortung und Navigation*, no. 2, 1980, p. 288-290. In German.

This paper investigates the importance of regional airports along with their development for use under various weather conditions. Airflight planning would consequently be improved. A modification of the clearance limit is considered which would place it closer to the landing site. Determination of a minimum descent altitude as a supplement to the minimum holding altitude is discussed. The general condition of airports and aircraft is also examined. R.C.

A81-13330 Quality control of precision castings for turbojet engine parts (Qualité et contrôle des pièces de fonderie de précision pour turbomachines). J. Thiery and J. Voeltzel (SNECMA, Paris, France). (*Colloque sur les Aciers et Alliages Spéciaux dans l'Aéronautique: La Qualité Métallurgique dans les Industries Aérospatiales, 8th, Le Bourget, Seine-Saint-Denis, France, June 1979.*) *Matériaux et Techniques*, vol. 67, Oct.-Nov. 1979, p. 349-357. In French.

Problems concerning the production of steel and refractory alloy castings for turbojet engines are examined. Methods for detecting and eliminating metallurgical defects in such castings are described. The approaches include the appropriate control and selection of materials as well as the selection of process methods and the strict control of manufacturing parameters. B.J.

A81-13331 Inspection methods for various critical steel parts for airframes (Méthodes de contrôle utilisées sur diverses pièces vitales en acier pour cellules d'avion). J. Bevalot and G. Piras (Avions Marcel Dassault-Bréguet Aviation, Vauvresson, Hauts-de-Seine, France). (*Colloque sur les Aciers et Alliages Spéciaux dans l'Aéronautique: La Qualité Métallurgique dans les Industries Aérospatiales, 8th, Le Bourget, Seine-Saint-Denis, France, June 1979.*) *Matériaux et Techniques*, vol. 67, Oct.-Nov. 1979, p. 361-367; Discussion, p. 367, 368. In French.

The quality inspection of airframe steel parts is discussed with regard to three examples: the wing attachment fittings of the Mirage F1, the horizontal empennage pivots of the Mirage F1, and the arrester hooks of the Etendard 4. These parts are subjected to very strict inspection and receive additional examination in case of incidents that may arise during manufacturing or in service. The use of ultrasonic, radiographic, and magnetoscopic inspection methods is described. B.J.

A81-13332 New avenues of research in ultrasonic inspection and their applications in the aerospace industry (Voies nouvelles en contrôle ultra-sonore et leurs applications dans l'industrie aérospatiale). J. F. de Bellevall (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine; Compiegne, Université de Technologie, Compiegne, France). (*Colloque sur les Aciers et Alliages Spéciaux dans l'Aéronautique: La Qualité Métallurgique dans les Industries Aérospatiales, 8th, Le Bourget, Seine-Saint-Denis, France, June 1979.*) *Matériaux et Techniques*, vol. 67, Oct.-Nov. 1979, p. 369-376; Discussion, p. 377, 23 refs. In French.

The use of ultrasonic echography for the inspection of metallic aircraft components is described. Ways to improve the ultrasonic inspection procedure is described. Ways to improve the ultrasonic inspection procedure are examined, including increasing the resolving power near the surface of controlled parts, detecting smaller defects, and increasing the automation of operations to improve productivity and eliminate human error. B.J.

A81-13351 Sensor Systems for the 80's Conference, Colorado Springs, Colo., December 2-4, 1980, Technical Papers. Conference sponsored by the American Institute of Aeronautics and Astronautics. New York, American Institute of Aeronautics and Astronautics, Inc., 1980. 194 p. Members, \$45; nonmembers, \$55.

The conference focused on smart sensors, space sensors, vector sensors, microwave sensing, and data transport and analysis of NASA systems and spacecraft. Papers were presented on data base management and archival mass memory system, the design of the Atmos sensor, multispectral data acquisition and classification of computer modeling for smart sensor design, thunderstorm overflight program, spacecraft mass memory design using self-structured magnetic bubbles, passive microwave sensing of coastal area waters, and the massively parallel processor. A.T.

A81-13364 # An airspeed vector sensor for V/STOL aircraft. E. Durbin (Princeton University, Princeton, N.J.) and T. McGeer (Stanford University, Stanford, Calif.). In: Sensor Systems for the 80's Conference, Colorado Springs, Colo., December 2-4, 1980, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 84-92. (AIAA 80-1938)

An airspeed vector sensing method which uses the ion beam of the positive corona discharge provides a simultaneous resolution and measurement of three airspeed components. In this technique, the ions in transit across an electrode gap may be deflected by airflow; measurements of their deflection determine the flow rate. A prototype sensor has been developed which demonstrated that (1) a response to each flow component is linear and almost insensitive to thermal and humidity variations, (2) the sensor measures speeds up to 50 m/s, and (3) the sensor has an accuracy of 0.01 to 0.1 m/s. A.T.

A81-13413 * Midair collisions - The accidents, the systems, and the Realpolitik. E. L. Wiener (Miami, University, Coral Gables, Fla.). *Human Factors*, vol. 22, Oct. 1980, p. 521-533. 42 refs. NASA-supported research.

Two midair collisions occurring in 1978 are described, and the air traffic control system and procedures in use at the time, human factors implications and political consequences of the accidents are examined. The first collision occurred in Memphis and involved a Falcon jet and a Cessna 150 in a situation in which the controllers handling each aircraft were not aware of the presence of the other aircraft until it was too late. The second occurred in San Diego four months later, when a Boeing 727 on a visual approach struck a Cessna 172 from the rear. Following the San Diego collision there arose a great deal of investigative activity, resulting in suggestions for tighter control on visual flight rules aircraft and the expansion of positive control airspace. These issues then led to a political battle involving general aviation, the FAA and the Congress. It is argued, however, that the collisions were in fact system-induced errors resulting from an air traffic control system which emphasizes airspace allocation and politics rather than the various human factors problems facing pilots and controllers. A.L.W.

A81-13414 Human error in ATC system operations. J. W. Danaher (National Transportation Safety Board, Bureau of Accident Investigation, Washington, D.C.). *Human Factors*, vol. 22, Oct. 1980, p. 535-545. 10 refs.

The role of human factors in present and future air traffic control systems is examined in light of the importance of human errors in aircraft accidents. The required tasks of air traffic controllers in the present system are reviewed, and the effects of automation on controller workload and performance are considered. Measures adopted to improve and quantify system errors are then discussed, with particular attention given to the FAA System Effectiveness Information System. Selected aircraft accidents and incidents in which air traffic control was in some way involved are examined to demonstrate the role of the human element in ATC system errors, with attention given to contributing factors including

inadequate coordination between controllers, improper communications phraseology, lapses in attention, the use of improper control procedures or techniques and faulty judgement in cases of a near midair collision, a controlled flight into terrain and a near collision on a runway. Areas for further research and consideration in the design of future systems are pointed out. A.L.W.

A81-13415 **The measurement of the air traffic controller.** V. D. Hopkin (RAF, Institute of Aviation Medicine, Farnborough, Hants., England). *Human Factors*, vol. 22, Oct. 1980, p. 547-560. 46 refs.

Measures of the air traffic controller are reviewed and critically assessed. There are many reasons for measuring the controller, and no measure can yet be treated as either indispensable or useless. Some of the most successful studies have employed many different measures. There has been a bias toward measuring the controller as part of the system rather than in his or her own right. It has proved difficult to establish adequate measurement criteria because of uncertainty about the relative importance of the factors involved. The development of new measures and the refinement of existing ones may lead to progress. A reinterpretation of the controller's tasks and functions in relation to psychological constructs should be attempted. (Author)

A81-13416 **An information-processing interpretation of air traffic control stress.** J. M. Finkelman and C. Kirschner (Baruch College, New York, N.Y.). *Human Factors*, vol. 22, Oct. 1980, p. 561-567. 24 refs.

The relation between the stress observed in air traffic controllers and their information-processing workloads is discussed. Evidence of stress or stress-related illnesses in air traffic controllers is considered, and it is pointed out that much of the stress results from information overloads and working near the limits of channel capacities. The consequences of information overloads on controller job performance and function in other areas (social relationships, physical and mental health) are considered, and a method is proposed by which individual differences in channel capacity may be assessed by means of a subsidiary task measurement technique. It is noted that such a technique may be useful in the screening of individuals with limited information processing ability or who are most susceptible to the effects of stress. A.L.W.

A81-13419 * **Evaluation of the potential format and content of a cockpit display of traffic information.** S. G. Hart and L. L. Loomis (Tufts University, Medford, Mass.). *Human Factors*, vol. 22, Oct. 1980, p. 591-604. 5 refs. Grant No. NsG-2156.

The types and formats of information most suitable to be displayed in a cockpit display of traffic information (CDTI) are investigated. Twenty three airline pilots and 13 instrumented general aviation pilots were asked to select from sets of symbols of various complexities incorporating various levels of information that would contain all information necessary for monitoring the traffic situation, detecting errors, maintaining separation and merging. Display features selected by a significant number of pilots were then evaluated for their capabilities in helping pilots to assess the lateral or vertical separation between their own and another aircraft in a dynamic simulation. It is found that while some of the features initially chosen by the pilots, such as flightpath predictors, aided the pilots in perceiving the traffic situation correctly, others, such as ground speed and climb/descend arrows and relative altitude encoding of symbols for other aircraft, did not contribute to improved performance speed or accuracy. A.L.W.

A81-13420 * **Perception of horizontal aircraft separation on a cockpit display of traffic information.** E. A. Palmer (NASA, Ames Research Center, Man-Vehicle Systems Research Div., Moffett Field, Calif.), S. J. Jago, D. L. Baty (San Jose State University, San Jose, Calif.), and S. L. O'Connor. *Human Factors*, vol. 22, Oct. 1980, p. 605-620. 14 refs.

The influence of various display symbologies in a cockpit display of traffic information (CDTI) on pilot perception of

horizontal aircraft separation is investigated. In a series of nine experiments using different combinations of display symbology, information update rate, display viewing time and encounter geometry, subjects were asked to predict whether an intruder aircraft would pass in front of or behind their own aircraft. It is found that displayed history did not improve task performance, although it was desired by the pilots when no other display of aircraft turn rate was available, and that pilots made fewer errors when they had predictive information. Variations in the rate of updating information from 0.1 to 4 sec and viewing times from 1 to 16 sec are not observed to affect performance. It is concluded that the present task, which may arise in a collision avoidance situation, would require an onboard computer to make a prediction of relative aircraft position and display it on the CDTI. A.L.W.

A81-13421 * **Air traffic control using a microwave landing system.** G. Gershohn (San Jose State University Foundation, San Jose, Calif.). *Human Factors*, vol. 22, Oct. 1980, p. 621-629. 12 refs. Grants No. NGL-05-046-002; No. NsG-2269.

The performance of air traffic controllers using a simulated microwave landing system to control the landing of STOL aircraft is investigated. In a series of two experiments, controllers were asked to achieve a 60-sec separation between targets at the missed approach point when only two targets were on the simulated radar scope, and in the presence of 25 targets, with up to 10 on the screen at any one time. In both experiments, the presence of a ground wind is found to degrade separation performance, and an increased work load results in even greater separation variability, as the controllers did not have time to convert aircraft distances into times. In addition, curved courses are found to have an effect on performance. It is thus recommended that in order to create a practical air traffic control system with separation standards based on time, as in the MLS, controller work loads should be reduced and aircraft positions should be displayed with respect to time rather than distance. A.L.W.

A81-13512 **Medical coordination in airport disasters.** A. C. Webb (Airport Medical Clinic, Minneapolis, Minn.). *Aviation, Space, and Environmental Medicine*, vol. 51, Nov. 1980, p. 1256-1258.

The goals of an airport disaster plan include the care, treatment and transportation of the wounded with the quality and quantity of care that minimizes the mortality and morbidity of the survivors of a crash. Coordination of the medical aspects of these plans requires participation by physicians, nurses, ambulance and hospital personnel, psychologists, and psychiatrists. To maintain these diverse groups in a state of readiness for a potential disaster which may have a frequency of 5-20 years is a challenging problem. This paper addresses methods of accomplishing this goal. (Author)

A81-13513 **Developing an emergency medical disaster plan for an airport.** J. I. Pixley (Minneapolis-St. Paul International Airport, Minneapolis, Minn.). *Aviation, Space, and Environmental Medicine*, vol. 51, Nov. 1980, p. 1258, 1259.

The development of the emergency medical disaster plan for Minneapolis-St. Paul International Airport as a model for other major hub airports is discussed. Conformance with federal regulations and the need to closely coordinate activities with both on-airport personnel and off-airport facilities are considered and incorporated into the plan. Manpower sources are reviewed and methods are developed for the efficient handling and treatment of disaster victims. Essential services for an emergency are categorized and their responsibilities designated. Centers of control for support personnel and vehicles are established. Consideration is also given to the special requirements of friends and relatives of the victims and of the news media. Conducting disaster drills as a means to evaluate and improve the basic plan is also examined. (Author)

A81-13514 **Mobilization of trauma teams for aircraft disasters.** L. D. Star, L. C. Abelson, L. R. M. Delguercio, and C. Pritchett (John F. Kennedy International Airport, Medical Office,

Jamaica, N.Y.). *Aviation, Space, and Environmental Medicine*, vol. 51, Nov. 1980, p. 1262-1266. 5 refs.

With more survivors of air crashes involving jumbo jets, an improved plan for life-saving emergency care at the crash site is discussed. The concept of airlifting pre-designated Trauma Teams to the crash site from large medical centers within a radius of 100 miles is discussed. The 'work-shop' for these teams is described in detail, providing an operating and intensive care facility at the scene of the disaster. It is shown how this kind of planning can be applied to natural disasters with multiple casualties as well as to airport disasters. (Author)

A81-13515 Passenger survival in wide-bodied jet aircraft accidents vs. other aircraft - A comparison. L. C. Abelson, L. D. Star, and J. X. Stefanki (John F. Kennedy International Airport, Medical Office, Jamaica, N.Y.). *Aviation, Space, and Environmental Medicine*, vol. 51, Nov. 1980, p. 1266-1269. 12 refs.

An analysis of survival of passengers involved in accidents over the last decade shows approximately three times fewer fatalities, in proportion to the number of passengers involved, in wide-bodied jets than in piston aircraft. Various factors affecting the improved survival rates are discussed. Application of these points with particular reference to airport disaster planning is made. It is shown that there are larger numbers of survivors when life-saving emergency treatment utilizes the concept of 'bringing the hospital to the disaster'. Details of the Mobile Emergency Hospital developed at Kennedy International Airport are described. (Author)

A81-13533 # Transonic flow past a wing profile in channels with permeable walls (Tranzvukovyye techeniia okolo krylovogo profilia v kanalakh s pronitsaemyimi granitsami). A. A. Blynskaia and Iu. B. Lifshits. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza*, Sept.-Oct. 1980, p. 99-107. 20 refs. In Russian.

The analysis deals with two-dimensional transonic gas flows past a wing in a wind tunnel with perforated walls. The values of the flow parameters are determined from a numerical solution of a certain boundary value problem for the velocity potential equations, which models the gas flow past a wing in a channel with perforated walls. The results obtained are used to construct an asymptotic theory of the influence of the wind tunnel height and the freestream Mach number on the characteristics of the flow over a wing. V.P.

A81-13544 # Determination of the vorticity of a small-aspect-ratio wing in hypersonic flow (Ob opredelenii zavikhrennosti na kryle malogo udlineniia pri giperzvukovom obtekanii). V. N. Golubkin. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza*, Sept.-Oct. 1980, p. 175-178. 6 refs. In Russian.

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

A81-13548 # Attainability of an attached flow in a nozzle with heavily curved walls (O vozmozhnosti bezotryvnogo techeniia v soople s sil'no izognutyimi stenkami). N. A. Podsypanina, E. G. Shifrin, and M. A. Shulakov. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza*, Sept.-Oct. 1980, p. 188, 189. 6 refs. In Russian.

A81-13570 # Sound generation by vortex shedding from a profile within a channel (Issledovanie generatsii vikhrevoogo zvuka pri obtekanii profilia v kanale). M. A. Il'chenko, A. N. Rudenko, and V. L. Epshtein. *Akusticheskii Zhurnal*, vol. 26, Sept.-Oct. 1980, p. 708-717. 9 refs. In Russian.

The paper deals with an experimental investigation of sound generation by vortex shedding from plates of various profiles in a channel of rectangular cross section (150 x 50 mm). The influence of

the plate profile, Mach number (0.05 to 0.3), and pressure ((1.05 to 2.5) x 10 to the fifth) on the frequency and amplitude of the generated oscillations was investigated. The results obtained were interpreted qualitatively. V.P.

A81-13573 # Influence of boundary-layer suction on the emission spectrum on a thin plate performing oscillations under the action of pressure pulsations (O vliianii otsosa pogranichnogo sloia na spektr izlucheniia tonkoi plastiny, kolebliushcheisia pod deistviem pul'satsii davleniia). R. A. Mkhitarov. *Akusticheskii Zhurnal*, vol. 26, Sept.-Oct. 1980, p. 772-775. 5 refs. In Russian.

The mean square sound pressure is calculated for a thin rectangular plate performing oscillations under the action of pressure pulsations in the boundary layer. Calculations are carried out for a freestream Mach number of 0.4, a Reynolds number of 5×10 to the fourth, and a suction intensity of 4.2×10 to the -3rd power. The mean square sound pressure is found to decrease, as compared to the flow conditions in the absence of suction, at low and moderate frequencies, and to increase at high frequencies. V.P.

A81-13612 Crack propagation in panels of pressurized fuselages upon simultaneous action of cyclic loading by pressurization and high-frequency vibrations. N. A. Mozzherova (Tsentral'nyi Aerogidrodinamicheskii Institut, Zhukovski, USSR). (*Problemy Prochnosti*, Jan. 1980, p. 63-66.) *Strength of Materials*, vol. 12, no. 1, Sept. 1980, p. 68-72. 8 refs. Translation.

It is emphasized that the science and crafts associated with the parting of solids are of considerable industrial, cultural and historical interest. Some principles of the modern theory of fracture which may be relevant to the controlled separation of a solid into pieces are reviewed. The use of path independent integrals in the analysis of indentation fracture is discussed, and some of the subtleties involved in treating the motion, deviation and forking of cracks and the energy balance in crushing and shattering are considered. The paper concludes with a brief account of some recent work on the theory of flint knapping and of the influence of the environment on the fracture process. (Author)

A81-13741 # A finite-span wing in transonic flow (Krylo konechnogo razmakha v tranzvukovom potoke). V. A. Eremenko and O. S. Ryzhov (Akademiia Nauk SSSR, Vychislitel'nyi Tsentr, Moscow, USSR). *Akademiia Nauk SSSR, Doklady*, vol. 254, no. 2, 1980, p. 313-316. 14 refs. In Russian.

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

A81-13753 # Harmonically oscillating airfoil in transonic stream of air. J. Benetka and Z. Pernica. *Zprava VZLU*, no. Z-34, 1980, p. 1-12. 8 refs.

Results are presented for pressure and optical measurements of an oscillating model of a NACA 0012 airfoil in a steady flow at Mach numbers of 0.4 to 0.96. The color schlieren technique is used for flow visualization in the experiments. The results obtained show that the damping nature of the aerodynamic forces can be misinterpreted if the analysis is restricted to the first harmonic. F.G.M.

A81-13811 Experiments on the validity of ground effect predictions for static noise testing of propeller aircraft. G. J. J. Ruijgrok (Delft, Technische Hogeschool, Delft, Netherlands). *Journal of Sound and Vibration*, vol. 72, Oct. 22, 1980, p. 469-479. 16 refs.

The practical importance of an advanced ground effect theory for the prediction of free field noise spectra from static field

measurements above grassland is investigated. Empirical noise data from a ground-based light propeller aircraft are compared with predictions. The results show that short range propagation of low frequency noise is adequately described by theory. It is also shown, however, that at intermediate and high frequencies detailed experiments on ground interference effects remain required to determine the characteristics of the noise source. (Author)

A81-13824 **Application of the equivalent surface source method to the acoustics of duct systems with non-uniform wall impedance.** M. Namba (Kyushu University, Fukuoka, Japan) and K. Fukushige (Toyota Motor Co., Ltd., Higashifuji Technical Center, Shizuoka, Japan). *Journal of Sound and Vibration*, vol. 73, Nov. 8, 1980, p. 125-146. 6 refs.

The paper outlines the application of the equivalent surface source method to the analysis of the acoustic field in a partially lined duct with arbitrarily nonuniform wall impedance. Lined sections of the duct wall are represented by unsteady mass source singularities, the strengths of which are determined by solving integral equations. The method is applicable to lined walls of impedance which is nonuniform in the streamwise and/or circumferential direction. Numerical examples are given to show the effects of various design parameters on sound attenuation. (Author)

A81-13860 **Towing tank tests on model wind turbine rotors.** M. G. Woollard and R. T. Griffiths (Swansea, University College, Swansea, Wales). In: *Wind Energy Workshop, 1st, Cranfield, Beds., England, April 19, 20, 1979, Proceedings*. London, Multi-Science Publishing Co., Ltd., 1979, p. 78-85. 9 refs.

Experimental wind turbine performance data may be obtained from measurements made in the natural wind or from tests on wind tunnel models, with the associated problems of assessment of wind speed and blockage effects respectively. Another method, suggested here, is to tow a model turbine through a water tank and this technique has been developed as a student project at University College, Swansea. The torque, rotational and towing speeds are continuously monitored by a computer, enabling the performance characteristics to be determined over a complete range of tip speed ratios. The results are sufficiently encouraging to stimulate further development of the technique. (Author)

A81-13870 **Improving the mechanical load matching of wind energy converters.** J. C. Dixon (Open University, Milton Keynes, Bucks., England). In: *Wind Energy Workshop, 1st, Cranfield, Beds., England, April 19, 20, 1979, Proceedings*. London, Multi-Science Publishing Co., Ltd., 1979, p. 181-189; Discussion, p. 185. 5 refs.

The efficiency of the conventional design of the windpump as an energy converter is about 0.05. This is due to three main factors: (1) rotor aerodynamics, with an efficiency of 0.3; (2) bad matching of pump to rotor with speed variation, with an efficiency of 0.4; and (3) cyclic variations of torque required by the pump, with an efficiency of 0.4. A high-speed horizontal axis rotor or vertical axis rotor, although economically attractive, has a torque characteristic particularly unsuitable for use with a typical positive displacement pump. Some methods of overcoming these difficulties are compared. The use of controlled leakage on a basically positive displacement pump can be used to overcome cyclic pump-torque problems and low rotor starting torques. There are several possibilities for improving matching across the speed range including variable swept volume, and variable volumetric efficiency possibly by utilizing the inertia of the pumped fluid. (Author)

A81-13873 **Wind speed measurement for wind turbine testing.** D. W. Bridson (Exeter, University, Exeter, England). In: *Wind Energy Workshop, 1st, Cranfield, Beds., England, April 19, 20, 1979, Proceedings*. London, Multi-Science Publishing Co., Ltd., 1979, p. 208-217.

The characteristics of wind velocity and its measurement are discussed taking into account wind direction, wind speed, and meteorological pressure. The turbine parameters including the rotor diameter, aerodynamics, and response rate, accuracy, and cost of wind speed instrumentation are described; currently available equipment such as anemometers, pitot tubes, and laser interferometers are considered. Field measurements using pitot/static tubes which achieve a flat directional response of minimum 45 deg in azimuth and pitch and a hot wire anemometer in which the fragile wire is embedded in resin are reported. A.T.

A81-13925 # **Experimental investigations on a harmonically swinging trail edge flap with a space (Experimentelle Untersuchungen an einer harmonisch schwingenden Hinterkantenklappe mit Spalt).** K. Kienappel (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Aeroelastik, Göttingen, West Germany), D. Round, and A. Vasel (Messerschmitt-Bölkow-Blohm GmbH, Hamburg, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, 13th, Braunschweig, West Germany, May 28-30, 1980, Paper 80-029*. 17 p. In German.

Non-steady flow around a wing with a swinging trail edge flap and flow through space is examined. An experimental model with a profile depth of 1 m and an aspect ratio of 1.5 is discussed. Experiments were carried out in a 3 m x 3 m low speed channel with an air speed of 50 m/sec. Measuring instruments with vector components are used to obtain non-steady pressure measurements. Emphasis is placed on the angle of incidence, the stationary flap angle, and the reduced frequency. Suitable agreement is found between a simplified theory and the experimental results in lower frequencies with a closed space for zero lift. Deviations are observed with increasing frequency in the flap angle and the angle of incidence. R.C.

A81-14075 # **On the utilization of hydrogen as a fuel for gas turbine. I - On the utilization of low temperature exergy of liquid hydrogen.** Y. Tsujikawa and T. Sawada (Osaka Prefecture, University, Sakai, Japan). *JSME, Bulletin*, vol. 23, Sept. 1980, p. 1506-1513. 5 refs.

In order to utilize the low temperature exergy of the liquid hydrogen, the characteristic of a gas turbine cycle employing a precooler and an auxiliary hydrogen turbine is discussed. The thermal efficiency and specific output of this cycle are superior to those of the simple cycle gas turbine which has the same components' efficiencies. The low temperature exergy is converted to work by decreasing the compressor input and hydrogen turbine output added. The merit of improvements in specific output of this cycle is about 20 percent of that of the simple cycle. The pressure loss coefficient of the precooler is very critical to the merit of improvements of the thermal efficiency. The critical value is about 5 percent. The thermal efficiency and the specific output are increased with an increasing ambient temperature, thus the performance degradation of the simple cycle gas turbine at high ambient temperature can be improved by introducing a precooling system. (Author)

A81-14228 # **Energy conservation through cogeneration. J. C. Solt (Solar Turbines International, San Diego, Calif.). In: Energy alternatives: An assessment; Proceedings of the Sixth Annual UMR-DNR Conference on Energy, Rolla, Mo., October 16-18, 1979. Volume 6. Rolla, Mo., University of Missouri-Rolla, 1980, p. 22-29.**

The use of gas turbine engines to provide site-generated electric power in industrial applications is discussed and a methodology for evaluating the benefits of a cogeneration system is presented. Analysis indicates that the economics of cogeneration type systems is particularly favorable for process industries with a high usage factor and a high thermal requirement, such as natural gas processing; petrochemical and refining; paper and pulp; food processing; textiles, clay, cement, and glass; lumber and wood products; and metals. V.L.

A81-14241 Carrier system simplifies freight handling - A new technical concept for Lufthansa's Frankfurt facility. L. Knepper (Carl Schenk AG, Darmstadt, West Germany). *Airport Forum*, vol. 10, Oct. 1980, p. 13, 14, 16-18.

The paper deals with Lufthansa's large complex air cargo terminal at the Frankfurt airport, to be completed in November 1981. Using specially designed carriers for pallets and containers, rollboxes, and a 23-m high, 103-m long container racking system, the cargo terminal will be able to handle 500,000 tons of freight per year at a vastly improved rate. V.P.

A81-14242 The future of airfreight - NASA study looks into the next century. *Airport Forum*, vol. 10, Oct. 1980, p. 20, 22, 23 (5 ff.).

In the present paper, the results of Cargo/Logistic Airlift System Study (CLASS) are summarized. The study is concerned with the future of airfreight in the United States and its trading partners. Key portions of the findings contained in the CLASS Summary Volume are presented, along with highlights from 'The Air Cargo Structure' and 'Future Air Cargo Aircraft', contained in the same volume. V.P.

A81-14243 Energy-saving ramp lighting with high-pressure sodium lamps. C.-H. Ziesenis (Philips GmbH, Hamburg, West Germany). *Airport Forum*, vol. 10, Oct. 1980, p. 75-77.

With increasing energy costs, airport ramp lighting systems have become a major cost factor in airport operational costs. The present discussion of the costs and characteristics of various lighting systems leads to the conclusion that only high-pressure metal halide lamps or high-pressure sodium lamps are suitable for airport purposes, and that the sodium lamps are the more cost effective. V.P.

A81-14254 A lightning protection program for the F-16 fly-by-wire system. C. S. Droste, R. T. Zeitler (General Dynamics Corp., Fort Worth, Tex.), and J. L. Dabold (USAF, Aeronautical Systems Div., Wright-Patterson AFB, Ohio). In: International Symposium on Electromagnetic Compatibility, 21st, San Diego, Calif., October 9-11, 1979, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 49-55.

The F-16 is the first operational aircraft with a fly-by-wire system where flight control is completely dependent on electrical/electronic circuitry. Because of this fly-by-wire system, a program was conducted to design the aircraft against the effects of lightning. Particular concern was paid to lightning-induced voltages and currents which could be coupled into the flight critical systems and subsequently cause damage to sensitive electronic components. This paper is an account of the lightning susceptibility test program performed on the F-16 fly-by-wire system and how that system was hardened against the effects of lightning. (Author)

A81-14255 Multiple-component lightning high-current testing. E. H. Schulte (McDonnell Aircraft Co., St. Louis, Mo.). In: International Symposium on Electromagnetic Compatibility, 21st, San Diego, Calif., October 9-11, 1979, Proceedings.

New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 56-61. 10 refs.

In the present paper, an attempt is made to show that certain test hardware must be subjected to a simulated lightning test waveform that consists of more than one lightning component (combinations of HPC, RHPC, IC, and CC) in order to obtain meaningful test results. The feasibility, though admittedly difficult, of coupling various generators to obtain the desired multiple-component lightning test waveform is demonstrated. V.P.

A81-14257 Lightning near fields generated by return stroke current. R. A. Pearlman (McDonnell Aircraft Co., St. Louis, Mo.). In: International Symposium on Electromagnetic Compatibility, 21st, San Diego, Calif., October 9-11, 1979, Proceedings.

New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 68-71. 8 refs.

A return stroke model was constructed to predict the nearby electromagnetic fields (20-200 meters from the channel) as a function of lightning parameters such as return stroke velocity, pulse rise time, and path tortuosity. It is shown that path tortuosity is not a major factor in the nearby induced fields. The electric field near the channel is predominantly electrostatic and proportional to the reciprocal of the wave velocity. The large magnitude of all field components in the vicinity of the channel suggests that a nearby strike could pose a real threat to aircraft electrical systems, even though the aircraft itself is not struck. B.J.

A81-14258 VHF-UHF precipitation-static interference effects on aircraft. J. D. Robb (Lightning and Transients Research Institute, St. Paul, Minn.), D. J. Brady, and L. Donatich (Fairchild Republic Co., Farmingdale, N.Y.). In: International Symposium on Electromagnetic Compatibility, 21st, San Diego, Calif., October 9-11, 1979, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 72-76. Contract No. F33657-76-C-0500.

Experimental studies of military and commercial aircraft have disclosed that severe interference is caused by electrically isolated metallic sections on the aircraft exterior which become charged by frictional contact with atmospheric particles and then spark over to the airframe. Also observed in the studies was receiver desensitization resulting from corona discharges from commercial grounded type VHF-UHF antennas. It is found that all VHF-UHF antennas having corona discharges from exposed metallic extremities may suffer this desensitization in flight without the flight crew being aware of it since the interference does not break the squelch. B.J.

A81-14259 A design guide for lightning protection of aircraft. J. A. Plumer (Lightning Technologies, Inc., Pittsfield, Mass.). In: International Symposium on Electromagnetic Compatibility, 21st, San Diego, Calif., October 9-11, 1979, Proceedings.

New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 77-84. 22 refs.

Basic steps in the design of lightning protection are (1) the determination of lightning strike zones, (2) the establishment of the lightning environment, (3) the identification of vulnerable systems or components, (4) the establishment of protection criteria, (5) the design of lightning protection, and (6) the verification of protection adequacy by test. Sets of checklists are provided for typical aircraft systems together with reference to sources of further information. Hardware discussed includes externally mounted components, non-metallic structures, fuel system hardware, and control surfaces. B.J.

A81-14260 RF compatibility-environment to component part. P. McBrayer (McDonnell Aircraft Co., St. Louis, Mo.) and B. Showalter (General Electric Co., Binghamton, N.Y.). In: International Symposium on Electromagnetic Compatibility, 21st, San Diego, Calif., October 9-11, 1979, Proceedings.

New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 91-95.

The Navy F-18 fighter aircraft's radio frequency environment on a carrier deck is known from MIL-HB-235. These levels have been analyzed by method of moments and tradeoffs were made for the aircraft weight and the equipment costs which initiated the development of high RF current filter pin connectors. Special tests and procedures were developed for these connectors. This paper discusses the analysis and trade study results and the general design and application techniques for filter pin connectors. The special test procedures for high RF current tests and lightning tests are discussed, and general results of the tests are presented. (Author)

A81-14263 The RAE research and development program on EMC for aircraft and flight weapons systems. J. M. Thomson (Royal Aircraft Establishment, Farnborough, Hants., England). In: International Symposium on Electromagnetic Compatibility, 21st,

San Diego, Calif., October 9-11, 1979, Proceedings.
New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 118-123. 12 refs.

Some of the main features of the RAE's EMC R&D program are described. Attention is given to the following areas of research: definition of the external electromagnetic environment, the coupling of the external environment into the interior, the definition of the internal electromagnetic environment, equipment specifications and test methods, aircraft specifications and test methods, and design for compatibility. B.J.

A81-14264 Electrical bonding in aircraft. J. Brettle and M. W. Baskerville (Plessey Co., Ltd., Allen Clark Research Centre, Towcester, Northants., England). In: International Symposium on Electromagnetic Compatibility, 21st, San Diego, Calif., October 9-11, 1979, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 124-130. Research supported by the Ministry of Defence.

The requirements for reliable low impedance electrical bonds in aircraft are discussed. The problems of making bonds and the often competing requirements of corrosion protection and low interface resistance are described. Some preliminary results on the electrical properties of carbon fibre composite (CFC) materials and bonding of CFC are presented. (Author)

A81-14265 Determination if fiber-optic immunity is adequate for deployment in the V/STOL airframe. J. A. Birken (U.S. Navy, Naval Air Systems Command, Washington, D.C.). In: International Symposium on Electromagnetic Compatibility, 21st, San Diego, Calif., October 9-11, 1979, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 131, 132.

Non-metallic materials will replace aluminum in the V/STOL airframe. Fiber-optics are being considered to compensate the material's low frequency transparency. Quantitative predictions and measurements are being conducted to assure that fiber-optic immunity is adequate and essential. (Author)

A81-14267 A case for submicrosecond rise-time lightning current pulses for use in aircraft induced-coupling studies. D. W. Clifford (McDonnell Aircraft Co., St. Louis, Mo.), E. P. Krider (Arizona, University, Tucson, Ariz.), and M. A. Uman (Florida, University, Gainesville, Fla.). In: International Symposium on Electromagnetic Compatibility, 21st, San Diego, Calif., October 9-11, 1979, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 143-149. 22 refs.

Recent measurements of lightning return stroke currents made using both direct and indirect techniques are reviewed and summarized. The data indicate that return stroke current pulses exhibiting submicrosecond rise times are common. Slower rise times reported previously may have been due to instrumentation limitations and, in some cases, to the investigator's definition of rise time. The earlier measurements led to the 2 x 50-microsecond current waveform which is the basis for lightning simulation specifications used in the aerospace industry. Laboratory induced-coupling studies and theoretical considerations are reported which indicate that, for aircraft work, use of the traditional 2 x 50-microsecond waveform represents inadequate testing, since the more realistic, faster pulses contain frequency components in the range of aircraft system resonances. (Author)

A81-14268 New techniques for the measurement of natural and simulated lightning phenomena. L. C. Walko and T. J. Seymour (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). In: International Symposium on Electromagnetic Compatibility, 21st, San Diego, Calif., October 9-11, 1979, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 156-159. 8 refs.

New lightning measurement and simulation techniques have evolved from the need to develop improved aircraft lightning

protection systems. This paper describes several such techniques with emphasis on the Lightning Simulation Test, and the Lightning Transient Analysis. Particular attention is given to the use of the Moebius loop magnetic field sensor, and to the use of digital processing equipment. B.J.

A81-14269 Evaluation of lightning-induced transients in aircraft using high-voltage shock excitation techniques. D. W. Clifford and K. S. Zeisel (McDonnell Aircraft Co., St. Louis, Mo.). In: International Symposium on Electromagnetic Compatibility, 21st, San Diego, Calif., October 9-11, 1979, Proceedings.

New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 160-166. 10 refs.

The time history of a long-spark discharge to a simulated in-flight aircraft and the corresponding transient signals induced on an internal wire pair were measured. Three separate induced coupling conditions related to the aircraft/lightning interaction process have been identified, and each condition has been studied. The three laboratory conditions are believed to be analogous, respectively, to nearby lightning, stepped-leader attachment and return stroke discharge. A unique arrangement of high-voltage (long-spark) generators, electrically floating E-field sensors, fiber optic data links and transient digital recorders was used in this study. Using this equipment, high-voltage shock excitation tests have been developed for each condition and have been labeled E-dot, V-dot and I-dot, respectively, since in each case the induced coupling depends upon the time rate of change of the excitation source. (Author)

A81-14270 Analyst/IAP interface and interactive graphics. S. J. Kubina, H. Widmer, and M. Vuille (Concordia University, Montreal, Canada). In: International Symposium on Electromagnetic Compatibility, 21st, San Diego, Calif., October 9-11, 1979, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 194-197. Department of Supply and Services Contract No. 2SU-76-00253.

