NASA

Aeronautical Engineering
A Continuing Bibliography with Indexes

NASA SP-7037(189)
July 1985

National Aeronautics and Space Administration

SPECIAL NOTICE ENCLOSED
NEW FOREIGN TECHNOLOGY INDEX INCLUDED IN THIS ISSUE

ACCESSION NUMBER RANGES

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

STAR (N-10000 Series)	N85-19221 – N85-22341
IAA (A-10000 Series)	A85-26197 – A85-29826

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SPECIAL NOTICE

FOREIGN TECHNOLOGY INDEX IN THIS ISSUE

Documents referred to in this bibliography whose country of intellectual origin is other than the United States are listed in the Foreign Technology Index (see page D-1).

A great deal of excellent scientific and technical work is done throughout the world. To the extent that U.S. researchers, engineers, and industry can utilize what is done in foreign countries, we save our resources. We can thus increase our country's productivity.

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NASA SP-7037(189)

AERONAUTICAL ENGINEERING

A CONTINUING BIBLIOGRAPHY WITH INDEXES

(Supplement 189)

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 June 1985 in

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

Scientific and Technical Information Branch 1985
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Washington, DC

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INTRODUCTION

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

This supplement to *Aeronautical Engineering -- A Continuing Bibliography* (NASA SP-7037) lists 579 reports, journal articles, and other documents originally announced in June 1985 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 by the first nine *STAR* specific categories and the remaining *STAR* major categories. This arrangement offers the user the most advantageous breakdown for individual objectives. The citations include the original accession numbers from the respective announcement journals. The *IAA* items will precede the *STAR* items within each category.

Seven indexes -- subject, personal author, corporate source, foreign technology, contract number, report number, and accession number -- are included.

An annual cumulative index will be published.

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DOMESTIC: NASA and NASA-sponsored documents and a large number of aerospace publications are available to the public for reference purposes at the library maintained by the American Institute of Aeronautics and Astronautics, Technical Information Service, 555 West 57th Street, 12th Floor, New York, New York 10019.

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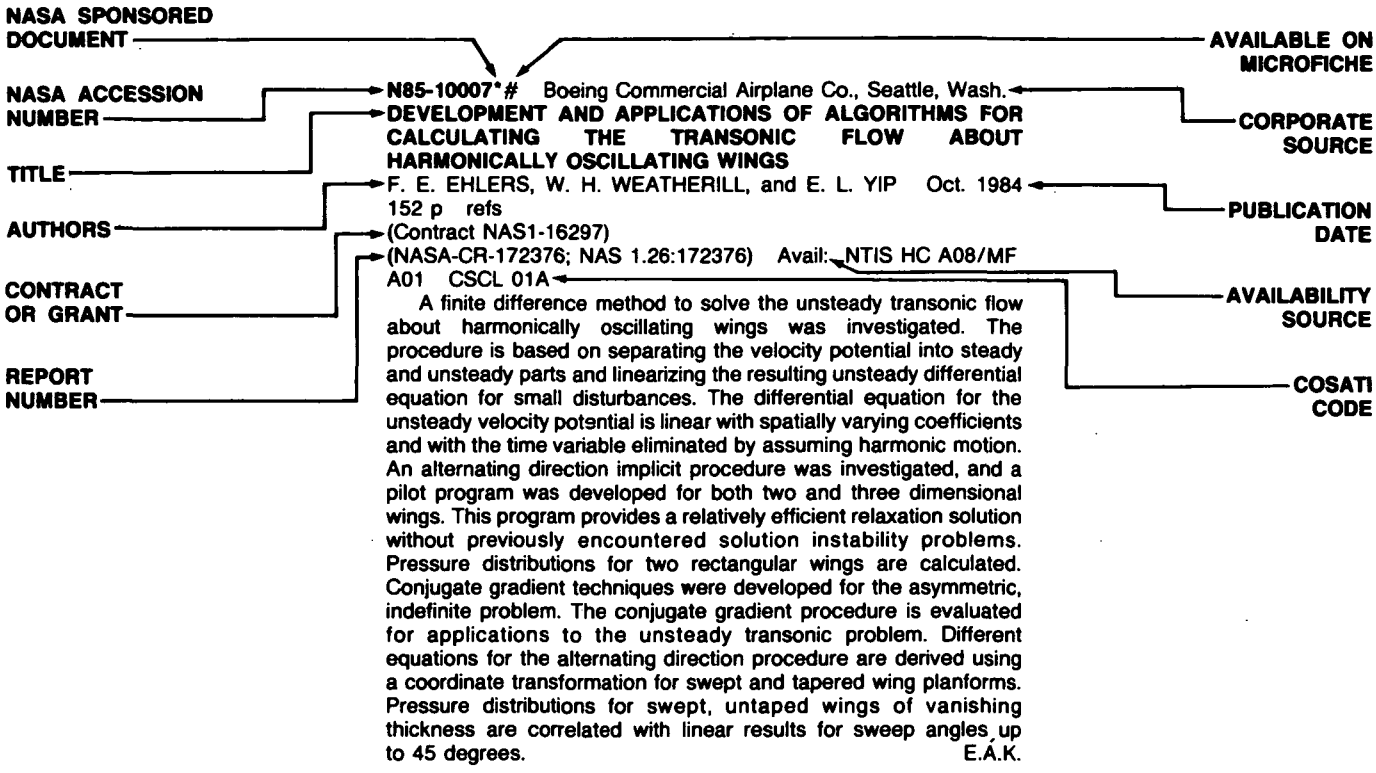

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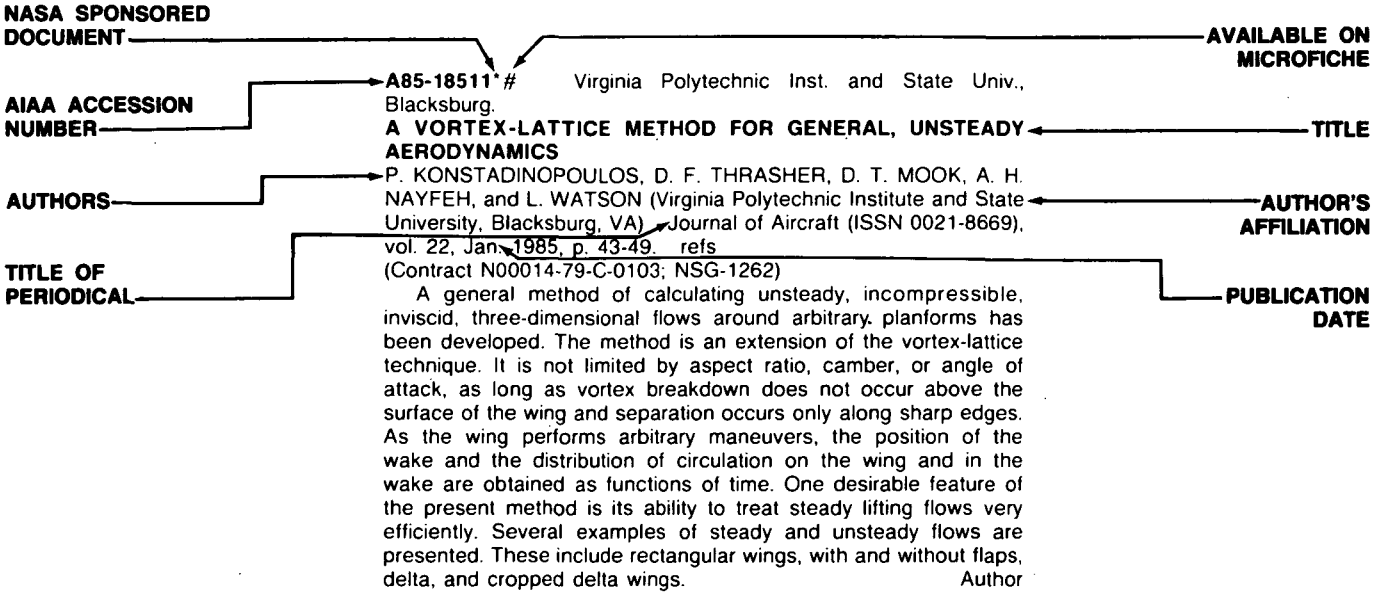

AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 189)

JULY 1985

01

AERONAUTICS (GENERAL)

A85-26426#
TO PURSUE OR TO EVADE - THAT IS THE QUESTION
A. W. MERZ (Lockheed Research Laboratories, Palo Alto, CA) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 8, Mar.-Apr. 1985, p. 161-166. refs

The one-on-one air combat problem has been analyzed under a variety of assumptions regarding the aircraft dynamics and the weapon-system characteristics. However, most of these studies have not considered the problem of role determination and the possibility of real-time implementation of the derived guidance laws. These questions are addressed for a simple but plausible dynamic model of the problem. The two capture regions, the mutual kill and draw regions, are found for a single value of weapon range. In addition, the min-max optimal time controls for both are found when either is in the capture region of the other. Finally, the feasibility of applying these guidance laws is discussed. Author

A85-26778
ATE IN THE FIELD SUPPORTING AIRBORNE ASW AVIONICS P-3 STYLE
G. POWERS (U.S. Navy, Naval Air Rework Facility, Alameda, CA) and J. HENSON (AAI West, Oakland, CA) IN: AUTOTESTCON '83; Proceedings of the Conference, Fort Worth, TX, November 1-3, 1983 . New York, Institute of Electrical and Electronics Engineers, Inc., 1983, p. 12-17.

The AN/USM-449(V) Test Set was procured and placed in service to support the P-3 Orion land based patrol aircraft. The primary objective was to improve the operational readiness of mission critical avionics systems. This paper describes some of the plans and procedures associated with the acquisition and deployment of the test set and provides a statistical assessment of the results achieved. Author

A85-26805
FLIGHT LINE EW SYSTEM TESTING - THE KEY TO OPERATIONAL READINESS
R. L. SCHERER (Sanders Associates, Electronic Warfare Div., Nashua, NH) IN: AUTOTESTCON '83; Proceedings of the Conference, Fort Worth, TX, November 1-3, 1983 . New York, Institute of Electrical and Electronics Engineers, Inc, 1983, p. 212-216.

Extensive on-board integration, extended RF ranges, high data rates and accuracy requirements of sophisticated EW systems led to development of a family of flight Line Test Sets. These Test Sets provide computer-controlled support on an antenna-to-antenna or end-to-end basis. Realistic, accurate threat simulation and test signals are input to the system under test (SUT), and real-time analysis is provided to determine the SUT's operational readiness. Antenna hats for specific aircraft types provide the RF coupling. Digital interface with the SUT produces rapid and discriminating performance and fault isolation. This paper discusses the significant differences in magnitude of test signals/threat simulation and analysis capability of two Test Sets. The AN/USM-406 is presently in the U.S. Navy inventory. The AN/USM-464 is under development for the U.S. Air Force inventory. Author

A85-26834#
ENHANCING THE F-111 AVIONICS INTERMEDIATE SHOP WITH DYNAMIC TEST STATIONS
A. E. PATTERSON, A. CARNEIRO, and E. M. LONG (USAF, Sacramento Air Logistics Center, McClellan AFB, CA) IN: AUTOTESTCON '83; Proceedings of the Conference, Fort Worth, TX, November 1-3, 1983 . New York, Institute of Electrical and Electronics Engineers, Inc., 1983, p. 407-413.

For some of the more complex F-111 digital avionics systems the existing shop Automatic Test Equipment (ATE) used in their test and repair has demonstrated an inability to duplicate and detect failures which are time dependent, intermittent, or dependent on the dynamic interaction of several units within the system. As a result, defective boxes are returned from the maintenance shops to the flight line after testing with some failures going undetected. When the maintenance personnel finally give up on cyclic boxes, they are sent to the depot for repair where the problem may or may not be corrected. To fill this testing void, shop Dynamic Test Stations are being developed which will enhance the shop ATE by interfacing avionics boxes as a system and providing for dynamic system level testing. These Testers are simplified, miniaturized versions of a dynamic simulation system packaged for a shop operational environment and ruggedized transportation. Author

A85-26847
INTERCOMPANY TECHNOLOGY TASK FORCES PROMOTE COOPERATION AT LOCKHEED
R. L. HEIMBOLD (Lockheed Space Operations Co., Titusville, FL) Lockheed Horizons, Feb. 1985, p. 2-14.

Attention is given to the features of a large aerospace corporation's 'technical task force' system, in which 13 such groups, each composed of five to 15 members from sister companies, meet several times a year in order to exchange technologies and computer programs, coordinate research plans, and arrange interchanges with universities and government agencies. An evaluation is made of the impact of these task forces in the fields of advanced metallic materials, communications research, composite materials, electronic warfare, computational aerodynamics, control systems, corrosion control, human factors engineering, nondestructive evaluation, and signal processing. O.C.

A85-26850
SUPPORTABILITY ENGINEERING WHY, HOW, WHEN, WHO
H. D. HALL (Lockheed-Georgia Co., Maintainability Engineering Dept., Marietta, GA) Lockheed Horizons, Feb. 1985, p. 48-56.

The U.S. Department of Defense has mandated that supportability criteria be given a more prominent position in aircraft design processes, in view of the fact that operating and support costs exceed acquisition costs over the life of such systems, and especially in virtue of the inherent difficulties that must be overcome in the management of support for increasingly complex aircraft systems. Attention is given to the reliability and maintainability trends established over the years by the transport aircraft designs C-5A, C-141, C-130, the state-of-the-art C-17, which is currently

under development, and the projected, next generation New Tactical Aircraft. The responsibilities of maintainability and reliability engineering during the conceptual, preliminary, and detailed design phases for transport aircraft are noted. O.C.

A85-27365#
JAPANESE AEROSPACE - SPLIT PERSONALITY ON THE MEND
N. W. DAVIS Aerospace America (ISSN 0740-722X), vol. 23, March 1985, p. 48-54.

The separate and interlocking projects, goals and achievement of the nascient Japanese aerospace complex, still divided into civil and military enterprises, are outlined. A strict division of projects is maintained between applications-oriented and scientific space activities. Licensed manufacture of F-16 fighters is providing industrial experience which may be applied to development of an indigenously produced stealth aircraft. Japanese manufacturers will also have a 25 percent share in the development of the 150 seat 7-7 transport aircraft and are studying a quiet STOL aircraft and a jet trainer. Although use is currently made of purchased Delta-based N II launchers to place 300 kg packages in GEO, work is under way to produce launch vehicles capable of lifting 4000 lb into GEO. Prospective science payloads include telecommunications, geodetic measurement and meteorological satellites. A persistent cross-movement of personnel between civil and military projects has been observed. M.S.K.