AAPG is an ECM analysis code that has been developed to make the man-computer interaction more natural, rapid, and productive. The user communicates with the computer program via a collection of graphical input/output modules, whereby he receives (almost instantaneously) plots, illustrations, and tables of desired information; the user is allowed to redesign subsystems and recompute the narrowband EMI margins as often as he requires during a single terminal session. AAPG is modularized into four independent packages, three for display of information and one for new input. This paper describes the structure of AAPG, and illustrates the effectiveness of each of the four graphics packages in interfacing the analyst to computer methodology for EMC analysis. B.J.

A81-14280 Antenna-to-antenna coupling in aircraft radio systems. D. A. Bull and B. W. Smithers (Electrical Research Association, Ltd., Leatherhead, Surrey, England). In: International Symposium on Electromagnetic Compatibility, 21st, San Diego, Calif., October 9-11, 1979, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 274-281. 7 refs. Research sponsored by the Ministry of Defence (Procurement Executive).

Interactions between co-sited antennas on airframes can seriously limit the performance of control, guidance and communications systems. Much ground and in-flight data has been gathered and laboratory investigations have indicated where improvements can be made. Empirical formulae have been developed which are applicable for both in-band and out-of-band frequencies. (Author)

A81-14300 # Numerical prediction of bypass engine jet noise. C. H. Berman (Boeing Commercial Airplane Co., Seattle, Wash.). American Institute of Aeronautics and Astronautics, Aerodynamics Conference, 6th, Hartford, Conn., June 4-6, 1980, Paper 80-1006. 12 p. 21 refs.

The bypass engine jet noise prediction method described here evolved from an earlier single jet computer program that calculates

both flow and noise. The major modifications involved the turbulence modeling of dual flows. Noise results are shown for high and low bypass engines and for inverted flows. Flight effect noise comparisons are made between the computer results and wind tunnel measurements. The capability of the earlier program to remove a singularity in the Lilley sound propagation equation is retained in the present program. (Author)

A81-14388 # The technical contributions of the Wright brothers to aviation. W. H. Arata, Jr. (American Institute of Aeronautics and Astronautics, Inc., New York, N.Y.). In: International Council of the Aeronautical Sciences, Congress, 11th, Lisbon, Portugal, September 10-16, 1978, Proceedings. Volume 2.

Cologne, International Council of the Aeronautical Sciences, 1980, p. 6-13.

Seventy-five years ago, the Wright brothers, Wilbur and Orville, successfully completed the world's first aircraft flight. In less than five years, they designed, constructed, and tested a series of gliders, leading to their first Wright Flyer. In the present paper, their efforts are summarized placing emphasis on the technical accomplishments. V.P.

A81-14389 # Application of advanced technology for improving the integration of engine and airframe for future transport aircraft. R. Hilbig, K.-D. Klevenhusen, G. Krenz, and R. Smyth (Vereinigte Flugtechnische Werke-Fokker GmbH, Bremen, West Germany). In: International Council of the Aeronautical Sciences, Congress, 11th, Lisbon, Portugal, September 10-16, 1978, Proceedings. Volume 2. Cologne, International Council of the Aeronautical Sciences, 1980, p. 14-32. 14 refs.

The engine-over-wing installation, making optimum use of positive interference effects between engine and airframe, is examined. A novel concept of 'over-the-wing blowing' is introduced, that uses a wing stub called the 'nacelle wing' above and ahead of the main wing for attachment of the engine nacelle. This solution makes it possible to keep the wing free of pylon disturbances, demands a minimum of complexity, and makes use of proven components. Measurements show a potential for 25% improvement in maximum lift and up to 80% for lift over drag. The engine location above the wing eliminates problems associated with ground clearance and classical high-speed interference drag problems of high bypass-ratio engines with the main wing. Investigations show that the proposed configuration will contribute to the improvement of the overall performance of future transport aircraft. The evaluation of noise characteristics show the possibilities of a significant noise reduction to meet or even overfulfill future, more stringent noise requirements. S.S.

A81-14390 # The effects of noise on laminar flow control drag reduction systems. J. S. Gibson (Lockheed-Georgia Co., Marietta, Ga.). In: International Council of the Aeronautical Sciences, Congress, 11th, Lisbon, Portugal, September 10-16, 1978, Proceedings. Volume 2. Cologne, International Council of the Aeronautical Sciences, 1980, p. 33-39. 24 refs.

The nature of boundary layer transition from laminar to turbulent flow and the problem of noise as a transition triggering mechanism are described. For historical perspective, the noise sources and laminar flow/noise criteria relative to the X-21A laminar flow control (LFC) research aircraft are reviewed. A more detailed review is given for a passenger LFC transport aircraft, which includes the definition of noise sources, noise predictions on aircraft LFC surfaces, and critically affected LFC areas. Current activities in the area of noise effects on laminar flow are briefly discussed, as are conclusions regarding needed research. (Author)

A81-14391 # Study of a variable sweep wing in sub or transonic flow (Etude d'une aile à fleche variable en écoulement sub ou transsonique). F. Manie, C. Rehbach, and V. Schmitt (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). In: International Council of the Aeronautical Sciences, Congress, 11th, Lisbon,

Portugal, September 10-16, 1978, Proceedings. Volume 2.

Cologne, International Council of the Aeronautical Sciences, 1980, p. 45-58. 15 refs. In French. (ONERA, TP no. 1978-106)

Detailed experiments were performed on models of a variable sweep wing emphasizing in particular flow separation and appearance of vortex structures at low speeds and the formation of shock waves at transonic speeds. The results of these tests have been compared with those of calculations made by available procedures such as a panel method for unseparated flows and an unsteady method based on a volume discretization of the vortex vector for separated flows. Transonic flows were calculated using relaxation methods based on the perturbation theory and on the full potential equation. (Author)

A81-14392 # Design and analysis of slat systems in transonic flow. B. Arlinger (Saab-Scania AB, Linkoping, Sweden) and W. Schmidt (Dornier GmbH, Friedrichshafen, West Germany). In: International Council of the Aeronautical Sciences, Congress, 11th, Lisbon, Portugal, September 10-16, 1978, Proceedings. Volume 2. Cologne, International Council of the Aeronautical Sciences, 1980, p. 59-70. 15 refs. Research supported by Saab-Scania AB; Bundesministerium der Verteidigung Contract No. T/R-421/70005/72403.

A numerical method for the analysis of two-dimensional transonic flow around two-element airfoil configurations has been extended to treat mixed analysis and design problems. By prescribing the pressure distribution along a part of one airfoil a new contour shape results. The method also works for thick trailing edges. Results are presented which show the redesign of slat lower surfaces. The boundary layer is accounted for in a couple of calculations where the displacement thickness has been added to the original shapes. A systematic analysis series is also presented of the effect of various geometric parameters on the pressure distribution about a slat-airfoil configuration. (Author)

A81-14393 # Qualitative calculations of transonic drag-rise characteristics using the equivalence rule. Y. C.-J. Sedin (Saab-Scania AB, Linkoping, Sweden). In: International Council of the Aeronautical Sciences, Congress, 11th, Lisbon, Portugal, September 10-16, 1978, Proceedings. Volume 2. Cologne, International Council of the Aeronautical Sciences, 1980, p. 71-84. 21 refs. Research supported by the Swedish Defence Material Administration.

The aerodynamic drag is very important to the performance of an aircraft. The present work is to find out if and how the classical transonic equivalence rule can be used in zero-lift drag-rise calculations of configurations with moderate spanwise extensions. Some preliminary calculations of drag-rise due to lift have also been considered. The calculations were aimed at qualitative rather than quantitative answers. A number of applications are shown for real aircrafts and wind tunnel models. Results are compared with performance data and tunnel tests. The wave drag is computed by numerically solving the nonlinear small perturbation equation about an equivalent axisymmetric body. (Author)

A81-14394 * # A nonlinear, discrete-vortex-perturbation method for unsteady lifting-surface problems with edge separations. O. A. Kandil (Old Dominion University, Norfolk, Va.) and M. Page. In: International Council of the Aeronautical Sciences, Congress, 11th, Lisbon, Portugal, September 10-16, 1978, Proceedings. Volume 2. Cologne, International Council of the Aeronautical Sciences, 1980, p. 85-93. 8 refs. Grant No. NsG-1262.

The nonlinear-discrete vortex method is coupled with a perturbation method to solve the problem of a rectangular wing with small oscillation about high angles of attack. The solution of the problem is based on decoupling the steady and unsteady effects. The steady part of the problem is a nonlinear one and is solved by the nonlinear-discrete vortex method. The unsteady part of the problem is a linear one and is solved directly without any iteration. So far, the

developed method is restricted to flat rectangular surfaces with pitching oscillations. Total and distributed loads of several rectangular wings are presented as numerical results. (Author)

A81-14395 # Acoustic fatigue assessment in the design of aerospace vehicles. M. Borri (Milano, Politecnico, Milan, Italy) and G. Cavallini (Pisa, Università, Pisa, Italy). In: International Council of the Aeronautical Sciences, Congress, 11th, Lisbon, Portugal, September 10-16, 1978, Proceedings. Volume 2. Cologne, International Council of the Aeronautical Sciences, 1980, p. 127-138. 31 refs. Research supported by the Consiglio Nazionale delle Ricerche.

The importance of acoustic fatigue problems is well established in the design of aircraft structures. In the field of aerospace structures the importance of such problems is likely to increase, since the trend in space missions is toward the use of powerful multimission reusable vehicles. In facing acoustic fatigue problems, both safe-life and damage tolerant design criteria may be followed. This paper gives an account of the approaches based on both criteria. In particular the role of input data (acoustic field characteristics, damping, fatigue and crack growth data) and the reliability of service life evaluation are discussed. (Author)

A81-14397 # Active suppression of aircraft flutter. H. Hönlinger and A. Lotze (Messerschmitt-Bölkow-Blohm GmbH, Munich, West Germany). In: International Council of the Aeronautical Sciences, Congress, 11th, Lisbon, Portugal, September 10-16, 1978, Proceedings. Volume 2. Cologne, International Council of the Aeronautical Sciences, 1980, p. 158-168. 7 refs. Research supported by the Bundesministerium der Verteidigung.

Active control systems which suppress aircraft store vibrations and flutter use additional vanes mounted on the external stores which generate counteracting aerodynamic forces. The system was flight tested on a FIAT G91/T3 showing that it could stabilize an aircraft for a high speed increment above the flutter velocity. The system can also be used as a mode excitation method for improved flight flutter for aircraft with wing mounted stores. A.T.

A81-14473 How will it be possible to pass from ILS to MLS (Comment sera-t-il possible de passer de l'ILS au MLS). O. Carel. *Navigation* (Paris), vol. 28, Oct. 1980, p. 426-437. In French. Various aspects of the transition from ILS to MLS are discussed. Attention is given to the historical background, the advantages of MLS compared to ILS, the current situation, problems associated with MLS, and the transition program and schedule. B.J.

A81-14475 * # Numerical prediction of vortex cores of the leading and trailing edges of delta wings. O. A. Kandil (Old Dominion University, Norfolk, Va.). *International Council of the Aeronautical Sciences, Congress, 12th, Munich, West Germany, Oct. 12-17, 1980, Paper*. 14 p. 44 refs. Grant No. NSG-1560.

The purpose of the present paper is to predict the roll-up of the vortex sheets emanating from the leading- and trailing-edges of delta wings with emphasis on the interaction of vortex cores beyond the trailing edge. The motivation behind the present work is the recent experimental data published by Hummel. The Nonlinear Discrete-Vortex method (NDV-method) is modified and extended to predict the leading- and trailing-vortex cores beyond the trailing edge. The present model alleviates the problems previously encountered in predicting satisfactory pressure distributions. This is accomplished by lumping the free-vortex lines during the iteration procedure. The leading- and trailing-edge cores and their feeding sheets are obtained as parts of the solution. The numerical results show that the NDV-method is successful in confirming the formation of a trailing-edge core with opposite circulation and opposite roll-up to those of the leading-edge core. This work is a breakthrough in the high angle of attack aerodynamics and moreover, it is the first numerical prediction done on this problem. (Author)

A81-14581 Solution of nonautomodeled problems of boundary-layer theory taking into account nonstationary conjugate heat exchange and blowing. V. I. Zinchenko and E. G. Trofimchuk (Tomskii Gosudarstvennyi Universitet, Tomsk, USSR). (*Inzhenerno-Fizicheskii Zhurnal*, vol. 38, Mar. 1980, p. 543-550.) *Journal of Engineering Physics*, vol. 38, no. 3, Sept. 1980, p. 327-332. 8 refs. Translation.

A solution is obtained to a conjugated heat transfer problem, involving a system of nonself-similar boundary layer equations, the equation of energy conservation in a porous body, and the energy conservation law at an interface. A numerical analysis of the supersonic flow of a perfect gas past a porous spherical shell leads to a heat-flux relationship, using which it proved possible to obtain analytical solutions to a variety of problems, which agree well with the results of numerical integration. L.M.

A81-14592 X-ray pulse method for investigation of the internal structure of a fuel jet. 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.) *Journal of Applied Mechanics and Technical Physics*, vol. 21, no. 1, July 1980, p. 97-103. 15 refs. Translation.

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.

A81-14754 # Influence of a change in power at the propeller on the properties of the aircraft (Wplyw zmiany mocy na smigle na wlasciwosci samolotu). *Technika Lotnicza i Astronautyczna*, vol. 35, Oct. 1980, p. 19-22. 10 refs. In Polish.

In the present paper, the influence of a change in power on the flight characteristics of a light aircraft is discussed in terms of the direct influence of the propeller and the influence of the airflow behind the propeller. The increase in dynamic pressure at the tail plane, caused by a change in power, is diagrammed, along with the coefficients defining the downward deviation of the airflow for single- and multiengine aircraft. V.P.

A81-14755 # Fuel saving methods in civil aviation. II (Metody oszczedzania paliwa w lotnictwie komunikacyjnym. II). M. Kawczynski. *Technika Lotnicza i Astronautyczna*, vol. 35, Oct. 1980, p. 24-27. In Polish.

It is pointed out that both ATC and flight crews could help to achieve substantial fuel savings by providing an optimal flight plan and seeking to sustain the optimal flight altitude and cruising speed. This applied also to takeoff and landing procedures and engine idling time. The far from negligible fuel savings which have been achieved by the Japan Air Lines through aircraft weight reduction, particularly, by developing a lighter paint and a lighter floor material, are noted. V.P.

A81-14770 # Turbine airfoil coating refurbishment. E. A. Ault (United Technologies Corp., Pratt and Whitney Aircraft Group, East Hartford, Conn.). *Metallurgical Society of AIME, Fall Meeting, Milwaukee, Wis., Sept. 16-20, 1979, Paper F79-10*. 13 p. Members \$2.00; nonmembers, \$4.00.

The paper deals essentially with three alternate procedures which may be used in the repair or refurbishment of damaged or degraded surface coatings. The easiest consists of a local repair of

damaged areas, using a slurry aluminide coating. The coatings are normally applied with a brush, but require repeated applications prior to diffusion heat treatment to obtain a coating of sufficient thickness. The second alternative involves complete recoating without prior removal of the underlying degraded coating. This procedure is inexpensive but requires thorough cleaning and removal of all traces of surface oxides, etc. The third, most common, procedure requires removal (stripping) of the existing coating. It has the advantage of allowing for other interim repairs prior to recoating.

V.P.

A81-14787 # The development of low-toxic combustion chambers of transport gas turbine engines (Razrabotka i issledovanie malotoksichnykh kamer sgoraniia transportnykh GTD). V. E. Kopylov (Gor'kovskii Avtomobil'nyi Zavod, Gorki, USSR), V. P. Lebedev, Iu. M. Pchelkin (Moskovskoe Vysshie Tekhnicheskoe Uchilishche, Moscow, USSR), and Iu. I. Freiman (Moskovskii Avtomekhanicheskii Institut, Moscow, USSR). *Promyshlennaya Teplotekhnika*, vol. 2, Nov.-Dec. 1980, p. 83-90. In Russian.

The practicality of prior fuel-air mixing for improving the efficiency and reducing the toxicity of combustion chambers was tested in model and full-scale experiments. The emission of toxic components was investigated with different compositions and pressures in air injector-stabilizers and microplume homogeneous hybrid chambers; parameters of low-toxicity combustion chambers of automotive gas-turbine GAZ are specified.

A.T.

A81-14799 # Subsonic parachute design, performance, and similarity laws /scale effects/ - A review of the Institute's activities during the last years. C. Saliaris (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Flugmechanik, Braunschweig, West Germany). *American Institute of Aeronautics and Astronautics, Parachute and Balloon Testing Capabilities Workshop, Edwards AFB, Calif., Oct. 6, 7, 1980, Paper. 27 p.* 12 refs. Research supported by the Bundesministerium der Verteidigung and U.S. Air Force.

A review is given of work accomplished under a data exchange agreement with the U.S. Air Force for the investigation of subsonic parachute design, performance, and similarity laws at the DFVLR Institute for Flight Mechanics. Mathematical procedures and experiments to identify the aerodynamics and flight mechanics of parachute-load systems are discussed as well as the equipment and testing facilities for this purpose. In addition, scale effects were investigated on the basis of an analysis of free-flight tests with flat circular parachutes. It is found that the most significant system parameters are the mass ratio and the Froude number.

B.J.

A81-14924 # Effect of surface roughness over the blade in compressor cascade. V. M. Saxena (Samrat Ashok Technological Institute, Vidisha, India), K. D. Shrivastava (Maulana Azad College of Technology, Bhopal, India), and P. K. Agrawal (Motilal Nehru Regional Engineering College, Allahabad, India). *Institution of Engineers (India), Journal, Mechanical Engineering Division*, vol. 61, Sept. 1980, p. 54-58. 10 refs.

Wind tunnel tests of compressor aerofoils indicate that a marked reduction in the loss coefficient with an increase in the flow deflection is obtained with the addition of surface roughness on the suction surface of the blades of 10% of the chord from the leading edge for all incidence angles. The performance of a cascade with a surface roughness, y , of 0.1 is better than that of a smooth cascade and much better than that of cascades with greater surface roughness ($y = 0.2, 0.3, \text{ and } 1.0$).

V.L.

A81-14945 * A simplified theory of oscillating aerofoils in transonic flow - Review and extension. E. H. Dowell (Princeton University, Princeton, N.J.). *Aeronautical Quarterly*, vol. 31, Nov. 1980, p. 252-282; Appendix, p. 283, 284. 30 refs. Grant No. N8G-2194.

A simplified theory of the dynamic motion of aerofoils of finite thickness in transonic flow is presented which excludes the effect of shock waves on the aerofoil itself and, thus, is restricted to free stream Mach numbers equal to unity or above. Numerical examples are analyzed for two-dimensional steady and unsteady (including transient) aerofoil motion and three-dimensional steady and unsteady flow over delta wings. The effects of flow separation and improvements in Bernoulli's equation and the surface boundary condition are briefly discussed.

V.L.

A81-14959 # Aerodamping of turbine blade vibrations under conditions of flow separation by an inhomogeneous stream (Aerodempfirovaniie kolebanii lopatok turbomashin v usloviakh sryvnyogo obtekaniiia neodnorodnym potokom). A. A. Kaminer, A. V. Dunaev, and A. L. Stel'makh (Akademiia Nauk Ukrainskoi SSR, Institut Problem Prochnosti, Kiev, Ukrainian SSR). *Problemy Prochnosti*, Oct. 1980, p. 28-30. In Russian.

A81-14994 * # Figure control of flexible structures - Optical surfaces of thin deformable primary mirrors. J. F. Creedon and A. J. Ostroff (NASA, Langley Research Center, Hampton, Va.). *Institute of Electrical and Electronics Engineers, Conference on Decision and Control, 19th, Albuquerque, N. Mex., Dec. 10-12, 1980, Paper. 9 p.* 7 refs.

Application of a modal control design technique to achieve discrete control of distributed parameter systems is considered. Results are presented for application of the design technique to achieve diffraction limited performance from the primary mirror of a space telescope and to provide flutter suppression for an aircraft wing.

(Author)

A81-14996 * # Analysis and design of a ceramic nozzle insert for the Langley 8-foot high temperature structures tunnel. J. C. Robinson, D. M. Smith, R. L. Puster, and J. R. Karns (NASA, Langley Research Center, Hampton, Va.). *Joint Army-Navy-NASA-Air Force Interagency Propulsion Committee, Carbon-Carbon Nozzle Technology Meeting, 2nd, U.S. Naval Postgraduate School, Monterey, Calif., Oct. 22, 23, 1980, Paper. 26 p.* 10 refs.

An analysis is presented of various ceramic design concepts intended to improve nozzle throat life and tunnel performance in the hypersonic Langley 8-Foot High-Temperature Structures Tunnel, which uses methane-air combustion products as the wind-tunnel test medium. Calculations of the axial pressure distribution and heating rates in the air-cooled nozzle throat are presented, and desirable characteristics of a ceramic material to be used in the nozzle throat are outlined, including high-temperature strength, thermal shock and erosion resistance, low conductivity and low thermal expansion. Ceramic nozzle throat design concepts are then examined, with attention given to monolithic and layered constructions of cast ceramics, reaction-bonded materials and a fiber-reinforced silica-silica ceramic. Results of a finite element analysis of the temperatures and stresses characteristic of the various concepts are then presented which indicate the monolithic silica-silica and the layered silica-silica/reaction bonded silicon nitride concepts to be the most promising of those investigated.

A.L.W.

A81-15118 The future of training for aerial combat (L'avenir de l'entraînement au combat aérien). Y. Lerendu (Centre de Documentation de l'Armement, Paris, France). *L'Aéronautique et l'Astronautique*, no. 83, 1980, p. 3-10. 13 refs. In French.

The ACMR/1 (Air Combat Maneuvering Range) system integrates for the first time in-flight and on-the-ground training. This paper gives a description of the ACMR/1 system, examines its advantages, and offers an economic analysis. Prospects for future development in this field are outlined.

B.J.

A81-15119 Aging study of the Caravelle 38 (Etude du vieillissement de la Caravelle No. 38). R. Loubet (Société Nationale Industrielle Aérospatiale, Direction des Etudes, Toulouse, France). *L'Aéronautique et l'Astronautique*, no. 83, 1980, p. 26-33. In French.

Structural inspections (fuselage, wings, and empennage) of the 17-year-old Caravelle-38 are described. Attention is given to fatigue and corrosion test results, and to an elaboration of the inspection strategy. B.J.

A81-15167 Air-traffic police steer a new approach. M. Hewish. *New Scientist*, vol. 88, Nov. 27, 1980, p. 566-568.

The paper deals with work being conducted (at a cost of over 100 million pounds) to improve the present ATC system which has proved to be no longer adequate. The main features of this effort are the introduction of modern computers and navigational aids, addition of secondary radars to the existing primary radars, and better ways of organizing flights - for instance by grouping airliners differently as they approach or leave airports. V.P.

A81-15168 The jet engine - Anniversary of a missed opportunity. G. Jones. *New Scientist*, vol. 88, Nov. 27, 1980, p. 570-573.

The article is dedicated to Sir Frank Whittle's invention of the jet engine, fifty years ago. Whittle's life as a RAF officer with great engineering and inventive abilities, is described in detail, together with the problems encountered in patenting and building the jet engine. Chronological events are presented, and a comparison with the German parallel efforts to develop the jet engine during the 1930s is made. V.P.

A81-15269 Choking effects in the blade rows of turbomachines. J. H. Horlock (Salford, University, Salford, Lancs., England). *Journal of Mechanical Engineering Science*, vol. 22, Aug. 1980, p. 161-173. 10 refs.

Three-dimensional flows through cascades of blades are studied, the blading being fully choked internally. Initially the two-dimensional flow through a 'zero stagger, zero camber' blade row, with subsonic entry and exit flow, is described. The radial flows are produced by radial variations in throat area, or by a variety of entry shear flows. Subsequently, the analysis is developed to describe similar fully choked flows through staggered blade rows, particularly the first rotating row of a transonic compressor. (Author)

A81-15326 Business aircraft turbofan technology progress in the 1970's, challenges in the 1980's. F. B. Wallace (AiResearch Manufacturing Company of Arizona, Phoenix, Ariz.). *Society of Automotive Engineers, Turbine Powered Executive Aircraft Meeting, Phoenix, Ariz., Apr. 9-11, 1980, Paper 800601*. 12 p. 6 refs. Members, \$1.95; nonmembers, \$2.95.

Turbofan engines for use in business aircraft have achieved a high level of productivity; technologies developed during the past decade have resulted in good fuel consumption, low noise and emissions, and higher thrust levels. In the present paper, recent progress in materials, aerodynamics, and acoustic technology are reviewed, along with the Garrett/NASA Quiet Clean General Aviation Turbofan (QCGAT) program. Some new technologies are projected, which can be developed in the 1980s to provide improvements in efficiency and productivity, as well as use of alternate fuels and materials, in response to changing world conditions. V.P.

A81-15327 A new high bypass fan for general aviation. J. W. Schrader (Avco Corp., Avco Lycoming Div., Stratford, Conn.). *Society of Automotive Engineers, Turbine Powered Executive Aircraft Meeting, Phoenix, Ariz., Apr. 9-11, 1980, Paper 800602*. 10 p. Members, \$1.95; nonmembers, \$2.95.

A small, high bypass turbofan engine for general aviation incorporates low noise, low emissions, and high propulsive efficiency. Engine tests indicated that the inlet lips did not affect the sea level static engine performance, that the acoustic panels in the inlet and exhaust ducts were satisfactory, and that the combustor modifications for improved emission did not affect aircraft operation. It was concluded that this engine could provide 22% reduction in aircraft weight and a 32% reduction of fuel load. (Author)

A81-15328 Forward swept wings and business airplanes. J. Roskam (Kansas, University, Lawrence, Kan.). *Society of Automotive Engineers, Turbine Powered Executive Aircraft Meeting, Phoenix, Ariz., Apr. 9-11, 1980, Paper 800605*. 10 p. Members, \$1.95; nonmembers, \$2.95.

From aerodynamic and structural considerations it is shown that forward swept wing (FSW) configurations are not only compatible with aft swept wings but have a number of advantages over the latter, particularly with respect to stall characteristics, flutter characteristics, roll control characteristics, and maximum trimmed lift. By combining the FSW with canard and horizontal tail configurations, some interesting designs may evolve. Some fundamental aspects of 'good' aircraft design are demonstrated, using a corporate turboprop as an example. V.P.

A81-15329 Cabin pressure control systems for general aviation aircraft. P. J. Taylor (AiResearch Manufacturing Company of California, Torrance, Calif.). *Society of Automotive Engineers, Turbine Powered Executive Aircraft Meeting, Phoenix, Ariz., Apr. 9-11, 1980, Paper 800606*. 14 p. Members, \$1.95; nonmembers, \$2.95.

A brief history is presented of early cabin pressure control systems, starting with the first production model intended for the Boeing B-29 aircraft and terminating with the systems used on commercial transports of the immediate post-WW II era. The two most significant control and outflow valve design breakthroughs, applicable to post-1950 commercial and general aviation cabin pressure control systems are discussed. An advanced-design automated microprocessor digital cabin pressure control system developed for new-generation jet aircraft is examined. Future cabin pressure control systems for reciprocating and jet-type general aviation aircraft are projected. V.P.

A81-15330 Environmental control systems for executive jet aircraft. G. Payne (AiResearch Manufacturing Company of California, Torrance, Calif.). *Society of Automotive Engineers, Turbine Powered Executive Aircraft Meeting, Phoenix, Ariz., Apr. 9-11, 1980, Paper 800607*. 14 p. Members, \$1.95; nonmembers, \$2.95.

This paper briefly presents the history of environmental control systems for executive jet aircraft and the current state of the art, and a summary of present trends. Bleed air controls, refrigeration equipment, temperature controls, interfaces with engines, and auxiliary power units are discussed. Bleed air control concepts have changed from the early systems where only one engine stage was bled and bleed air did not require precooling, to current systems incorporating precooling, bleed air switching between high- and low-stage engine ports, and double redundancy requirements for certification above 45,000 ft. Refrigeration equipment is reviewed from early simple turbine and fan units to current three-wheel and air bearing designs, through the various recirculation schemes using compound machines, jet pumps, and fans to reduce the bleed air extraction penalties and the use of high-pressure water separation, which, when combined with an air bearing turbine, completely eliminates periodic maintenance. Temperature controls are traced from early vacuum tube and relay types to current pneumatic and solid-state-driven electropneumatic transducers, with a brief discussion of skin temperature sensors. (Author)

A81-15331 Business aircraft APU's. W. M. Owen (Solar Turbines International, San Diego, Calif.). *Society of Automotive*

Engineers, Turbine Powered Executive Aircraft Meeting, Phoenix, Ariz., Apr. 9-11, 1980, Paper 800608. 8 p. Members, \$1.95; nonmembers, \$2.95.

This paper discusses the reasons for using aircraft APU's and why a gas turbine power unit best meets the requirements for aircraft APU's. This paper also reviews the history of APU's in the military, commercial and business aircraft markets. A discussion of the various types of gas turbine APU's is presented and a typical executive APU and secondary power system is described in some detail. Finally, a description of a new small APU, which is currently being certified for small turboprop and jet executive aircraft, is presented. (Author)

A81-15332 Lear fan propulsion system. D. E. Cooney (Lear Avia Corp., Reno, Nev.). *Society of Automotive Engineers, Turbine Powered Executive Aircraft Meeting, Phoenix, Ariz., Apr. 9-11, 1980, Paper 800609.* 9 p. 9 refs. Members, \$1.95; nonmembers, \$2.95.

The paper deals with a propulsion system being developed for the Lear Fan airplane, which uses two turboshaft engines driving a pusher propeller through driveshafts and a combining gear box to provide Mach 0.6 flight. Greater operational safety and improved aircraft efficiency are expected from this system. The design features, installation considerations, operational characteristics of the system, and methods of system analysis are examined. V.P.

A81-15333 Advanced materials for agricultural aircraft. R. O. Boyles (Lockheed-Georgia Co., Marietta, Ga.). *Society of Automotive Engineers, Turbine Powered Executive Aircraft Meeting, Phoenix, Ariz., Apr. 9-11, 1980, Paper 800610.* 20 p. Members, \$1.95; nonmembers, \$2.95.

A study of advanced system design requirements for aerial applications aircraft for agriculture by the Lockheed-Georgia Company under contract to the NASA indicated that advanced composite structures appear to offer both performance and economic advantages when applied to these aircraft. Agricultural aircraft preliminary designs incorporating both conventional and advanced composite structural materials were studied using an aerial application operations analysis model. These studies indicate that an all-composite agricultural aircraft would provide a 6% improvement in mission productivity over that of a conventional all-aluminum aircraft, and essentially equal mission economics. Used selectively in its most effective structural manner, composite materials can provide improvements of the order of 5% in both mission productivity and economics. These studies also indicate that composite materials offer a significant potential for reducing the severe corrosion problems common to aerial application aircraft. (Author)

A81-15334 Thermal expansion molding process for aircraft composite structures. W. S. Cremens (Lockheed-Georgia Co., Marietta, Ga.). *Society of Automotive Engineers, Turbine Powered Executive Aircraft Meeting, Phoenix, Ariz., Apr. 9-11, 1980, Paper 800612.* 15 p. Members, \$1.95; nonmembers, \$2.95.

Thermal expansion molding is a low-cost manufacturing method for fabricating fiber-reinforced-resin composite structures. In its simplest form, the tooling is self-pressurized by thermal expansion of solid 'rubber' blocks inside a closed hard mold box. To provide closer control of molding pressure, hollow rubber blocks may be pressurized from an external source. In the present paper, a procedure for sizing castable rubber tools is described. Several examples of integrally molded complex structures are examined. V.P.

A81-15335 Improvements required in air traffic control to meet increasing general aviation turbine powered aircraft operations. D. D. Thomas (General Aviation Manufacturers Association, Washington, D.C.). *Society of Automotive Engineers, Turbine Powered Executive Aircraft Meeting, Phoenix, Ariz., Apr. 9-11, 1980, Paper 800614.* 7 p. Members, \$1.95; nonmembers, \$2.95.

This paper discusses the effect of increases in the general aviation turbine power fleet on airports, air traffic control, and weather information systems. Six thousand general aviation jets and

7300 general aviation turbo-props are projected for 1990, and the combined flight time of 7.2 million hours will nearly equal the 8.2 million hours for the forecast fleet of 3100 air carrier airplanes. Methods of increasing automation in air traffic control and weather service are examined, and the problem of growth in airport capacity in metropolitan areas is investigated. R.C.

A81-15336 Aircraft collision avoidance and separation assurance. C. D. Wright (Aircraft Owners and Pilots Association, Washington, D.C.). *Society of Automotive Engineers, Turbine Powered Executive Aircraft Meeting, Phoenix, Ariz., Apr. 9-11, 1980, Paper 800616.* 6 p. Members, \$1.95; nonmembers, \$2.95.

It is recommended that the FAA continue the development of the Beacon Collision Avoidance System (BCAS) concept, because the BCAS will work effectively against any aircraft equipped with modern transponders and encoders. The exploration of DABS as the air-to-air link of the BCAS and for future use with the automated AT-C system is also supported. V.P.

A81-15337 Vibration aspects of small turbine engines in aircraft installations. M. Botman (Pratt and Whitney Aircraft of Canada, Ltd., Longueuil, Quebec, Canada). *Society of Automotive Engineers, Turbine Powered Executive Aircraft Meeting, Phoenix, Ariz., Apr. 9-11, 1980, Paper 800617.* 10 p. 12 refs. Members, \$1.95; nonmembers, \$2.95.

Vibrations experienced in PT6 and JT15D installations are reviewed. The JT15D turbojet vibrations are due primarily to rotor unbalances which may produce significant responses at some of the critical speeds. The PT6 turboprop vibrations are mainly caused by the propeller and, therefore, occur at low frequencies. PT6 gearbox vibrations at very high frequencies are of interest in the production process. Typical vibration problems are discussed. (Author)

A81-15338 Research on a high work axial gas generator turbine. K. V. Patel (Pratt and Whitney Aircraft of Canada, Ltd., Longueuil, Quebec, Canada). *Society of Automotive Engineers, Turbine Powered Executive Aircraft Meeting, Phoenix, Ariz., Apr. 9-11, 1980, Paper 800618.* 9 p. 5 refs. Members, \$1.95; nonmembers, \$2.95. Research supported by the Defence Research Board, Department of Industry, Trade and Commerce, and Pratt and Whitney Aircraft of Canada.

A previous phase of the Canadian government and in-house sponsored turbine research program established guide lines for the current design of a high-work axial gas turbine, capable of operating at a high total pressure ratio of 3.9. Aerodynamic results from tests on this research turbine are presented in this paper. A number of variants of this basic design was also tested, which indicated the effect on aerodynamic performance of geometric changes such as vane tangential lean, rotor tip partial shrouds and tip clearance. (Author)

A81-15339 Evolutions in business jet fuel systems as seen in the Falcon Jet series. W. L. Hubbard (Falcon Jet Corp., Teterboro, N.J.). *Society of Automotive Engineers, Turbine Powered Executive Aircraft Meeting, Phoenix, Ariz., Apr. 9-11, 1980, Paper 800621.* 6 p. Members, \$1.95; nonmembers, \$2.95.

The evolution of the fuel systems of business jet aircraft over the past 20 years is illustrated by the fuel systems of the Falcon Jet series. The wing and fuselage fuel tanks and associated pressurization systems, primary and secondary fuel transfer systems, engine feed system and fuel-defuel system of the Falcon 20, a twin-engine jet first constructed in 1962, are examined in detail, and simplifications to the system represented by the design of the Falcon 10 in 1969 are indicated. The fuel system of the Falcon 50B, which first flew in 1978, is then presented, with attention given to developments in the wing and fuselage fuel tanks, primary and secondary fuel transfer systems, engine feed systems and transfer system of the three-engine jet. The importance of system reliability in the design of the fuel systems is pointed out, and future advances in the area of fuel system instrumentation are predicted. A.L.W.

A81-15340 Aircraft fire and overheat detection and extinguishment. J. J. Waldman (Fenwal, Inc., Ashland, Mass.). *Society of Automotive Engineers, Turbine Powered Executive Aircraft Meeting, Phoenix, Ariz., Apr. 9-11, 1980, Paper 800622*. 14 p. Members, \$1.95; nonmembers, \$2.95.

This paper presents the historical evolution of aircraft fire and overheat detection devices and systems, as well as extinguishing equipment. It details briefly that equipment currently in general use and near term future considerations. (Author)

A81-15341 Discrete Address Beacon System - The obvious alternative. P. D. Hodgkins (FAA, Systems Research and Development Service, Washington, D.C.). *Society of Automotive Engineers, Turbine Powered Executive Aircraft Meeting, Phoenix, Ariz., Apr. 9-11, 1980, Paper 800625*. 9 p. Members, \$1.95; nonmembers, \$2.95.

The Discrete Address Beacon System is a major development program to upgrade the Air Traffic Control (ATC) system of the future. It provides improved ATC automation services and a ground based collision avoidance system - Automatic Traffic Advisory and Resolution Services (ATARS). It is totally compatible with the present civil/military ATC system and reduces the present RF interference environment. It has an integral data link system to service the ATARS and provide other ATC related services. The ATARS is being developed for use in high aircraft density airspace such as major airport terminals. It is concluded that DABS is the obvious alternative to meet the air traffic control needs of the future. (Author)

A81-15342 Flight management systems - Central ingredient of the 1980's avionics shipset. G. W. Tomsic (Rockwell International Corp., Collins General Aviation Div., Cedar Rapids, Iowa). *Society of Automotive Engineers, Turbine Powered Executive Aircraft Meeting, Phoenix, Ariz., Apr. 9-11, 1980, Paper 800626*. 8 p. Members, \$1.95; nonmembers, \$2.95.