A85-27448
A NEW ERA IN COMMERCIAL AIRCRAFT FLIGHT MANAGEMENT
G. CORMERY (Aerospatiale, Toulouse, France) Aerospace (UK) (ISSN 0305-0831), vol. 12, Feb. 1985, p. 7-22.

Progress, trends, and future goals for avionics systems are reviewed from the point of view that avionics are a subassembly of the general aircraft system. Attention is given to the acceptable limits of fly-by-wire controls, the capabilities of CRT displays for simplifying the data in a pilot's field-of-view, and improvements necessary in optic fibers for them to gain ascendancy over current hard-wired components and connections. The architectures of Flight Management, Thrust Control, Augmentation and Control Computers are explored, along with their functions. Finally, the progressive simplification of the flight deck is traced and the limits on further development of digitized, automated, safe, reliable and efficient aircraft avionics are laid on software and software reliability, which will be produced by the manufacturers. M.S.K.

A85-27471#
IMPORTANCE OF TEST AND EVALUATION IN NAVY'S LAMPS MK III PROGRAM
P. B. FLAGG (IBM Corp., Federal Systems Div., Owego, NY) ITEA Journal of Test and Evaluation, vol. 6, Winter 1985, p. 15-19.

Testing and evaluation procedures, as part of the transition from development to production, are assessed in the framework of the Navy's Light Airborne Multipurpose Systems (LAMPS) MK III anti-submarine warfare (ASW) helicopter program. An emphasis is placed on such aspects of the testing phase as independence of the tester, incremental delivery of software products internally, the structural control of hardware assets, and the formation of a test force which combines users and designers. It is noted that the use of the combined test force made it possible to integrate some 2000 lbs of avionics on the aircraft and 3.5 tons of electronics on the ship systems. The benefits also include better communication between the designer and the operator, leading, *in turn, to higher operational efficiency.* L.T.

A85-27527
RADIO TECHNICAL COMMISSION FOR AERONAUTICS, ANNUAL ASSEMBLY MEETING AND TECHNICAL SYMPOSIUM, WASHINGTON, DC, NOVEMBER 15-17, 1983, PROCEEDINGS AND SUPPLEMENT
J. ALCORN, ED. (Radio Technical Commission for Aeronautics, Washington, DC) Washington, DC, Radio Technical Commission for Aeronautics, 1984. Proceedings, 196 p.; Supplement, 59 p. For individual items see A85-27528 to A85-27534.

Topics related to National Airspace System Plan implementation are discussed, taking into account evolving technology aircraft and their relationship to the National Airspace System Plan and its evolution, future communications/navigation/surveillance requirements for Department of Defense air transport operations, questions regarding the capabilities and needs of aircraft in 2005, and the need for continuing community involvement in the plan implementation. Other subjects explored are related to an aviation communications system modernization plan, surveillance and weather systems, and the economics of space systems for aviation. *Attention is given to helicopter operational requirements involving* communications issues, the plan for an integrated FAA surveillance and weather system, data link applications for surveillance and weather, the development of a terminal sensor for hazardous weather and wake turbulence detection, and weather information in the USSR ATC systems. G.R.

A85-27534*# National Aeronautics and Space Administration, Washington, D. C.
WHAT WILL AIRCRAFT CAPABILITIES AND NEEDS REALLY BE IN 2005?
J. M. BEGGS (NASA, Washington, DC) IN: Radio Technical Commission for Aeronautics, Annual Assembly, Meeting and Technical Symposium, Washington, DC, November 15-17, 1983, Supplement . Washington, DC, Radio Technical Commission for Aeronautics, 1984, p. 13, 15-19.

Developments related to the U.S. aviation industry during the first 25 years of NASA's existence are briefly examined and the current status of the industry is evaluated. It is found that advances in the past were accomplished generally as a large number of relatively small improvements in the technologies rather than as a single revolutionary change. However, it is felt, that emerging technology in the future has the potential for providing just such a revolutionary jump in the efficiency and productivity of air transportation. New technologies are projected to result in aircraft which can generate in excess of 200 seat-miles per gallon of fuel. A new generation of supersonic transports can show large gains in range and payload capability with a tripling of productivity over subsonic aircraft. Aircraft with the considered advanced capabilities, if available by the year 2005, will provide the kind of revolution which resulted from the introduction of the first jet transport. G.R.

A85-27600
USE OF STRUCTURAL ADHESIVES IN AIRCRAFT TURBINE ENGINE NACELLES
E. C. MILLARD (Rohr Industries, Inc., Riverside, CA) (Plastics and Rubber Institute, International Adhesion Conference, Nottingham, England, Sept. 12-14, 1984) International Journal of Adhesion and Adhesives (ISSN 0143-7496), vol. 4, Oct. 1984, p. 171-174.

The modern aircraft turbine nacelle and thrust reverser provide comprehensive and novel uses for a variety of structural adhesives. The varying uses of adhesive systems in both sandwich and non-sandwich forms are described, together with surface preparation techniques. Use of bonded sandwich structures designed to absorb engine-generated noise is discussed, together with the performance requirements for these adhesives in the nacelle environment. Author

A85-27603
AIRCREW AND AUTOMATION
B. J. CALVERT (Royal Institute of Navigation, London, England) Journal of Navigation (ISSN 0020-3009), vol. 38, Jan. 1985, p. 1-18. refs

The growing influence of automation on the navigational tasks of aircraft pilots is discussed from a historical perspective. Consideration is given to the major technical achievements in the field of aircraft navigation, including the gyroscopic stabilizer, magnetic compass, and the first autopilot. Particular progress is noted in the development of integrated flight monitor and control systems over the last few decades. Among the specific modern advances discussed are: single channel autopilots; Doppler navigation systems; analog computer systems in navigational applications; and interactive flight management systems. Several photographs of the devices are provided. I.H.

A85-27718#
THE EFFICIENCY OF AN AGRICULTURAL AIRPLANE AS A FUNCTION OF THE COVERAGE AND TRANSVERSE DISTRIBUTION OF THE CHEMICALS [WYDAJNOSC ROLNICZEGO STATKU POWIETRZNEGO A SZEROKOSC ROBOCZA I CIAGLOSC ROZKLADU POPRZECZNEGO SRODKOW CHEMICZNYCH]
R. OLSZOWKA (Osrodek Badawczo-Rozwojowy Sprzetu Komunikacyjnego, Mielec, Poland) Technika Lotnicza i Astronautyczna (ISSN 0040-1145), vol. 39, Feb. 1984, p. 21-23. In Polish.

A85-27720#
AN ASSESSMENT OF THE EFFECT OF THE USE OF CONVENTIONAL WEAPONS ON THE OPERATION OF A JET ENGINE [OCENA WPLYWU UZYCIA UZBROJENIA LUFOWEGO NA PRACE SILNIKA ODRZUTOWEGO]
A. ADAMOWICZ (Instytut Techniczny Wojsk Lotniczych, Warsaw, Poland) Technika Lotnicza i Astronautyczna (ISSN 0040-1145), vol. 39, June 1984, p. 10, 11. In Polish.

A model is presented which describes air flow in front of the barrel of a conventional aircraft gun formed as a result of the interaction between the translational motion of the aircraft and the flow of gun powder gases issuing from the barrel. The model makes it possible to determine the region of vorticity ahead of the air intake of the engine. Results are presented in graphical form. V.L.