Currently, a Flight Management System (FMS) is capable of managing an extensive set of tasks to support a direct flight from origin to destination. In the present paper, it is seen that FMS will be extensively used in the aircraft cockpit of the 1980s. By providing the pilot with a consolidated system to simplify the flight management task while optimizing aircraft operating time and saving fuel, these systems must be considered a necessary ingredient in the 1980's avionics. Their greatest asset may be their ability to reduce the time the pilot spends on tasks that detract him from his primary objective, that of ensuring safe aircraft flight. V.P.

A81-15343 Future trends in automatic flight control systems. P. Rauschelbach (Sperry Flight Systems, Avionics Div., Phoenix, Ariz.). *Society of Automotive Engineers, Turbine Powered Executive Aircraft Meeting, Phoenix, Ariz., Apr. 9-11, 1980, Paper 800627*. 10 p. Members, \$1.95; nonmembers, \$2.95.

The technology and configuration of today's business jet autopilots are reviewed and their future developments are examined. It is seen that the future development will build on present day configurations, using technological advancements, such as microprocessors, memory systems, solid-state sensors, and electrical displays. Architecture of future autopilots will be further integrated with peripheral systems, dual redundant in configuration, and interconnected on a digital bus, and will utilize solid-state displays. Operational features will include new modes, improved reliability, and self-monitoring and maintenance tests. V.P.

A81-15344 Test results from an analytically designed axial compressor stage of 1.65:1 pressure ratio. T. Yoshinaka and A. D. LeBlanc (Pratt and Whitney Aircraft of Canada, Ltd., Longueuil, Quebec, Canada). *Society of Automotive Engineers, Turbine Powered Executive Aircraft Meeting, Phoenix, Ariz., Apr. 9-11, 1980, Paper 800629*. 13 p. 16 refs. Members, \$1.95; nonmembers, \$2.95. Research sponsored by the Department of Industry, Trade and Commerce.

A single stage axial compressor was designed for 1.53:1 pressure ratio using a quasi-three-dimensional design method which consists of an iterative calculation between the radial equilibrium and blade-to-blade analyses including surface boundary layers. This stage was tested in a research gas generator. Based on stator exit traverses, the research stage reached 87.8% adiabatic efficiency and 1.65:1 pressure ratio at the design speed. The overall compressor efficiency improved significantly at high speeds in comparison with the existing 3A+1C compressor, without any obvious performance deterioration at partial velocity. (Author)

A81-15345 Experimental investigations to fully map the flow field around a wind tunnel model of a transport airplane. P. M. Stremel (Boeing Commercial Airplane Co., Renton, Wash.). *Society of Automotive Engineers, Turbine Powered Executive Aircraft Meeting, Phoenix, Ariz., Apr. 9-11, 1980, Paper 800630*. 9 p. Members, \$1.95; nonmembers, \$2.95.

Results are described of research conducted to fully map the three-dimensional flow field associated with a typical transport airplane. Details of the method employed to map the flow field; pictures of the longitudinal development of forebody vortices, and a comparison of the experimental results with empirical methods are presented. The results also include a graphic description of the wake propagation behind deflected spoiler panels. (Author)

A81-15374 # Aerospace highlights 1980. *Astronautics and Aeronautics*, vol. 18, Dec. 1980, p. 18-20, 22-26, 28-42 (64 fig.).

A series of special articles prepared by AIAA technical committees on current developments in aerospace technology is presented. Topics discussed include aircraft design, air transportation systems, communications systems, computer systems, ground testing and simulation, life sciences and systems, missile systems, space processing, space sciences and astronomy, structures, terrestrial energy systems, plasmadynamics, and guidance and control. B.J.

A81-15375 # A survey on airbreathing propulsion education. R. P. Shreeve (U.S. Naval Postgraduate School, Monterey, Calif.) and G. C. Oates (Washington, University, Seattle, Wash.). *Astronautics and Aeronautics*, vol. 18, Dec. 1980, p. 114-119, 129.

Results of a questionnaire relating to the role of the university in airbreathing propulsion education are discussed. The survey has shown that ABP education is in a fairly healthy condition. The traditional role of the universities generally satisfies the ABP community. B.J.

A81-15388 # Calculation of the nonlinear aerodynamic characteristics of finite-span wing (Raschet nelineinykh aerodinamicheskikh kharakteristik kryla konechnogo razmakha). V. A. Algazin. *PMTF - Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki*, July-Aug. 1980, p. 97-107. 13 refs. In Russian.

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

A81-15623 The FFCC cockpit of the A310 is practically defined (Le cockpit 'FFCC' de l'A.310 est pratiquement défini). G. Collin. *Air et Cosmos*, vol. 18, Nov. 15, 1980, p. 26-29. In French.

The development of the FFCC (Forward Facing Crew Concept) cockpit for the A310 Airbus is described. The current status of the project is examined with attention given to the operational FFCC simulator at Toulouse, the primary flight display, and the navigation display. B.J.

A81-15681 Integrated flight displays. S. N. Roscoe (New Mexico State University, Las Cruces, N. Mex.) and J. E. Eisele. In: *Aviation Psychology*. Ames, Iowa State University Press, 1980, p. 48-61.

Various types of integrated flight display systems are described. The display systems are classified according to the point of view presented, the mode of information coding, and the method of display presentation. Forward-looking vertical situation displays (VSDs) are examined, together with downward-looking horizontal situation displays, and sideways-looking flight profile displays. The modes of information coding are shown to range from direct literal optional projections through electronically scanned TV, IR, and radar pictures to fully synthetic computer-generated visual scenes. The displays classified according to the method of presentation include head-down direct-view displays, head-up projected displays, helmet-mounted displays, pictorial VSDs, literal VSDs, and analog VSDs. Display-control synthesis is briefly considered. F.G.M.

A81-15682 Rate-field displays. L. Swartzendruber and S. N. Roscoe (New Mexico State University, Las Cruces, N. Mex.). In: *Aviation Psychology*. Ames, Iowa State University Press, 1980, p. 62-67.

The paper discusses the development and possible uses of rate fields, which are unitary display fields on which rate information is conspicuously displayed by means of gross temporal or spatial changes of the field. An experiment is described in which airspeed and runway rate-field displays were concurrently tracked by relatively inexperienced pilots using hand controls. It is shown that the presence of rate fields reduces rms tracking error, particularly with the runway display, but that ambiguous direction-of-motion relations degrade the effectiveness of rate fields. F.G.M.

A81-15683 Display motion relationships. S. N. Roscoe (New Mexico State University, Las Cruces, N. Mex.), S. L. Johnson and R. C. Williges. In: *Aviation Psychology*. Ames, Iowa State University Press, 1980, p. 68-81.

The motion relationships of dynamic displays are discussed with reference to the differences between earth coordinates and aircraft coordinates. Display frequency separation is also considered. Experimental results are examined which show that the frequency-separation principle is an ideal candidate for use both by pilots in training and by those with higher levels of experience. F.G.M.

A81-15684 Display-control synthesis. S. N. Roscoe (New Mexico State University, Las Cruces, N. Mex.). In: *Aviation Psychology*. Ames, Iowa State University Press, 1980, p. 82-94.

The use of computers to achieve an optimum display/control system is discussed. Design alternatives are considered with respect to lower orders of control, integrated pictorial displays, pursuit and compensatory steering, flight path prediction, command guidance, and predicting and quickening. Rate fields as flight directors are examined. Research and development results are reviewed by presenting integrated computer-generated display configurations for several standard phases of a representative flight mission. F.G.M.

A81-15686 Time-compressed displays for target detection. L. A. Scanlan and S. N. Roscoe (New Mexico State University, Las Cruces, N. Mex.). In: *Aviation Psychology*. Ames, Iowa State University Press, 1980, p. 108-124.

This paper reviews studies which were designed to investigate the interactive effects of critical spatial and temporal variables on the detection of moving targets in the presence of random noise and fixed clutter on visual time-compression displays. Because it is the appearance of motion that impresses an observer subjectively, and because detection performance correlates highly with ratings of motion quality, the superior performance with infinite time compression, in which motion disappears, still remains a puzzle; it is suggested that part of the answer involves the maximization of the target duty factor. Time-compression ratios that retain the phenome-

non of apparent motion continue to be used effectively in several practical applications for which the mere spatial integration of several successive image frames would be ineffective. One of the most notable of these applications is the detection and tracking of earth satellites against a background of stars by the U.S. Air Force. P.T.H.

A81-15693 Transfer and cost effectiveness of ground-based flight trainers. S. N. Roscoe (New Mexico State University, Las Cruces, N. Mex.). In: *Aviation Psychology*. Ames, Iowa State University Press, 1980, p. 194-203.

A representation of the complex relationships between transfer of training and simulator cost as differential functions of response versus stimulus fidelity is discussed. Negatively accelerating increments in transfer, either positive or negative, are associated with increasing stimulus fidelity at exponentially accelerating costs. Negative transfer is uniquely associated with positive stimulus fidelity paired with negative response fidelity, an example of which might be highly faithful dynamic responses to control inputs but with reversed direction-of-motion relationships. The rapid decay in either positive or negative transfer reflects the empirical finding that increasingly complex military systems, because of their unreliability, become virtually impossible to maintain and use effectively. The selection of training devices is discussed in the light of these considerations. P.T.H.

A81-15695 Visual cue requirements in contact flight simulators. S. N. Roscoe (New Mexico State University, Las Cruces, N. Mex.) and J. E. Eisele. In: *Aviation Psychology*. Ames, Iowa State University Press, 1980, p. 217-226.

A multivariate analysis experiment was conducted to study visual cue requirements in contact flight simulators. Regression equations for 21 dependent variables were obtained. It is found that the pictorial representation of synthetic guidance cues, such as a modified 'highway in the sky', within a dynamic visual display would enhance a student's landing performance in a simulator. In the absence of augmented guidance cues, the presence of a runway outline contributes most to correct responses at far and medium ranges from touchdown, whereas at near ranges the presence of a runway centerline becomes the dominant basis for correct judgments. P.T.H.

A81-15696 Visual cue augmentation in contact flight simulation. G. Lintern and S. N. Roscoe (New Mexico State University, Las Cruces, N. Mex.). In: *Aviation Psychology*. Ames, Iowa State University Press, 1980, p. 227-238.

Studies on visual cue augmentation are reviewed with regard to simulation of dynamic visual scenes, adaptive simulator training with augmented feedback, and interactions between augmented feedback and intrinsic feedback. Particular attention is given to an experiment performed at the University of Illinois which demonstrated the transfer effectiveness of the automatic presentation and withdrawal of guidance cues in a simple skeletal computer-generated visual landing scene, in lieu of the verbal and manual assistance normally provided by the flight instructor during initial landing training. It is suggested that displays could be more effective for landing training if they were augmented with cues that provide guidance information not present in the real-world visual scene; further improvement might be expected from the adaptive presentation of flight-path prediction symbology. P.T.H.

A81-15699 The evolution of operational systems. D. B. Beringer and S. N. Roscoe (New Mexico State University, Las Cruces, N. Mex.). In: *Aviation Psychology*. Ames, Iowa State University Press, 1980, p. 259-269.

The process of system analysis, synthesis, and evaluation is considered as part of the greater continuing process of system evolution. It is shown that in applying the method to the upgrading of a particular real-world system both common and unique considerations and constraints will inevitably test the robustness of the approach. A prime example of an evolving real-world aviation

problem calling for a systematic solution is the automation of the National Airspace System (NAS) and the consequent change of the role of pilots and air traffic controllers. The automation of the NAS is discussed with regard to operational constraints, experimental strategy, function allocation, and implementation strategy. P.T.H.

A81-15702 **Developments in the area of cryo-wind tunnel technology by the DFVLR (Arbeiten der DFVLR auf dem Gebiet der Kryo-Windkanaltechnik).** F. Maurer (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für experimentelle Strömungsmechanik, Göttingen, West Germany), G. Viehweger (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Hauptabteilung Niedergeschwindigkeitswindkanäle, Cologne, West Germany), and W. Lorenz-Meyer (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für experimentelle Strömungsmechanik, Cologne, West Germany). *DFVLR-Nachrichten*, Nov. 1980, p. 8-12. In German.

Research into new wind tunnel assemblies, which in contrast to available models simulate free flight conditions, is presented. In addition to the Mach number, the Reynolds number is taken into consideration for the similarity of the friction level and the flow separation. The German-Dutch subsonic wind tunnel (DNW) approaches the desired results, though the drive power increases not only with the size but grows to the third power of the speed. To obtain transonic speed would require large assemblies, and pressure limits in the tunnel are present. Further increases in the Reynolds number are achieved through a sharp decrease in temperature with cryotechnology. R.C.

A81-15703 **Testing stand for the measurement of non-steady aerodynamic forces in the transonic wind tunnel at Göttingen (Versuchsstand zur Messung instationärer Luftkräfte im Transkanal in Göttingen).** E. Schmidt (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Aeroelastik, Göttingen, West Germany). *DFVLR-Nachrichten*, Nov. 1980, p. 13-16. In German.

An experimental station for research into nonsteady aerodynamic forces is discussed in which aircraft models can be moved in transonic wind tunnel flow. Emphasis is placed on wind tunnel measurements for aircraft of high maneuverability, especially military aircraft. Accurate measurements of nonsteady aerodynamic force are significant at large angles of incidence and at flight speeds near the sound barrier. The construction of a single degree of freedom balance for harmonic pitch and yaw movement is presented. The measurement and control circuitry is examined and illustrated in a block diagram. R.C.

A81-15704 **Roll and spin measurements in the low speed wind tunnel at Braunschweig (Roll- und Trudelmessungen im Niedergeschwindigkeits-Windkanal in Braunschweig).** H. Otto (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Hauptabteilung Niedergeschwindigkeits-Windkanäle, Braunschweig, West Germany). *DFVLR-Nachrichten*, Nov. 1980, p. 16-18. In German.

The measurement of aerodynamic forces and moments on aircraft models that undergo roll and spin movements in wind tunnel jets is examined. The model carries out a uniform rotary motion on an axis in the direction of the wind jet. A roll movement is performed when the axis of rotation serves as the reference point of the model. A spin movement occurs when the reference point lies away from the axis of rotation. The assembly has the advantage that a change of the angle of pitch between the model and the axis of rotation can be performed by remote control without bringing the assembly to a standstill. R.C.

A81-15705 **The aerodynamics of airfoil boats (Zur Aerodynamik des Stauflügelflugzeugs).** D. Steinbach (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für theoretische Strömungsmechanik, Göttingen, West Germany). *DFVLR-Nachrichten*, Nov. 1980, p. 19-22. In German.

The design and testing of airfoil boats is discussed. The test models are based on a slightly modified Clark-Y profile with an

11.7% thickness of profile and a straight underside. Lift coefficients are compared at various angles of inclination of the wing profile. In tests with a model of the X-114 airfoil boat, a decrease in drag resistance is observed as the model approaches the base plate. Variations in the air flow under the air foil are investigated, and measured lift and angle of pitch coefficients are examined in relation to theoretical frictionless calculations. R.C.

A81-15706 **Research on mechanical flight problems in aircraft parachute systems (Auftragsforschung an flugmechanischen Problemen von Flugkörper-Fallschirm-Systemen).** D. Münscher and P. Hamel (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Flugmechanik, Braunschweig, West Germany). *DFVLR-Nachrichten*, Nov. 1980, p. 24-28. In German.

The use of parachute systems for deceleration, stabilization, and landing of aircraft is discussed. Investigations are performed on aircraft with multiple payloads, unstable cylindrical aircraft, aircraft with salvageable stages, and unmanned devices. A series of geometrically and mechanically similar experimental models with a range of 5 to 250 kg has been developed for tests under various conditions. Test models are equipped to measure acceleration, angular velocity, and flight attitude, along with parachute inflation forces and pressure distribution. The relation between the parachute rope length and the angle of pitch of the load is illustrated. R.C.

A81-15719 # **Fuel economy and extension of the service life of aircraft gas turbine engines (Rasshirenie resursov i ekonomiiia topliv dlia aviatsionnykh gazoturbinnykh dvigatelei).** A. F. Gorenkov, E. P. Seregin, I. G. Kliuiko, and E. I. Domkin. *Khimiia i Tekhnologiya Topliv i Masel*, no. 11, 1980, p. 38-40. In Russian.

The paper deals with current work conducted in an effort to reduce the fuel consumption and extending the service life of aircraft gas turbine engines by optimizing engine design and fuel production, and introducing improved technological and organizational measures. Some aspects of the substitution of liquid hydrogen for hydrocarbon fuels are examined. V.P.

A81-15720 # **Substantiation of oil change periods for ship and aircraft turbine engines (Obosnovanie srokov smeny masel dlia sudovykh i aviatsionnykh turbinnnykh dvigatelei).** G. T. Novosartov, A. V. Vilenkin, P. A. Mikheichev, and O. P. Kuliaev. *Khimiia i Tekhnologiya Topliv i Masel*, no. 11, 1980, p. 47, 48. 6 refs. In Russian.

Studies of the dynamics of oil quality changes have shown that viscosity and the acid number undergo appreciable changes, whereas all other Q factors remain at an acceptable level during turbine engine operation. Two formulas proposed by Kuliaev for calculating the actual quality changes of oils are analyzed. V.P.

A81-15796 * **Computer-aided roll pass design in rolling of airfoil shapes.** N. Akgerman, G. D. Lahoti, and T. Altan (Battelle Columbus Laboratories, Columbus, Ohio). *Journal of Applied Metalworking*, vol. 1, July 1980, p. 30-40. 9 refs. Contract No. NAS3-20380.

This paper describes two computer-aided design (CAD) programs developed for modeling the shape rolling process for airfoil sections. The first program, SHPROL, uses a modular upper-bound method of analysis and predicts the lateral spread, elongation, and roll torque. The second program, ROLPAS, predicts the stresses, roll separating force, the roll torque and the details of metal flow by simulating the rolling process, using the slab method of analysis. ROLPAS is an interactive program; it offers graphic display capabilities and allows the user to interact with the computer via a keyboard, CRT, and a light pen. The accuracy of the computerized models was evaluated by (a) rolling a selected airfoil shape at room temperature from 1018 steel and isothermally at high temperature from Ti-6Al-4V, and (b) comparing the experimental results with computer predictions. The comparisons indicated that the CAD systems, described here, are useful for practical engineering purposes and can be utilized in roll pass design and analysis for airfoil and similar shapes. (Author)

A81-15798 Aerodynamic sound generated by a slotted trailing edge. M. S. Howe (Bolt Beranek and Newman, Inc., Cambridge, Mass.). *Royal Society (London), Proceedings, Series A - Mathematical and Physical Sciences*, vol. 373, no. 1753, Nov. 25, 1980, p. 235-252. 16 refs.

The theory of the generation of sound by turbulent flow over a trailing edge flap of an airfoil or guidevane is analyzed by using a narrow slot which separates the flap from the airfoil. The configuration is modeled by a semiinfinite rigid plate with a slot at an arbitrary, finite distance from the edge; the aerodynamic sound problem is formulated in terms of an integral equation solved in closed form when the width of the slot is small compared with the acoustic wavelength and the chord of the flap. It was found that at low subsonic mean flow Mach numbers, the slot reduces the level of the radiated noise provided the product of the characteristic wave number and the chord of the flap does not exceed 10. A.T.

A81-15880 # Method for reducing the tangential velocities in aircraft trailing vortices. H. C. Smith (Pennsylvania State University, University Park, Pa.). *Journal of Aircraft*, vol. 17, Dec. 1980, p. 861-866. 17 refs.

A method is presented to reduce the tangential velocities in the trailing vortex system shed from an airplane wing. The device employed is a porous section of the wing at the tip which essentially tends to equalize the pressure on the upper and lower surfaces. Experiments were conducted on a full-scale aircraft in flight and vorticity measured by probes devised specifically for this purpose. Results showed significant reduction in tangential velocities close behind the wing and to a lesser degree far downstream. Controllable porosity is suggested as a means of reducing the vortex tangential velocities and subsequent potential induced rolling moment imposed on a following aircraft. (Author)

A81-15881 * # Numerical lifting line theory applied to drooped leading-edge wings below and above stall. J. D. Anderson, Jr. (Maryland, University, College Park, Md.), S. Corda, and D. M. Van Wie. *Journal of Aircraft*, vol. 17, Dec. 1980, p. 898-904. 20 refs. Research supported by the Minta Martin Fund for Aeronautical Research; Grant No. NsG-1570.

A numerical iterative solution to the classical Prandtl lifting-line theory, suitably modified for poststall behavior, is used to study the aerodynamic characteristics of straight rectangular finite wings with and without leading-edge droop. This study is prompted by the use of such leading-edge modifications to inhibit stall/spins in light general aviation aircraft. The results indicate that lifting-line solutions at high angle of attack can be obtained that agree with experimental data to within 20%, and much closer for many cases. Therefore, such solutions give reasonable preliminary engineering results for both drooped and undrooped wings in the poststall region. However, as predicted by von Karman, the lifting-line solutions are not unique when sectional negative lift slopes are encountered. In addition, the present numerical results always yield symmetrical lift distributions along the span, in contrast to the asymmetrical solutions observed by Schairer in the late 1930's. Finally, a series of parametric tests at low angle of attack indicate that the effect of drooped leading edges on aircraft cruise performance is minimal. (Author)

A81-15882 # Single-parameter terrain classification for terrain following. E. P. Cunningham (Johns Hopkins University, Laurel, Md.). *Journal of Aircraft*, vol. 17, Dec. 1980, p. 909-914. 6 refs. Contract No. N00024-18-C-5384.

A method of classifying terrain shows that the probability of crashing for a terrain-following missile is affected by the variances of missile altitude error and error rate. Linearized studies of the missile control system interacting with stationary terrain statistics show that the altitude error and error rate vary with the standard deviation of the terrain; this suggests that even for the nonlinear, nonstationary case, the ratio of the standard deviation of the terrain to the terrain correlation length affects the missile terrain-following performance. The actual digitized terrain processed to obtain moving estimates of

this ratio provides a single-parameter classification method for various terrains; simulated flights over strips of terrain confirmed that the missile encountered difficulties when the ratio had a maximum value. A.T.

A81-15883 # Lift effect on transonic wind-tunnel blockage. Y. Y. Chan (National Research Council, High Speed Aerodynamics Laboratory, Ottawa, Canada). *Journal of Aircraft*, vol. 17, Dec. 1980, p. 915, 916. 6 refs.

Perturbation analysis of wind-tunnel wall interference to the airfoil in transonic flows is used to determine an effective flow displacement due to lift as induced by the nonlinear compressibility condition. This effective flow displacement is significant compared to that due to the geometrical area of the airfoil, especially at high lift and a freestream Mach number close to unity. An approximate relation in the form of an effective doublet is derived for this effect; it can be applied directly in the blockage calculation. B.J.

A81-15887 # Aerodynamic effects of body slots on a guided projectile with cruciform surfaces. W. H. Appich, Jr. and R. E. Wittmeyer (Martin Marietta Aerospace, Orlando, Fla.). *American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Boulder, Colo., Aug. 6-8, 1979, Paper 79-1658.* *Journal of Spacecraft and Rockets*, vol. 17, Nov.-Dec. 1980, p. 522-528. 7 refs. Grant No. DAAA09-76-C-2001.

Aerodynamic characteristics are examined for a cannon-launched guided projectile with internally stored cruciform wings and tails. Effects of longitudinal body slots required for wings and tail deployment are emphasized. The control section design permits internal air flow longitudinally and transversely between slots during flight; however, no flow exists through the sealed projectile base. Wind tunnel test data for a full-scale model are presented for Mach numbers of 0.5 and 1.5. Body-alone, body-tail, body-wing, and body-wing-tail configurations were tested with open and closed body slots. Compared to a closed body, open slots change normal force and aerodynamic center of pressure in complex ways, depending upon configuration, Mach number, roll angle, and angle of attack. Open slots also reduce untrimmed lift/drag ratio as much as 33% at low angles of attack, due primarily to severe increases in 'effective' forebody drag. (Author)

A81-15894 * # Discrete-continuous variable structural synthesis using dual methods. L. A. Schmit (California, University, Los Angeles, Calif.) and C. Fleury. *AIAA Journal*, vol. 18, Dec. 1980, p. 1515-1524. 12 refs. Grant No. NsG-1490.

Approximation concepts and dual methods are extended to solve structural synthesis problems involving a mix of discrete and continuous sizing type of design variables. Pure discrete and pure continuous variable problems can be handled as special cases. The basic mathematical programming statement of the structural synthesis problem is converted into a sequence of explicit approximate primal problems of separable form. These problems are solved by constructing continuous explicit dual functions, which are maximized subject to simple nonnegativity constraints on the dual variables. A newly devised gradient projection type of algorithm called DUAL 1, which includes special features for handling dual function gradient discontinuities that arise from the discrete primal variables, is used to find the solution of each dual problem. Computational implementation is accomplished by incorporating the DUAL 1 algorithm into the ACCESS 3 program as a new optimizer option. The power of the method set forth is demonstrated by presenting numerical results for several example problems, including a pure discrete variable treatment of a metallic swept wing and a mixed discrete-continuous variable solution for a thin delta wing with fiber composite skins. (Author)

A81-15895 # Instantaneous velocity measurements in a periodically pulsed plane turbulent jet. J. C. S. Lai and J. M. Simmons (Queensland, University, Brisbane, Australia). *AIAA Journal*, vol. 18, Dec. 1980, p. 1532-1534. 13 refs. Australian Research Grants Committee Grant No. F77/15026.

A constant-temperature hot-wire anemometer was used to measure the velocity in a periodically pulsed plane turbulent jet. Instantaneous velocity measurements across the jet and up to 100 nozzle widths downstream of the nozzle were obtained. Measurements in the steady jet indicate that the rate of decay of the centerline velocity, the spreading rate, and the momentum conservation all fall within the ranges of values reported in the literature. Hence the steady jet in this study is a good basis for unsteady experiments. At every streamwise location and for all pulsation frequencies and amplitudes, the mean profiles collapse onto the corresponding steady jet profile. However, this possible unsteady effect is not conclusive enough to provide a test for the evaluation of theoretical predictions. B.J.

A81-15896 * # Numerical solutions of transonic flows by parametric differentiation and integral equation techniques. N. T. Sivaneri and W. L. Harris (MIT, Cambridge, Mass.). *AIAA Journal*, vol. 18, Dec. 1980, p. 1534-1536. 15 refs. Grant No. NSG-1219.

The paper discusses results of an exploratory study of the advantages obtained by combining integral equation methods with the method of parametric differentiation in the treatment of transonic flow problems. In the proposed method, the nonlinear unsteady transonic flow equation for small perturbations is transformed into a linear equation by the use of the method of parametric differentiation. The linear equation is split into a pair of weakly coupled partial differential equations by writing the transformed perturbation potential as the sum of a steady component and an unsteady component. The solution of the steady equation as an integral equation is based on Ogana's treatment (1978). As a test case, the formulation is applied to predict the steady transonic flow over a nonlifting parabolic-arc airfoil. B.J.

A81-15897 # Separation of laminar boundary layer induced by aerodynamic interference. E. E. Covert (MIT, Cambridge, Mass.). *AIAA Journal*, vol. 18, Dec. 1980, p. 1537, 1538. 7 refs.

A theoretical analysis is presented of separation on a surface covered by a laminar boundary layer. A nearby body causes a pressure gradient on the first surface that, under circumstances, will lead to boundary layer separation on the first surface. For the case of flow in a wind tunnel containing a large model, when self-streamlined wind tunnel walls are used to reduce wall interference, the induced separation is most likely at high-induced pressure gradients near the angle of attack where the airfoil stalls. The study is based on the use of simple shapes with laminar boundary layers on the extended surface and is conducted for two-dimensional incompressible flow. Results are presented which show the conditions under which external-flow-induced separation is possible. B.J.

A81-15900 * # Thin-layer approximation for three-dimensional supersonic corner flows. C. M. Hung and S. S. Kurasaki (NASA, Ames Research Center, Moffett Field, Calif.). *AIAA Journal*, vol. 18, Dec. 1980, p. 1544-1546. 12 refs.

The thin-layer approximation is extended to an axial corner that is formed by the intersection of two perpendicular plates, one of which has an inclination angle with respect to the free stream. A computer code developed by Hung and MacCormack (1978) is modified for the thin-layer approximation, and a case with Mach 5.9 and a wedge angle of 6 deg is computed. In addition, it is shown that it is not necessary to solve the complete Navier-Stokes equations for a three-dimensional high-Reynolds-number corner flow. B.J.

A81-16019 # The measurement of pressure distribution around a parachute canopy. D. S. Jorgensen and D. J. Cockrell (Leicester, University, Leicester, England). *American Institute of Aeronautics and Astronautics, Parachute and Balloon Testing Capabilities Workshop, Edwards AFB, Calif., Oct. 6, 7, 1980, Paper*. 14 p. 5 refs. Ministry of Defence Contract No. 2026/019XR/EP.

Means for the accurate measurement of pressure distributions over cruciform parachute canopies at near full-scale Reynolds numbers are investigated. Following a review of the aerodynamic

characteristics that can be derived from pressure distribution measurements, existing techniques for distribution measurements are evaluated, with attention given to the method of static tappings and the use of strain-gage-type pressure transducers. Refinements made to the technique of measuring the pressure distribution by the introduction of miniature transducers with strain gage resistors vacuum etched onto the diaphragms are presented, and an experimental application of the transducers in a wind tunnel investigation is outlined. The use of pressure transducers in full-scale in-flight tests, where problems of canopy shape modeling, Reynolds number comparability, blockage and interference encountered in wind tunnel testing are absent, is then considered. A.L.W.

A81-16020 # Preliminary consideration of parameter identification analysis from parachute aerodynamic flight test data. D. J. Cockrell (Leicester, University, Leicester, England). *American Institute of Aeronautics and Astronautics, Parachute and Balloon Testing Capabilities Workshop, Edwards AFB, Calif., Oct. 6, 7, 1980, Paper*. 13 p. 11 refs.

The application of parameter identification analysis, a sophisticated mathematical modelling technique, is examined as a means for determining unknown data in air mass calculations for parachute performance. To determine the unknown parameters, the parachute-store-associated air mass system is excited by a suitable input, as the input and system response are measured. Values for the parameters are then inferred, with the requirement that the dynamic model response to the input agrees with the actual system response. The problem is complicated by the presence of additive instrument noise, static noise, and modelling errors. Procedures for gathering parachute flight by data by Cockrell and Eaton (1979) are also reported. R.C.

A81-16119 Development of specifications from measured environments. R. N. Hancock (Vought Corp., Dallas, Tex.). (*Society of Environmental Engineers, Symposium on Environmental Engineering Today, London, England, May 9-11, 1979.*) *Society of Environmental Engineers, Journal*, vol. 19-4, Dec. 1980, p. 3-10. 6 refs.

Specification tailoring and testing with combined mission profile environments are two concepts generated recently for the purpose of decreasing procurement and life-cycle costs and improving the reliability of defense weapon systems. These concepts are described along with difficulties to be expected in defining and specifying an environment from measurements. Examples of vibration measurements (performed on the YA-7E aircraft) are used to illustrate some of the problems, and a typical combination of thermal, electrical, and vibration environments is used to discuss reliability growth test application. B.J.

A81-16136 Wind shear effects on aircraft - Low-level shear and clear-air turbulence as accident causes. C. Bulloch. *Interavia*, vol. 35, Dec. 1980, p. 1155-1158.

Wind shear, defined as the difference in wind behavior between two points in space, is discussed. Three different forms of wind shear are discussed, change of direction in the horizontal plane, in the vertical plane, and horizontal shearing air masses that are in vertical motion. Emphasis is placed on predicting a clear air turbulence (CAT). An attempt to improve the statistical data base by the British Meteorological Office for turbulence probability prediction is reported. A total of 4,378 replies to a questionnaire were collected over a ten day period and covering North Atlantic and European regions. Turbulence reports were plotted geographically and compared with conventional turbulence forecasts. Vertical shear is reported to be the most reliable indicator of turbulence. The use of airborne CAT detection equipment, particularly radiometers, is examined along with Doppler radars for analyzing the internal structure of thunderstorms, and local sensors such as the Low Level Wind Shear Alert System. R.C.

A81-16179 **Charting a course for V/STOL.** R. Braybrook. *Air International*, vol. 19, Dec. 1980, p. 284-287.

This paper examines the development of V/STOL combat aircraft. Wing material composition and drag characteristics are compared for the McDonnell Douglas AV-8B and the British Aerospace GR5. The use of plenum chamber burning (PCB) in vectored-thrust engines is discussed. PCB's allow for a smaller, lighter engine, but eliminate the possibility of operating from unprepared surfaces. A proposal to droop the front nozzles to counter the recirculation of hot gases to the air intakes with the PCB's is also investigated. A V/STOL demonstrator proposed by Rolls-Royce is presented using a Pegasus Eleven with droop-and-trail PCB with static thrust at approximately 27,000 lb. R.C.

A81-16198 **Flying safety /Revised and enlarged edition/.** R. L. Collins. New York, Delacorte Press /Eleanor Friede, 1981. 331 p. \$12.95.

A survey of accidents is presented which includes analysis of actual representative cases and their apparent causes - weather, mechanical failure, human error, or a combination of these. Accident avoidance tactics and techniques are given as well as miscellaneous factors that pilots need to know to minimize accident risks. V.L.

A81-16231 **Interferometric study of the initial stage of supersonic jets of gases with various specific-heat ratios from conical nozzles.** V. M. Dobrynin, V. B. Kisliakov, and V. G. Maslennikov (Akademii Nauk SSSR, Fiziko-Tekhnicheskii Institut, Leningrad, USSR). (*Zhurnal Tekhnicheskoi Fiziki*, vol. 50, Feb. 1980, p. 317-326.) *Soviet Physics - Technical Physics*, vol. 25, Feb. 1980, p. 187-192. 10 refs. Translation.

A81-16248 **The origins of the turbojet revolution.** E. W. Constant, II. Research supported by Northwestern University and Carnegie-Mellon University. Baltimore, Md., Johns Hopkins University Press (Johns Hopkins Studies in the History of Technology: New Series, No. 5), 1980. 324 p. 450 refs. \$22.50.

The origin and development of the turbojet engine, which made possible a technological revolution in aeronautics, are examined. A model is developed for the technological change represented by the turbojet engine, and the antecedents of the turbojet engine in water turbines and turbine pumps and steam turbines, turbocompressors and internal combustion gas turbines are discussed. The development of the science of aeronautics leading to the convergence of prior technologies, traditions, and economic and political interests in the production of the turbojet engine is reviewed, along with that of the normal aviation technology in force at the time of turbojet development. National differences in aeronautical research and applications in the period 1920-1940 are considered, and the initiation of the turbojet revolution by Whittle in England and by von Ohain, Wagner and Schelp in Germany is discussed, together with the development of turbojet technology into the new norm. A.L.W.

A81-16276 **Optimal design of frames with substructuring.** A. K. Govil (Iowa, University, Iowa City, Iowa; MNR Engineering College, Allahabad, India), J. S. Arora, and E. J. Haug (Iowa University, Iowa City, Iowa). *Computers and Structures*, vol. 12, July 1980, p. 1-10. 19 refs. Army-supported research.

This paper presents a formulation for optimal design of large scale, two and three dimensional framed structures. Von Mises equivalent stress constraints and displacement constraints are imposed at all points in the structure. Member size constraints and constraints based on Schilling's approach for member buckling are also imposed. Three example problems of varying degrees of difficulty are solved, using a gradient projection algorithm with state space design sensitivity analysis and substructuring. Results of these examples are analyzed and conclusions are presented. (Author)

A81-16301 **Calculation of critical flutter speeds on an aircraft in subsonic flow.** N. L. Maricic (Vazduhoplovnotehnicki

Institut Zarkovo, Yugoslavia). (*Norske Veritas, International Conference on Engineering Application of the Finite Element Method, Hovik, Norway, May 9-11, 1979.*) *Computers and Structures*, vol. 12, Oct. 1980, p. 475-482. 13 refs.

The procedure for calculation of critical flutter speeds of an aircraft in subsonic flow on minicomputer, is displayed in the paper. Problem of vibrational asymmetry, determined during vibrational tests, is solved using decomposition of each mode into inertially normalized symmetrical and antisymmetrical parts. Unsteady aerodynamic loadings are determined by the doublet-lattice method. Modest memory of minicomputer used dictated the choice of the method of optimal elimination for solution of an asymmetric system of complex linear equations. Interpolation of total matrices of generalized aerodynamical forces is done by, in this paper proposed, modified method of natural cubic spline. Flutter eigenvalues are calculated using iterative Laguerre's procedure. (Author)

A81-16307 **Nonlinear incremental analysis up to failure of aeronautical structures.** C. Nysen (Liège, Université, Liège, Belgium). (*Norske Veritas, International Conference on Engineering Application of the Finite Element Method, Hovik, Norway, May 9-11, 1979.*) *Computers and Structures*, vol. 12, Oct. 1980, p. 593-605. 11 refs.