A85-28632
FLIGHT TESTING TODAY: INNOVATIVE MANAGEMENT AND TECHNOLOGY; PROCEEDINGS OF THE FOURTEENTH ANNUAL SYMPOSIUM, NEWPORT BEACH, CA, AUGUST 15-19, 1983
Symposium sponsored by the Society of Flight Test Engineers. Lancaster, CA, Society of Flight Test Engineers, 1983, 231 p. For individual items see A85-28633 to A85-28658.

In a discussion of subjects related to management, attention is given to the training and development of engineers at the Air Force Flight Test Center, automation and flight test engineering, the use of engineering simulation to support aircraft flight testing at the U.S. Air Force Flight Test Center, the unique management experience obtained in connection with the flight testing of the digital electronic engine control concept, the automated KC-135R test program, and ground support facilities as an approach to effective avionics flight testing. Other topics explored are related to test results, test methods, data reduction and analysis, and instrumentation and data acquisition. The flight test and evaluation of the A-10 is considered along with the Model 2100 emergency egresss system, natural icing flight tests, the use of oil for in-flight flow visualization, community noise testing, fighter aircraft dynamic performance, the microcomputer in flight test data reduction, takeoff performance data using onboard instrumentation, and a digital pressure transducer. G.R.

A85-28658
IMPACT OF CAD/CAM ON MODIFICATION OF FLIGHT TEST VEHICLES
P. P. PANZARELLA (USAF, Aeronautical Systems Div., Wright-Patterson AFB, OH) IN: Flight testing today: Innovative management and technology; Proceedings of the Fourteenth Annual Symposium, Newport Beach, CA, August 15-19, 1983 . Lancaster, CA, Society of Flight Test Engineers, 1983, p. 6.6-1 to 6.6-7.

A survey and analysis were made of an aircraft modification/prototype fabrication and installation organization to see if available Computer Integrated Engineering and Manufacturing (CIEM) techniques could reduce aircraft modification costs. The result of the study indicated the Computer Aided Design (CAD) and Computer Aided Manufacturing (CAM) technologies were available to decrease these costs. A 7 million-dollar modernization program was entered into and resulted in a reduction in overall modification cost of approximately 20 percent. Productivity of between 1.5:1 and 1.7:1 for the CAD element of the CIEM system and aproximately 6.5:1 for the CAM element of the CIEM system was demonstrated. Reductions in modification times, as well as such ancillary benefits such as higher quality documentation packages and easier transitions from prototype engineering and manufacturing to production engineering and manufacturing documentation packages, can be obtained through use of this technology. System payback was found to occur between thirty-nine and forty-two months. Author

A85-28824
BOEING'S AIRLINER LAUNCH CRITERIA
C. BIRKETT Flight International (ISSN 0015-3710), vol. 127, March 9, 1985, p. 30-32.

High R&D costs, market slump and the need for flexibility in any base design for a new aircraft are the factors which presently govern the development of new aircraft by manufacturers. The DC-9 baseline design, e.g., accommodates four fuselage stretches, wing and cockpit variants, and engines of different thrusts. The 767, 737, 737-300 and 747 are also adaptable. New starts are not made until a market is assured, keeping in mind that airlines in a deregulated industry have difficulty planning for fleet mixes more than 5 yr ahead. One result has been a high degree of standardization for interior furnishings. Another tactical mode of action now followed is to wait until one manufacturer develops a new aircraft which opens a new market, then produce a better aircraft which incorporates technological improvements to capitalize on the need for increased efficiencies in the new market. M.S.K.

A85-28825
MAN POWERED FLIGHT ADVANCES
R. MOULTON Flight International (ISSN 0015-3710), vol. 127, March 16, 1985, p. 22-26.

Design and performance improvements in man-powered flight are being focused around the Kremer competitions in the U.K. Wide sweep, ultralight materials and direct connection manual controls were devised for the Gossamer Condor and Solar Challenger flights across the English Channel and a figure-8 flight over a short course. The competition now concentrates around the rapidity with which the figure-8 course can be flown. New rules have allowed some on-board energy storage, which has encouraged installation of electric propeller motors, batteries and solar cells. The stored energy is used after attainment of the maximum flight speed, which has been pushed to 24 mph. The frequency of accidents has climbed with the flight speed. The Musculair vehicle, built in 12 weeks, is fully cantilevered, has a 16 percent thickness composite structure, and features a 1:3.8 glide ratio, similar to soaring aircraft. It flies with no energy storage equipment. M.S.K.

A85-29854
AERONAUTICAL APPLICATIONS OF ADHESIVE BONDING [LES APPLICATIONS AERONAUTIQUES DU COLLAGE]
G. BRIENS (Aerospatiale, Direction de la Qualite, Paris, France) Materiaux et Techniques (ISSN 0032-6895), vol. 72, June-July 1984, p. 239-246. In French.

The history and technology of the use of glued structures in aircraft and spacecraft are surveyed and illustrated with drawings, diagrams, and photographs, with a focus on European developments. Currently available adhesives are classified in terms of physical characteristics, chemical nature, application range, hardening temperature, and service life; the principal application types are desribed (sandwich constructions, panel stiffening, and thickness reenforcement); the advantages, limitations, and failure modes of bonded joints are listed; the problems posed by water penetration and corrosion at the metal-adhesive interface during long-term service are discussed; and trends in current applications are indicated. Consideration is given to the extreme demands placed on adhesives used in space structures (mass loss of 1 percent or less after 24 h at 125 C and 1 microtorr), techniques for bonding with 150-g/sq m films, and anodic oxidation procedures. T.K.

N85-19921* National Aeronautics and Space Administration, Washington, D. C.
HIGH ROAD TO CHINA
B. POANICS Jan. 1984 115 p
(PR-1) Avail: NTIS HC A06/MF A01 CSCL 01A

This bibliography lists 409 reports, articles and other documents introduced into the NASA scientific and technical information system in December 1983. Author

N85-19922# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ACTA AERONAUTICA ET ASTRONAUTIC SINICA (SELECTED ARTICLES)
C. LIU, H. GAO, and Q. X. GONG 27 Nov. 1984 42 p Transl. into ENGLISH from Hangkong Xuebao (China), v. 5, no. 1, 1984 p 11-29
(AD-A148830; FTD-ID(RS)T-1150-84) Avail: NTIS HC A03/MF A01 CSCL 20D

An analysis of various vibrational modes affecting the control and performance of fixed wing military combat aircraft was made. Among those topics considered were: (1) the state time spectrum of aircraft ambient vibration; (2) the longitudinal feedback coefficients of a stability augmentation system designed to meet the requirements of riding quality; and (3) aircraft lateral directional limit cycle oscillations induced by aerodynamic hysteresis. Mathematical modeling methods were used to formulate analytical equations and solutions suitable for these applications. G.L.C.