Two complex aeronautical structures are analyzed up to failure. The first problem consists of the numerical prediction of the burst velocity of a turbine rotor due to an accidental overspeed. In the second analysis, one examines the extreme internal pressure of rocket motor heads. The feasibility and accuracy of the nonlinear finite element analysis are demonstrated. The important task of the modelling of the nonlinear material behaviors is discussed in both cases. The influence of the different types of strong nonlinearities involved on the computed structural responses are also carefully examined. (Author)

A81-16422 # **Civil aviation safety. IV - Accident severity.** W. Tye. *Aircraft Engineering*, vol. 52, Nov. 1980, p. 2-4.

Aircraft accident severity is discussed with attention given to levels of severity, examples of counting accidents according to severity, the distribution of accidents according to the type of accident, and the likelihood of fatal accidents. The use of accident rates as measures of safety is examined in detail. F.G.M.

A81-16423 # **How do aircraft break down - Some studies of reliability data feedback.** J. P. Fielding (Cranfield Institute of Technology, Cranfield, Beds., England). *Aircraft Engineering*, vol. 52, Nov. 1980, p. 15-19. 8 refs.

Studies aimed at examining the feedback of safety and reliability information from civil transport aircraft in the United Kingdom are described. Attention is given to the use of information by operators and to the use of safety and reliability information by manufacturers. A case study involving information feedback from the windshield of a U.S. wide-body transport aircraft is considered along with parallel studies of information feedback. The main findings are presented with regard to information in source documents, the quality of operational reliability information that is received by manufacturers, reliability information for standard items, design continuity, designers' contracts with operators, and the creation of a National Aerospace Reliability Data Bank. Finally, the production of aids for designers and operators is considered; standard reliability statistics source documents, reliability prediction formulas, and studies of mechanical defect modes in guided weapon systems are discussed. F.G.M.

A81-16424 # **The contribution of structural testing to total airworthiness.** W. G. Heath (British Aerospace, Weybridge, Surrey, England). *Aircraft Engineering*, vol. 52, Nov. 1980, p. 20-22.

The contribution of structural testing to total airworthiness is reviewed with regard to six phases of aviation project development: advice (or requirements, design, and manufacture), analysis, accep-

tance, after-sales service, accident investigation, and advanced development (e.g., composite materials and structures). Attention is given to such specific issues as the analysis of complex forgings and castings, concessions and process specifications in the acceptance phase, the use of NDT techniques, and the recognition and variability and degradation in composite materials. F.G.M.

A81-16454 # Nonstationary method for the direct statistical modeling of rarefied-gas flows (O nestatsionarnom metode priamogo statisticheskogo modelirovaniia techenii razrezhennogo gaza). O. M. Belotserkovskii, A. I. Erofeev, and V. E. Ianitskii. *Zhurnal Vychislitel'noi Matematiki i Matematicheskoi Fiziki*, vol. 20, Sept.-Oct. 1980, p. 1174-1204. 40 refs. In Russian.

Results concerning the development of a direct statistical method for modeling rarefied-gas flows are presented. The method is based on a splitting procedure and on a strictly Markovian model for collisional processes in an ideal gas. This method is characterized by moderate demands on the computer resources, and therefore can be used to calculate rarefied-gas flows past aircraft on medium-capacity computers. Results on rarefied-gas flows in the two-dimensional and three-dimensional cases are presented. P.T.H.

A81-16455 # Variational problems of gas dynamics (Variatsionnye zadachi gazovoi dinamiki). Iu. D. Shmyglevskii. *Zhurnal Vychislitel'noi Matematiki i Matematicheskoi Fiziki*, vol. 20, Sept.-Oct. 1980, p. 1205-1220. 38 refs. In Russian.

The paper surveys research performed on variational problems of gas dynamics at the continuum-mechanics laboratory of the Computational Center of the Soviet Academy of Sciences since 1955. Attention is given to such topics as conservation laws in hydrodynamics, the calculation of plane and axisymmetric supersonic gas flows by the method of characteristics, the optimal shape of bodies in supersonic flow, and discontinuous solutions of variational problems of gas dynamics. Variational problems of gas dynamics for equilibrium and nonequilibrium flows, maximum thrust nozzles with arbitrary isoperimetric conditions, and the method of spatial characteristics for calculating potential gas flows are also discussed. P.T.H.

A81-16474 # Operational radar display of the structure of thunderstorm hail clouds (Operativnoe radiolokatsionnoe otobrazhenie struktury grozo-gradovykh oblakov). M. T. Abshaev (Vysokogornyi Geofizicheskii Institut, Nalchik, USSR). *Meteorologiya i Gidrologiya*, Oct. 1980, p. 29-38. 11 refs. In Russian.

A high-performance radar system for the operational acquisition and display of the cell structure of thunderstorm hail clouds is described. The method is based on the acquisition of the cell structure of cloud radar echoes in the form of radar reflectivity isolines; the background of the display includes hail centers, lightning-discharge directions, and turbulence zones, identified by multichannel data processing. Experimental results are presented on the structure and dynamics of hail clouds studied by using this technique. P.T.H.

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STAR ENTRIES

N81-12012*# National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.
FLIGHT EVALUATION OF THE EFFECT OF WINGLETS ON PERFORMANCE AND HANDLING QUALITIES OF A SINGLE-ENGINE GENERAL AVIATION AIRPLANE
 Bruce J. Holmes, Cornelis P. vanDam (Kansas Univ., Lawrence), Philip W. Brown, and Perry L. Deal Dec. 1980 28 p refs
 (NASA-TM-81892; L-13960) Avail: NTIS HC A03/MF A01 CSCL 01C

A flight evaluation was conducted to determine the effects of winglets on the performance and handling qualities of a light, single-engine general aviation airplane. The performance measurements were made with a pace airplane to provide calibrated airspeeds; uncalibrated panel instruments in the test airplane were used to provide additional quantitative performance data. These tests were conducted with winglets on and off during the same day to measure relative performance effects. Handling qualities were evaluated by means of pilot comments. Winglets increased cruise speed 8 knots (5.6 percent) at 3962 m (13,000 ft) density altitude and 51 percent maximum continuous power setting. Maximum speed at 3962 m was virtually unchanged. Rate of climb increased approximately 6 percent, or 0.25 m/sec (50 ft/min), at 1524 m (5000 ft). Stall speed was virtually unchanged. Handling qualities were favorably affected. Author

N81-12013# Administrative Sciences Corp., Falls Church, Va.
NAVAL AIRCRAFT OPERATING AND SUPPORT COST-ESTIMATING MODEL: FY78 REVISION
 Mar. 1980 82 p
 (Contract N00014-77-C-0180)
 (AD-A090044; ASC-R-126) Avail: NTIS HC A05/MF A01 CSCL 14/1

This report provides the updated equations using fiscal 1978 data for the Administrative Sciences Corporation Aircraft Operating and Support (O S) Cost-Estimating Model. It is intended to be used as an addendum to Naval Aircraft Operating and Support Cost-Estimating Model - FY77 Revision, ASC-R-120, February 1979, which contains an extensive discussion of each cost element as well as other background material. Several initiatives to improve the quality and accuracy of the cost-estimating relationships were incorporated into this version of the model. The most notable is the examination of Replenishment Spares consumption over a two year period rather than a single year. As more data becomes available, the period will be lengthened even more. Substantial work was also done in the areas of Engine Rework and Modifications. For engines, the recently implemented Engine Analytical Maintenance Plan which has changed the Navy's engine maintenance philosophy for most engines from one of scheduled overhaul to one without scheduled overhaul was investigated. This new policy provides for engine components to be replaced/overhauled periodically but not the entire engine. Although much useful data was obtained on engine removal rates and differentiation of maintenance costs for engines utilized in different aircraft (e.g., the J52-P8 in the A-4E and the A-6E); the data does not yet reflect the new maintenance policy. GRA

N81-12014*# Nielsen Engineering and Research, Inc., Mountain View, Calif.

A COMPUTER PROGRAM TO CALCULATE THE LONGITUDINAL AERODYNAMIC CHARACTERISTICS OF UPPER-SURFACE-BLOWN WING-FLAP CONFIGURATIONS Final Report

Michael R. Mendenhall Washington NASA Aug. 1978 103 p

refs

(NASA-CR-3005; NEAR-TR-158) Avail: NTIS
 HC A06/MF A01 CSCL 01A

A user's manual is presented for a computer program in which a vortex-lattice lifting-surface method is used to model the wing and multiple flaps. The engine wake model consists of a series of closely spaced vortex rings with rectangular cross sections. The jet wake is positioned such that the lower boundary of the jet is tangent to the wing and flap upper surfaces. The two potential flow models are used to calculate the wing-flap loading distribution including the influence of the wakes from up to two engines on the semispan. The method is limited to the condition where the flow and geometry of the configurations are symmetric about the vertical plane containing the wing root chord. The results include total configuration forces and moments, individual lifting-surface load distributions, pressure distributions, flap hinge moments, and flow field calculation at arbitrary field points. The use of the program, preparation of input, the output, program listing, and sample cases are described. A.R.H.

N81-12015*# National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.
LOW-SPEED AERODYNAMIC CHARACTERISTICS OF A 13 PERCENT THICK MEDIUM SPEED AIRFOIL DESIGNED FOR GENERAL AVIATION APPLICATIONS
 Robert J. McGhee and William D. Beasley Aug. 1979 79 p refs
 (NASA-TP-1498; L-12976) Avail: NTIS HC A04/MF A01 CSCL 01A

Wind tunnel tests were conducted to determine the low speed, two dimensional aerodynamic characteristics of a 13 percent thick medium speed airfoil designed for general aviation applications. The results were compared with data for the 13 percent thick low speed airfoil. The tests were conducted over a Mach number range from 0.10 to 0.32, a chord Reynolds number range from 2.0 x 10 to the 6th power to 12.0 x 10 to the 6th power, and an angle of attack range from about -8 deg to 10 deg. The objective of retaining good high-lift low speed characteristics for an airfoil designed to have good medium speed cruise performance was achieved. S.F.

N81-12016*# Boeing Commercial Airplane Co., Seattle, Wash. Preliminary Design Dept.
ASSESSMENT OF VARIABLE CAMBER FOR APPLICATION TO TRANSPORT AIRCRAFT
 Nov. 1980 94 p refs
 (Contract NAS1-15231)
 (NASA-CR-158430) Avail: NTIS HC A05/MF A01 CSCL 01A

The potential benefits were determined for the variable camber of commercial transport airplanes designed for intercontinental and domestic missions. A variable camber concept was developed and incorporated into airplanes designed for the two missions. Benefits were evaluated by comparing the mission performance and direct operating costs for the variable camber airplanes with those for reference airplanes designed for the same missions but having fixed geometry high speed wings. Several technical uncertainties associated with implementing variable camber were also examined. R.C.T.

N81-12019*# Mississippi State Univ., Mississippi State.
FULL SCALE VISUALIZATION OF THE WING TIP VORTICES GENERATED BY A TYPICAL AGRICULTURAL AIRCRAFT Final Report
 Ernest J. Cross, Jr., Philip D. Bridges, Joe A. Brownlee, and W. Wayne Liningston Nov. 1980 103 p refs
 (Grant NSG-1511)
 (NASA-CR-159382) Avail: NTIS HC A06/MF A01 CSCL 01A

The trajectories of the wing tip vortices of a typical agricultural aircraft were experimentally determined by flight test. A flow visualization method, similar to the vapor screen method used in wind tunnels, was used to obtain trajectory data for a range of flight speeds, airplane configurations, and wing loadings. Detailed measurements of the spanwise surface pressure

distribution were made for all test points. Further, a powered 1/8 scale model of the aircraft was designed, built, and used to obtain tip vortex trajectory data under conditions similar to that of the full-scale test. The effects of light wind on the vortices were demonstrated, and the interaction of the flap vortex and the tip vortex was clearly shown in photographs and plotted trajectory data. Author

N81-12020# Air Force Academy, Colo.

B-52 WAKE INVESTIGATION

Wade H. Bailey, Jr. and Thomas A. Durham 10 Mar. 1980 20 p refs Backup document for AIAA Synoptic scheduled for publication in Journal of Aircraft in Jan. or Feb. 1981 (LOG-C3932) Avail: NTIS HC A02/MF A01

The wake characteristics of a B-52 in flight are determined. Of specific concern is the fact that variations in the ambient atmosphere introduced by an aircraft wake manifested by increased wind velocities and gas constituents can cause fluctuations in laser beam propagation. By flying a B-52 upwind of a highly instrumented metrological tower, wake vortex wind speeds and gas concentrations of the exhaust were obtained. The test was conducted in crosswinds as high as 80 ft/sec which allowed the inspection of wakes 5 seconds in age and 2000 feet behind the aircraft. In this region, it was found that the vortex contained: (1) wind speeds in excess of 210 ft/sec and (2) a 250 percent increase in the concentrations of CO₂. The implication of these results is that propagation of high energy lasers through aircraft wakes could be seriously degraded. M.G.

N81-12021*# National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.

EXPERIMENTAL AND THEORETICAL AERODYNAMIC CHARACTERISTICS OF TWO HYPERSONIC CRUISE AIRCRAFT CONCEPTS AT MACH NUMBERS OF 2.96, 3.96, AND 4.63

Jimmy L. Pittman and Gregory D. Riebe Dec. 1980 116 p refs (NASA-TP-1767; L-13868) Avail: NTIS HC A06/MF A01 CSDL 01A

The longitudinal and lateral directional aerodynamic characteristics for two Mach 5 cruise aircraft concepts were determined for test Mach numbers of 2.96, 3.96, and 4.63. Estimates from hypersonic impact theory and first order supersonic linearized theory were compared with data to indicate the usefulness of these methods. The method which applied tangent cone empirical theory to the body and tangent wedge theory to the wings and to the horizontal and vertical tails provided the best estimates. The tangent cone empirical theory applied to all components showed poor agreement with data, and the linear theory estimates were accurate only for lift coefficient and drag coefficient at low angles of attack. Author

N81-12022*# Kentron International, Inc., Hampton, Va.

INDUCED DRAG IDEAL EFFICIENCY FACTOR OF ARBITRARY LATERAL-VERTICAL WING FORMS

John DeYoung Washington NASA Dec. 1980 50 p refs (Contract NAS1-16000) (NASA-CR-3357) Avail: NTIS HC A03/MF A01 CSDL 01A

A relatively simple equation is presented for estimating the induced drag ideal efficiency factor e for arbitrary cross sectional wing forms. This equation is based on eight basic but varied wing configurations which have exact solutions. The e function which relates the basic wings is developed statistically and is a continuous function of configuration geometry. The basic wing configurations include boxwings shaped as a rectangle, ellipse, and diamond; the V-wing; end-plate wing; 90 degree cruciform; circle dumbbell; and biplane. Example applications of the e equations are made to many wing forms such as wings with struts which form partial span rectangle dumbbell wings; bowtie, cruciform, winglet, and fan wings; and multiwings. Derivations are presented in the appendices of exact closed form solutions found of e for the V-wing and 90 degree cruciform wing and for an asymptotic solution for multiwings. Author

N81-12024# Vought Corp. Advanced Technology Center, Inc., Dallas, Tex.

LOW DRAG AIRFOIL DESIGN UTILIZING PASSIVE LAMINAR FLOW AND COUPLED DIFFUSION CONTROL TECHNIQUES Final Report, 30 Sep. 1977 - 1 Dec. 1979

R. L. Mask Sep. 1980 84 p refs (Contracts N62269-77-C-0442; N62269-79-C-0277) (AD-A090778; ATC-R-91100/9CR-71; NADC-79119-60) Avail: NTIS HC A05/MF A01 CSDL 20/4

A two dimensional high chord Reynolds number passive laminar airfoil was designed for a $C_{sub} l = 0.73$ at a M at infinity = 0.6 and $Re_{sub} c = 4$ times 10 to the 7th power providing an extremely high $L/D = 240$. This laminar airfoil design concept integrates passive laminar flow stabilization, by pressure gradient shaping, with active diffusion control techniques on the airfoil trailing edge. A discussion of the airfoil design concept and the predicted performance is presented. Full scale Reynolds number passive laminar flow/transition experiments defining maximum transition Reynolds number and real flow environment influence on transition are presented. Examination of wind tunnel scaling influences and real flow environment effects on the ATC/laminar airfoil performance are discussed and summarized for typical low turbulence tunnels. GRA

N81-12026# Vought Corp. Advanced Technology Center, Inc., Dallas, Tex.

TURBULENCE MODELING FOR APPLICATION TO V/STOL PROPULSION INDUCED EFFECTS: TWO DIMENSIONAL FORMULATION Final Report, Jan. - Oct. 1979

Andres H. Ybarra 15 Nov. 1979 61 p refs (Contract N00019-79-C-0136) (AD-A090331; ATC-R-91000/9CR-66) Avail: NTIS HC A04/MF A01 CSDL 20/4

Feasibility is established for the use of a statistical vortex model of turbulence to characterize shear flows associated with mixing and entrainment. The model is an extension of an approach used successfully for prediction of inlet flow maximum distortion levels. Analytically it forms the closure required for the governing Reynolds and kinetic energy turbulent flow equations. Applicability of the model to shear flows is validated by focusing on fully developed turbulent flow in a two dimensional channel. The solutions completely characterize the flow with a single distributive set of vortex (or eddy) properties. This includes the mean velocity profiles, cross correlation (Reynolds) stress terms, root-mean-square levels of the axial and lateral velocity perturbations, and energy production, diffusion, and dissipation terms. Comparisons with an extensive channel data base verify the characterization. In addition, the solutions provide the framework for coupling the analytics with experimental boundary (or initial) conditions to define scaling relations. The studies indicate that a definite variation in turbulence eddy properties exists across the channel. These variations can be determined from measurements of the flow field unsteady pressure fluctuations. The results are applicable to turbulent flow boundary layers and flow mixing problems in general, and ultimately to aircraft propulsion induced effects (e.g., V/STOL) where jet mixing and entrainment dominate the flight/model scaling and simulation requirements. GRA

N81-12029# Rolls-Royce Ltd., Derby (England).

SYSTEM TO MEASURE THE PRESSURE DISTRIBUTION ON FAN AEROFOIL SURFACES DURING FLUTTER CONDITIONS

John W. H. Chivers 1980 6 p refs (PNR-90013) Avail: NTIS HC A02/MF A01

High speed flutter tests were conducted on a research fan in which the blade surface pressures were measured by means of miniature silicon diaphragm pressure transducers embedded in selected fan blades. 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 enabled a cross correlation to be made on the blade surface pressure data and the blade tip angles. Author (ESA)

N81-12033# National Aerospace Lab., Amsterdam (Netherlands). Fluid Dynamics Div.

EVALUATION OF LEVINSKY'S METHOD FOR THE CALCULATION OF THE LIFT DISTRIBUTION ON A WING IN PROPULSIVE JETS

T. Zandbergen and R. A. Maarsingh 21 Jan. 1980 49 p refs (Contract NIVR-1068)

(NLR-TR-77104-U) Avail: NTIS HC A03/MF A01

Based on comparison with results from experiments, an evaluation was performed of a method used to calculate the spanwise lift distribution on wings immersed in propulsive jets. Modifications of the original method were investigated. It is found that the method gives satisfactory results for an unflapped wing. However, even at a relatively small flap deflection the jet-induced effects are strongly underrated. The discrepancies can be reduced somewhat by adopting an improved wing model. It is concluded that this approach has a fundamental weakness, which must be input to the rigid jet model. The result is that basic features of the wing jet interaction, such as jet mixing and deformation, cannot be accounted for. Author (ESA)

N81-12038# Royal Aircraft Establishment, Farnborough (England).

THE PREDICTION OF THE BURSTING OF LAMINAR SEPARATION BUBBLES IN THE DESIGN OF TWO DIMENSIONAL HIGH-LIFT AEROFOILS

B. R. Williams London HMSO May 1980 37 p refs (RAE-TR-80060; RAE-AERO-3479; BR74909) Avail: NTIS HC A03/MF A01

The structure of laminar separation bubbles is described and methods of predicting the bursting of these bubbles on the slat of a high-lift wing are examined. In particular Horton's method is found to give a useful description of the growth and bursting of the bubble. A method of predicting the burst of short bubbles is developed by combining the Crabtree maximum pressure rise parameter with the assumption that the separated turbulent shear layer is an equilibrium flow. Author (ESA)

N81-12039*# National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.

AIR CARGO MARKET OUTLOOK AND IMPACT VIA THE NASA CLASS PROJECT

Matthew M. Winston and D. William Conner Oct. 1980 22 p refs Presented at the 10th Intern. Forum for Air Cargo, Amsterdam, 30 Sep. - 2 Oct. 1980

(NASA-TM-81886) Avail: NTIS HC A02/MF A01 CSCL 05C

An overview is given of the Cargo/Logistics Airlift Systems Study (CLASS) project which was a 10 man-year effort carried out by two contractor teams, aimed at defining factors impacting future system growth and obtaining market requirements and design guidelines for future air freighters. Growth projection was estimated by two approaches: one, an optimal systems approach with a more efficient and cost effective system considered as being available in 1990; and the other, an evolutionary approach with an econometric behavior model used to predict long term evolution from the present system. Both approaches predict significant growth in demand for international air freighter services and less growth for U.S. domestic services. Economic analysis of air freighter fleet options indicate very strong market appeal of derivative widebody transports in 1990 with little incentive to develop all new dedicated air freighters utilizing the 1990's technology until sometime beyond the year 2000. Advanced air freighters would be economically attractive for a wide range of payload sizes (to 500 metric tons), however, if a government would share in the RD and T costs by virtue of its needs for a slightly modified version of a civil air freighter design (a.g. military airlifter). A.R.H.

N81-12040# Committee on Commerce, Science, and Transportation (U. S. Senate).

AVIATION SAFETY

Washington GPO 1980 168 p Hearings before the Subcomm. on Aviation of the Comm. on Com., Sci., and Transportation,

96th Congr., 2nd Sess., 25-27 Aug. 1980

(GPO-68-717) Avail: Subcommittee on Aviation

The human factor errors which have caused airline accidents and incidents were reviewed. Human failures represent 80% of the causative factors in aviation accidents. All aspects of airline operations and aircraft safety are discussed. T.M.

N81-12041# Committee on Ways and Means (U. S. House).

COMMUTER AIRPORT SAFETY

Washington GPO 1980 52 p Hearing before Comm. on Ways and Means, 96th Congr., 2d Sess., 13 Feb. 1980

(GPO-60-512) Avail: Subcommittee on Oversight

The hearing before the Subcommittee on Oversight of the Committee on Ways and Means on commuter airport safety is presented. The hearing was on whether the airport and airway trust fund was doing an adequate job of making commuter airports safe. T.M.

N81-12042# National Transportation Safety Board, Washington, D. C.

AEROMEXICO DC-10-30, XA-DUH, OVER LUXEMBOURG, EUROPE Aircraft Incident Report

7 Nov. 1980 34 p

(NTSB-AAR-80-10) Avail: NTIS HC A03/MF A01

About 2138, on November 11, 1979, AEROMEXICO, Flight 945, XA-DUH, a McDonnell-Douglas DC-10-30 aircraft, entered a prestall buffet and a sustained stall over Luxembourg, Europe, at 29,800 ft while climbing to 31,000 ft en route to Miami, Florida, from Frankfurt, German. Stall recovery was effected at 18,900 ft. After recovery, the crew performed an inflight functional check of the aircraft and, after finding that it operated properly, continued to their intended destination. After arrival at Miami, Florida, it was discovered that portions of both outboard elevators and the lower fuselage tail area maintenance access door were missing. There were no injuries to the 311 persons on board Flight 945. No injuries or damage to personnel or property on the ground was reported. Visual meteorological conditions prevailed at the time of the incident. The National Transportation Safety Board determined that the probable cause of this incident was the failure of the flightcrew to follow standard climb procedures and to adequately monitor the aircraft's flight instruments. This resulted in the aircraft entering into a prolonged stall buffet which placed the aircraft outside the design envelope. Author

N81-12043*# National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.

A SIMULATOR STUDY FOR THE DEVELOPMENT AND EVALUATION OF OPERATING PROCEDURES ON A SUPERSONIC CRUISE RESEARCH TRANSPORT TO MINIMIZE AIRPORT-COMMUNITY NOISE

William D. Grantham, Paul M. Smith (Kentrion International, Inc., Hampton, Va.), and Perry L. Deal Nov. 1980 79 p refs

(NASA-TP-1742; L-13881) Avail: NTIS HC A05/MF A01 CSCL 01C

Piloted-simulator studies were conducted to determine takeoff and landing operating procedures for a supersonic cruise research transport concept that result in predicted noise levels which meet current Federal Aviation Administration (FAA) certification standards. With the use of standard FAA noise certification test procedures, the subject simulated aircraft did not meet the FAA traded-noise-level standards during takeoff and landing. However, with the use of advanced procedures, this aircraft meets the traded-noise-level standards for flight crews with average skills. The advanced takeoff procedures developed involved violating some of the current Federal Aviation Regulations (FAR), but it was not necessary to violate any FAR noise-test conditions during landing approach. Noise contours were also determined for some of the simulated takeoffs and landings in order to indicate the noise-reduction advantages of using operational procedures other than standard. Author

N81-12044# National Transportation Safety Board, Washington, D. C.

AIRCRAFT ACCIDENT REPORT: ALLEGHENY AIRLINES, INC., NORD 262, MOHAWK/FRAKES 298, N29824, BENEDUM AIRPORT, CLARKSBURG, WEST VIRGINIA, FEBRUARY 12, 1979

16 Aug. 1979 32 p
 (NTSB-AAR-79-12) Avail: NTIS HC A03/MF A01
 At 1300 e.s.t., on February 12, 1979, a Nord 262, Mohawk/Frakes 298, N29824, operating as Allegheny Flight 561, departed Benedum Airport, Clarksburg, West Virginia, for National Airport, Washington, D.C., with 25 persons on board. The aircraft crashed about 14 sec after liftoff. Two persons were killed and eight persons were seriously injured; the aircraft was destroyed. The official weather at the time of departure was: Sky - partial obscuration, 1,000 ft overcast; visibility - 5/8 mi in snow; wind - calm; altimeter - 29.89 inHg. The National Transportation Safety Board determined that the probable cause of the accident was the captain's decision to take off with snow on the aircraft's wing and empennage surfaces which resulted in a loss of lateral control and a loss of lift as the aircraft ascended out of ground effect. Author

N81-12045# National Transportation Safety Board, Washington, D. C.

AIRCRAFT ACCIDENT REPORT: NEW YORK AIRWAYS, INC., SIKORSKY S61-L, N618PA NEWARK, NEW JERSEY, APRIL 18, 1979

27 Sep. 1979 39 p
 (NTSB-AAR-79-14) Avail: NTIS HC A03/MF A01
 About 1823 e.s.t., Flight 972 had just taken off from the airport and was at an altitude of 1,200 ft about 1 mile to the east when one of five blades broke and separated from the tail rotor. Severe vibrations in the tail rotor assembly caused the tail rotor gearbox and rotor assembly to separate from the aircraft when it had descended to about 150 ft above the ground. Without a tail rotor to maintain its stability, the helicopter entered a rapid nosedown, right turn to the ground. Of the 18 persons on board, 3 passengers were killed; 10 passengers and 3 crewmembers were injured seriously. Metallurgical examination revealed that the tail rotor blade failed after a fatigue crack propagated across 90 percent of the blade's leading edge spar and about 2 in. of the blade skin, which weakened the blade structure. The probable cause of this accident was the separation of the tail rotor assembly and gearbox from the aircraft at an altitude which made further controlled flight impossible. The rotor assembly and gearbox separated because of severe vibrations in the rotor assembly which were induced by the loss of a tail rotor blade due to fatigue failure. A.R.H.

N81-12046# National Transportation Safety Board, Washington, D. C.

AIRCRAFT ACCIDENT REPORT: CHAMPION HOME BUILDERS COMPANY, GATES LEARJET 25B, N999HG, SANFORD, NORTH CAROLINA, SEPTEMBER 8, 1977

20 Sep. 1979 31 p
 (NTSB-AAR-79-15) Avail: NTIS HC A03/MF A01
 The investigation of the September 8, 1977 crash of a Gates Learjet 25B, N999HG is documented. It is determined that the probable cause of this accident was one or more low order explosions in the aircraft's aft fuselage which resulted in a fire and loss of control capability. The fuel and ignition sources of the initial explosion could not be determined conclusively, however, gases from the aircraft's batteries or fuel leakage from fuel system components, or both, could have been present in the area of the initial explosion. M.G.

N81-12048# Federal Aviation Administration, Washington, D.C. Office of Aviation Policy.

IFR AIRCRAFT HANDLED FORECAST BY AIR ROUTE TRAFFIC CONTROL CENTER, FISCAL YEARS 1980-1991

Bernard F. Hannan May 1980 109 p
 (AD-A090803; FAA-VP-80-4) Avail: NTIS HC A06/MF A01 CSCL 01/2
 The report presents the forecasts of Instrument Flight Rule (IFR) aircraft handled by FAA air route traffic control centers (ARTCC). It serves as a base for the FAA planning and budget

process in determining future requirements for facilities, equipment and manpower. The forecasts show that total aircraft handled will increase from 30.1 million in FY 1979 to 44.0 million in FY 1991. These national total numbers along with those for the intervening years are broken down by FAA region and for each air route traffic control center in this report. GRA

N81-12049# SRI International Corp., Menlo Park, Calif. Transportation Center.

AIRPORT AND AIRSPACE DELAY MODEL DESCRIPTION Final Report

John C. Bobick and George J. Couluris Oct. 1979 103 p
 (Contract DOT-FA77WA-4033; SRI Proj. 6824)
 (AD-A090781; FAA-VP-79-11) Avail: NTIS HC A06/MF A01 CSCL 01/2

The Airport and Airspace Delay Model (AADM) is a computerized event-step simulation developed to replicate the movement of aircraft through enroute and terminal airspace and runway complexes. The model, which is written in the high-level SIMSCRIPT II.5 programming language, produces output statistics describing aircraft delay and travel time and a log of all simulation events. AADM is designed to model various air traffic conditions including multiple airports, variable route structures and runway use configurations, variable separation rules and control procedures, multiple control sectors, sector capacities, wind conditions, aircraft performance characteristics, variable traffic loadings, and the like. The AADM program logic includes airspace traffic control and airport/airspace interface components. The airspace logic simulates three levels of the operational control process: Level I--tactical control; Level II--sequencing control; and Level III--strategic control. The airport/airspace interface logic simulates final approach, takeoff and landing interleaving and departure control procedures. The multiple airport complex and airspace serving the San Francisco area are used to demonstrate the AADM application. GRA

N81-12051# Peat, Marwick, Mitchell and Co., San Francisco, Calif.

AIRCRAFT TOWING FEASIBILITY STUDY Final Report

Sep. 1980 174 p refs
 (Contract DE-AC01-79CS-50069)
 (DOE/CS-50069/1) Avail: NTIS HC A08/MF A01

A preliminary assessment of the constraints on and feasibility of extended aircraft towing is provided. Past aircraft towing experience and the state of the art in towing equipment are reviewed. Safety and operational concerns associated with aircraft towing are identified, and the benefits and costs of implementing aircraft towing at 20 major U.S. airports are analyzed. It was concluded that extended aircraft towing is technically feasible and that substantial reductions in aircraft fuel consumption and air pollutant emissions can be achieved through its implementation. It was also concluded that, although capital and operating costs associated with towing would be increased, net savings could generally be attained at these airports. Due to the lack of past experience and the necessity of proving the cost effectiveness of the towing concept, a demonstration of the feasibility of large scale aircraft towing is necessary. The study evaluates the suitability of the 20 study airports as potential demonstration sites and makes recommendations for the first demonstration project. DOE

N81-12052# Societe Nationale Industrielle Aerospatiale, Suresnes (France). Lab. Centrale.

TESTS ON THE FIRE RESISTANCE BEHAVIOR OF MATERIALS INSIDE CIVIL AIRCRAFT (LES ESSAIS DE COMPORTEMENT AU FEU DES MATERIAUX D'INTERIEUR D'AVIONS CIVILES)

Andre A. Blavy Paris 22 Apr. 1980 23 p In FRENCH Presented at Assoc. des Amis de l'Ecole Natl. Super. de l'Aeron. et de l'Espace/l'Ecole Natl. Super. des Tech. Avancees Stage de Perfectionnement sur Mater. Aeron. M-01, 22 Jan. 1980 (SNIAS-801-551-101) Avail: NTIS HC A02/MF A01

The equipment employed to perform tests and to identify the gases released from exact replicas of cabin elements is presented. Details are given on the way in which these tests

are carried out, the criteria imposed and the results obtained.

Author (ESA)

N81-12053# National Transportation Safety Board, Washington, D. C.

AIRCRAFT ACCIDENT REPORTS. BRIEF FORMAT, US CIVIL AVIATION: ISSUE NO. 11, 1979 ACCIDENTS

30 Oct. 1980 171 p

(NTSB-BA-80-8) Avail: NTIS HC A08/MF A01

Selected aircraft accident reports, in brief format, occurring in U.S. civil aviation operations during calendar year 1979 are described. The 299 General Aviation accidents represent a random selection. This publication is issued irregularly, normally fifteen times each year. The brief format presents the facts, conditions, circumstances, and probable cause(s) for each accident. Additional statistical information is tabulated by injury index, injuries, and causal factors.

R.K.G.

N81-12054*# American Electronic Labs., Inc., Lansdale, Pa.
LOW COST AIRBORNE MICROWAVE LANDING SYSTEM RECEIVER, TASK 3 Final Report

James B. Hager and James R. VanCleave Dec. 1979 191 p
(Contract NAS2-9332)

(NASA-CR-152409) Avail: NTIS HC A09/MF A01 CSCL 17G

Work performed on the low cost airborne Microwave Landing System (MLS) receiver is summarized. A detailed description of the prototype low cost MLS receiver is presented. This detail includes block diagrams, schematics, board assembly drawings, photographs of subassemblies, mechanical construction, parts lists, and microprocessor software. Test procedures are described and results are presented.

T.M.

N81-12055# Committee on Post Office and Civil Service (U. S. House).

AIR TRAFFIC CONTROLLERS AND FLIGHT SERVICE STATION SPECIALISTS

Washington GPO 1979 263 p refs Hearings on H. R. 1262, H. R. 1781, H. R. 3479 and H. R. 3503 before the Subcomm. on the Civil Serv. of the Comm. on Post Office and Civil Serv., 96th Congr., 1st Sess., 26 and 30 Jun. and 2 and 13 Jul. 1979

(GPO-51-381) Avail: Subcommittee on the Civil Service

The hearings before the House Subcommittee on Civil Service concerning air traffic controllers and flight service station specialists are presented. Legislation dealing with second-career training and early retirement rights is examined.

M.G.

N81-12058# Army Aviation Research and Development Command, St. Louis, Mo.

LR-80 FLIGHT TEST REPORT Final Report, Aug. 1979 - Feb. 1980

James Maguire and Stanley John Sokolowski, II. Sep. 1980 43 p

(AD-A090284; USAAVRADCOM-TR-80-E-2) Avail: NTIS HC A03/MF A01 CSCL 17/7

The report presents and analyzes the flight test results of the LR-80 Attitude and Heading Reference System (AHRs) for the advanced attack helicopter (AAH).

GRA

N81-12062# Army Avionics Research and Development Activity, Fort Monmouth, N. J.

ARMY GPS-DOPPLER HYBRID NAVIGATION SYSTEM

Jack Gray Jun. 1980 15 p refs

(AD-A090394) Avail: NTIS HC A02/MF A01 CSCL 17/7

In accordance with the Department of the Army's approved Positioning and Navigation System (PANS) Materiel Need, the Army's stated objective is to field 'a mix of externally referenced Positioning Subsystems, self-contained subsystems, and hybrid systems to allow for determination of heading, azimuth, and range for navigation and present position'. The intent is to avoid losing completely Pos/Nav/orientation capability for critical

missions through dependence by the Army upon any one Nav system in the field. More specifically, the fiscal 1980 Scientific and Technical Objectives Guide defines the need to provide superior accuracy and reliable navigation continuity over the battlefield under all visibility, terrain, and weather conditions for such missions as Aerial Scout Helicopter and Advanced Attack Helicopter. To satisfy these requirements, the Army is developing a family of advanced externally referenced and self-contained Pos/Nav systems and the techniques to hybrid these to satisfy mission requirements at lowest cost. One of these, the Doppler navigator or, ASN-128, is a fully self-contained, EW Secure, sophisticated, dead-reckoning system. However due to residual heading/attitude and velocity errors, its position accuracy degrades as a function of distance traveled. Therefore, mission aircraft which require high accuracy at all times must use a form of position-updated doppler navigator.

GRA

N81-12063# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugfuehrung.

SYNOPSIS ON AIRCRAFT INTEGRATED DATA SYSTEMS AND ENGINE HEALTH MONITORING AND MAINTENANCE

Guenter Dahl, Helmut Hardegen, and Wolfgang Hentschel Feb. 1980 240 p refs

(DFVLR-Mitt-80-08) Avail: NTIS HC A11/MF A01; DFVLR, Cologne DM 45,40

Summaries and a comparative survey in tabular form are given of the main points of 304 references on aircraft integrated data systems, engine monitoring, fault detection, and maintenance. Instruments, recording systems, analysis methods, and results are classified by characteristics.