N85-21103# Transportation Systems Center, Cambridge, Mass.
GENERAL AVIATION ACTIVITY AND AVIONICS SURVEY Annual Summary Report, for CY 1983
J. C. SCHWENK Oct. 1984 229 p
(AD-A149572; DOT-TSC-FAA-84-3; FAA-MS-84-5) Avail: NTIS HC A11/MF A01 CSCL 01C

This report presents the results and a description of the 1983 General Aviation Activity and Avionics Survey. The survey was conducted during 1984 by the FAA to obtain information on the activity and avionics of the United States registered general aviation aircraft fleet, the dominant component of civil aviation in the U.S. The survey was based on a statistically selected sample of about 10.7 percent of the general aviation fleet and obtained a response rate of 62 percent. Survey results are based upon responses but are expanded upward to represent the total population. Survey results revealed that during 1983 an estimated 35.2 million hours of flying time were logged by the 213,293 active general aviation aircraft in the U.S. fleet, yielding a mean annual flight time per aircraft of 164 hours. The active aircraft represented about 82 percent of the registered general aviation fleet. The report contains breakdowns of these and other statistics by manufacturer/model group, aircraft type, state and region of based aircraft, and primary use. Also included are fuel consumption, lifetime airframe hours, avionics, and engine hours estimates. In addition, tables are included for detailed analysis of the avionics capabilities of the GA fleet. Estimates of general aviation miles flown in 1983 have been included for the first time, broken down by aircraft type. Author (GRA)

N85-21104# Air Force Academy, Colo.
AIR FORCE ACADEMY AERONAUTICS DIGEST Final Report
J. DEJONGH, W. HEISER, and M. HALE Sep. 1984 144 p
(AD-A149614; USAFA-TR-84-7) Avail: NTIS HC A07/MF A01 CSCL 01C

This Digest covers unclassified research in aeronautics performed by individuals assigned to or associated with the United States Air Force Academy. This report includes technical papers in the specific areas of aerodynamics, propulsion, instrumentation, and engineering education. GRA

N85-21105# Joint Publications Research Service, Arlington, Va.
TRANSPORTATION
27 Feb. 1985 104 p Transl. into ENGLISH from various Russian articles
(JPRS-UTR-85-004) Avail: NTIS HC A06

This U.S.S.R. report contains research in the area of transportation. Quality control measures in civil aviation plants are investigated. The advantages of flight simulators as compared to conventional flight training methods are cited. The construction of airport facilities in Tenkeli are reported. The development and current applications of airships in the U.S.S.R. are discussed.

N85-21106# Joint Publications Research Service, Arlington, Va.
AVIATION REPAIR PLANT DIRECTORS ON QUALITY CONTROL MEASURES
In USSR Rept.: Transportation (JPRS-UTR-85-004) p 1-4 27 Feb. 1985 Transl. into ENGLISH from Vozdushnyy Transport (Moscow), 29 Dec. 1984 and 3 Jan. 1985
Avail: NTIS HC A06

Responses to an editorial concerning the quality of aircraft maintenance in he U.S.S.R. are reported. Special plans and measures are developed in connection with the problems raised in the article. New reserves which make it possible to improve the quality of maintenance work are also introduced. Technical control measures are investigated. B.W.

02

AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

A85-26494
GASDYNAMIC MODEL AND SIMILARITY RELATIONS FOR THE STARTING PROCESS IN SUPERSONIC NOZZLES AND JETS
S. F. CHEKMAREV and N. V. STANKUS (Akademiia Nauk SSSR, Institut Teplofiziki, Novosibirsk, USSR) (Zhurnal Tekhnicheskoi Fiziki, vol. 54, Aug. 1984, p. 1576-1583) Soviet Physics - Technical Physics (ISSN 0038-5662), vol. 29, Aug. 1984, p. 920-925. Translation. refs

Starting processes in highly underexpanded jets and flows in hypersonic nozzles with flat walls are analyzed for a case of an instantaneous initiation of a numerically modeled radial source. The gases under consideration are argon, nitrogen, and CO2 streams emerging into argon-filled and nitrogen-filled vessels. The model, together with experimental data available, reveals that for a fixed pair of gases the motion of strong discontinuity surfaces is self-similar in the defining parameters B and the ratio of the heat capacities of the outflowing and ambient gases, which simplifies the calculation of nozzle start-up times. It is also found that under typical experimental conditions vibrational relaxation has

little influence on the motion of strong discontinuity surfaces and the duration of the starting process. L.T.

A85-26690
A SPECIAL BOUNDARY ELEMENT TECHNIQUE IN TRANSONIC FLOW
Z. YANG (Nanjing Aeronautical Institute, Nanjing, People's Republic of China) IN: Boundary elements; Proceedings of the Fifth International Conference, Hiroshima, Japan, November 8-11, 1983 Berlin, Springer-Verlag GmbH, 1983, p. 293-300.

The boundary-element method of Brebbia (1978) is adapted to investigate the nonlinear transonic flow around a three-dimensional wing, treating both the full inviscid velocity-potential equation and the transonic small-perturbation velocity-potential equation by means of a weighted residual formulation. An artificial viscosity term is introduced to assure shock irreversibility, solution stability, and convergence in the supercritical wing, and the finite-element discretization of Yang (1982) is used in the reduction of the boundary-integral equations to a system of linear algebraic equations. Numerical results for several sample problems are presented graphically and shown to be in good agreement (with considerable gains in simplicity and computing time) with those obtained using finite-element or finite-difference methods. T.K.

A85-26699
A FULL NAVIER-STOKES SOLUTION OF VISCOUS GAS FLOW THROUGH PROFILE CASCADE ON S1 STREAM SURFACE OF REVOLUTION EMPLOYING NONORTHOGONAL CURVILINEAR COORDINATE SYSTEM
N. CHEN and F. ZHANG (Chinese Academy of Sciences, Institute of Engineering Thermophysics, Beijing, People's Republic of China) Scientia Sinica, Series A - Mathematical, Physical and Technical Sciences (ISSN 0253-5831), vol. 27, Oct. 1984, p. 1112-1120. refs

A numerical calculation method is developed on the basis of the stream function equation, energy equation, entropy equation, and formulas for estimating viscous force, work done by viscous force, dissipation function, and heat-transfer term. Computations of viscous gas flow through a channel between two parallel plates, and turbine and compressor cascades have been carried out to examine this method. The calculated results show that the present method can be used to obtain a numerical solution of the full Navier-Stokes equations. Author

A85-26751#
TESTS OF WALL SUCTION AND BLOWING IN HIGHLY OFFSET DIFFUSERS
W. H. BALL (Boeing Military Airplane Co., Seattle, WA) Journal of Aircraft (ISSN 0021-8669), vol. 22, March 1985, p. 161-167. Previously cited in issue 16, p. 2297, Accession no. A83-36922.

A85-26752#
EXPERIMENTAL DEFINITION OF NONAXISYMMETRIC EXHAUST NOZZLE PLUMES
M. COMPTON and D. BOWERS (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) Journal of Aircraft (ISSN 0021-8669), vol. 22, March 1985, p. 168-174. Previously cited in issue 16, p. 2297, Accession no. A83-36924. refs

A85-26753#
ROTATING STALL CELLS IN A LOW-SPEED AXIAL FLOW COMPRESSOR
F. A. E. BREUGELMANS, K. MATHIOUDAKIS (Institut von Karman de Dynamique des Fluides, Rhode-Saint-Genese, Belgium), and F. CASALINI (Bari, Universita, Bari, Italy) (International Symposium on Air Breathing Engines, 6th, Paris, France, June 6-10, 1983, Symposium Papers, p. 632-642) Journal of Aircraft (ISSN 0021-8669), vol. 22, March 1985, p. 175-181. Previously cited in issue 16, p. 2292, Accession no. A83-35874. refs