Author (ESA)

N81-12064*# National Aeronautics and Space Administration, Hugh L. Dryden Flight Research Center, Edwards, Calif.

THE EFFECT OF THERMAL STRESSES ON THE INTEGRITY OF THREE BUILT-UP AIRCRAFT STRUCTURES

Jerald M. Jenkins Nov. 1980 60 p refs

(NASA-TM-81352; H-1138) Avail: NTIS HC A04/MF A01 CSCL 01C

A Mach 6 flight was simulated in order to examine heating effects on three frame/skin specimens. The specimens included: a titanium truss frame with a lockalloy skin; a stainless steel z-frame with a lockalloy skin; and a titanium z-frame with a lockalloy skin. Thermal stresses and temperature were measured on these specimens for the purpose of examining their efficiency, performance, and integrity. Measured thermal stresses were examined with respect to material yield strengths, buckling criteria, structural weight, and geometric locations. Principal thermal stresses were studied from the standpoint of uniaxial stress assumptions. Measured thermal stresses were compared to predicted values.

R.C.T.

N81-12065*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

A MATHEMATICAL MODEL OF THE CH-53 HELICOPTER

William R. Sturgeon and James D. Phillips Nov. 1980 60 p refs

(NASA-TM-81238; A-8345) Avail: NTIS HC A04/MF A01 CSCL 01C

A mathematical model suitable for real time simulation of the CH-53 helicopter is presented. This model, which is based on modified nonlinear classical rotor theory and nonlinear fuselage aerodynamics, will be used to support terminal-area guidance and navigation studies on a fixed-base simulator. Validation is achieved by comparing the model response with that of a similar aircraft and by a qualitative comparison of the handling characteristics made by experienced pilots.

Author

N81-12067*# Lockheed-California Co., Burbank.

YF-12 COOPERATIVE AIRFRAME/PROPULSION CONTROL SYSTEM PROGRAM, VOLUME 1 Final Report

D. L. Anderson, G. F. Connolly, F. M. Mauro, and P. J. Reukauf 1980 120 p refs

(NASA-CR-163099; SP-5317-Vol-1) Avail: NTIS

HC A06/MF A01 CSCL 01C

Several YF-12C airplane analog control systems were converted to a digital system. Included were the air data computer, autopilot, inlet control system, and autothrottle systems. This conversion was performed to allow assessment of digital technology applications to supersonic cruise aircraft. The digital system was composed of a digital computer and a specialized interface unit. A large scale mathematical simulation of the airplane was used for integration testing and software checkout. The system was flown for approximately 23 hours. Author

N81-12068# Aircraft Research and Development Unit, Edinburg (Australia).

PILATUS PORTER: PROVISION OF REVISED TAKE-OFF AND LANDING PERFORMANCE DATA

M. J. Tobin Aug. 1980 19 p refs
(AD-A089964; ARDU-TI-698) Avail: NTIS HC A02/MF A01 CSCL 01/2

The provision of additional take-off and landing data to extend Pilatus Porter flight manual information from the previous gross weight limit of 5700 lb (2585 kg) to the currently authorized limit of 6100 lb (2767 kg) was requested under Technical Investigation No 698. Using ARDU computer facilities, the existing flight manual take-off and landing data were extrapolated to predict performance at the increased weight. Take-off and landing performance was then evaluated during five test periods totalling 5.5 hours in day VMC. Tests were conducted with aircraft gross weight in the range 4380 - 6090 lb (1987 - 2762 kg) using sealed and grassed runways. Aircraft performance was also evaluated with external stores carried on underwing racks. The data generated satisfied both the currently available performance charts and the predicted performance from the extrapolated charts. Carriage of the external stores on the wing racks increased the ground roll by 50% and the distance to climb to 50 ft by 20%. Operation from short dry grass did not significantly affect take-off distances but landing distances were reduced by 20%. Inclusion of the revised charts in the flight manual is recommended. GRA

N81-12070# Army Materials and Mechanics Research Center, Watertown, Mass.

ACOUSTIC EMISSION AS A NDE TECHNIQUE FOR DETERMINING COMPOSITE ROTOR BLADE RELIABILITY

Richard J. Shuford and William W. Houghton Jun. 1980 15 p refs
(AD-A090440) Avail: NTIS HC A02/MF A01 CSCL 11/4

This paper will discuss the progress made in an ongoing program to investigate the use of acoustic emission (AE) to determine the structural integrity of a composite main rotor blade. The blade is constructed primarily of S glass/epoxy and aramid/epoxy. GRA

N81-12071# Army Research and Technology Labs., Moffett Field, Calif. Aeromechanics Lab.

STABILITY OF NONUNIFORM ROTOR BLADES IN HOVER USING A MIXED FORMULATION

Wendell B. Stephens, Dewey H. Hodges, John H. Avila (Technology Development of California, Santa Clara), and Ru-Mei Kung (Technology Development of California, Santa Clara) 1980 20 p refs Presented at the 6th European Rotorcraft and Powered Lift Aircraft Forum, Bristol, England, 16-19 Sep. 1980
(AD-A090756) Avail: NTIS HC A02/MF A01 CSCL 01/3

A mixed formulation for calculating static equilibrium and stability eigenvalues of nonuniform rotor blades in hover is presented. The static equilibrium equations are nonlinear and are solved by an accurate and efficient collocation method. The linearized perturbation equations are solved by a one step, second-order integration scheme. The numerical results correlate very well with published results from a nearly identical stability analysis based on a displacement formulation. Slight differences in the results are traced to terms in the equations that relate moments to derivatives of rotations. With the present ordering scheme, in which terms of the order of squares of rotations are neglected with respect to unity, it is not possible to achieve completely equivalent models based on mixed and displacement formulations. A study of the one step methods reveals that a second order Taylor expansion is necessary to achieve good

convergence for nonuniform rotating blades. Numerical results for a hypothetical nonuniform blade, including the nonlinear static equilibrium solution, were obtained with no more effort or computer time than that required for a uniform blade with the present analysis. GRA

N81-12072# Army Research and Technology Labs., Fort Eustis, Va. Applied Technology Lab.

STATUS OF IMPROVED AUTOROTATIVE LANDING CAPABILITY RESEARCH

William A. Pleasants, III and G. Thomas White, III Jun. 1980 20 p refs

(AD-A090431) Avail: NTIS HC A02/MF A01 CSCL 01/2

While the frequency of all emergency autorotative landings (i.e., rate per 100,000 flight hours) has decreased over the past several years for Army single-engine fleet helicopters, the percentage of unsuccessful landings resulting from emergency autorotations has remained relatively high. United States Army Safety Center accident statistics reveal that at least 30 percent of all emergency autorotative landings involving AH-1, UH-1, OH-58, and OH-6A helicopters result in some degree of vehicle damage or personnel injury. These statistics further indicate that the probability of each of these helicopters experiencing at least one emergency autorotation accident during an assumed 10,000-hour service life is as follows: OH-6(94.0%), AH-1(77.5%), OH-58(76.3%), and UH-1(63.3%). Recent design studies and supplementary research of previously documented findings indicate that it is possible to significantly improve helicopter autorotation capability and reduce demands on pilot skill through helicopter rotor energy augmenting concepts. This paper discusses results of current studies as well as an outline for future in-depth research. GRA

N81-12073# Air Force Flight Test Center, Edwards AFB, Calif. USAF Test Pilot School.

FLIGHT TEST HANDBOOK: FLYING QUALITIES THEORY AND FLIGHT TEST TECHNIQUES Final Report

Nov. 1979 1082 p Supersedes AFFTC-TIH-77-1-Vol-1; AFFTC-TIH-77-1-Vol-2

(AD-A090525; AFFTC-TIH-79-2; AFFTC-TIH-77-1-Vol-1; AFFTC-TIH-77-1-Vol-2) Avail: NTIS HC A99/MF A01 CSCL 01/2

This handbook has been compiled by the instructors of the USAF Test Pilot School for use in Flying Qualities portion of the School's course. Most of the material in this handbook has been extracted from several reference books and is oriented towards the test pilot. The flight test techniques and data reduction methods have been developed at the Air Force Flight Test Center, Edwards Air Force Base, California. GRA

N81-12074# Army Research and Technology Labs., Fort Eustis, Va. Structures Lab.

ON THE USE OF ACTIVE HIGHER HARMONIC BLADE PITCH CONTROL FOR HELICOPTER VIBRATION REDUCTION

Charles E. Hammond and John E. Cline Jun. 1980 17 p refs
(AD-A090398) Avail: NTIS HC A02/MF A01 CSCL 01/3

Vibration levels have been a problem in helicopters since their inception. The reason for this lies in the method whereby the helicopter generates its lift, namely, the rotor system. As the rotor blades rotate they encounter a continuously changing aerodynamic environment which results in a continuously changing environment which results in a continuously changing aerodynamic loading on the blades. This changing environment is repeated on each revolution of the rotor. Hence, the rotor develops aerodynamic loads which are oscillatory in nature. These oscillatory loads are transferred directly to the helicopter airframe through the mechanical connection of the rotor to the airframe, i.e., the rotor-shaft/transmission attachment. Oscillatory loads are also transmitted to the airframe by impingement of the rotor wake on the upper portion of the airframe, but the mechanically transferred loads are in most cases much more significant than the aerodynamically transferred loads. GRA

N81-12075# Boeing Vertol Co., Philadelphia, Pa.
ADVANCED TRANSMISSION COMPONENTS INVESTIGA-

**TION PROGRAM: BEARING AND SEAL DEVELOPMENT
Final Report, 28 Jun. 1976 - Dec. 1979**

Joseph W. Lenski, Jr. Aug. 1980 288 p refs
(Contract DAAJ02-76-C-0045; DA Proj. 1L1-62209-AH-76)
(AD-A090675; D210-11591-1; USAAVRADCOM-TR-80-D-19)
Avail: NTIS HC A13/MF A01 CSCL 01/3

The objective of the Advanced Transmission Components Investigation Program was to conduct development testing on selected critical components for a helicopter advanced transmission which could enter engineering development in the 1980-90 timeframe. Under this contract, advanced transmission components have been designed, analyzed, and tested with the aim of reducing drive system weight and cost, increasing reliability, and improving other important attributes. The work reported in this volume includes the evaluation of VASCO-X2 steel as a bearing material, design and test of a ribbed cup tapered roller bearing with integrated inner race and shaft, test of a magnetic seal design, and development of an advanced finite element analysis of complex bearing structure. The aims and objectives of each component development have been formulated and are compared against test results to develop a measure of improvement to be expected when these developments become operational.

GRA

N81-12076# British Aerospace Aircraft Group, Weybridge (England).

THE CHANGING SCENE OF STRUCTURAL AIRWORTHINESS

W. G. Heath Paris Association Aeronautique et Astronautique de France 1979 29 p refs Presented at 14th Intern AAAF Aeron. Congr. on New Develop. in Struct. and Mater., Paris, 6-8 Jun. 1979

(AAAF-NT-79-24; ISBN-2-7170-0572-2) Avail: NTIS HC A03/MF A01; CEDOCAR, Paris FF 22 (France and EEC) FF 27 (others)

The state of the art and the development history of aircraft structures reliability design are reviewed, partly as they are mirrored in official requirements, and partly as they are seen by workers in the field. Included are loading and stress calculations, aeroelasticity, dynamic response, the fatigue problem, and the utilization of composite materials are discussed. Author (ESA)

N81-12077# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.

OPTIMAL DESIGN STUDIES ON COMPOSITE WINGS WITH STATIC AND DYNAMIC CONSTRAINTS

V. B. Venkayya, T. Harris, and N. S. Khot Paris Association Aeronautique et Astronautique de France 1979 43 p refs Presented at 14th Intern. AAAF Aeron. Congr. on New Develop. in Struct. and Mater., Paris, 6-8 Jun. 1979

(AAAF-NT-79-29; ISBN-2-7170-0577-3) Avail: NTIS HC A03/MF A01; CEDOCAR, Paris FF 34 (France and EEC) FF 39 (others)

Design studies on composite lifting surfaces using two computer programs are described. These programs are based on the displacement method of finite element analysis and serve to optimize structures for minimum weight with given strength and gage requirements. The method includes the study of the sensitivity of the flutter speed to change in frequency and the development of the optimization algorithms from frequency considerations. An analysis of failure criteria and optimization at element and play level is also included. A design example is presented. Author (ESA)

N81-12079# Societe Nationale Industrielle Aerospatiale, Toulouse (France). Direction des Etudes.

SYNTHESIS OF TEST RESULTS OBTAINED WITH CONCORDE AT HIGH INCIDENCES [SYNTHESE DE RESULTATS D'ESSAIS DU CONCORDE A GRANDES INCIDENCES]

D. Collard Paris Association Aeronautique et Astronautique de France 1980 14 p In FRENCH Presented at 16th Colloq. d'Aerodyn. Appl., Lille, 13-15 Nov. 1979

(AAAF-NT-80-26; ISBN-2-7170-0622-2) Avail: NTIS HC A02/MF A01; CEDOCAR, Paris FF 25 (France and EEC) FF 30 (others)

The lift experienced by Concorde continues to increase uniformly up to an angle of incidence of thirty five degrees. A change in flow characteristics over the airfoil occurs at an angle of twenty two degrees. The consequences of this phenomenon on the aircraft's flight behavior are studied. Most of the results were obtained in wind tunnel experiments with series aircraft models. Comparisons are also made between some in flight and wind tunnel test results. It is concluded that relatively minor changes in the shape of the airfoil can have extremely important effects on aircraft flight behavior. Author (ESA)

N81-12080# European Space Agency, Paris (France).
INVESTIGATION OF LANDING FLARE IN THE PRESENCE OF WIND SHEAR

Knut Wilhelm and Martin Marchand Jun. 1980 51 p refs Transl. into ENGLISH of "Ein Beitrag zur Berechnung des Abfangvorgangs beim Auftreten von Schewind", Rept. DFVLR-FB-79-20, DFVLR, Brunswick Jun. 1979 Original report in GERMAN previously announced as X80-74199 Original German report available from DFVLR, Cologne DM 11,50

(ESA-TT-631; DFVLR-FB-79-20) Avail: NTIS HC A04/MF A01

A method is presented, which describes the flight path in analytical form with respect to the flare maneuver of the pilot and the wind shear, occurring during the landing flare. The equations of motion were transposed in such a way that systematic treatment of the problem areas was possible. Examples of this approach are given for conventional and short takeoff type landing flare of a large transport aircraft. The influence of coupled control (direct lift control) is shown. It was found that: maintenance of a control function selected by the pilot leads to a reduction in the decay of flight path angle when wind velocity decreases; to achieve touchdown conditions comparable to the undisturbed case, the pilot must vary his control function; a comparison with flight tests shows that a flare path in the form of a fourth order parabola realistically reproduces the actual conditions; and the control function to achieve this flare path can contain a progressive component in addition to the linear increase in pitch attitude. Author (ESA)

N81-12081# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.

DEVELOPMENTS IN AIRCRAFT STRUCTURAL MATERIALS

R. J. H. Wanhill, W. G. J. T. Hart, and W. vanderHoeven Sep. 1979 22 p refs In DUTCH; ENGLISH summary Submitted for publication

(NLR-MP-79042-U) Avail: NTIS HC A02/MF A01

An overview of recent and ongoing development in aircraft structural materials is given. In view of current and predicted usage the most important developments concern aluminum alloys and advanced composites. Developments in titanium alloys, high strength steels and adhesive bonding are also discussed.

Author (ESA)

N81-12082 Rolls-Royce Ltd., Derby (England).
THE DESIGN DEVELOPMENT AND OPERATION OF GAS TURBINE RADIO TELEMETRY SYSTEMS

J. G. B. Worthy 31 Jan. 1980 9 p refs Presented at ASME 25th Ann. Intern. Gas Turbine Conf., Mar. 1980 (EIR-00733) Avail: NTIS HC A02

Measurements made on the rotating components of aero gas turbines are discussed. Radio telemetry systems designed and manufactured with that purpose are reviewed. A summary of operating experience is presented, which includes the problems encountered and the measures taken to overcome them.

Author (ESA)

N81-12084*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

LOW-SPEED AERODYNAMIC PERFORMANCE OF 50.8 CENTIMETER DIAMETER NOISE-SUPPRESSING INLETS FOR THE QUIET, CLEAN, SHORT-HAUL EXPERIMENTAL ENGINE (QCSEE)

John M. Abbott, James H. Diedrich, and Robert C. Williams
Aug. 1978 37 p refs
(NASA-TP-1178; E-9542) Avail: NTIS HC A03/MF A01 CSCL
21E

Two basic inlet concepts, a high throat Mach number (0.79) design and a low throat Mach number (0.60) design, were tested with four diffuser acoustical treatment designs that had face sheet porosity ranging from 0 to 24 percent for the high Mach number inlet and 0 to 28 percent for the low Mach number inlet. The tests were conducted in a low speed wind tunnel at free stream velocities of 0, 41, and 62 m/sec and angles of attack to 50 deg. Inlet throat Mach number was varied about the design value. Increasing the inlet diffuser face sheet porosity resulted in an increase in total pressure loss in the boundary layer for both the high and low Mach number inlet designs, however, the overall effect on inlet total pressure recovery of 0.991 at the design throat Mach number, a free stream velocity of 41 m/sec, and an angle of attack of 50 deg; inlet flow separation at an angle of attack of 50 deg was encountered with only one inlet configuration the high Mach number design with the highest diffuser face sheet porosity (24 percent). A.R.H.

N81-12085*# General Electric Co., Evendale, Ohio. Aircraft Engine Business Group.

ENGINE DIAGNOSTICS PROGRAM: CF6-50 ENGINE PERFORMANCE DETERIORATION

Ray H. Wulf Nov. 1980 208 p refs
(Contract NAS3-20631)
(NASA-CR-159867) Avail: NTIS HC A10/MF A01 CSCL
21E

Cockpit cruise recordings and test cell data in conjunction with hardware inspection results from airline overhaul shops were analyzed to define the extent and magnitude of performance deterioration of the General Electric CF6-50 high bypass turbofan engine. The magnitude of short term deterioration was isolated from the long term, and the individual damage mechanisms that were the cause for the majority of the performance deterioration was identified. It was determined that the long term engine performance deterioration characteristics were different for the 3 aircraft types currently powered by the CF6-50 engine, but these differences were due to operational considerations (flight length and takeoff derate) and not to differences associated with the aircraft type. Unrestored losses, that is, performance deterioration which remains after engine refurbishment, represents over 70 percent of the total performance deterioration at engine shop visit. Superficial damage, such as, increased surface roughness, leading edge shape changes on airfoils, and increases in the average clearances between rotating and stationary components is the major contributor to these losses. Seventy one percent of the unrestored losses are cost effective to restore, and if implemented could reduce fuel consumed by CF6-50 engines by 26 million gallons in 1980. R.C.T.

N81-12086*# General Electric Co., Cincinnati, Ohio.
CORE COMPRESSOR EXIT STAGE STUDY. VOLUME 3: DATA AND PERFORMANCE REPORT FOR SCREENING TEST CONFIGURATIONS

D. C. Wisler Nov. 1980 53 p refs
(Contract NAS3-20070)
(NASA-CR-159499; R80AEG313-Vol-3) Avail: NTIS
HC A04/MF A01 CSCL 21E

Rear stage blading designs that have lower losses in their endwall boundary layer regions were developed. Test data and performance results for rotor B, stator B, and stator C - blading designs that offer promise of reducing endwall losses relative to the baseline are given. A low speed research compressor was the principal investigative tool. The tests were conducted using four identical stages of blading so that the test data would be obtained in a true multistage environment. S.F.

N81-12087*# Pratt and Whitney Aircraft Group, East Hartford, Conn.

ROTOR REDESIGN FOR A HIGHLY LOADED 1800 FT/SEC TIP SPEED FAN, 2 Final Report

C. R. Bolt Dec. 1980 185 p refs

(Contract NAS3-20591)
(NASA-CR-159879; PWA-5523-92) Avail: NTIS
HC A09/MF A01 CSCL 21E

Tests were conducted on a 0.5 hub/tip ratio single-stage fan designed to produce a pressure ratio of 2.280 at an efficiency of 83.8 percent with a rotor tip speed of 548.6 m/sec (1800 ft/sec). The rotor was designed utilizing a quasi three dimensional design system and four-part, multiple-circular-arc airfoil sections. The rotor is the third in a series of single-stage fans that have included a precompression airfoil design and a multiple-circular-arc airfoil design. The stage achieved a peak efficiency of 82.8 percent after performance had deteriorated by 0.6 of a point. The design mass flow was achieved at the peak efficiency point, and the stage total pressure ratio was 2.20, which is lower than the design goal of 2.28. The surge margin of 13% from the peak efficiency point exceeded the design goal of 7%. Author

N81-12088*# AiResearch Mfg. Co., Phoenix, Ariz.
LOW-COST DIRECTIONALLY-SOLIDIFIED TURBINE BLADES, VOLUME 2

R. E. Dennis, G. S. Hoppin, III, and L. G. Hurst Apr. 1979
41 p

(Contract NAS3-20073)
(NASA-CR-159562; AiResearch-21-2953-2-Vol-2) Avail: NTIS
HC A03/MF A01 CSCL 21E

An endothermically heated technology was used to manufacture low cost, directionally solidified, uncooled nickel-alloy blades for the TFE731-3 turbofan engine. The MAR-M 247 and MER-M 100+Hf blades were finish processed through heat treatment, machining, and coating operations prior to 150 hour engine tests consisting of the following sequences: (1) 50 hours of simulated cruise cycling (high fatigue evaluation); (2) 50 hours at the maximum continuous power rating (stress rupture endurance (low cycle fatigue). None of the blades visually showed any detrimental effects from the test. This was verified by post test metallurgical evaluation. The specific fuel consumption was reduced by 2.4% with the uncooled blades. A.R.H.

N81-12089*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

EFFECT OF HOLE GEOMETRY AND ELECTRIC-DISCHARGE MACHINING (EDM) ON AIRFLOW RATES THROUGH SMALL DIAMETER HOLES IN TURBINE BLADE MATERIAL

Steven A. Hippensteele and Reeves P. Cochran Nov. 1980
14 p
(NASA-TP-1716; E-417) Avail: NTIS HC A02/MF A01 CSCL
21E

The effects of two design parameters, electrode diameter and hole angle, and two machine parameters, electrode current and current-on time, on air flow rates through small-diameter (0.257 to 0.462 mm) electric-discharge-machined holes were measured. The holes were machined individually in rows of 14 each through 1.6 mm thick IN-100 strips. The data showed linear increase in air flow rate with increases in electrode cross sectional area and current-on time and little change with changes in hole angle and electrode current. The average flow-rate deviation (from the mean flow rate for a given row) decreased linearly with electrode diameter and increased with hole angle. Burn time and finished hole diameter were also measured. Author

N81-12090*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

PROPULSION CONTROLS, 1979
Oct. 1980 147 p refs Proc. of symp. held in Cleveland,
17-19 May 1979
(NASA-CP-2137; E-477) Avail: NTIS HC A07/MF A01 CSCL
21E

The state of the art of multivariable engine control is examined in order to determine future needs and problem areas and to establish the appropriate roles of government, industries, and universities in addressing these problems.

N81-12091*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

MULTIVARIABLE IDENTIFICATION USING CENTRALIZED FIXED MODES

Walter C. Merrill *In its Propulsion Controls*, 1979 Oct. 1980 p 3-10 refs

Avail: NTIS HC A07/MF A01 CSCL 21E

A procedure to determine a state space model of a multivariable system (λ inputs, m outputs) is presented. The model is suitable for control studies and uses single input, single output (SISO) system data in the identification procedure. The procedure can be defined in three distinct steps. First, the system's $\lambda \times m$ SISO transfer functions are identified by using any standard or known identification technique for SISO systems. One objective of this step is to identify SISO transfer functions with as few distinct modes as possible between any two functions. Second, the time domain realization of each SISO transfer function is obtained in a straightforward manner and combined into a total multivariable realization. This total realization, in all probability, has more state variables than are required to define system response. In the third step, these excess or redundant states are removed by using minimal realization theory. The remaining states are related to system centralized fixed modes. Eigenvalue-eigenvector techniques were recently reported that yield a computationally feasible solution to the problem posed in step three. The procedure is applied to QCSEE data to demonstrate its feasibility. Author

N81-12092*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

PERFORMANCE SEEKING CONTROLS

Kurt Seldner *In its Propulsion Controls*, 1979 Oct. 1980 p 11-17 refs

Avail: NTIS HC A07/MF A01 CSCL 21E

A performance logic algorithm (PSL) was developed to optimize the performance of propulsion systems for component and sensor degradations by monitoring the performance of the engine system and minimizing thrust specific fuel consumption (TSFC) while retaining a constant engine net thrust. Engine constraints such as surge margin, speed, pressure, and temperature are observed. The PSL algorithm was applied to the quiet, clean, short haul experimental engine. Engine control set points were modified for component degradations in order to restore the nominal net thrust. Results show convergence to the optimum value can be obtained within 60 to 90 seconds, which makes the program acceptable to on line operation with present state of the art minicomputers. Tests indicate that in most cases the PSL algorithm offers some improvement in thrust specific fuel consumption over the manual throttle. A.R.H.

N81-12093*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

F100 MULTIVARIABLE CONTROL SYNTHESIS PROGRAM: A REVIEW OF FULL SCALE ENGINE ALTITUDE TESTS

Bruce Lehtinen and James F. Soeder *In its Propulsion Controls*, 1979 Oct. 1980 p 20-34 refs

Avail: NTIS HC A07/MF A01 CSCL 21E

The benefits of linear quadratic regulator synthesis methods in designing a multivariable engine control capable of operating an engine throughout its flight envelope were demonstrated. The entire multivariable control synthesis program is reviewed with particular emphasis on engine tests conducted in the NASA Lewis propulsion systems laboratory altitude facility. The multivariable control has basically a proportional plus integral, model following structure with gains scheduled as functions of flight condition. The multivariable control logic design is described, along with control computer implementation aspects. Altitude tests demonstrated that the multivariable control logic could control an engine over a wide range of test conditions. Representative transient responses are presented to demonstrate engine behavior and the functioning of the control logic. A.R.H.

N81-12094*# Pratt and Whitney Aircraft Group, East Hartford, Conn. Commercial Products Div.

DESIGN OF A MULTIVARIABLE INTEGRATED CONTROL FOR A SUPERSONIC PROPULSION SYSTEM

Edward C. Beattie *In NASA, Lewis Research Center Propulsion Controls*, 1979 Oct. 1980 p 35-47 refs

Avail: NTIS HC A07/MF A01 CSCL 21E

An inlet/engine/nozzle integrated control mode for the propulsion system of an advanced supersonic commercial aircraft was studied. Results show that integration of these control functions can result in both operational and performance benefits for the propulsion system. For example, this integrated control mode may make it possible to minimize the use of inlet bypass doors for shock position control. This may be of benefit to the aircraft as a result of minimizing: (1) bypass bleed drag effects; (2) perturbations to the aircraft resulting from the side thrust effect of the bypass bleeds; and (3) potential unstarts of the inlet. A conceptual integrated control mode was developed which makes use of many cross coupling paths between inlet and engine control variables and inlet and engine sensed variables. A multivariable control design technique based upon linear quadratic regulator theory was applied to designing the feedback gains for this control to allow a simulation evaluation of the benefits of the integrated control mode. Author

N81-12095*# Pratt and Whitney Aircraft Group, East Hartford, Conn. Government Products Div.

PROPULSION CONTROLS

Ronald D. Harkney *In NASA, Lewis Research Center Propulsion Controls*, 1979 Oct. 1980 p 49-59 refs

Avail: NTIS HC A07/MF A01 CSCL 21E

Increased system requirements and functional integration with the aircraft have placed an increased demand on control system capability and reliability. To provide these at an affordable cost and weight and because of the rapid advances in electronic technology, hydromechanical systems are being phased out in favor of digital electronic systems. The transition is expected to be orderly from electronic trimming of hydromechanical controls to full authority digital electronic control. Future propulsion system controls will be highly reliable full authority digital electronic with selected component and circuit redundancy to provide the required safety and reliability. Redundancy may include a complete backup control of a different technology for single engine applications. The propulsion control will be required to communicate rapidly with the various flight and fire control avionics as part of an integrated control concept. A.R.H.

N81-12097*# Boeing Military Airplane Development, Seattle, Wash.

SHOULD WE ATTEMPT GLOBAL (INLET ENGINE AIRFRAME) CONTROL DESIGN?

Christopher M. Carlin *In NASA, Lewis Research Center Propulsion Controls*, 1979 Oct. 1980 p 71-82

Avail: NTIS HC A07/MF A01 CSCL 21E

The feasibility of multivariable design of the entire airplane control system is briefly addressed. An intermediate step in that direction is to design a control for an inlet engine augmentor system by using multivariable techniques. The supersonic cruise large scale inlet research program is described which will provide an opportunity to develop, integrate, and wind tunnel test a control for a mixed compression inlet and variable cycle engine. The integrated propulsion airframe control program is also discussed which will introduce the problem of implementing MVC within a distributed processing avionics architecture, requiring real time decomposition of the global design into independent modules in response to hardware communication failures. M.G.

N81-12098*# Detroit Diesel Allison, Indianapolis, Ind.

ROAD MAP TO ADAPTIVE OPTIMAL CONTROL

Robert Boyer *In NASA, Lewis Research Center Propulsion Controls*, 1979 Oct. 1980 p 83-87

Avail: NTIS HC A07/MF A01 CSCL 21E

A building block control structure leading toward adaptive, optimal control for jet engines is developed. This approach

simplifies the addition of new features and allows for easier checkout of the control by providing a baseline system for comparison. Also, it is possible to eliminate certain features that do not have payoff by being selective in the addition of new building blocks to be added to the baseline system. The minimum risk approach specifically addresses the need for active identification of the plant to be controlled in real time and real time optimization of the control for the identified plant. M.G.

N81-12099*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

PROPULSION CONTROL AND CONTROL THEORY: A NEW RESEARCH FOCUS

John R. Zeller *In its Propulsion Controls*, 1979 Oct. 1980 p 89-95

Avail: NTIS HC A07/MF A01 CSCL 21E

Technological developments necessary for the implementation of advanced digital control concepts for aircraft propulsion are identified and discussed. Developments associated with the replacement analog controllers with digital control systems, sensors and actuators, and control modes and software are reported. M.G.

N81-12100*# Virginia Polytechnic Inst. and State Univ., Blacksburg.

ENGINE IDENTIFICATION FOR ADAPTIVE CONTROL

Robert G. Leonard and Eric M. Arnett *In NASA*, Lewis Research Center *Propulsion Controls*, 1979 Oct. 1980 p 97-104 refs

(Grant NsG-3119)

Avail: NTIS HC A07/MF A01 CSCL 21E

An attempt to obtain a dynamic model for a turbofan gas turbine engine for the purpose of adaptive control is described. The requirements for adaptive control indicate that a dynamic model should be identified from data sampled during engine operation. The dynamic model identified was of the form of linear differential equations with time varying coefficients. A turbine engine is, however, a highly nonlinear system, so the identified model would be valid only over a small area near the operating point, thus requiring frequent updating of the coefficients in the model. Therefore it is necessary that the identifier use only recent information to perform its function. The identifier selected minimized the square of the equation errors. Known linear systems were used to test the characteristics of the identifier. It was found that the performance was dependent on the number of data points used in the computations and upon the time interval over which the data points were obtained. Preliminary results using an engine deck for the quiet, clean, shorthaul experimental engine indicate that the identified model predicts the engine motion well when there is sufficient dynamic information, that is when the engine is in transient operation. M.G.

N81-12101*# Purdue Univ., Lafayette, Ind. School of Mechanical Engineering.

MULTIVARIABLE NYQUIST ARRAY METHOD WITH APPLICATION TO TURBOFAN ENGINE CONTROL

Gary G. Leininger *In NASA*, Lewis Research Center *Propulsion Controls*, 1979 Oct. 1980 p 105-110 refs

Avail: NTIS HC A07/MF A01 CSCL 21E

Extensions to the multivariable Nyquist array (MNA) method are used to design a feedback control system for the quiet clean shorthaul experimental engine. The results of this design are compared with those obtained from the deployment of an alternate control system design on a full scale nonlinear, real time digital simulation. The results clearly demonstrate the utility of the MNA synthesis procedures for highly nonlinear sophisticated design applications. M.G.

N81-12102*# Bendix Corp., Detroit, Mich. Energy Control Div.

MULTIVARIABLE SYNTHESIS WITH TRANSFER FUNCTIONS

Joseph L. Peczkowski *In NASA*, Lewis Research Center

Propulsion Controls, 1979 Oct. 1980 p 111-127 refs

Avail: NTIS HC A07/MF A01 CSCL 21E

A transfer function design theory for multivariable control synthesis is highlighted. The use of unique transfer function matrices and two simple, basic relationships - a synthesis equation and a design equation - are presented and illustrated. This multivariable transfer function approach provides the designer with a capability to specify directly desired dynamic relationships between command variables and controlled or response variables. At the same time, insight and influence over response, simplifications, and internal stability is afforded by the method. A general, comprehensive multivariable synthesis capability is indicated including nonminimum phase and unstable plants. Gas turbine engine examples are used to illustrate the ideas and method. M.G.

N81-12103*# Notre Dame Univ., Ind.

ALTERNATIVES FOR JET ENGINE CONTROL

Michael K. Sain and R. Michael Schafer *In NASA*, Lewis Research Center *Propulsion Controls*, 1979 Oct. 1980 p 129-138 refs

(Grant NsG-3048)

Avail: NTIS HC A07/MF A01 CSCL 21E

Alternatives to linear quadratic regulator theory in the linear case are examined along with nonlinear modelling and optimization approaches for global control. Context for the studies has been set by the DYNGEN digital simulator and by models generated for various phases of the F100 Multivariable Control Synthesis Program. With respect to the linear alternatives, the multivariable frequency domain is stressed. Progress is reported in both the direct algebraic approach to exact model matching, by means of stimulating work on the basic computational issues, and in the indirect generalized Nyquist approach. With respect to nonlinear modelling and optimization, the emphasis is twofold: the development of analytical nonlinear models of the jet engine and the use of these models in conjunction with techniques of mathematical programming in order to study global control over nonincremental portions of the flight envelope. The possibility of using tensor methods is explored. M.G.

N81-12104*# Toledo Univ., Ohio.

SENSOR/ACTUATOR FAILURE DETECTION FOR TURBOFAN ENGINES

Khosrow Behbehani and Gary G. Leininger (Purdue Univ., Lafayette, Ind.) *In NASA*, Lewis Research Center *Propulsion Controls*, 1979 Oct. 1980 p 139-143 refs

Avail: NTIS HC A07/MF A01 CSCL 21E

A procedure for sensor/actuator failure detection using a generalized likelihood ratio (GLR) test is described. The GLR concept can provide a reliable evaluation of failure occurrence when associated with a feedback control design which does not require sensor outputs to provide data estimates. A GLR detector was developed and tested. M.G.

N81-12105*# Cincinnati Univ., Ohio.

EFFECT OF AMBIENT CONDITIONS ON THE EMISSIONS FROM A GAS TURBINE COMBUSTOR Final Report

C. W. Kauffman Washington NASA Nov. 1980 105 p refs (Grant NsG-3045)

(NASA-CR-3355) Avail: NTIS HC A06/MF A01 CSCL 21E

The effect of variations in the ambient conditions of pressure, temperature, and relative humidity upon the emissions of a gas turbine combustion are investigated. A single combustor can from a Pratt and Whitney JT8D-17 engine was run at parametric inlet conditions bracketing the actual engine idle conditions. Data were correlated to determine the functional relationships between the emissions and ambient conditions. Mathematical modelling was used to determine the mechanism for the carbon monoxide and hydrocarbon emissions. Carbon monoxide emissions were modelled using finite rate chemical kinetics in a plug flow scheme. Hydrocarbon emissions were modelled by a vaporization scheme throughout the combustor. M.G.

N81-12106# Atlantic Research Corp., Gainesville, Va.
EFFECTS OF ADVANCES IN PROPULSION TECHNOLOGY ON MISSILE EFFECTIVENESS

C. R. Limage and J. L. Fields 5 Sep. 1980 26 p
 (AD-A090645) Avail: NTIS HC A03/MF A01 CSCL 21/5

This paper presents the effects of propulsion technology evolution on the performance capability of advanced missile systems. The evolution of the missile propulsion system from rocket to ramjet with increased emphasis on advanced airbreathing missile cycles, has significantly extended missile operational capabilities. The development of these new areas of ramjet technology, specifically in solid fuel propellants, offers the advantages of large increases in heating value, density, burning efficiency and improves system packaging. Application of these technology advancements to potential mission scenarios produces impressive increases in overall mission performance. These large performance gains provide a basis for improvements in mission effectiveness in terms of kill probability and survivability. Kill probability is increased by application of shorter intercept times, improved multi-shot capability and reductions in individual system size to improve weapon carrier payload capability. Survivability is enhanced by increased standoff distances and higher penetration velocities. Demonstration of these improved capabilities, over a variety of tactical mission are provided by a direct comparison of missile performance for a variety of missile propulsion systems. The systems studied range from the conventional solid rocket system to the advanced highly energetic boron solid fuel ramjet concept. GRA

N81-12107# Texas Technological Univ., Lubbock. Dept. of Mechanical Engineering.

NUMERICAL ANALYSIS OF THE FLOW IN THE CONNECTING PASSAGE BETWEEN THE FAN SECTION AND HIGH PRESSURE SECTION OF A TURBOJET ENGINE Final Report

Allen Goldman Jun. 1980 88 p refs
 (Grant AF-AFOSR-3561-78; AF Proj. 2307)
 (AD-A090506; AFOSR-80-0755TR) Avail: NTIS
 HC A05/MF A01 CSCL 20/4

The flow field in a bifurcated channel was calculated using finite difference techniques which incorporated a body fitted coordinate system. The flow model used was incompressible and could be axisymmetric or two dimensional and laminar or turbulent flow. The objective was to calculate the flow field for a Reynolds number of 750,000. It was found that the results obtained from the axisymmetric formulation were different from the two dimensional formulation. Since the actual flow geometry is axisymmetric this means that only the axisymmetric formulation should be used in further investigations. The maximum velocity in the channel was 1.7 times the inlet velocity which corresponds to a Mach number of greater than .5. Therefore, the flow is compressible and further investigations should incorporate this fact. GRA

N81-12108# General Motors Corp., Indianapolis, Ind. Diesel Allison Div.

THE EFFECTS OF SOLIDITY, INTERBLADE PHASE ANGLE AND REDUCED FREQUENCY ON THE TIME-VARIANT AERODYNAMIC RESPONSE OF A COMPRESSOR STATOR Annual Report, 1 May 1979 - 1 May 1980

Robert L. Jay and William A. Bennett Jun. 1980 196 p refs
 (Contract F49620-78-C-0070; AF Proj. 2307)
 (AD-A090546; DDA-EDR-10339; AFOSR-80-1041TR) Avail:
 NTIS HC A09/MF A01 CSCL 21/5

An experimental investigation was conducted to provide basic unsteady pressure distributions on a stationary vane row, with the primary source of excitation being the wakes generated from an upstream rotor. This was accomplished over a wide range of key parameters in a large-scale, low-speed, single stage compressor. The excitation, the velocity defect created by the rotor blade wakes, was measured with a crossed hot wire. The resulting time-variant aerodynamic response was measured by means of flush mounted high response pressure transducers mounted on a stator vane over a wide range in incidence angles. The dynamic data were analyzed to determine the chordwise distribution of the dimensionless dynamic pressure coefficient

and aerodynamic phase lag as referenced to the transverse gust at the vane leading edge. GRA

N81-12109*# National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.

SIMULATION COMPARISON OF A DECOUPLED LONGITUDINAL CONTROL SYSTEM AND A VELOCITY VECTOR CONTROL WHEEL STEERING SYSTEM DURING LANDINGS IN WIND SHEAR

G. Kimball, Jr. Nov. 1980 76 p refs
 (NASA-TP-1734; L-13738) Avail: NTIS HC A05/MF A01 CSCL 01C

A simulator comparison of the velocity vector control wheel steering (VCWS) system and a decoupled longitudinal control system is presented. The piloting task was to use the electronic attitude direction indicator (EADI) to capture and maintain a 3 degree glide slope in the presence of wind shear and to complete the landing using the perspective runway included on the EADI. The decoupled control system used constant prefilter and feedback gains to provide steady state decoupling of flight path angle, pitch angle, and forward velocity. The decoupled control system improved the pilots' ability to control airspeed and flight path angle during the final stages of an approach made in severe wind shear. The system also improved their ability to complete safe landings. The pilots preferred the decoupled control system in severe winds and, on a pilot rating scale, rated the approach and landing task with the decoupled control system as much as 3 to 4 increments better than use of the VCWS system. R.K.G.

N81-12110*# Systems Technology, Inc., Hawthorne, Calif.
PRACTICAL OPTIMAL FLIGHT CONTROL SYSTEM DESIGN FOR HELICOPTER AIRCRAFT. VOLUME 2: SOFTWARE USER'S GUIDE Final Report

Susan A. Riedel Mar. 1979 254 p refs
 (Contract NAS2-9946)
 (NASA-CR-152306; TR-1127-1-Vol-2) Avail: NTIS
 HC A12/MF A01 CSCL 01C

A method by which modern and classical control 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. The first step is to establish the differences, distinguishing characteristics and connections between the modern and classical control theory approaches. Ultimately, this uncovers a relationship between bandwidth goals familiar in classical control and cost function weights in the equivalent optimal system. In order to obtain a practical optimal solution, it is also necessary to formulate the problem very carefully, and each choice of state, measurement and output variable must be judiciously considered. Once design goals are established and problem formulation completed, the control system is synthesized in a straightforward manner. Three steps are involved: filter-observer solution, regulator solution, and the combination of those two into the controller. Assessment of the controller, permits and examination and expansion of the synthesis results. J.M.S.

N81-12111# Universite des Sciences et Techniques de Lille (France). Inst. de Mecanique des Fluides.

INFLUENCE OF LIGHT AIRCRAFT ARCHITECTURE ON ITS SPIN CHARACTERISTICS [INFLUENCE DE L'ARCHITECTURE DES AVIONS LEGERS SUR LEUR VRILLE]

L. Beurain Paris Association Aeronautique et Astronautique de France 1980 40 p In FRENCH; ENGLISH summary Presented at 16th Colloq. d'Aerodyn. Appl., Lille, 13-15 Nov. 1979

(AAAF-NT-80-11; ISBN-2-7170-0607-9) Avail: NTIS
 HC A03/MF A01; CEDOCAR, Paris FF 40 (France and EEC)
 FF 45 (others)

The effects of the geometry of certain elements on aircraft spin characteristics are deduced from a parametric study performed in a vertical wind tunnel using a free model. Some verifications in actual flight were also done. It is shown that the most critical factors are the rear body cross section and the vertical location

of the tail control surface. Several measures to improve spin recovery are discussed. Author (ESA)

N81-12112# Universite des Sciences et Techniques de Lille (France). Inst. de Mecanique des Fluides.

SOME NEW RESEARCH APPROACHES TO AIRCRAFT SPIN STUDIES [QUELQUES NOUVEAUX AXES DE RECHERCHE DANS LE DOMAINE DE LA VRILLE]

M. Vanmansart and D. Tristrant Paris Association Aeronautique et Astronautique de France 1980 29 p In FRENCH; ENGLISH summary Presented at 16th Colloq. d'Aerodyn. Appl., Lille, 13-15 Nov. 1979

(AAAF-NT-80-12; ISBN-2-7170-0608-7) Avail: NTIS HC A03/MF A01; CEDOCAR, Paris FF 40 (France and EEC) FF 45 (others)

Included are a statistical correlation between aircraft geometry and spin and recovery characteristics, the analytical elaboration of actual flight data records, and a quantitative analysis of the conventional free spin test method in vertical wind tunnels are included. The development of better telemetry instrumentation for free spin model testing and the utilization of a rotative balance are discussed. Author (ESA)

N81-12113# Royal Aircraft Establishment, Bedford (England). Flight Systems Dept.

THE FLYING QUALITIES OF AIRCRAFT WITH ACTIVELY AUGMENTED PITCH AND YAW STABILITY

W. J. G. Pinsker London Feb. 1979 94 p refs Supersedes RAE-TR-79 and ARC 38234

(ARC-R/M-3848; RAE-TR-79029; ARC-38234) Avail: NTIS HC A05/MF A01; HMSO £ 16 PHI

Ignoring the dynamics of the automatic control loop hardware, the effects were studied on rigid body mode stability, gust response and pilot control of aircraft in which relaxed longitudinal or directional stability is augmented by various alternative feedbacks to the elevator and rudder. It is shown that indirect augmentation by such methods as feedback of pitch rate, integral pitch rate or normal acceleration in longitudinal case or lateral acceleration in the directional case can give rise to significant adverse characteristics which could limit the amount of instability which can be so corrected or which may demand additional corrective feedback loops. Direct feedback of incidence or sideslip will restore behavior indistinguishable from that of naturally stable configurations, provided these quantities can be sensed accurately and reliably. Attention is drawn to difficulties with indirect feedbacks in maintaining stability near and beyond the stall and to gust response characteristics. Author (ESA)

N81-12114# National Technical Information Service, Springfield, Va.

CLOSED LOOP CONTROL SYSTEMS: AIRCRAFT. CITATIONS FROM THE NTIS DATA BASE Progress Report, Mar. 1975 - Jun. 1980

Guy E. Habercom, Jr. Jul. 1980 147 p Supersedes NTIS/PS-79/0904 and NTIS/PS-78/0809

(PB80-813710; NTIS/PS-79/0904; NTIS/PS-78/0809) Avail: NTIS HC \$30.00/MF \$30.00 CSCL 01C

Adaptive control and feedback control closed loop systems relative to aircraft flight control are investigated. Studies on guidance and control of drones and remotely piloted vehicles are included. This updated bibliography contains 164 citations, 22 of which are new entries to the previous edition. GRA

N81-12115# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).

REPORT ON A COOPERATIVE PROGRAMME ON ACTIVE FLUTTER SUPPRESSION

London Aug. 1980 55 p refs In ENGLISH and FRENCH Meeting held in Athens, Apr. 1980

(AGARD-R-689; ISBN-92-835-0270-2) Avail: NTIS HC A04/MF A01

The results of a cooperative program on active flutter suppression on a dynamic model of the YF-17 aircraft are presented. Control laws for active flutter suppression were derived for one explosive wing-store flutter case of the model. Phase

control laws were all tested and compared during wind tunnel tests performed in the Langley 16 ft wind tunnel. Results were quite promising and open the way for future cooperation on full-scale aircraft.

N81-12116*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

WIND TUNNEL TEST OF A FIGHTER AIRCRAFT WING/STORE FLUTTER SUPPRESSION SYSTEM: AN INTERNATIONAL EFFORT

C. Hwang, E. H. Johnson, G. R. Mills, T. E. Noll, and M. G. Farmer In AGARD Rept. on a Coop. Programme on Active Flutter Suppression Aug. 1980 23 p refs Prepared in cooperation with Northrop Corp., Hawthorne, Calif. and AFFDL, Wright-Patterson AFB, Ohio

Avail: NTIS HC A04/MF A01 CSCL 01C

A 30% scale, half span model of a lightweight fighter aircraft with an active wing/store flutter suppression system was tested in the NASA Langley Research Center sixteen foot transonic dynamics tunnel. The test featured a store configuration that was intentionally designed to exhibit a violent flutter condition. In addition to Northrop organized control laws, three European countries also contributed control laws to stabilize this condition. After the control laws were mechanized by Northrop, they were tested at the Langley facility. The model was tested up to 170% of the open loop flutter dynamic pressure in a number of cases, with the indication that a substantially greater improvement was achievable. Some special features of the test model are discussed and the design and implementation of the control laws as well as the test monitoring techniques and results are presented.

R.C.T.

N81-12117# Messerschmidt-Boelkow G.m.b.H., Munich (West Germany). Airplane Div.

ACTIVE CONTROL OF AN EXPLOSIVE WING-STORE FLUTTER CASE

H. Honlinger, O. Sensburg, M. Kuhn, and H. Godel In AGARD Rept. on Coop. Programme on Active Flutter Suppression Aug. 1980 8 p refs

Avail: NTIS HC A04/MF A01

Control laws were calculated, using optimal control theory, to suppress an explosive wing-store flutter case on a YF-17 dynamically scaled model. The trailing edge flap was used for flutter suppression because usually hydraulically driven ailerons are available in modern fighters. The design aim of 1.5 times the flutter dynamic pressure was demonstrated during the wind tunnel test. It is shown that no changes to the analytically developed control law were necessary in the test which proves that theory has well advanced during the last years. R.C.T.

N81-12118# Office National d'Etudes et de Recherches Aerospatiales, Leclerc (France).

TEST AND ANALYSES OF AN ACTIVE FLUTTER SUPPRESSION SYSTEM ON AN FFDL MODEL OF YF17

Roger Destuynder In AGARD Rept. on Coop. Programme on Active Flutter Suppression Aug. 1980 8 p refs In FRENCH; ENGLISH summary

Avail: NTIS HC A04/MF A01

A flutter control law was calculated for a YF-17 model equipped with a store at the wingtip. The control law used stiffness injection on the wing by the help of the unsteady aerodynamic forces induced by a control surface. The leading edge control surface and only one accelerometer, located in the wing close to the nodal line of the pitching mode of the external store, were used. During the wind tunnel tests the nominal control law was used without considering the existing differences between eigen modes and frequencies introduced in the calculations and eigen modes and frequencies existing on the model itself when mounted in the wind tunnel. The control at constant Mach number $M = 0.80$, permitted to increase substantially the dynamic critical pressure and also to reduce considerably the explosivity of the flutter phenomenon. R.C.T.

N81-12119# British Aerospace Aircraft Group, Bristol (England).
**WIND TUNNEL TESTS ON A FIGHTER AIRCRAFT WING/
 STORE FLUTTER SUPPRESSION SYSTEM: THE B.Ae
 CONTROL LAW**

M. R. Turner *In* AGARD Rept. on Coop. Programme on Active
 Flutter Suppression Aug. 1980 10 p refs

Avail: NTIS HC A04/MF A01

A B.Ae control law designed using analytical data was tested on a model of the YF-17 in the NASA Langley 16 foot wind tunnel and succeeded in meeting the requirement to increase the flutter dynamic pressure by 70% at $M = 0.8$. Because the store configuration chosen for these tests produced a flutter mechanism which was both hard and near to classical frequency coalescence, it was necessary to use a multiple output control law to achieve the stability margin objectives of \pm or $- 60$ deg and \pm or $- 6$ dB. The B.Ae control law was designed using a novel procedure which provides these stability margins, uses minimum control surface movement in turbulence and can be designed using either analytical or empirical data. Two wing tip accelerometers and a leading edge control surface were used. Empirical open loop transfer functions obtained during the test showed that the analytical data overestimated the response of the flutter mode to leading edge control surface excitation.

R.C.T.

N81-12120*# Old Dominion Univ., Norfolk, Va. Dept. of
 Mechanical Engineering and Mechanics.
**EFFECTS OF BOUNDARY-LAYER TREATMENT ON CRYO-
 GENIC WIND-TUNNEL CONTROLS** Progress Report, period
 ending Aug. 1980

S. Balakrishna Aug. 1980 62 p refs
 (Grant NsG-1503)

(NASA-CR-159372) Avail: NTIS HC A04/MF A01 CSCL
 14B

Various techniques of realizing the desired boundary layer wall mass removal are considered in order to obtain the desired flow field over the model for various airfoils. The complementary problem of overall thermodynamic equilibrium maintenance created by the side wall boundary layer bleed is also addressed.

R.C.T.

N81-12180# Rolls-Royce Ltd., Derby (England).
**THE DEVELOPMENT OF THE COMPOSITE MATERIAL
 ENGINE NACELLE**

H. X. Bennett Paris Association Aeronautique et Astronautique
 de France 1979 27 p refs Presented at 14th. Intern. AAAF
 Aeron. Congr. on New Develop. in Struct. and Mater., Paris,
 6-8 Jun. 1979

(AAAF-NT-79-38; ISBN-2-7170-0586-2) Avail: NTIS
 HC A03/MF A01; CEDOCAR, Paris FF 22 (France and EEC)
 FF 27 (others)

The manufacturing techniques for composite carbon fiber (CFC) engine nacelles are discussed and the overall cost and weight results examined. The design and construction of the four components of a nose cowl are described, where a 25 to 29 percent weight reduction was obtained. Alternative manufacturing methods are compared. Automated production of a nose cowl in CFC would result in a cost reduction of 20 percent in spite of a raw material cost ratio of ten (CFC to aluminum).

Author (ESA)

N81-12181# System Development Corp., Santa Monica, Calif.
TESTING OF COMPOSITE STRUCTURES

G. E. Mueller Paris Association Aeronautique et Astronautique
 de France 1979 23 p refs Presented at 14th Intern. AAAF
 Aeron. Congr. on New Develop. in Struct. and Mater., Paris,
 6-8 Jun. 1979

(AAAF-NT-79-41; ISBN-2-7170-0589-7) Avail: NTIS
 HC A02/MF A01; CEDOCAR, Paris FF 22 (France and EEC)
 FF 27 (others)

A critical analysis of published reports on testing of composite structures is presented, centered on the reliability of nondestructive testing procedures. It is concluded that no

combination of current nondestructive test techniques can ensure airworthiness today.

Author (ESA)

N81-12182# Societe Nationale Industrielle Aerospatiale,
 Marignane (France.)

**IMPACT OF MODERN MATERIALS ON THE DEVELOPMENT
 OF ROTATING AIRFOIL EQUIPMENT [IMPACTS DES
 MATERIAUX MODERNES SUR LE DEVELOPPEMENT DES
 APPAREILS A VOILURES TOURNANTES]**

G. Petit and F. d'Ambra Paris Association Aeronautique et
 Astronautique de France 1979 36 p *In* FRENCH

(AAAF-NT-79-43; ISBN-2-7170-0591-9) Avail: NTIS
 HC A03/MF A01; CEDOCAR, Paris FF 34 (France and EEC)
 FF 39 (others)

Improvements in nonmetallic materials used in helicopter construction are presented. The specific uses of these materials for the different components of helicopters are described. Emphasis is given to the applications of modern composites. The financial, technical and safety aspects associated with the use of these materials are discussed together with some specific problems, e.g., maintenance. A 6 to 8 ton class tactical helicopter is treated as an example.

Author (ESA)

N81-12183# Avions Marcel Dassault-Breguet Aviation,
 Saint-Cloud (France). Etudes Structures.

**MIRAGE 2000 AND MIRAGE 4000 FIBER STRUCTURES
 [STRUCTURES FIBRES SUR MIRAGE 2000 ET MIRAGE
 4000]**

Marcel Peyrony Paris Association Aeronautique et Astronautique
 de France 1979 36 p *In* FRENCH Presented at 14th Intern.

AAAF Aeron. Congr. on New Develop. in Struct. and Mater.,
 Paris, 6-8 Jun. 1979

(AAAF-NT-79-44; ISBN-2-7170-0592-7) Avail: NTIS
 HC A03/MF A01; CEDOCAR, Paris FF 34 (France and EEC)
 FF 39 (others)

The applications of modern fiber materials for various components are discussed. The criteria determining whether glues or mechanical fixation are to be employed are presented. Structural behavior, optimization, and test results are given. Some of the techniques used are extensions of existing methods. Nondestructive testing is described. The weights of various components are tabulated.

Author (ESA)

N81-12191# Monsanto Research Corp., Dayton, Ohio.
TRACE CHEMICAL ANALYSIS METHODOLOGY Final
 Report, 5 Feb. 1975 - 15 Mar. 1980

William J. Hillan, Joseph J. Brooks, Thomas G. Duffy, Mark T.
 Winiger, and William D. Ross Apr. 1980 256 p refs
 (Contract F33615-75-C-1130)

(AD-A090762; MRC-DA-934) Avail: NTIS HC A12/MF A01
 CSCL 07/4

A method was developed for the analysis of aqueous nitrates and nitrites. In this method, the sample is treated with benzene, hydrogen peroxide (for nitrite ion analysis), and sulfuric acid to produce nitrobenzene which is then detected by electron capture gas chromatography. This analytical method was adapted to determine oxides of nitrogen in air. A system to sample and analyze the hydrocarbon portion of jet engine exhaust to assess its environmental consequences was evaluated. Exhaust samples were collected and analyzed from five jet fuels and isooctane. The samples were collected on a combination sorbent trap packed with Tenax GC and Carbosieve B, then desorbed into a gas chromatograph.

GRA

N81-12192# Science Applications, Inc., Canoga Park, Calif.
 Combustion Dynamics and Propulsion Technology Div.

MIXING AND COMBUSTION IN HIGH SPEED AIR FLOWS
 Final Report, Apr. 1977 - May 1980

P. T. Harsha and R. B. Edelman Jul. 1980 69 p refs
 (Contract F49620-77-C-0044; AF Proj. 2308)

(AD-A090536; SAI-80-020-CP; AFOSR-80-1005TR) Avail:
 NTIS HC A04/MF A01 CSCL 21/5

The development and application of a modular model for the prediction of the performance of sudden expansion burners

as a function of the controllable parameters relevant to combustor design is described. The model is based on a concept in which the recirculation zone, treated as a stirred reactor, is coupled to a parabolic boundary layer formulation for the flow outside the recirculation zone. Hydrocarbon oxidation kinetics and turbulent kinetic energy models are employed in the model development. In addition to the parabolic-flow and stirred reactor elements, a module representing the fuel injection process has been developed. Results of the application of the modular model to the analysis of cold-flow and reacting-flow dump combustor experimental data are described. GRA

N81-12209 Rolls-Royce Ltd., Bristol (England). Aero Div.
METALLURGICAL ASPECTS OF MATERIALS PROCESSING AND MANUFACTURING FOR AERO-ENGINE COMPONENTS

P. Wildgoose 1980 32 p
 (PNR-90019) Avail: NTIS HC A03

A number of processes are discussed in terms of their metallurgical value and their effects on material properties and integrity, with particular reference to gas turbine applications. Included are precision casting, vacuum casting, blade/vane cooling, hot isostatic pressing, uni-directional solidification, titanium casting, high temperature protective coatings, inertia bonding, high strength brazing, small hole drilling, electrochemical machining, and electrodischarge machining is considered for gas turbine engine components. Author (ESA)

N81-12225* Boeing Commercial Airplane Co., Seattle, Wash. Preliminary Design Dept.

AIRCRAFT SURFACE COATINGS STUDY: ENERGY EFFICIENT TRANSPORT PROGRAM Final Report
 Jan. 1979 115 p refs
 (Contract NAS1-14742)
 (NASA-CR-158954; D6-46699) Avail: NTIS
 HC A06/MF A01 CSCL 11C

Surface coating materials for application on transport type aircraft to reduce drag, were investigated. The investigation included two basic types of materials: spray on coatings and adhesively bonded films. A cost/benefits analysis was performed, and recommendations were made for future work toward the application of this technology. Author

N81-12255* United Technologies Corp., East Hartford, Conn.
EXPERIMENTAL STUDY OF THE STABILITY OF AIRCRAFT FUELS AT ELEVATED TEMPERATURES

Alexander Vranos and Pierre J. Marteney Dec. 1980 31 p refs
 (Contract NAS3-21593)
 (NASA-CR-165165; R80-954440-17) Avail: NTIS
 HC A03/MF A01 CSCL 21D

An experimental study of fuel stability was conducted in an apparatus which simulated an aircraft gas turbine fuel system. Two fuels were tested: Jet A and Number 2 Home Heating oil. Jet A is an aircraft gas turbine fuel currently in wide use. No. 2HH was selected to represent the properties of future turbine fuels, particularly experimental Reference Broad Specification, which, under NASA sponsorship, was considered as a possible next-generation fuel. Tests were conducted with varying fuel flow rates, delivery pressures and fuel pretreatments (including preheating and deoxygenation). Simulator wall temperatures were varied between 422K and 672K at fuel flows of 0.022 to 0.22 Kg/sec. Coking rate was determined at four equally-spaced locations along the length of the simulator. Fuel samples were collected for infrared analysis. The dependence of coking rate in Jet A may be correlated with surface temperature via an activation energy of 9 to 10 kcal/mole, although the results indicate that both bulk fluid and surface temperature affect the rate of decomposition. As a consequence, flow rate, which controls bulk temperature, must also be considered. Taken together, these results suggest that the decomposition reactions are initiated on the surface and continue in the bulk fluid. The coking rate data for No. 2 HH oil are very highly temperature dependent above approximately 533K. This suggests that bulk phase reactions can become controlling in the formation of coke. Author

N81-12320# Royal Aircraft Establishment, Farnborough (England).

THE INTELLIGIBILITY OF SPEECH PRESENTED OVER THE TELEPHONES OF THE Mk 4 FLYING HELMET

M. K. Cogger London HMSO Mar. 1980 21 p refs
 (RAE-TM-FS-313; BR73977) Avail: NTIS HC A02/MF A01

The intelligibility of speech presented over the earphones of the Mk 4 flying helmet was assessed using the procedure laid down in the Type Test Schedule. Results obtained using three phonetically balanced word lists presented to six subjects on two occasions indicate that speech intelligibility reaches 80 percent, the criterion of acceptability laid down in the schedule. Frequency response curves for the transducer earpiece assemblies of the helmet are given. The total harmonic distortion of the equipment used to present the spoken word lists is shown. Author (ESA)

N81-12353# Royal Signals and Radar Establishment, Malvern (England).

A COMPARISON BETWEEN ELECTRIC FIELD STRENGTHS SIMILARLY GENERATED AND MEASURED IN THE OPEN AIR, IN A SHIELDED ENCLOSURE AND IN A LARGE AIRCRAFT HANGAR, OVER FREQUENCY RANGE 10 TO 110 MHZ

M. Dew and F. Harrison London Feb. 1980 18 p refs
 (RSRE-MEMO-3248; BR73471) Avail: NTIS
 HC A02/MF A01

Field strength measurements over 10 to 110 MHz were made using a tracking generator counter, a spectrum analyzer, and a biconical antenna. The dimensions of the shielded enclosure were 6.1 x 3.66 x 3.0 m, and the concrete floored, metal hangar 80 x 40 x 10 m. It was found that in each polarization the hangar performance deviated much less from that in the open air than did the shielded enclosure performance. The latter shows deviations with modulus as great as 38 dB (vertical pol) and 26 dB (horizontal pol). For any electric field strength measured in the shielded enclosure (in 10 kHz bandwidth in the range 10 to 110 MHz) the probability that the result would be at least 6 dB different from that similarly obtained in the open air was 38% or 43.5% according to polarization and that when similarly measured in the hangar the corresponding probabilities were 0% and 1%. Hangar results were shown to lie much closer to the open air results than do the shielded enclosure results. This is further demonstrated by the rms deviations of the shielded enclosure and hangar readings from those of the open air. Author (ESA)

N81-12394# National Research Council of Canada, Ottawa (Ontario).

A COMPARISON OF METHODS FOR CALIBRATION AND USE OF MULTI-COMPONENT STRAIN GAUGE WIND TUNNEL BALANCES

R. D. Galway (National Aeronautical Establishment, Ottawa, Ontario) Mar. 1980 47 p refs
 (AD-A090484; NRC-18227; NAE-LR-600) Avail: NTIS HC A03/MF A02 CSCL 14/2

A method is presented for calibration of strain-gauge balances which does not require that the components can be loaded independently. Applicable to both 'internal' and 'external' types of balance, the procedure uses a single varying calibration load to determine all linear and non-linear calibration coefficients. Constant 'secondary' loads on one or more components are unnecessary, although they may be used if desired. The usual iterative solution of the second order balance equations is outlined, and an approximate non-iterative scheme is included for completeness, though not recommended. Two methods of accounting for dependency of the calibration coefficients on the signs of the component loads are presented. A concept of 'buoyancy' is introduced to simplify the application of force balance tares, and a procedure for determining the component outputs for absolute zero load (the 'buoyant' offsets) is given. Balance data at a series of model attitudes are used to define these offsets, and also the coefficients in the equations defining the component load distribution of the tare weight at any attitude. The topics covered are ideally suited to formulation and solution

by matrix methods, which have been used throughout.

Author (GRA)

N81-12395# Litton Systems, Inc., Woodland Hills, Calif. Guidance and Control Systems Div.

RING LASER GYRO Status Report

Thomas J. Hutchings 9 Sep. 1980 15 p refs Presented at AIAA Strategic/Tactical Missile Systems and Space Sci. Meeting (AD-A090643) Avail: NTIS HC A02/MF A01 CSCL 17/7

A general review of laser gyros is presented. Basic concepts of the gas ring laser are reviewed. These include the 'lock-in' phenomena, geometric performance factors, and other problem areas. Various biasing methods to eliminate some of these basic problems are presented. Salient features of the laser gyro which are unique for gyro instruments are shown with data. Various laser gyro design parameters are reviewed with respect to projected performance requirements for various applications.

GRA

N81-12426# Pratt and Whitney Aircraft, West Palm Beach, Fla.

ADVANCED INDUSTRIAL GAS TURBINE TECHNOLOGY READINESS DEMONSTRATION Quarterly Technical Report, 1 Dec. 1979 - 29 Feb. 1980

20 Mar. 1980 11 p refs (Contracts DE-AC05-76OR-05035; DE-AC05-76ET-15343) (DOE/OR-05035/T1; FR-13019; QTPR-12) Avail: NTIS HC A02/MF A01

The component technology base required for improved industrial gas turbine conversion efficiency is discussed. Specific goals were to demonstrate the high-pressure compressor and turbine cooling technologies required to achieve industrial gas turbine efficiencies of 34 to 36% simple cycle and 45 to 48% in combined cycle operation while reducing the number of compressor and turbine parts 80% over state-of-the-art units. The approach involves combining aircraft turbine cooling and high pressure compressor technology with the simplicity and ruggedness required of industrial engines to achieve not only improved performance, but also increased durability and low initial cost.

DOE

N81-12427# Avco Systems Div., Wilmington, Mass.

STATE-OF-THE-ART REVIEW OF FLYWHEEL BURST CONTAINMENT

Alan D. Sapowith, Emmet A. Witmer (MIT, Cambridge), Arthur L. Gurson, John A. McElman (Lowell Univ.), and Herbert Kaehler (AVCO Lycoming Div., Stratford, Conn.) 15 May 1980 109 p refs Prepared for California Univ., Livermore. Lawrence Livermore Lab.

(Contract W-7405-eng-48) (UCRL-15257; AVSD-0154-80-RR) Avail: NTIS HC A06/MF A01

Ballistic tests investigating local puncture show that glass composites are easier to contain than steel of equal kinetic energy by a factor of 2.5. Low cost simulation methods for obtaining empirical data required to correctly implement simplified strain energy analyses for containment ring design are suggested. Containment ring weight is markedly reduced if flywheel burst energy is captured as rotational energy as against translational energy. Kevlar is the lightest weight material for containing aircraft turbine bursts but does not offer substantial weight savings over steel for composite flywheel containment. A work plan is presented at several levels of effort leading to a final burst containment design.

S.F.

N81-12433# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium). Turbomachinery Dept.

REVERSE FLOW, PRE-ROTATION AND UNSTEADY INLET FLOW IN CENTRIFUGAL PUMPS

Mete Sen, F. A. E. Breugelmanns, and B. Schiavello (Worthington Spa.) Jul. 1979 34 p refs Presented at Natl. Eng. Lab. Silver Jubilee Conf. on Fluid Mech., East Kilbridge, England, 27-29 Nov. 1979 Submitted for publication

(VKI-PREPRINT-1979-15) Avail: NTIS HC A03/MF A01

The inlet flow field at partial deliveries in centrifugal pumps was studied. Pump design parameters which influence the reverse flow were investigated. To determine the governing parameters of the reverse flow, several impellers were designed, and details of flow conditions were examined in the suction pipe to determine the governing parameters of the reverse flow. It is shown that the principal factor affecting reverse flow is aerodynamic blade loading. Yaw angle measurements were done in the suction pipe to study the unsteady inlet flow.

Author (ESA)

N81-12446*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

STABILITY OF LARGE HORIZONTAL-AXIS AXISYMMETRIC WIND TURBINES Ph.D. Thesis - Delaware Univ.

M. S. Hirschbein and M. I. Young (Delaware Univ., Newark) 1980 37 p refs Presented at 3d Miami Conf. on Alternative Energy Sources, Miami, 15-17 Dec. 1980

(NASA-TM-81623; E-633) Avail: NTIS HC A03/MF A01 CSCL 20K

The stability of large horizontal axis, axis-symmetric, power producing wind turbines was examined. The analytical model used included the dynamic coupling of the rotor, tower and power generating system. The aerodynamic loading was derived from blade element theory. Each rotor blade was permitted to principal elastic bending degrees of freedom, one degree of freedom in torsion and controlled pitch as a rigid body. The rotor hub was mounted in a rigid nacelle which may yaw freely or in a controlled manner. The tower can bend in two principal directions and may twist. Also, the rotor speed can vary and may induce perturbation reactions within the power generating equipment. Stability was determined by the eigenvalues of a set of linearized constant coefficient differential equations. All results presented are based on a 3 bladed, 300 ft. diameter, 2.5 megawatt wind turbine. Some of the parameters varied were: wind speed, rotor speed structural stiffness and damping, the effective stiffness and damping of the power generating system and the principal bending directions of the rotor blades. Unstable or weakly stable behavior can be caused by aerodynamic forces due to motion of the rotor blades and tower in the plane of rotation or by mechanical coupling between the rotor system and the tower.

Author

N81-12448*# National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.

DYNAMIC RESPONSE OF A FORWARD-SWEPT-WING MODEL AT ANGLES OF ATTACK UP TO 15 DEG AT A MACH NUMBER OF 0.8

Robert V. Doggett, Jr. and Rodney H. Ricketts Nov. 1980 31 p refs

(NASA-TM-81863; L-13872) Avail: NTIS HC A03/MF A01 CSCL 20K

Root mean square (rms) bending moments for a dynamically scaled, aeroelastic wing of a proposed forward swept wing, flight demonstrator airplane are presented for angles of attack up to 15 deg at a Mach number of 0.8. The 0.6 size semispan model had a leading edge forward sweep of 44 deg and was constructed of composite material. In addition to broad band responses, individual rms responses and total damping ratios are presented for the first two natural modes. The results show that the rms response increases with angle of attack and has a peak value at an angle of attack near 13 deg. In general, the response was characteristic of buffeting and similar to results often observed for aft swept wings. At an angle of attack near 13 deg, however, the response had characteristics associated with approaching a dynamic instability, although no instability was observed over the range of parameters investigated.

Author

N81-12451# Nielsen Engineering and Research, Inc., Mountain View, Calif.

AEROELASTIC OPTIMIZATION WITH MULTIPLE CONSTRAINTS Final Scientific Report, 15 Jul. 1978 - 14 Nov. 1979

S. C. McIntosh, Jr. Sep. 1980 58 p refs (Contract F49620-78-C-0105; AF Proj. 2307)

(AD-A090775; NEAR-TR-228; AFOSR-80-1070TR) Avail:

NTIS HC A04/MF A01 CSCL 01/1

Two optimality-criterion algorithms for treating problems with multiple behavioral constraints are described. The first employs slack variables to recast inequality constraints as equality constraints, so that the optimization procedure can be based on an earlier one developed for multiple equality constraints. The second is based on earlier work that uses Gauss-Seidel iteration to identify the active constraints by identifying the set of positive Lagrange multipliers. Both methods are applied to some simple test cases with two design variables, and then the slack-variable algorithm is applied to optimize the weight of a biconvex sandwich wing under various combinations of flutter and frequency constraint. The behavior of this algorithm is discussed and recommendations are given for future work. GRA

N81-12463# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio. Structures and Dynamics Div.

APPLICATION OF FRACTURE MECHANICS TO US AIR FORCE AIRCRAFT STRUCTURAL INTEGRITY REQUIREMENTS

R. M. Bader and J. W. Lincoln Paris Association Aeronautique et Astronautique de France 1979 33 p refs (AAAF-NT-79-25; ISBN-2-7170-0573-0) Avail: NTIS HC A03/MF A01; CEDOCAR, Paris FF 34 (France and EEC) FF 39 (others)

The development of the structural maintenance plan for an older aircraft is discussed as well as for a new aircraft where damage tolerance requirements are an integral part of the development contract. Flaw sizes used for the calculation of the inspection intervals to protect the safety of the force are based on inspection capabilities and damage that might exist in the structure from manufacturing or rework processes. The durability of economic life assessment is, however, based on the average of typical quality achieved through the manufacturing process.

The relation between the damage tolerance assessment which leads to the force structural maintenance plan and the durability assessment is discussed. Current research efforts underway to alleviate these difficulties are listed with recommendations.

Author (ESA)

N81-12464# Laboratorium fuer Betriebsfestigkeit, Darmstadt (West Germany).

CURRENT DEVELOPMENTS IN AIRCRAFT FATIGUE EVALUATION PROCEDURES

O. Buxbaum and D. Schutz Paris Association Aeronautique et Astronautique de France 1979 34 p refs Presented at 14th Intern. AAAF Aeron. Congr. on New Develop. in Struct. and Mater., Paris, 6-8 Jun. 1979 (AAAF-NT-79-33; ISBN-2-7170-0581-1) Avail: NTIS HC A03/MF A01; CEDOCAR, Paris FF 34 (France and EEC) FF 39 (others)

Current developments in the field of aircraft fatigue evaluation are reviewed including the description of loads for fatigue evaluation, the damage tolerance concept, concepts for the prediction of fatigue life, fatigue life improvement during production, load transfer in mechanical joints, and the characteristics of the fiber reinforced materials. There is not yet a satisfactory theory to explain the fatigue mechanism. Fatigue testing is the most important tool in defining the life of aircraft structures.

Author (ESA)

N81-12465# Saab-Scania, Goteberg (Sweden).