A85-26756*# Informatics General Corp., Palo Alto, Calif.
EFFICIENT ALGORITHM FOR UNSTEADY TRANSONIC AERODYNAMICS OF LOW-ASPECT-RATIO WINGS
G. P. GURUSWAMY (Informatics General Corp., Palo Alto, CA) and P. M. GOORJIAN (NASA, Ames Research Center, Moffett Field, CA) (Structures, Structural Dynamics and Materials Conference, 25th, Palm Springs, CA, May 14-16, 1984, and AIAA Dynamics Specialists Conference, Palm Springs, CA, May 17, 18, 1984, Technical Papers. Part 2, p. 17-26) Journal of Aircraft (ISSN 0021-8669), vol. 22, March 1985, p. 193-199. Previously cited in issue 13, p. 1832, Accession no. A84-31686. refs

A85-26758#
A COMPARISON OF SEPARATED FLOW AIRFOIL ANALYSIS METHODS
J. D. BLASCOVICH (Grumman Aerospace Corp., Bethpage, NY) Journal of Aircraft (ISSN 0021-8669), vol. 22, March 1985, p. 208-215. Previously cited in issue 06, p. 702, Accession no. A84-17845. refs

A85-26760#
SUBSONIC WING ROCK OF SLENDER DELTA WINGS
P. KONSTADINOPOULOS, D. T. MOOK, and A. H. NAYFEH (Virginia Polytechnic Institute and State University, Blacksburg, VA) Journal of Aircraft (ISSN 0021-8669), vol. 22, March 1985, p. 223-228. Previously cited in issue 07, p. 840, Accession no. A85-19582. refs
(Contract N00014-75-C-0381; NR PROJECT 061-201)

A85-26762*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THE EFFECTS OF GUSTS ON THE FLUCTUATING AIRLOADS OF AIRFOILS IN TRANSONIC FLOW
W. J. MCCROSKEY (NASA, Ames Research Center; U.S. Army, Aeromechanics Laboratory, Moffett Field, CA) Journal of Aircraft (ISSN 0021-8669), vol. 22, March 1985, p. 236-243. Previously cited in issue 18, p. 2569, Accession no. A84-39315. refs

A85-26765#
NONPLANAR DOUBLET LATTICES
K. L. ROGER (Boeing Military Airplane Co., Wichita, KS) Journal of Aircraft (ISSN 0021-8669), vol. 22, March 1985, p. 256.

The present nonplanar formulation of the unsteady lifting surface solutions which are commonly obtained as influence matrices relating a lattice of forces to one of normal washes is compatible with assumed loadings other than the point doublet. The lattice elements obtained are 'smeared' in a manner that is intermediate between a point doublet and a true integration, but always become exactly integrated in the coplanar limit. O.C.

A85-26916* California Univ., Los Angeles.
ENTROPY CONDITION SATISFYING APPROXIMATIONS FOR THE FULL POTENTIAL EQUATION OF TRANSONIC FLOW
S. OSHER, M. HAFEZ, and W. WHITLOW, JR. (NASA, Langley Research Center, Hampton, VA; California, University, Los Angeles, CA) Mathematics of Computation (ISSN 0025-5718), vol. 44, Jan. 1985, p. 1-29. Previously announced in STAR as N84-20485. refs
(Contract NAG1-273; NSF MCS-82-00788; DAAG29-82-K-0090)

A class of conservative difference approximations for the steady full potential equation was presented. They are, in general, easier to program than the usual density biasing algorithms, and in fact, differ only slightly from them. Rigorous proof indicated that these new schemes satisfied a new discrete entropy inequality, which ruled out expansion shocks, and that they have sharp, steady, discrete shocks. A key tool in the analysis is the construction of a new entropy inequality for the full potential equation itself. Results of some numerical experiments using the new schemes are presented: Author

A85-26920
THE ADDITION OF QUASI-THREE-DIMENSIONAL TERMS INTO A FINITE ELEMENT METHOD FOR TRANSONIC TURBOMACHINERY BLADE-TO-BLADE FLOWS
R. D. CEDAR and P. STOW (Rolls-Royce, Ltd., Derby, England) International Journal for Numerical Methods in Fluids (ISSN 0271-2091), vol. 5, Feb. 1985, p. 101-114. refs

This paper describes the extension of a purely two-dimensional finite element method for the calculation of transonic turbomachinery blade-to-blade flows to include the quasi-three-dimensional terms. These terms account for the effect of variations in streamline radius, stream-tube height and blade rotation. By approximating the stream surface as a piecewise linear function, then using a local developed cone transformation on an element basis, the finite element equations are shown to remain of the same form as the two-dimensional equations. The numerical results presented demonstrate that the stream-tube height, streamline radius and blade rotation terms must be included if the prediction of the Mach number distribution around a gas turbine blade is to be calculated correctly. Author

A85-26921
A FINITE ELEMENT METHOD FOR THE SOLUTION OF TWO-DIMENSIONAL TRANSONIC FLOWS IN CASCADES
D. S. WHITEHEAD (Cambridge University, Cambridge, England) and S. G. NEWTON (Rolls-Royce, Ltd., Derby, England) International Journal for Numerical Methods in Fluids (ISSN 0271-2091), vol. 5, Feb. 1985, p. 115-132. refs

Steady two-dimensional transonic flow is calculated in cascades of compressor and turbine blades using a mesh of triangular finite elements. A velocity potential is used, the equations being solved by the Newton-Raphson technique. The resulting computer program is fast, and is shown to give good accuracy. Shock waves are well represented, provided they are not too strong. Author

A85-27090#
COMPUTATIONAL DESIGN AND VALIDATION TESTS OF ADVANCED CONCEPT SUBSONIC INLETS
T. J. BARBER (United Technologies Research Center, East Hartford, CT), D. C. IVES, D. P. NELSON, and R. MILLER (United Technologies Corp., Pratt and Whitney Group, East Hartford, CT) Journal of Propulsion and Power (ISSN 0748-4658), vol. 1, Mar.-Apr. 1985, p. 97-102. Previously cited in issue 16, p. 2277, Accession no. A84-35173. refs

A85-27091*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
TWO-DIMENSIONAL VISCOUS SIMULATION OF INLET/DIFFUSER FLOWS WITH TERMINAL SHOCKS
N. A. TALCOTT, JR. and A. KUMAR (NASA, Langley Research Center, High-Speed Aerodynamics Div., Hampton, VA) Journal of Propulsion and Power (ISSN 0748-4658), vol. 1, Mar.-Apr. 1985, p. 103-108. Previously cited in issue 16, p. 2278, Accession no. A84-35192. refs

A85-27092#
EXPERIMENTAL STUDY OF FLOWS IN A TWO-DIMENSIONAL INLET MODEL
M. SAJBEN, T. J. BOGAR, and J. C. KROUTIL (McDonnell Douglas Research Laboratories, St. Louis, MO) Journal of Propulsion and Power (ISSN 0748-4658), vol. 1, Mar.-Apr. 1985, p. 109-117. Research sponsored by the McDonnell Douglas Independent Research and Development Program. Previously cited in issue 05, p. 581, Accession no. A83-16571. refs

A85-27093#
RESPONSE OF A SUPERSONIC INLET TO DOWNSTREAM PERTURBATIONS
T. J. BOGAR, M. SAJBEN, and J. C. KROUTIL (McDonnell Douglas Research Laboratories, St. Louis, MO) Journal of Propulsion and Power (ISSN 0748-4658), vol. 1, Mar.-Apr. 1985, p. 118-125. Previously cited in issue 16, p. 2296, Accession no. A83-36403. refs
(Contract N00014-80-C-0481)

A85-27348
NUMERICAL CALCULATION OF A LAMINAR TWO DIMENSIONAL STRAIGHT CASCADE FLOW
M. ROSENFELD and M. WOLFSHTEIN (Technion - Israel Institute of Technology, Haifa, Israel) Computers and Fluids (ISSN 0045-7930), vol. 12, no. 4, 1984, p. 293-310. refs

The laminar and incompressible flow in a straight cascade is investigated. Numerical solutions of the full Navier-Stokes equations are obtained using the vorticity-stream function formulation and body fitted coordinate system. The numerical method includes a special force balance for the determination of the downstream boundary condition and a double sweep deferred correction which allows a second order accuracy but with the stability properties of an upwind first order scheme. Results for cylindrical, elliptical and NACA 0012 airfoils are presented including separated flow regions. Good agreement with experiments and previous computations is obtained. Author

A85-27825#
THE NUMERICAL ANALYSIS OF TRANSONIC FLOW AROUND A CIRCULAR AIRFOIL USING HYBRID DIFFERENCE SCHEME
Y.-Y. WANG and T. FUJIWARA (Nagoya University, Nagoya, Japan) Nagoya University, Faculty of Engineering, Memoirs (ISSN 0027-7657), vol. 36, May 1984, p. 68-78.

A 'hybrid' mixed difference computational scheme is applied to the numerical analysis of transonic flow around a circular airfoil. The thickness-to-chord ratio of the airfoil was 10 percent and the freestream Mach number was 0.83. The differencing scheme is based on a combination of the upwind differencing scheme of Beam et al. (1976) and the two-step second-order noncentered scheme developed by MacCormack (1976). Analysis of the calculations obtained with the hybrid scheme showed that they were accurate to within 0.001 for every flow variable. A diagram is given which describes the pressure distributions for the circular airfoil, on the basis of the hybrid calculations. I.H.

A85-27876*# State Univ. of New York, Oneonta.
HYBRID APPROACH TO STEADY TRANSONIC NORMAL SHOCK-COMPRESSIBLE LAMINAR BOUNDARY LAYER INTERACTIONS OVER AIRFOILS WITH SUCTION
R. B. RAM (New York, State University, Oneonta, NY), C. S. VEMURU (Old Dominion University, Norfolk, VA), and W. D. HARVEY (NASA, Langley Research Center, Airfoil Aerodynamics Branch, Hampton, VA) American Institute of Aeronautics and Astronautics, Shear Flow Control Conference, Boulder, CO, Mar. 12-14, 1985. 15 p. refs
(Contract NAG1-131)
(AIAA PAPER 85-0522)

Transonic airfoil flow is to a large degree affected by viscous-inviscid interactions. Among them a key role is played by the boundary layer interaction with the shock wave embedded in the flow field and the interaction of the boundary layer with the sustained adverse pressure gradients. The effects of these interactions can be controlled or suppressed by introducing surface mass transfer such as suction. This investigation deals strictly with the study of shock-laminar boundary layer interactions including distributed mass transfer. The present calculations agree with experiments on a swept LFC wing at low speeds which indicates that with a suitable choice of the extent of the airfoil surface over which suction is applied and adjustment of the suction velocity, full-chord laminar flow can be maintained and separation can be prevented completely. Author

A85-27877*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
CONTROL PLATE FOR SHOCK-BOUNDARY LAYER INTERACTION
W. L. GOODMAN, E. L. MORRISETTE, M. Y. HUSSAINI, and D. M. BUSHNELL (NASA, Langley Research Center, Hampton, VA) American Institute of Aeronautics and Astronautics, Shear Flow Control Conference, Boulder, CO, Mar. 12-14, 1985. 11 p. refs
(AIAA PAPER 85-0523)

Paper describes tests and computations for a relatively unique technique to greatly reduce/eliminate the separation region for shock-boundary layer interactions. A number of studies have shown that the usual effects of such interactions include increased local heating and wall pressures, thickening of the boundary layer and a decrease in the momentum of the flow and, for stronger waves, flow separation. This flow situation is particularly prevalent in supersonic and hypersonic inlets where severe performance degradation can occur due to flow separation. High performance engine design generally requires a uniform entering flow field with little stagnation pressure loss. Previous approaches to the problem involved primarily active devices (e.g., suction or blowing); the present paper considers a passive device. The boundary layer separation control technique considered herein involves the placement of an embedded plate in the outer portion of the boundary layer and parallel to the wall. This control plate is situated such that the incident shock impinges upon and reflects from its surface, thus greatly lessening the pressure gradient in the low momentum near wall region. Author

A85-27878#
UNSTEADY SURFACE PRESSURE MEASUREMENTS ON A PITCHING AIRFOIL
J. M. WALKER (USAF, Frank J. Seiler Research Laboratory, Colorado Springs, CO), H. E. HELIN (USAF, Frank J. Seiler Research Laboratory; U.S. Air Force Academy, Colorado Springs, CO), and D. C. CHOU (USAF, Frank J. Seiler Research Laboratory, Colorado Springs, CO; New Mexico, University, Albuqueque, NM) American Institute of Aeronautics and Astronautics, Shear Flow Control Conference, Boulder, CO, Mar. 12-14, 1985. 13 p. refs
(AIAA PAPER 85-0532)

Surface pressure measurements were taken in an experimental investigation of energetic dynamic stall vortices. The associated unsteady flowfield was generated by a 6-in. NACA 0015 airfoil pitching at high rates to large angles of attack. The airfoil pitch rates varied from 230 deg/sec to 1380 deg/sec, and angles of attack varied from 0 deg to 60 deg. Pitching occurred about its quarter-chord axis. Pitch rate, Reynolds number, and the nondimensional pitch rate, alpha(+), were varied to determine the effects on pressure and lift coefficients. It was found that increases in pitch rate and Reynolds number had inverse effects on the flowfield in the immediate vicinity of the airfoil. Maintenance of a constant nondimensional pitch rate produced very similar flowfields and pressure coefficients. Author

A85-27885#
A VISCOUS-INVISCID INTERACTION METHOD FOR COMPUTING UNSTEADY TRANSONIC SEPARATION
J. C. LE BALLEUR and P. GIRODROUX-LAVIGNE (ONERA, Chatillon-sous-Bagneux, Hauts-de-Seine, France) (Symposium on Numerical and Physical Aspects of Aerodynamic Flows, 3rd, California State University, Long Beach, CA, Jan. 20-24, 1985) ONERA, TP, no. 1985-5, 1985, 19 p. refs
(ONERA, TP NO. 1985-5)

A semi-implicit coupling algorithm is developed for simulating unsteady transonic separated flows featuring strong viscous-inviscid interaction. A two-parameter velocity profile is assumed and a two equation turbulence model for entrainment is solved by an implicit and space-marching integration technique. An interactive-marching relaxation method defines the semi-implicit coupling when applied to the viscous influence function of the boundary layer and to the inviscid parameters. The interaction converges at each time step and yields the full viscous upstream effects, including those in the supersonic regime. Sample results are presented for steady and unsteady flows over NLR 7301 and NACA 64 A010 airfoils, the latter experiencing shock-induced separation. M.S.K.