BUCKLING OF SANDWICH PANELS SUBJECTED TO AXIAL COMPRESSION, SHEAR FORCES AND LATERAL PRESSURE. PART 2: ANALYSIS

Sven Erik Larsson, Harald Bengtsson, and Sten Oeberg 1980 79 p refs (SAAB-TN-AE-72-Pt-2) Avail: NTIS HC A05/MF A01

A comprehensive study on analysis and testing of sandwich panels subjected to combined in-plane and normal loading is presented. The investigation is related to bonded panels with aluminum skins and aluminum honeycomb core. The purpose was to develop and verify analysis methods applied in the stress and strength analysis of honeycomb panels used in aircraft primary structures. A significant part of the work was performed as

development work for the Swedish Air Force Viggen aircraft. It is concluded that the calculation method derived gives satisfactory results in estimating ultimate panel loads. Author (ESA)

N81-12475# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.

APPLICATION OF FRACTURE MECHANICS TO BUILT-UP STRUCTURES

H. Vlieger Nov. 1979 116 p refs (NLR-MP-79044-U) Avail: NTIS HC A06/MF A01

The interaction of reinforced and cracked elements in built-up panels of sheets and stringers, and discussions of residual strength and of fatigue crack propagation are presented. The sheet-stiffener interaction problem, modeling of rivet connections, partial failures of stiffeners, and debonding of adhesive bonded panels are reviewed. Available computer programs are referenced. Residual strength of flat panels loaded in uniaxial tension, of curved panels subject to cabin pressure loads, and applicability of fracture mechanics principles to real structures are summarized. The fatigue crack propagation curve, damage development assumptions, and integrally stiffened panels are covered. Example problems with real structures are included. Author (ESA)

N81-12477# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.

FLIGHT SIMULATION ENVIRONMENTAL FATIGUE CRACK PROPAGATION IN 2024-T3 AND 7475-T761 ALUMINUM

R. J. H. Wanhill Jan. 1980 10 p refs Presented at 12th ICAS Congr., Munich, 12-17 Oct. 1980 (NLR-MP-80003-U) Avail: NTIS HC A02/MF A01

Flight simulation fatigue crack propagation tests on 2024-T3 and 7475-T761 aluminum alloy sheet were carried out using a gust spectrum representative of the load history of an under wing skin in a transport aircraft. The investigation included tests at several design stress levels and in environments of laboratory air and air plus water spray. The results are discussed with respect to the choice of structural concepts using 7475 alloy and evaluation of the fatigue properties of such concepts.

Author (ESA)

N81-12536# European Space Agency, Paris (France).

REMOTE SENSING METHODS FOR THE DETERMINATION OF SLANT RANGE VISIBILITY

Christian Werner Jun. 1980 93 p refs Transl. into ENGLISH of 'Fernmessmethoden zur Bestimmung der Schraegsichtweite'. DFVLR, Oberpfaffenhofen, West German Report DFVLR-FB-79-14, Mar. 1979 Original report in GERMAN previously announced as N80-23759 Original German report available from DFVLR, Cologne DM 8.70 (ESA-TT-627; DFVLR-FB-79-14) Avail: NTIS HC A03/MF A01

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)

N81-12633# Aeronautical Research Inst. of Sweden, Stockholm. Aerodynamics Dept.

APPLICATION OF A METHOD FOR AERODYNAMIC ANALYSIS AND DESIGN OF HORIZONTAL AXIS WIND TURBINES, PART 1

Anders L. Gustafsson, Stig Lundgren, and Boerje Frisk 26 Feb. 1980 74 p refs (Contract NE-5061-012)

(FFA-TN-AU-1499-Pt-1) Avail: NTIS HC A04/MF A01

The application of a momentum theory method is presented for static performance analysis and for design of blades for horizontal axis wind turbines. The method is based on a combination of blade element and momentum theory. The performance results are presented as power coefficient or shaft

power versus windspeed and static blade and turbine loads to be used for structural design. The combination of turbine performance and wind characteristics to obtain annual energy production is treated. The procedure to obtain the chord and twist distribution that maximizes blade performance at a specified wind is described. Numerical results for the Swedish wind power test unit Kalkugnen are presented. Author (ESA)

N81-12634# Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.

OPTIMIZED PITCH CONTROLLER FOR LOAD ALLEVIATION ON WIND TURBINES

Brad S. Liebst Stockholm Aeronautical Research Inst. of Sweden 19 Aug. 1980 195 p refs Sponsored in part by MIT Aeronautical Research Foundation (Contract NE-5061-013) (FFA-TN-HU-2189-Pt-1) Avail: NTIS HC A09/MF A01

An optimum feedback control law for load alleviation utilizing a pitching blade segment on a wind turbine is developed. The analysis is made for an isolated blade on a completely rigid tower. The blade is assumed to be completely rigid and constrained by three flexible springs. Pitch, flap, and lag blade degrees of freedom are included as well as shaft torsion and generator dynamics. A quasi-steady analysis is used in predicting aerodynamic loads. Gravity loads are included, as well as wind shear and tower shadow effects. The nonlinear equations of motion are linearized by perturbation methods. The controller determined minimizes a penalty integral that is the sum of a quadratic in state perturbations and a quadratic in the control. A FORTRAN program is presented which solves the resulting Riccati equations for the feedback gains. The program developed is used to determine the control law for the NASA-ERDA 100 kW wind turbine considering only the flapping degree of freedom.

Author (ESA)

N81-12644# Wyle Labs., Inc., El Segundo, Calif.

NOISE EXPOSURE OF CIVIL AIRCARRIER AIRPLANES THROUGH THE YEAR 2000. VOLUME 1: METHODS, PROCEDURES, RESULTS Final Report, Aug. 1977 - Feb. 1979

Carroll Bartel and Louis C. Sutherland Feb. 1979 141 p refs 2 Vol.

(Contract EPA-68-01-3514)

(EPA-550/9-79-313-1; WR-78-11-Vol-1) Avail: NTIS HC A07/MF A01

A noise prediction model was used to show the possible effectiveness of reducing aircraft noise exposure by modifications to FAR 36 which would progressively lower noise limits for newly designed aircraft, and by using alternative power cutback procedures coupled with minor variations on approach procedures. Exposure was measured in terms of land area and number of people subjected to various levels of noise from L(dn) 60 to 80 db. Subsonic aircraft were emphasized; however, the isolated exposure of only supersonic operations was also analyzed. Results show that the application to subsonic aircraft of the noise technology certification rules for 1980 and 1985 proposed by EPA will show a substantial decrease in noise exposure in future years but the result will not be felt until well beyond the year 2000. A more immediate achievement noise reduction is possible by using an improved takeoff procedure. The proposed ALPA/NWA Max Cutback procedure offers additional noise reduction on an average for the nation's airports over that provided by the AC91-30 procedure for current technology aircraft. A.R.H.

N81-12645# Wyle Labs., Inc., El Segundo, Calif.

NOISE EXPOSURE OF CIVIL AIRCARRIER AIRPLANES THROUGH THE YEAR 2000. VOLUME 2: APPENDICES A THROUGH F Final Report, Aug. 1977 - Feb. 1979

Carroll Bartel and Louis C. Sutherland Feb. 1979 296 p refs 2 Vol.

(EPA-550/9-70-313-2; WR-78-11-Vol-2) Avail: NTIS HC A13/MF A01

Airports with more than 10 jet departures per year are listed and procedures are given for forecasting the moderate and expansive growth of civil air carriers to the year 2000. Graphs show the noise characteristics and assumed performance

characteristics for each aircraft classification studied. The expected range in noise exposure to the year 2000 due to supersonic aircraft operations is analyzed for various scenarios. The impact of both the average airport and at the nations level for all aircraft classifications examined is forecasted. A.R.H.

N81-12646*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

HIGH-VOLTAGE SPARK CARBON-FIBER STICKY-TAPE DATA ANALYZER

Lien C. Yang and Glen G. Hull 15 Jun. 1980 60 p refs

(Contract NAS7-100)

(NASA-CR-163747; JPL-Pub-80-55) Avail: NTIS HC A04/MF A01 CSCL 13B

An efficient method for detecting carbon fibers collected on a stick tape monitor was developed. The fibers were released from a simulated crash fire situation containing carbon fiber composite material. The method utilized the ability of the fiber to initiate a spark across a set of alternately biased high voltage electrodes to electronically count the number of fiber fragments collected on the tape. It was found that the spark, which contains high energy and is of very short duration, is capable of partially damaging or consuming the fiber fragments. It also creates a mechanical disturbance which ejects the fiber from the grid. Both characteristics were helpful in establishing a single discharge pulse for each fiber segment. R.C.T.

N81-12651# Air Force Engineering and Services Center, Tyndall AFB, Fla. Engineering and Services Lab.

USAF AIRCRAFT ENGINE EMISSION GOALS, A CRITICAL REVIEW Final Report, Sep. 1978 - Jun. 1979

Richard W. Boubel and Joseph A. Martone Sep. 1979 114 p refs

(AF Proj. 1900)

(AD-A090282; AFESC/ESL-TR-79-30) Avail: NTIS HC A09/MF A01 CSCL 21/5

This report is a comprehensive summary and analysis of proposed aircraft turbine engine air pollution regulations and their relevance to the USAF. Existing USAF aircraft turbine engine emission goals are critically reviewed, and revised goals are proposed. The original goals contained emission standards and compliance dates; the proposed goals contain neither. The authors believe that the goals should be set to provide an incentive for emission reduction and should not be numerical standards and dates, which may or may not be met. The proposed USAF goals cover the critical turbine engine emissions. Carbon monoxide and oxides of sulfur are not considered serious problems at today's emission levels, while smoke and hydrocarbon emissions appear to warrant the highest priority for reduction. Although cost effective oxides of nitrogen control (NO sub x) is viewed with pessimism, it is concluded that NO sub x reduction deserves continued USAF research. GRA

N81-12652# Air Force Engineering and Services Center, Tyndall AFB, Fla. Engineering and Services Lab.

THE IMPLICATIONS OF ALTERNATIVE AVIATION FUELS ON AIRBASE AIR QUALITY Final Report, Nov. 1977 - Aug. 1980

Harold A. Scott, Jr. Aug. 1980 48 p refs

(AF Proj. 2103)

(AD-A090283; AFESC/ESL-TR-80-38) Avail: NTIS HC A02/MF A01 CSCL 21/4

Aircraft alternative fuel emission factors from turbine engine combustor performance tests are integrated into the Air Quality Assessment Model (AQAM) to predict the air quality impact of alternative fuels use in the vicinity of Air Force bases. AQAM computes the alternative fuel emission factors from fuel property inputs, enabling the model to predict concentrations for any proposed alternative fuel blend. In addition to aircraft alternative fuel emissions calculations, AQAM was modified to calculate alternative fuel handling and breathing loss emissions from the fuel properties. Using AQAM with two aircraft engine models, the aircraft alternative fuel annual emissions and resulting short-term pollutant concentrations are computed for a typical Air Force base. The analysis indicates that alternative fuel

emissions cause a slight increase in pollution concentrations when compared with the baseline JP-4 fuel. A reduction of evaporative hydrocarbon emissions is predicted due to the alternative fuels' lower volatility in comparison with JP-4. GRA

N81-12653# Acurex Corp., Mountain View, Calif. Energy and Environmental Div.

AN AUTOMATIC ISOKINETIC SAMPLER FOR PARTICULATE EMISSIONS FROM AIRCRAFT GAS TURBINE ENGINES Final Report, Feb. 1975 - Jun. 1978

Hans Joachim Dehne Jan. 1980 37 p refs Sponsored in part by ESL

(Contract N00123-75-C-1075; AF Proj. 1900)

(AD-A090280; ACUREX-78-315; AFESC/ESL-TR-80-04;

AESO-161-01-80) Avail: NTIS HC A03/MF A01 CSDL 14/2

An automated isokinetic sampler for evaluating particulate emissions from aircraft gas turbine engines was designed, constructed and tested. The sampler is capable of collecting the particulate mass emitted by an aircraft gas turbine at the exit plane (non-afterburner operation) for gravimetric measurements and permits simultaneous on-line particle size distribution measurements to be performed. The particulate is collected on a fiber glass filter for gravimetric measurement. The size distribution is determined by conditioning the gas turbine exhaust gases and passing them through a mobility particulate size distribution analyzer. The sampler has two-axis traverse capability and a maximum sampling capability of 226 l/min (8 scfm). Test data are automatically recorded. Control of the sampler is by means of 12 bit microprocessor. Preliminary tests were performed at the Naval Air Rework Facility, Alameda, California, at various construction stages of the sampler to evaluate its performance and to measure the effects of fuel additives on particulate emissions on a TF41 gas turbine engine. GRA

N81-12667# National Technical Information Service, Springfield, Va.

AIRPORT NOISE. CITATIONS FROM THE NTIS DATA BASE Progress Report, 1964 - Jun. 1980

Guy E. Habercom, Jr. Jul. 1980 290 p refs Supersedes NTIS/PS-79/0878; NTIS/PS-78/0807

(PB80-813231; NTIS/PS-79/0878; NTIS/PS-78/0807) Avail: NTIS HC \$30.00/MF \$30.00 CSDL 13B

Aircraft created noise, noise intensity, noise exposure, and physiological effects, all in airport environments, are investigated in these research reports. This updated bibliography contains 285 citations, 20 of which are new entries to the previous edition. GRA

N81-12822*# National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.

A COMPARISON OF THE THREE METHODS USED TO OBTAIN ACOUSTIC MEASUREMENTS FOR THE NASA FLIGHT EFFECTS PROGRAM

Arnold W. Mueller Oct. 1980 37 p refs

(NASA-TM-81906) Avail: NTIS HC A03/MF A01 CSDL 20A

The NASA Flight Effects Program has a requirement to compare acoustic data obtained from flyover, static test stand, and wind tunnel tests. Results of a laboratory study of the acoustic characteristics of the three techniques used to measure noise during these tests are presented. Recommendations are made to allow for a comparison of data obtained with each technique. Author

N81-12824# Army Research and Technology Labs., Moffett Field, Calif. Aeromechanics Lab.

TRANSONIC ROTOR NOISE - THEORETICAL AND EXPERIMENTAL COMPARISONS

F. H. Schmitz and Y. H. Yu 1980 29 p refs Presented at the 6th European Rotorcraft and Powered Lift Aircraft Forum, Bristol, England, 16-19 Sep. 1980

(AD-A090806; Rept-22) Avail: NTIS HC A03/MF A01 CSDL 20/1

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

N81-12825# Rolls-Royce Ltd., Derby (England). Advanced Research Lab.

SHEAR LAYER INSTABILITY NOISE PRODUCED BY VARIOUS JET NOZZLE CONFIGURATIONS

C. J. Moore and D. H. Brierley 1980 8 p refs

(PNR-90018) Avail: NTIS HC A02/MF A01

When a jet shear layer is disturbed by internal or external flow fluctuations at the correct frequency the broadband mixing noise increases. The investigation of this phenomenon is extended to the flow from coaxial and silencer nozzles. It is concluded that a surrounding co-flowing stream tends to suppress the broadband noise caused by instability wave interaction in a jet shear layer if the velocity ratio is greater than 0.5, and that the shear layers produced by jet silencer nozzles do not permit instability waves to grow to sufficient amplitude to produce extra broadband noise. Author (ESA)

N81-12826# European Space Agency, Paris (France).

SPECTRAL ANALYSIS OF NONSTATIONARY RANDOM PROCESSES. APPLICATION TO NOISE OF FLYOVER TYPE Ph.D. Thesis - Paris-Sud Univ.

Max Ernoult Sep. 1980 275 p refs Transl. into ENGLISH of "Analyse Spectrale des Processus Aleatoires non Stationnaires. Application aux Bruits de Type Servol d'Avion". Rept. ONERA-NT-1979 ONERA, Paris, 1979 Original report in FRENCH previously announced as N80-24134

(ESA-TT-639; ONERA-NT-1979-4) Avail: NTIS HC A12/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)

N81-12828*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

LOOKING FOR HEAVIER WEAK BOSONS WITH DUMAND

R. W. Brown (Case Western Univ., Cleveland, Ohio) and F. W. Stecker Oct. 1980 10 p refs Presented at the 1980 DUMAND Summer Workshop Submitted for publication

(Grant NSF PHY-80-08548)

(NASA-TM-82027) Avail: NTIS HC A02/MF A01 CSDL 20H

One or more heavier weak bosons may coexist with the standard weak boson, a broad program may be laid out for a search for the heavier W's via change in the total cross section due to the additional propagator, a concomitant search, and a subsequent search for significant antimatter in the universe involving the same annihilation, but being independent of possible neutrino oscillations. The program is likely to require detectors sensitive to higher energies, such as acoustic detectors. S.F.

N81-12943*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

AERODYNAMIC DESIGN OF ELECTRIC AND HYBRID VEHICLES: A GUIDEBOOK

D. W. Kurtz 30 Sep. 1980 92 p refs
(Contracts NAS7-100; DE-A101-78CS-4209)
(NASA-CR-163744; JPL-PUB-80-69) Avail: NTIS
HC A05/MF A01 CSCL 13F

A typical present-day subcompact electric hybrid vehicle (EHV), operating on an SAE J227a D driving cycle, consumes up to 35% of its road energy requirement overcoming aerodynamic resistance. The application of an integrated system design approach, where drag reduction is an important design parameter, can increase the cycle range by more than 15%. This guidebook highlights a logic strategy for including aerodynamic drag reduction in the design of electric and hybrid vehicles to the degree appropriate to the mission requirements. Backup information and procedures are included in order to implement the strategy. Elements of the procedure are based on extensive wind tunnel tests involving generic subscale models and full-scale prototype EHVs. The user need not have any previous aerodynamic background. By necessity, the procedure utilizes many generic approximations and assumptions resulting in various levels of uncertainty. Dealing with these uncertainties, however, is a key feature of the strategy. Author

N81-12956# Office of Management and Budget, Washington, D. C.

AERONAUTICS AND SPACE REPORT OF THE PRESIDENT, 1979 ACTIVITIES

1979 119 p

Avail: NTIS HC A06/MF A01

Developments in communications, Earth resources sensing, space transportation, and space energy are summarized and the activities of NASA and the Departments of Commerce, Interior, Defense, Transportation, and Energy are delineated. Budgets for space ventures and aeronautics are tabulated. The White House fact sheet on the management of the U.S. civilian remote sensing is included along with the text of the United Nations Moon Treaty and an analysis and commentary by the Department of State. A.R.H.

N81-12977*# National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.

RESEARCH AND TECHNOLOGY OF THE LANGLEY RESEARCH CENTER Annual Report, 1980

Nov. 1980 45 p

(NASA-TM-81910) Avail: NTIS HC A03/MF A01 CSCL 05B

Descriptions of the research and technology activities at the Langley Research Center are given. Topics include laser development, aircraft design, aircraft engines, aerodynamics, remote sensing, space transportation systems, and composite materials. M.G.

N81-12980*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

NASA RESEARCH IN AEROPROPULSION

Warner L. Stewart *In its Impact for the 80's: Proc. of a Conf. on Selected Technol. for Business and Ind.* Nov. 1980 p 11-26

Avail: NTIS HC A11/MF A01 CSCL 21E

The role of the Lewis Research Center in aeronautical propulsion is described. The state of the art in engine systems and components are discussed and some of the problems that confront the civil and military aeronautic sectors are addressed. Some of the programs that are under way are summarized with emphasis on the future needs and opportunities in aeronautics. R.C.T.

N81-12982*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

PROGRESS IN MATERIALS AND STRUCTURES AT LEWIS RESEARCH CENTER

Thomas K. Glasgow, Richard W. Lauer, Gary R. Halford, and Robert L. Davies *In its Impact for the 80's: Proc. of a Conf. on Selected Technol. for Business and Ind.* Nov. 1980 p 43-64

refs

Avail: NTIS HC A11/MF A01 CSCL 11G

The development of power and propulsion system technology is discussed. Specific emphasis is placed on the following: high temperature materials; composite materials; advanced design and life prediction; and nondestructive evaluation. Future areas of research are also discussed. R.C.T.

N81-12996# Societe Nationale d'Etudes et de Construction de Moteurs d'Aviation, Moissy-Cramayel (France).

STUDYING THE EXHAUST GAS FROM A POST COMBUSTION TURBOJET ENGINE [ETUDE DES GAZ DECHAPPEMENT DUN TURBOREACTEUR EN RECHAUFFE]

Ph. Gastebois and S. Ropars *In AGARD Testing and Meas. Tech. in Heat Transfer and Combust.* Sep. 1980 12 p In FRENCH Prepared in cooperation with Centre d'Essaisdes Propulseurs, Saclay, France

Avail: NTIS HC A13/MF A01

Knowledge of local temperatures and of the concentrations of pollutant species in the jet of a turbojet engine is useful for optimizing post combustion efficiency and for evaluating the importance of the air pollution created by the engine. A means is presented for analyzing gas removed by separator from the blast pipe of an OLYMPUS engine both on the ground and in simulated altitude. Results obtained show the difficulty of fixing the composition of gas taken before analysis and the necessity of improving techniques for measuring high temperature exhaust gases. A.R.H.

N81-12998# Kraftwerk Union A.G., Mulheim (West Germany). **APPLICATION OF MODEL LAWS WHEN DETERMINING THE HEAT TRANSFER COEFFICIENTS BY EXPERIMENTS ON COOLED TURBINE BLADES**

O. A. vonSchwerdtner and H.-G. Hosenfeld *In AGARD Testing and Meas. Tech. in Heat Transfer and Combust.* Sep. 1980 13 p refs

Avail: NTIS HC A13/MF A01

Model laws were fulfilled for geometry, aerodynamics, and heat transfer by reducing temperature and pressure of the operational and cooling fluids as opposed to the conditions in the turbine. The conception of a cascade wind tunnel with closed circuit enables the independent variation of influence values, e.g., Mach no. and Reynolds no., degree of turbulence and temperature ratio operating fluid/cooling fluid. Two measuring methods used were: (1) determining the local heat transfer coefficients by calorimetric means when cooling the blade surface with water in sections and (2) distribution of the cooling efficiency on the profile contour with the original cooling process. E.D.K.

N81-13008# Poitiers Univ. (France). Lab. d'Energetique et de Detonique.

THE APPLICATION OF UV SPECTROSCOPY TO THE QUANTITATIVE ANALYSIS OF NITROGEN OXIDE [APPLICATION DE LA SPECTROSCOPIE U. V. AU DOSAGE DE LOXYDE NITRIQUE]

J. Ph. Durand and J. C. Bellet *In AGARD Testing and Meas. Tech. in Heat Transfer and Combust.* Sep. 1980 10 p refs In FRENCH

Avail: NTIS HC A13/MF A01

Measurements of nitrogen oxide concentration in combustion products, obtained under very different experimental conditions, by ultraviolet absorption spectrometry and by sampling and quantitative analysis using a chemiluminescence analyzer were compared. Results demonstrate that parasitic absorptions of oxygen and anhydrous carbon must be considered when the temperature exceeds about 700 K for the (1,0) gamma band, and 900 K for the (0,0) gamma band. In addition, measurements made in the jet of a turbojet engine at the SMECMA test stand show that other parasitic species not yet identified, but probably incombustibles, interfere with measurements. Transl. by A.R.H.

N81-13019*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

NASA CONTRIBUTIONS TO RADIAL TURBINE AERODYNAMIC ANALYSES

Arthur J. Glassman 1980 20 p refs Presented at Automotive Technol. Develop. Contractor Coord. Meeting, Dearborn, Mich., 11-13 Nov. 1980
(NASA-TM-81644; E-9356-1) Avail: NTIS HC A02/MF A01 CSCL 01A

A brief description of the radial turbine and its analysis needs is followed by discussions of five analytical areas: design geometry and performance, off design performance, blade row flow, scroll flow, and duct flow. The functions of the programs, areas of applicability, and limitations and uncertainties are emphasized. Both past contributions and current activities are discussed.

Author

N81-13021# Cambridge Univ. (England). Dept. of Engineering.

FORCE AND MOMENT COEFFICIENTS FOR HIGH DEFLECTION CASCADES

D. S. Whitehead and R. J. Grant May 1980 42 p refs
(CUED/A-Turbo/TR-98; ISSN-0309-6521) Avail: NTIS HC A03/MF A01

The development of a computer program for the prediction of force and moment coefficients for the vibration of compressor and turbine blades having a large amount of deflection of the mean flow, using a finite element approach, is described. The program is limited to subsonic inlet and outlet flows (but can deal with local supersonic patches) and to flow without inlet vorticity and without shock waves. Results for the moment coefficients on a turbine cascade show good agreement with experiment.

Author

N81-13022*# Bihrl Applied Research, Inc., Jericho, N. Y. **ROTARY BALANCE DATA FOR A SINGLE ENGINE GENERAL AVIATION DESIGN HAVING A HIGH ASPECT-RATIO CANARD FOR AN ANGLE-OF-ATTACK RANGE OF 30 DEG TO 90 DEG Final Report**

William J. Mulcaj and Robert Rose Washington NASA Dec. 1980 105 p refs
(Contract NAS1-14849)

(NASA-CR-3170) Avail: NTIS HC A06/MF A01 CSCL 01A

Aerodynamic characteristics obtained in a helical flow environment utilizing a rotary balance located in the Langley spin tunnel are presented in plotted form. The configurations tested included the basic airplane, various control deflections, two canard locations, and wing leading edge modifications, as well as airplane components.

Author

N81-13023# National Aerospace Lab., Tokyo (Japan). **NUMERICAL STUDY OF TRANSONIC FLUTTER OF A TWO DIMENSIONAL AIRFOIL**

Koji Isogai Jul. 1980 26 p refs
(NAL-TR-617T) Avail: NTIS HC A03/MF A01

Transonic flutter characteristics of a NACA64A010 airfoil with two degrees of freedom are investigated theoretically. An unsteady aerodynamic code based on the transonic small perturbation equations, which can be applied for the wide range of the reduced frequency based on semichord ($0 < \omega r = k < 0.5$) and Mach number (from subcritical to above Mach 1), was developed. The finite difference scheme employed in the code is a time marching, semi-implicit and implicit two sweep procedure. Flutter calculations are performed for two typical binary systems, one of which simulates the vibrational characteristics of a typical streamwise section of a sweptback wing, and the other of which simulates that of an unswept wing. A sharp transonic dip of the flutter boundary was predicted for the former case while the relatively mild dip for the latter. For the purpose of identifying the possible mechanism of the transonic dip phenomenon, examinations are made of not only the flutter modes and frequencies but also the shock wave patterns and the unsteady load distributions at each Mach number corresponding to the flutter boundary. It is concluded that the mechanism of the single degree of freedom flutter, which is caused by the large negative

damping produced by the phase lag of the shock wave motion, is dominating the flutters at the bottom of the transonic dip when the mass ratio is relatively large. M.G.

N81-13024# Aircraft Research Association Ltd., Bedford (England).

RESULTS OF OSCILLATORY PITCH AND RAMP TESTS ON THE NACA 0012 BLADE SECTION

M. E. Wood Dec. 1979 115 p refs
(ARA-MEMO-220) Avail: NTIS HC A06/MF A01

Two programs of dynamic tests on the NACA 0012 blade section were run in the ARA two dimensional tunnel using the two-degree-of-freedom pitch and heave rig. The tests, run in the pitching mode only, covered a range of Mach number from 0.3 to 0.9. The experimental results are compiled in the form of normal force and pitching moment hysteresis loops obtained by chordwise integration of the wing pressures. Author

N81-13026# Cambridge Univ. (England). Dept. of Engineering.

MEASURED PRESSURE DISTRIBUTIONS AND SHOCK SHAPES ON A BUTLER WING

L. C. Squire 1979 18 p refs
(CUED/A-Aero/TR-9) Avail: NTIS HC A02/MF A01

Results of an experimental investigation of the flow over a delta wing designed for a Mach number of 3.5 are presented. Complete pressure distributions were measured for incidences of 0, 10 and 20 degree at Mach numbers of 2.5 and 3.5. A number of schlieren photographs of the shock system were obtained. The measurements were made to support numerical calculations. Author

N81-13031# Naval Postgraduate School, Monterey, Calif. Dept. of Aeronautics.

TRANSONIC CASCADE WIND TUNNEL MODIFICATION AND INITIAL TESTS M.S. Thesis

Karl Ferdinand Volland, Jr. Jun. 1980 107 p refs
(AD-A091080) Avail: NTIS HC A06/MF A01 CSCL 14/2

The transonic cascade wind tunnel at the Turbomachinery Laboratory was modified by incorporating a perforated wall section in the upper nozzle block. The purpose of this modification was to cancel the oblique shock waves from the cascade blades and to aid in starting the supersonic flow in the tunnel. Tests results indicated that the modification performed successfully. Supersonic flow was established through the cascade blading which models the relative flow at the tip of the laboratory's transonic compressor. A butterfly valve must yet be installed in the cascade exhaust to produce back pressures corresponding to the compressor's transonic operation. GRA

N81-13033# Pennsylvania Transportation Inst., University Park. Applied Research Lab.

UNSTEADY PRESSURE DISTRIBUTIONS ON AIRFOILS IN CASCADE

I. Chung Shen 1 Apr. 1980 155 p refs
(Contract N00024-79-C-6043)
(AD-A091173; ARL/PSU/TM-80-45) Avail: NTIS HC A08/MF A01 CSCL 20/4

The results of a study of unsteady pressure distributions in a two dimensional cascade of blades caused by spatial inflow velocity variations are presented. An existing incompressible, inviscid theory which employs a simplified vortex model in conjunction with the assumptions of thin airfoil theory has been used by Henderson and Bruce to derive expressions for the unsteady response, which includes the cascade unsteady lift and pitching moment. An alternative way to obtain these unsteady response parameters is to establish the expression for the unsteady pressure distribution. The unsteady lift and pitching moment are calculated by direct numerical integration over the unsteady pressure difference across the airfoil chord. Comparison of the computed theoretical results using these two approaches shows satisfactory agreement except when the wavelength of the velocity variations approaches the cascade blade spacing. Good agreement

is also observed between the existing measured and predicted data. The effects of design parameters of a cascade, such as space chord ratio, maximum blade camber, and mean incidence angle, on the unsteady response are presented and discussed.

GRA

N81-13034# Pratt and Whitney Aircraft Group, West Palm Beach, Fla. Government Products Div.

SUPERCRITICAL AIRFOIL TECHNOLOGY PROGRAM WAKE EXPERIMENTS AND MODELING FOR FORE AND AFT LOADED COMPRESSOR CASCADES Final Report

D. E. Hobbs, Joel H. Wagner, J. F. Dannenhoffer, and R. P. Dring Sep. 1980 122 p refs

(Contract N00019-79-C-0229)

(AD-A091378; PWA-FR-13514) Avail: NTIS HC A06/MF A01 CSCL 20/4

A procedure has been developed for designing supercritical cascade airfoils satisfying practical aerodynamic and structural requirements. The purpose of the research reported herein is to improve the calculation of flow turning and profile loss for these airfoils through the use of a model of the viscous wake. Wakes were measured in a large scale, low speed facility for two cascades. The first cascade configuration was a fore loaded supercritical design; the second was a conventional aft loaded design. The experimental results were used to analytically model the viscous wake in an inviscid potential flow calculation.

GRA

N81-13036# Naval Surface Weapons Center, Dahlgren, Va. Strategic Systems Dept.

OPTIMAL BODIES FOR MINIMUM TOTAL DRAG AT SUPERSONIC SPEEDS Final Report

Nicholas J. Moga May 1980 57 p refs (SF32392591)

(AD-A091235; NSWC/TR-80-208) Avail: NTIS HC A04/MF A01 CSCL 20/4

Two new methods were developed for predicting projectile shape which yield minimum total drag at supersonic speeds. The first technique is an Eulerian scheme that uses modified Newtonian theory and Prandtl-Meyer expansion for pressure drag with Van Driest skin friction and semi-empirical base drag prediction. The second scheme iterates body coordinates with the second order shock expansion theory and the same skin friction and base drag methods to minimize the total drag. A different shape is determined for each length-to-diameter ratio and Mach number. The first technique was found to calculate a reasonably accurate optimal shape, but did not predict accurate drag coefficients. It was found that the modified Newtonian theory plus Prandtl-Meyer expansion predicted pressure drag coefficients much too low whereas the second order shock expansion method gave good results. The second technique predicted both accurate optimal shapes and drag coefficients. Optimal shapes were predicted using the second techniques for Mach numbers 2-5 and length-to-diameter ratios of 4, 5, and 6. They were found to compare well with experimental data.

GRA

N81-13038# Transportation Systems Center, Cambridge, Mass. **VISUAL CONFIRMATION (VICON) OF VOICE TAKE-OFF CLEARANCE OF COST-AND-DEPLOYMENT ANALYSES AND STRATEGIES** Final Report, Jan. 1978 - Aug. 1980

John R. Coonan Sep. 1980 31 p refs

(Contract DOT-FA021R-0119)

(AD-A091007; TSC-FAA-80-16; FAA-RD-80-108) Avail: NTIS HC A03/MF A01 CSCL 01/2

The first results of a program undertaken by the Transportation Systems Center are presented. Cost and deployment strategies of VICON installation were studied over a four year period.

E.D.K.

N81-13039# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio. Crew Escape and Subsystems Branch.

EVALUATION OF THE IMPACT COMPUTER PROGRAM AS A LINEAR DESIGN TOOL FOR BIRD RESISTANT AIRCRAFT TRANSPARENCIES Final Report, 1 Jan. - 1 Aug. 1978

Robert E. McCarty Mar. 1980 166 p refs

(AF Proj. 2402)

(AD-A091051; AFFDL-TR-79-3103) Avail: NTIS CSCL 01/3

The use of a finite element structural analysis computer program called IMPACT to simulate the transient response of B-1 aircraft windshield panels to bird impact is discussed. For the two simulations accomplished, computed results were compared to experimental data acquired during bird impact tests of actual windshield panels. For the first case of a panel tested at ambient temperature, the computed results were qualitatively accurate. Strain levels measured during the test exceeded those calculated by IMPACT, however, and the disagreement was attributed to the presence of geometric nonlinearities in the test structure the effects of which were not accounted for in the IMPACT analysis. For the second case of a panel heated to an outer surface temperature of 220 deg F the computed results were unreasonable. Disagreement between computed and experimental data was attributed to errors in the theoretical formulation or coding of IMPACT relating to its capability to account for the effects of elevated temperatures or temperature gradients within the structure. Continued development of IMPACT is not recommended; a currently available fully nonlinear finite element program is identified which has more potential of serving as a transparency birdstrike analysis tool.

GRA

N81-13040# Martin Marietta Corp., Orlando, Fla. **PERFORMANCE VERIFICATION OF THE SUPERJET LAMINAR ANGULAR RATE SENSOR** Final Report, 5 Nov. 1979 - 5 May 1980

Boyd W. Curry, Jr. May 1980 311 p refs

(Contract DAAK40-79-D-0017)

(AD-A091089; OR-16127; NADC-80081-60) Avail: NTIS HC A14/MF A01 CSCL 01/3

The need exists for small rugged rate sensors applicable to the Navy's Maximum Performance Escape System. A recent study indicated that a prime candidate for this system is the Superjet rate sensor used on the U.S. Army Copperhead Program. The purpose of this performance verification task is to determine through test and analyses the suitability of the Hamilton-Standard Superjet angular rate sensor for the possible application in NADC's Maximum Performance Escape System (MPES) program.

GRA

N81-13041# Committee on Science and Technology (U. S. House).

AIRCRAFT COLLISION AVOIDANCE

Washington GPO 1979 682 p refs Hearings before the Subcomm. on Transportation, Aviation and Comm. of the Comm. on Sci. and Technol., 96th Congr., 1st Sess., no. 29, 27-28 Jun. and 24 Jul. 1979

(GPO-50-158) Avail: Subcommittee on Transportation, Aviation and Communications

Prevention of midair collisions was investigated. Aircraft approach spacing along with improvements in air traffic control were examined. The possible implementation of warning systems and the available technology was studied.

T.M.

N81-13042# Federal Aviation Administration, Atlantic City, N.J. **TOWER CAB DIGITAL DISPLAY** Final Report, Jan. - Mar. 1980

Philip Karsten Sep. 1980 18 p refs

(AD-A090616; FAA-CT-80-31; FAA/RD-80-101) Avail: NTIS HC A02/MF A01 CSCL 01/5

This report discusses the operational evaluation of the Tower Cab Digital Display (TCDD). The TCDD is used for air traffic control operations in the St. Petersburg control tower and the MacDill Air Force Base ground control approach (GCA) and control tower facilities as part of the Automated Radar Terminal System (ARTS) 3A Remote Tower Display System. Evaluation objectives were to determine the usefulness and suitability of TCDD operational features. Resultant findings will be input to the Systems Research and Development Service (SRDS) technical data package for future production TCDD's. For the most part, resultant findings are favorable to existing TCDD capabilities. Some modifications are recommended for future production models.

GRA

N81-13044*# Lockheed-California Co., Burbank.
YF-12 COOPERATIVE AIRFRAME/PROPULSION CONTROL SYSTEM PROGRAM, VOLUME 1 Final Report
 D. L. Anderson, G. F. Connolly, F. M. Mauro, P. J. Reukauf, and Ralph Marks, ed. Nov. 1980 120 p refs 2 Vol.
 (NASA-CR-163099; SP-5317; H-1136) Avail: NTIS HC A06/MF A01 CSCL 01C

Several YF-12C airplane analog control systems were converted to a digital system. Included were the air data computer, autopilot, inlet control system, and autothrottle systems. This conversion was performed to allow assessment of digital technology applications to supersonic cruise aircraft. The digital system was composed of a digital computer and specialized interface unit. A large scale mathematical simulation of the airplane was used for integration testing and software checkout. Author

N81-13045# Committee on Science and Technology (U. S. House).

DESIGN ANALYSIS OF WIDE-BODY AIRCRAFT

Washington GPO 1980 562 p Hearings before the Subcomm. on Invest. and Oversight of the Comm. on Sci. and Technol., 96th Congr., 1st Sess., no. 98, 17-18, 21 Jul., 6, 15 Aug. and 4 Oct. 1980

(GPO-60-652) Avail: Subcommittee on Investigations and Oversight

Technical design details of the DC-10, such as pylons, slats, and cockpit stall indications were examined. The various design philosophies for wide body aircraft and the research and development upon which those philosophies are based were investigated. T.M.

N81-13046# Pacer Systems, Inc., Burlington, Mass.
STUDY OF HELICOPTER PERFORMANCE AND TERMINAL INSTRUMENT PROCEDURES Final Report

A. G. DeLucien, D. L. Green, H. R. Price, and F. D. Smith Jun. 1980 188 p refs
 (Contract DOT-FA79WAI-019)
 (AD-A090052; FAA-RD-80-58) Avail: NTIS HC A09/MF A01 CSCL 01/3

In an effort to provide data needed to examine the feasibility of new procedures and criteria for terminal instrument procedures, this study effort addresses helicopter IFR operations in two parts. First, it documents, in a collective sense, the Instrumental Meteorological Conditions and Visual Meteorological Conditions performance capabilities of currently IFR certified helicopters. A number of proposed helicopter procedures are analyzed for their suitability for further consideration or experimental testing, considering the current helicopter parametric performance envelopes. Second, helicopter instrument procedures are addressed in the long term sense and recommendations are offered for development of post 1985 operations. GRA

N81-13047# Bell Helicopter Co., Fort Worth, Tex.
EXPERIMENTAL INSTALLATION OF MAST MOUNTED SIGHT ON AN OH-58C HELICOPTER Final Report, Mar. 1978 - Jan. 1980

James A. Rule, Horace W. Hanson, Harry K. Harr, John R. Norvell, and David A. Popelka Oct. 1980 82 p refs
 (Contract DAAK10-78-C-0115; DA Proj. 1L2-63206-D-043)
 (AD-A091074; USAAVRADCOM-TR-80-D-25) Avail: NTIS HC A05/MF A01 CSCL 01/3

The purpose of this effort was to investigate the load and vibration effects of installing a Rockwell mast mounted sight (MMS) on an OH-58C helicopter and to determine the environment in which the sight would operate. The task consisted of analytical studies, tests with a dummy sight, and installation and test of an operational sight. GRA

N81-13048# Goodyear Aerospace Corp., Litchfield Park, Ariz.
SUPERHARD TRANSPARENT COATING OPTIMIZATION PROGRAM Final Report

Richard S. Hassard, Glenn E. Wintermute, and John Uram, Jr. Sep. 1980 43 p refs
 (Contract DAAK51-79-C-0047; DA Proj. 1L1-62209-AH-76)
 (AD-A091083; GERA-2448) Avail: NTIS HC A03/MF A01 CSCL 11/3

This report covers the results of a study program for the optimization of a hard transparent coating that was previously developed and laboratory tested by Goodyear Aerospace Corp. Subsequent field tests of the coating on UH-1 helicopter windows revealed certain deficiencies which this program was designed to overcome. Modifications of the No. 210 coating consisted primarily of discrete changes in the quantities of the reactive components. GRA

N81-13049# San Antonio Air Logistics Center, Kelly AFB., Tex.

CONTAMINANT INCREASE IN AIRCRAFT LIQUID OXYGEN CONVERTERS: ANALYSIS OF DATA Progress Report, Mar. - May 1979

Lester L. Dziuk Aug. 1980 22 p
 (AD-A090975; SAALC/SFQ-TR-80-1) Avail: NTIS HC A02/MF A01 CSCL 07/2

Analysis of data collected during a study of contaminant buildup in an aircraft liquid oxygen converter is presented. The data indicates that contaminants increase during the interval between fillings and that contaminants are removed during fillings. No overall trend of contaminant increase was observed. GRA

N81-13050# Human Engineering Labs., Aberdeen Proving Ground, Md.

HELICOPTER IN-FLIGHT VALIDATION SYSTEM (HELIVAL) Final Report

Thomas L. Frezell, Gordon Herald, Richard S. Camden, and Clarence A. Fry Aug. 1980 25 p refs
 (AD-A091129; HEL-TM-17-80) Avail: NTIS HC A02/MF A01 CSCL 14/3

This report described the Helicopter In-Flight Validation System (HELIVAL). The system monitors all six degrees of freedom of the helicopter flight control position to include cyclic, collective and anti-torque pedals; along with airspeed, altitude (both barometric and absolute), and geographic position. These data are recorded digitally on a magnetic tape recorder mounted in the helicopter. The recorded data is then processed and reduced in a ground station. GRA

N81-13051 Maryland Univ., College Park.
DYNAMICS OF A HELICOPTER-SLUNG LOAD SYSTEM Ph.D. Thesis

Prasad Sampath 1980 164 p
 Avail: Univ. Microfilms Order No. 8027137

Stability of a tandem rotor helicopter carrying a slung cargo container was investigated. Lagrange equations were used to write the equations of motion. The cables of the sling were modeled as massless rigid extensible rods, which collapse under compressive loads. Extensibility was provided by considering the rods as linear springs with viscous damping. Aerodynamics of the cable were neglected. Tabulated static aerodynamic data were considered for the helicopter as well as the load. The equations were divided into two sets, one representing the towing vehicle (referred to as Subsystem 1) and the other representing the slung load (referred to as Subsystem 2). Subsystem 2 corresponds to a wind tunnel model of a slung load. Stability of Subsystem 2 was investigated for various flow velocities and sling configurations. The results were compared with the results of wind tunnel tests of scaled models. The influence of the load oscillations on the helicopter is substantially reduced when the helicopter is flown with its stability augmentation system on. Without the intervention of the pilot, load oscillations cause the helicopter, with or without the stability augmentation system, to oscillate. Pilot inputs can also induce oscillations in the load. Dissert. Abstr.

N81-13052# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugfuerung.

AN EQUIPMENT FOR TESTING AND MEASURING A HELMET MOUNTED SIGHT AND DISPLAY SYSTEM WITH A COUPLED TV-CAMERA IN THE FLIGHT SIMULATOR FOR RESEARCH OF THE DFVLR

Friedrich Erdmann Jan. 1980 81 p refs In GERMAN; ENGLISH

summary

(DFVLR-MITT-80-04) Avail: NTIS HC A05/MF A01

Equipment for testing a helmet sight and display system (HMS/D) in a flight simulator for research is described. The values to be measured and the corresponding reference values are defined. The software and hardware of the testing equipment, the control program of the equipment, and the methods of data recording are presented. Special aspects of the mathematical background and measurement of static errors of a HMS/D system (Honeywell) are given in the appendixes. E.D.K.

N81-13053# Boeing Commercial Airplane Co., Seattle, Wash. **AIRCRAFT ALERTING SYSTEMS STANDARDIZATION STUDY Final Report, Jan. - Nov. 1979**

G. P. Boucek, J. B. Erickson, B. L. Berson, D. C. Hanson, and M. F. Leffler Feb. 1980 372 p refs Prepared in cooperation with Douglas Aircraft Co., Santa Monica, Calif. and Lockheed Aircraft Corp., Sunnyvale, Calif. (Contract DOT-FA79WA-4268) (AD-A090834; D6-49273; FAA-RD-80-68) Avail: NTIS HC A16/MF A01 CSCL 01/4

This report is one of a series of documented studies and experiments directed to the improvement and standardization of cockpit alerting systems. The efforts in this current study are noteworthy in that the three major manufacturers of Commercial Transport Aircraft, Douglas, Lockheed, and Boeing conducted the tests and co-authored this report. The primary purpose of the study is to extend and validate, through simulation, the precepts advanced in the previous contract study. The primary purpose of this report is to document the results of objective and subjective tests and the development of the functional design of the candidate alerting systems which will be implemented and evaluated in a flight simulator. GRA

N81-13054 Virginia Polytechnic Inst. and State Univ., Blacksburg. **AN INVESTIGATION OF THE DYNAMIC STALLING CHARACTERISTICS OF ROTATING AXIAL-FLOW COMPRESSOR BLADES Ph.D. Thesis**

Michael Ray Sexton 1980 199 p
Avail: Univ. Microfilms Order No. 8028161

Data taken while the experimental compressor was operating with a distortion screen upstream of the rotor was utilized to develop a transfer function was developed by considering the dynamic total pressure loss distribution around the rotor to be a response function driven by a quasi-steady total pressure loss distribution as a forcing function. Fourier transforms of both the dynamic and the quasi-steady distributions were calculated. The quotient obtained by dividing the Fourier transform of the response function by the Fourier transform of the forcing function was the desired transfer function. This experimentally determined transfer function was then used in a new semi-actuator disc model to predict the dynamic response of the experimental compressor. Dissert. Abstr.

N81-13055 Illinois Inst. of Tech., Chicago. **EFFECTS OF AXISYMMETRIC CONTRACTIONS ON TURBULENCE OF VARIOUS SCALES Ph.D. Thesis**

Jimmy Tan-Atichat 1980 393 p
Avail: Univ. Microfilms Order No. 8026159

Digitally acquired and processed results from an experimental investigation of grid-generated turbulence of various scales through and downstream of nine matched cubic axisymmetric contractions ranging in area ratio from 2 to 36, and in length-to-inlet diameter ratio from 0.25 to 150. In addition, a fifth order contraction was utilized for studying the contour shape effect were examined. Key features of this experiment included powering the wind tunnel with compressed air to eliminate minute extraneous velocity fluctuations caused by the blower fan blades which amplify and affect the components of turbulent kinetic energy unequally in a contracting stream, and the concurrent utilization of both digital and analog instrumentation to achieve a higher quality of the recorded data. Results indicate that the extent to which the turbulence is altered by the contraction depends on the incoming turbulence scales, the total strain

experienced by the fluid, as well as the contraction ratio and the strain rate. Dissert. Abstr.

N81-13056*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

NASA RESEARCH IN AEROPROPULSION

Warner L. Stewart and Richard J. Weber 1981 24 p Proposed for presentation at the 26th Ann. Intern. Gas Turbine Conf., Houston, Tex., 8-12 Mar. 1981; sponsored by the ASME (NASA-TM-81633; E-645) Avail: NTIS HC A02/MF A01 CSCL 21E

Selected examples of recent accomplishments and current activities that are relevant to the principal classes of civil and military vehicles: subsonic transports, commuters, supersonic transports, general aviation, rotorcraft, V/STOL, and high performance. Some instances of emerging technologies with potential high impact on further progress are discussed. E.D.K.

N81-13057*# Pratt and Whitney Aircraft Group, East Hartford, Conn. Commercial Products Div.

MODEL AERODYNAMIC TEST RESULTS FOR TWO VARIABLE CYCLE ENGINE COANNULAR EXHAUST SYSTEMS AT SIMULATED TAKEOFF AND CRUISE CONDITIONS Final Report

D. P. Nelson 17 Dec. 1980 70 p refs
(Contract NAS3-20061) (NASA-CR-159818; PWA-5550-37) Avail: NTIS HC A04/MF A01 CSCL 21E

Wind tunnel tests were conducted to evaluate the aerodynamic performance of a coannular exhaust nozzle for a proposed variable stream control supersonic propulsion system. Tests were conducted with two simulated configurations differing primarily in the fan duct flowpaths: a short flap mechanism for fan stream control with an isentropic contoured flow splitter, and an iris fan nozzle with a conical flow splitter. Both designs feature a translating primary plug and an auxiliary inlet ejector. Tests were conducted at takeoff and simulated cruise conditions. Data were acquired at Mach numbers of 0, 0.36, 0.9, and 2.0 for a wide range of nozzle operating conditions. At simulated supersonic cruise, both configurations demonstrated good performance, comparable to levels assumed in earlier advanced supersonic propulsion studies. However, at subsonic cruise, both configurations exhibited performance that was 6 to 7.5 percent less than the study assumptions. At take off conditions, the iris configuration performance approached the assumed levels, while the short flap design was 4 to 6 percent less. Author

N81-13059# Cambridge Univ. (England). Dept. of Engineering.

GERRY CASING TREATMENT

D. S. Whitehead, N. Hall, and A. Poursartip May 1980 24 p refs
(CUED/A-Turbo/TR-101) Avail: NTIS HC A02/MF A01

Three different configurations were tested. A semi-circular circumferential groove in the outer casing centered on the trailing edge of the blade row caused no significant improvements in the stall margin. With the addition of shoulders and ramps downstream of the groove the performance suffered a small but definite deterioration. Axial velocity, and outlet flow angle downstream of the rotor were also obtained for all configurations. Author

N81-13060# Army Propulsion Lab., Cleveland, Ohio. Propulsion Lab.

THE RESPONSE OF TURBINE ENGINE ROTORS TO INTERFERENCE RUBS

Albert F. Kascak Jun. 1980 15 p refs
(AD-A090408) Avail: NTIS HC A02/MF A01 CSCL 21/5

In a typical aircraft gas turbine there are many instances in which rotor rubs occur. Two of the most common are blade tip and seal rubs, which are caused by thermal mismatch, rotor imbalance, high 'g' maneuver loads, aerodynamic forces, etc. Current interest in fuel efficiency is a consideration which drives the engine design toward closer operating clearances. Thus increasing the probability of rotor rubs. The interaction of a rotor

with its case, (rotor rubs), has been studied. A steady state interaction between a rotor with a rigid case neglecting friction at the interface and a steady state interaction between a linear flexible rotor and case including friction at the interface were studied. The critical transient situation in which the rotor bounces off the case was not considered. It is known that rotor rubs can have an important effect on the rotor dynamics. When a rotor rubs on the case, a frictional force is generated which can drive a rotor to whirl in a direction opposite to the direction of rotation, (backward whirl). This frictional force is relatively constant up to the backward whirl speed at which the rotor rolls around the case. Since this rolling contact speed is proportional to the rotational speed of the rotor times the ratio of the diameter to the rotor clearance, the whirl speed can be hundreds of times the rotational speed of the rotor; and thus be potentially very dangerous. GRA

N81-13061# ARO, Inc., Arnold Air Force Station, Tenn.
PERFORMANCE EVALUATION OF A PROTOTYPE NON-INTERFERENCE TECHNIQUE FOR MEASUREMENT OF TURBINE ENGINES COMPRESSOR BLADE STRESS Final Report, 1 Oct. 1977 - 1 Jan. 1979
 P. E. McCarty and J. W. Thompson, Jr. AEDC Oct. 1980
 23 p refs Sponsored by AF
 (AD-A090566; AEDC-TR-80-5) Avail: NTIS
 HC A02/MF A01 CSCL 21/5

A noninterference technique for measuring stress in compressor blades of turbine engines is being developed to alleviate disadvantages associated with conventional strain gage measurement systems. The noninterference technique uses blade-tip deflection measurements and special data processing algorithms to infer local blade stress. A prototype of the noninterference technique equipped with a nonintegral blade vibration data processing algorithm has been experimentally validated. GRA

N81-13062# Federal Aviation Administration, Atlantic City, N.J.
EXHAUST EMISSIONS CHARACTERISTICS AND VARIABILITY FOR PRATT AND WHITNEY JT8D-7A GAS TURBINE ENGINES SUBJECTED TO MAJOR OVERHAUL AND REPAIR Final Report, Nov. 1978 - Feb. 1979
 Eric E. Becker, Gary Frings, and William C. Cavage Sep. 1980
 55 p refs
 (FAA Proj. 201-521-100)
 (AD-A091011; FAA-CT-79-53) Avail: NTIS
 HC A04/MF A01 CSCL 21/5

Seven Pratt and Whitney Aircraft (PWA) JT8D-7A turbofan engines were tested at Kennedy International Airport, New York, to evaluate exhaust emissions characteristics and data variability after overhaul. The measured data show that the engines tested did not meet the Environmental Protection Agency (EPA) emission standards. A comparison of the measured data, obtained from the seven overhauled engines evaluated under this program, with new engine data obtained from PWA show that there is a great deal of similarity between the two sets of data. Differences shown in this report between new engine and overhauled engine data are due to the quantity of the engines sampled; the new engine data represent a larger sample size. Satisfactory data can be measured by using the test procedures, instrumentation, and equipment defined in this report. GRA

N81-13064# Battelle Columbus Labs., Ohio.
MECHANICAL PROPERTY IMPROVEMENT OF PROTECTIVE COATINGS FOR TURBINE ENGINES USING COAL-DERIVED FUELS Final Report
 H. A. Beale 1 Sep. 1980 21 p refs
 (Contract DE-AC03-78ET-12293)
 (DOE/ET-12293/T1) Avail: NTIS HC A02/MF A01

Nb-NbC and Nb-NbB2 coatings were studied to determine, how thermal expansion differences between a metal matrix and a dispersed phase affect the coating properties. The Nb-NbC and Nb-Nb-NB2 coatings were deposited by dual source electron beam evaporation. Transmission electron microscopic (TEM) examination of the deposited coatings revealed that the NbC and NbB2 in the coating was randomly dispersed with particle

size of less than 50 A. The effect of such finely dispersed particles on the Peierls stress in the coating was found to have negligible impact on the coating properties. DOE

N81-13065*# National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.
PSEUDOSTEADY-STATE ANALYSIS OF NONLINEAR AIRCRAFT MANEUVERS
 John W. Young, Albert A. Schy, and Katherine G. Johnson Dec. 1980 64 p refs
 (NASA-TP-1758; L-13743) Avail: NTIS HC A04/MF A01 CSCL 01C

An analytical method was developed for studying the combined effects of rotational coupling and nonlinear aerodynamics on aircraft response for specified control inputs. The method involves the simultaneous solution of two nonlinear equations which are functions of angle attack, roll rate, and control inputs. The method was applied to a number of maneuvers for a fighter-type aircraft. Time history responses verified the usefulness of the analysis for predicting a variety of response characteristics caused by interacting nonlinear aerodynamic and inertial effects, including spin conditions. Author

N81-13067# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio. Flight Control Div.
DESIGN OF A LATERAL STABILITY AUGMENTATION SYSTEM FOR THE F106 TO IMPROVE LATERAL HANDLING QUALITIES DURING TRACKING Final Technical Report, May 1977 - Jan. 1979
 Richard D. Holdridge Jul. 1980 165 p refs
 (AF Proj. 2403)
 (AD-A091014; AFWAL-TR-80-3015) Avail: NTIS
 HC A08/MF A01 CSCL 01/2

An improved lateral stability augmentation system has been developed to improve the handling qualities of the F-106 in the air-to-air tracking task. The existing yaw rate and roll rate feedbacks, as well as the aileron to rudder interconnect, were removed and replaced with calculated sideslip rate and measured sideslip feedbacks. An advanced root locus technique, the root map was used to set the gains on sideslip and sideslip rate. The resulting system was evaluated using a nonpiloted hybrid simulation as well as a digital frequency domain analysis program. The system was then evaluated by operational F-106 pilots using the Flight Dynamics Laboratory's LAMARS motion based simulator. Based on simulator results, the system was installed on an F-106 and flight tested at Tyndall AFB, Florida. The results of basic analyses, nonpiloted simulations, piloted simulations, and flight test are presented. GRA

N81-13068# ARO, Inc., Arnold Air Force Station, Tenn.
A DIRECT MODEL PITCH MEASUREMENT WITH A LASER INTERFEROMETER USING RETROREFLECTORS Final Report, Oct. 1978 - 5 Sep. 1979
 W. H. Goethert AEDC Jan. 1980 42 p ref Sponsored by AF
 (AD-A090722; AEDC-TR-79-87) Avail: NTIS
 HC A03/MF A01 CSCL 20/6

A laser interferometer was developed to measure pitch angles of test models in a wind tunnel environment. Small retroreflectors imbedded flush with the surface of the test item provided the necessary reflected light for optical processing of pitch information. The first tunnel measurements indicated pitch measurements could be made providing the retroreflectors remained illuminated with the expanded laser beams. Because of the axial motion of the model relative to the optics systems, provisions for scanning the laser beams to follow retroreflector motion was incorporated. Using an actual test model, data were taken demonstrating this tracking capability. Calibration data were also taken comparing the interferometer data with the tunnel standard inclinometer. GRA

N81-13069# Federal Aviation Administration, Washington, D.C. Airports Service.

AIRPORT CRASH/FIRE/RESCUE CFR SERVICE COST AND BENEFIT ANALYSIS. VOLUME 2: APPENDIXES

Jul. 1980 263 p
(AD-A091155; FAA-AS-80-2-Vol-2) Avail: NTIS
HC A12/MF A01 CSCL 13/12

Contents: national CFR equipment inventory; the 221 air carrier accidents with potential CFR benefits selected in pass one; the 129 air carrier accidents that pass two determined to provide no CFR benefits; a list of the 61 air carrier accidents studied in detail in pass three for which NTSB records were available; the 31 air carrier accidents for which detailed NTSB were unavailable; description of the 61 air carrier accidents studied in detail in pass three for which NTSB records were available; and estimates of CRF crash benefits for air carrier accident, 1966-1978. GRA

N81-13072# Pacer Systems, Inc., Arlington, Va.
STUDY OF HELIPORT AIRSPACE AND REAL ESTATE REQUIREMENTS Final Report, Mar. - Jul. 1980

A. G. DeLucien and F. D. Smith Aug. 1980 150 p refs
(Contract DOT-FA79WAI-019)
(AD-A091156; FAA-RD-80-107; PAR-037-80) Avail: NTIS
HC A07/MF A01 CSCL 01/5

This report documents the review and evaluation of real estate and airspace requirements as set forth in applicable U.S. heliport design criteria. International criteria are reviewed to discern their rationale for various requirements. Helicopter performance during normal and failure state operations is analyzed. The suitability of current criteria is examined with respect to various operational profiles. Modifications to current criteria are suggested which would accommodate various operational requirements and varying levels of terminal instrument procedures capability. Recommendations include a revised heliport classification scheme with corresponding changes to real estate and airspace criteria for IFR operations; helicopter performance chart standardization for flight manuals with specific data requirements; consideration of obstacle clearance for failure-state operations; additional criteria for offshore facilities; and revised criteria for elevated heliports/helipads. GRA

N81-13085 Purdue Univ., Lafayette, Ind.
UNSTEADY THREE-DIMENSIONAL SUBSONIC FLOW IN A SOLID PROPELLANT ROCKET MOTOR INCLUDING THE EFFECT OF MOTOR ROTATION Ph.D. Thesis

Jeffrey Jonathan Brown 1980 311 p
Avail: Univ. Microfilms Order No. 8027259

A mathematical analysis and a computer program based upon that analysis are presented for calculating the effects of high rotation rates on the subsonic flow field in a solid propellant rocket motor. The geometry of the propellant grain and propulsive nozzle was assumed to be axisymmetric. The flow field was three dimensional due to the effects of the motor rotation. The governing equations for unsteady three dimensional flow were derived in a noninertial reference frame attached to the missile for the most general case where the missile has both angular velocity and acceleration, as well as linear acceleration all with respect to Earth. Inviscid flow of a thermally and calorically perfect gas was considered. The solid propellant burning rate law is the well known pressure exponent empirical correlation including erosive burning. The resulting equations were integrated numerically using the variation of the method of characteristics due to Kentzer. The numerical integration procedure and a production type computer program for implementing the procedure are presented. Dissert. Abstr.

N81-13251# Range Commanders Council, White Sands Missile Range, N. Mex. Inter-Range Instrumentation Group.

NONCOHERENT C-BAND TRANSPONDER STANDARDS
1980 18 p
(AD-A091282; IRIG-STANDARD-115-80) Avail: NTIS
HC A02/MF A01 CSCL 17/9

Most of the modern noncoherent C-band pulse transponders available today are the result of commercial development with some guidance from the U.S. Government in terms of specifica-

tions or user requirements. The transponder manufacturing field is rather small and limited to companies who have become strongly entrenched over the years. As a general statement, most of these companies meet, or can meet, the standards set forth in this document. These standards have been written to accommodate the present state of the art in both the radar and the transponder fields. Not all existing C-band instrumentation radars are completely compatible with all existing transponders. These system standards are an IRIG recommendation primarily for the purpose of establishing and preserving compatibility of the noncoherent C-band pulse transponders and C-band range instrumentation radars of the present and near future. GRA

N81-13303*# National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.
EVALUATION OF FLOW QUALITY IN TWO LARGE NASA WIND TUNNELS AT TRANSONIC SPEEDS

William D. Harvey, P. Calvin Stainback, and F. Kelvin Owen (COMPLERE Inc., Palo Alto, Calif.) Dec. 1980 76 p refs
(NASA-TP-1737; L-13448) Avail: NTIS HC A05/MF A01
CSCL 20D

Wind tunnel testing of low drag airfoils and basic transition studies at transonic speeds are designed to provide high quality aerodynamic data at high Reynolds numbers. This requires that the flow quality in facilities used for such research be excellent. To obtain a better understanding of the characteristics of facility disturbances and identification of their sources for possible facility modification, detailed flow quality measurements were made in two prospective NASA wind tunnels. Experimental results are presented of an extensive and systematic flow quality study of the settling chamber, test section, and diffuser in the Langley 8 foot transonic pressure tunnel and the Ames 12 foot pressure wind tunnel. Results indicate that the free stream velocity and pressure fluctuation levels in both facilities are low at subsonic speeds and are so high as to make it difficult to conduct meaningful boundary layer control and transition studies at transonic speeds. E.D.K.

N81-13355 Florida Univ., Gainesville.
A UNIFIED APPROACH TO THE MASS BALANCING OF ROTATING FLEXIBLE SHAFTS Ph.D. Thesis

Mark Sandor Darlow 1980 325 p
Avail: Univ. Microfilms Order No. 8029051

A new balancing procedure is analytically developed and is referred to as the Unified Balancing Approach. A detailed procedure is outlined for its implementation and test results are reported which verify the effectiveness of the Unified Balancing Approach. These results demonstrate its superiority over modal and influence coefficient balancing, in terms of both efficiency and effectiveness. The Unified Balancing Approach was specifically designed to take into account practical rotor balancing considerations. This is of particular importance since the ultimate test of any rotor balancing method must involve practical applications. Combined with modern microcomputer hardware, the Unified Balancing Approach forms an operation oriented balancing tool which is ideally suited to fill the current gap in flexible rotor balancing, particularly for use in the field. The design of such a portable balancing tool is described in detail. Dissert. Abstr.

N81-13465*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.**IGNITION OF LEAN FUEL-AIR MIXTURES IN A PREMIXING-PREVAPOORIZING DUCT AT TEMPERATURES UP TO 1000 K**

Robert R. Tacine Dec. 1980 16 p refs
(Contract DE-AI01-77CS-51040)
(NASA-TM-81645; E-9356-3; DOE/NASA/51040-19) Avail:
NTIS HC A02/MF A01 CSCL 21B

Conditions were determined in a premixing prevaporizing fuel preparation duct at which ignition occurred. An air blast type fuel injector with nineteen fuel injection points was used to provide a uniform spatial fuel air mixture. The range of inlet conditions where ignition occurred were: inlet air temperatures

of 600 to 1000 K air pressures of 180 to 660 kPa, equivalence ratios (fuel air ratio divided by stoichiometric fuel air ratio) from 0.12 to 1.05, and velocities from 3.5 to 30 m/s. The duct was insulated and the diameter was 12 cm. Mixing lengths were varied from 16.5 to 47.6 and residence times ranged from 4.6 to 107 ms. The fuel was no. 2 diesel. Results show a strong effect of equivalence ratio, pressure and temperature on the conditions where ignition occurred. The data did not fit the most commonly used model of auto-ignition. A correlation of the conditions where ignition would occur which apply to this test apparatus over the conditions tested is $(p/V)\phi$ to the 1.3 power = 0.62 e to the 2804/T power where p is the pressure in kPa, V is the velocity in m/e, ϕ is the equivalence ratio, and T is the temperature in K. The data scatter was considerable, varying by a maximum value of 5 at a given temperature and equivalence ratio. There was wide spread in the autoignition data contained in the references. A.R.H.

N81-13545# Argonne National Lab., Ill. Energy and Environmental Systems Div.

IMPACT OF AIRCRAFT EMISSIONS ON AIR QUALITY IN THE VICINITY OF AIRPORTS. VOLUME 2: AN UPDATED MODEL ASSESSMENT OF AIRCRAFT GENERATED AIR POLLUTION AT LAX, JFK AND ORD Final Report, Jan. 1978 - Jul. 1980

R. J. Yamartino, D. G. Smith, S. A. Bremer, D. Heinold, D. Lamich, and B. Taylor Jul. 1980 88 p refs Prepared in cooperation with Environmental Research and Technology, Inc., Concord, Mass.

(Contract DOT-FA77WAI-736)

(AD-A091005; FAA-EE-80-09B-Vol-2) Avail: NTIS HC A05/MF A01 CSCL 13/2

This report documents the results of the Federal Aviation Administration (FAA)/Environmental Protection Agency (EPA) air quality study which has been conducted to assess the impact of aircraft emissions of carbon monoxide (CO), hydrocarbons (HC), and oxides of nitrogen (NOx) in the vicinity of airports. This assessment includes the results of recent modeling and monitoring efforts at Washington National (DCA), Los Angeles International (LAX), Dulles International (IAD), and Lakeland, Florida airports and an updated modeling of aircraft generated pollution at LAX, John F. Kennedy (JFK) and Chicago O'Hare (ORD) airports. The Airport Vicinity Air Pollution (AVAP) model which was designed for use at civil airports was used in this assessment. In addition, the results of the application of the military version of the AVAP model the Air Quality Assessment Model (AQAM) are summarized. Both the results of the pollution monitoring analyses in Volume 1 and the modeling studies in Volume 2 suggest that: maximum hourly average 60 CO concentrations from aircraft are unlikely to exceed 5 parts per million (ppm) in areas of public exposure and are thus small in comparison to the National Ambient Air Quality Standard of 35 ppm; maximum hourly HC concentrations from aircraft can exceed 0.25 ppm over an area several times the size of the airport; and while annual average NO2 concentrations from aircraft are estimated to contribute only 10 to 20 percent of the NAAQS limit level. GRA

N81-13555# Environmental Protection Agency, Las Vegas, Nev. Office of Research and Development.

THE RAPS (REGIONAL AIR POLLUTION STUDY) HELICOPTER AIR POLLUTION MEASUREMENT PROGRAM, ST. LOUIS, MISSOURI Final Report, 1974 - 1978

David T. Mage, Roy B. Evans, Charles Fitzsimmons, Norman Hester, Frank Johnson, Steve Pierett, George Siple, and Robert Snelling Dec. 1979 208 p refs

(PB80-213119; EPA-600/4-79-078) Avail: NTIS HC A10/MF A01 CSCL 13B

This research program was initiated with the overall objective of providing measurement of air pollution and temperature gradient over the St. Louis, Missouri/Illinois, metropolitan area to complement surface measurements of air pollution by the Regional Air Monitoring System (RAMS) of the Regional Air Pollution Study (RAPS). The helicopter data collection program is described in detail and the missions flown by date, time,

flight pattern and purpose are cataloged. These data, collected on magnetic tape, are deposited in the RAPS data bank maintained by the U.S. Environmental Protection Agency. Sufficient examples are provided, with figures and tables, to enable the prospective users of these data to understand the measurements and their limitations and to facilitate usage of the data bank. GRA

N81-13568*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

TABULATIONS OF AMBIENT OZONE DATA OBTAINED BY GASP AIRLINERS, MARCH 1975 TO DECEMBER 1977

Gregory D. Nastrom (Control Data Corp., Minneapolis) and James D. Holdeman Sep. 1980 111 p refs

(Contract DOT-FA78WAI-893)

(NASA-TM-81528; E-481; FAA-EE-43) Avail: NTIS HC A06/MF A01 CSCL 04A

Tabulations are given of GASP ambient ozone mean, standard deviation, median, 84th percentile, and 98th percentile values, by season, flight level, and geographical region. In addition, selected empirical probability variations are highlighted to illustrate the types of curves which might be appropriate in specific analyses of the tabulated data, and an example-case calculation is presented to illustrate how the tables can be used to estimate the frequency of commercial airline flights encountering high cabin ozone levels. Author

N81-13717# Federal Aviation Administration, Washington, D.C. Office of Environment and Energy.

NOISE LEVELS AND DATA CORRECTION ANALYSIS FOR SEVEN GENERAL AVIATION PROPELLER AIRCRAFT Final Report

David W. Ford and Edward J. Rickley Sep. 1980 376 p refs (AD-A091292; FAA/EE-80-26) Avail: NTIS HC A17/MF A01 CSCL 13/2

This document reports noise levels of a general aviation propeller aircraft noise test at the FAA National Aviation Facility Experimental Center located in Atlantic City, New Jersey. The test was performed to acquire noise data on general aviation type aircraft and examine how these noise levels are influenced by variables such as distance, aircraft speed, power settings, and propeller speeds. Aircraft were tested during takeoff, approach, and flyover modes and data are given in EPNL and in 'A'-weighted decibels. All measurements were performed in accordance with FAR 36 Appendix C and Appendix F procedures. GRA

N81-13719# Wyle Labs., Inc., El Segundo, Calif.

CORRECTION PROCEDURES FOR AIRCRAFT NOISE DATA. VOLUME 3: FILTER EFFECTS Final Report

Louis C. Sutherland Jul. 1980 93 p refs

(Contract DOT-FA78WA-4143)

(AD-A091016; WR-79-9-Vol-3; FAA-EE-80-1-Vol-3) Avail: NTIS HC A05/MF A01 CSCL 20/1

A method has been developed to quantify errors in measurement, correction and extrapolation of aircraft noise data which are attributable to spectrum slope and nonideal filter transmission characteristics. The method's fundamental basis is an iterative calculation scheme which recovers an estimate of the true spectrum shape of a signal from its measured band levels. This 'true' spectrum can then be extrapolated to other distances or have frequency dependent corrections made to it on an exact basis without need for worry about filter or slope errors. The new spectrum may then be re-integrated to produce band levels suitable for input to EPNdB or PNL calculations. Applying this procedure to real flyover data and comparing the resultant values of EPNL with those using FAR Part 36 procedures showed only small differences usually. However, the technique provides a consistent method for the analysis of errors due to these sources and should be useful for estimating their magnitude in the future. GRA

N81-13720# Wyle Labs., Inc., El Segundo, Calif.

CORRECTION PROCEDURES FOR AIRCRAFT NOISE DATA. VOLUME 5: PROPELLER AIRCRAFT NOISE Final Report

David Brown and Louis C. Sutherland Jul. 1980 59 p refs

(Contract DOT-FA78WA-4143)
 (AD-A091017; WR-79-9-Vol-5; FAA-EE-80-1-Vol-5) Avail:
 NTIS HC A04/MF A01 CSCL 20/1

This report examines three particular problem areas associated with the measurement of noise levels of propeller-driven small airplanes required to comply with FAR Part 36, Appendix F. These problems are directly related to effects of atmospheric conditions on (1) the performance capabilities of an airplane when tested at various barometric pressures and altitude densities; (2) the noise signature generated at such conditions; and (3) the propagation of sound from the airplane to the measuring station. The first two of these have been addressed by deriving potential correction procedures which could be applied to noise levels obtained by tests not in strict compliance with Appendix F. These corrections are based on aircraft operations conducted within a specific margin of power setting. The corresponding measured noise levels are subsequently corrected for variation of propeller tip speed, forward velocity and barometric pressure relative to predetermined reference conditions. The third effect, that of sound propagation, is examined by applying SAE ARP 866A to a typical propeller airplane noise spectrum and demonstrating the range of A-weight noise levels that would result within a range of ambient conditions. G/A

N81-13804*# National Aeronautics and Space Administration,
 Washington, D. C.

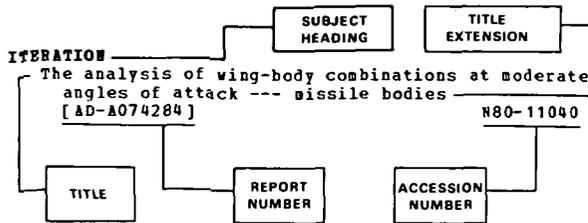
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1980 62 p refs
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The concept of productivity in a Federal research and development agency is multifaceted and complex. Four approaches were considered: the contribution of NASA to national productivity external to the agency; the use of new technology to increase the output of NASA's R&D effort; the achievement of management improvement which involves planning, organization, staffing, direction, and control; and the efficiency with which the agency's civil service labor resources are used to produce goods and services. Author

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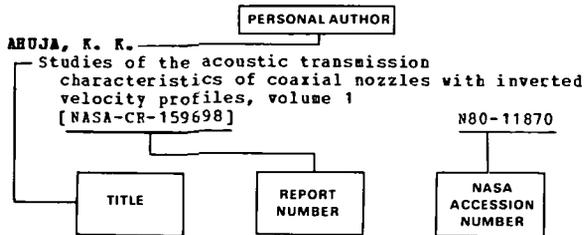
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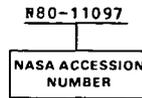
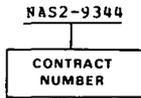
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