A85-27886#
X-MARCHING METHODS TO SOLVE THE NAVIER-STOKES EQUATIONS IN TWO- AND THREE-DIMENSIONAL FLOWS
J. COUSTEIX, X. DE SAINT-VICTOR, and R. HOUDEVILLE (ONERA, Centre d'Etudes et de Recherches de Toulouse, Toulouse, France) (Symposium on Numerical and Physical Aspects of Aerodynamic Flows, 3rd, California State University, Long Beach, CA, Jan. 20-24, 1985) ONERA, TP, no. 1985-6, 1985, 13 p. refs
(ONERA, TP NO. 1985-6)

The solution of the Navier-Stokes equations for studying aerodynamic problems is approached by using iterative X-marching methods. The main feature is to solve the equations by sweeping iteratively the calculation domain from upstream to downstream in the direction of the main flow. In this process, the pressure is relaxed. The paper discusses in particular the extension of the method to three-dimensional flow. Applications are given in laminar flow for two-dimensional configurations which involve separated zone and mixings of shear flows and for a three-dimensional case which is an idealized wing-body junction for which the flow is computed upstream and downstream of the trailing edge. Author

A85-27887#
TRANSITION CALCULATIONS IN THREE-DIMENSIONAL FLOWS
R. MICHEL, E. COUSTOLS, and D. ARNAL (ONERA, Centre d'Etudes et de Recherches de Toulouse, Toulouse, France) (Symposium on Numerical and Physical Aspects of Aerodynamic Flows, 3rd, California State University, Long Beach, CA, Jan. 20-24, 1985) ONERA, TP, no. 1985-7, 1985, 13 p. Sponsorship: Direction des Recherches, Etudes et Techniques. refs
(Contract DRET-84-002)
(ONERA, TP NO. 1985-7)

Results given by the laminar stability theory are used for elaborating transition criteria in three-dimensional flows. On swept wings, transition may occur through streamwise instability, cross-flow instability and leading edge contamination. A criterion is developed for each of these mechanisms and it is assumed that transition will occur when it is detected by one or another criterion. The computer code is completed with an 'intermittency method', which allows the transition region to be calculated. These techniques are applied to a parametric study of the effects of the angle of sweep on a given airfoil profile. Finally, a critical evaluation of the proposed criteria is performed. Author

A85-27891#
ROTOR WAKE MEASUREMENTS FOR A ROTOR IN FORWARD FLIGHT
A. DESOPPER (ONERA, Chatillon-sous-Bagneux, Hauts-de-Seine, France) (International Conference on Rotorcraft Basic Research, Research Triangle Park, NC, Feb. 19-21, 1985) ONERA, TP, no. 1985-12, 1985, 11 p. refs
(ONERA, TP NO. 1985-12)

In order to have a better knowledge of the flowfield around a helicopter blade in forward flight and to obtain data for comparison with new inflow models, laser measurements of the velocity components in the vicinity of the rotor disk and in the wake have been performed. Three-dimensional measurements can be performed with the laser Doppler velocimeter used in these experiments but most of the results shown were obtained in two-dimensional form, some in the backscattered mode and others in the forward scattered mode. The main experimental results obtained in different vertical planes of the advancing blade side for a three-blade rotor are presented. In particular the azimuthal evolutions of the tangential and vertical velocity components and the trajectory of the tip vortex in the vertical plane are studied. Author

A85-27892#
NUMERICAL CALCULATION OF ROTOR PERFORMANCES IN REAL FLIGHT CONFIGURATIONS
B. CANTALOUBE (ONERA, Chatillon-sous-Bagneux, Hauts-de-Seine, France) (International Conference on Rotorcraft Basic Research, Research Triangle Park, NC, Feb. 19-21, 1985) ONERA, TP, no. 1985-13, 1985, 8 p. refs
(ONERA, TP NO. 1985-13)

Rehbach's (1978) vortex particle method used for translating lifting surfaces has been extended to unsteady incompressible flows around interacting bodies in relative motion. For this purpose a time upwinding method has been implemented in order to minimize computational cost. The body surfaces are modeled with quadrangular panels over each of which a normal doublet intensity is kept constant. The free vortex domain is represented with a set of vortex carrying particles. As numerical examples, results obtained for a three-bladed rotor in hover are reviewed, along with results about an eight-bladed propeller interacting with an axisymmetric hub. A two-bladed rotor is considered in three flight configuration cases, without flapping, with flapping and with interaction between the flapping rotor and a fuselage, using a time upwinding method. The effects of the different configurations are compared. Author

A85-28209* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
IMPLICIT TOTAL VARIATION DIMINISHING (TVD) SCHEMES FOR STEADY-STATE CALCULATIONS
H. C. YEE, R. F. WARMING (NASA, Ames Research Center, Moffett Field, CA), and A. HARTEN (Tel Aviv University, Tel Aviv, Israel; New York University, New York, NY) Journal of Computational Physics (ISSN 0021-9991), vol. 57, Feb. 1985, p. 327-360. refs

The novel implicit and unconditionally stable, high resolution Total Variation Diminishing (TVD) scheme whose application to steady state calculations is presently examined is a member of a one-parameter family of implicit, second-order accurate systems developed by Harten (1983) for the computation of weak solutions for one-dimensional hyperbolic conservation laws. The scheme will not generate spurious oscillations for a nonlinear scalar equation and a constant coefficient system. Numerical experiments for a quasi-one-dimensional nozzle problem show that the experimentally determined stability limit correlates exactly with the theoretical stability limit for the nonlinear scalar hyberbolic conservation laws. O.C.

A85-28373
INCOMPRESSIBLE FLOW ROUND AN AIRFOIL IN A STRAIGHT-LINE CASCADE AND BETWEEN PARALLEL WALLS, WITH SOME PHENOMENA IN THE BOUNDARY LAYER TAKEN INTO CONSIDERATION [NIESCISLIWY OPLYW PROFILU UMIESZCZONEGO W PALISADZIE PROSTOLINIOWEJ ORAZ MIEDZY SCIANKAMI ROWNOLEGLYMI Z UWZGLEDNIENIEM NIEKTORYCH ZJAWISK ZACHODZACYCH W WARSTWIE PRZYSCIENNEJ]
J. STELLER Instytut Maszyn Przeplywowych, Prace (ISSN 0079-3205), no. 87, 1984, p. 3-23. In Polish. refs

The Jacob method for calculating velocity distributions for separated flow round finite systems of airfoils has been adapted for straight-line blade cascades. To this end, use was made directly of the theory of harmonic vector fields (Martensen and Sengbusch, 1960). An alternating blade cascade as appearing in the problem of flow round an airfoil between parallel walls was considered as a particular case. A number of semiempirical criteria used to define the long and short separation bubbles and the point of natural transition is presented. A flow chart of the calculation method is shown. The particulars of the respective numerical calculation units as well as the experimental verification of the algorithm is discussed separately. Author

A85-28380
GENERAL FEATURES CHARACTERIZING SEPARATED FLOWS ARISING IN SUPERSONIC AND HYPERSONIC FLOWS PAST BLUNT BODIES [NEKOTORYE OBSHCHIE ZAKONOMERNOSTI OTRYVNYKH TECHENII, VOZNIKAIUSHCHIKH PRI OBTEKANII ZATUPLENNYKH TEL SVERKH- I GIPERZVUKOVYMI POTOKAMI]
A. I. GLAGOLEV, A. I. ZUBKOV, and B. E. LIAGUSHIN IN: Problems of contemporary mechanics. Part 1 . Moscow, Izdatel'stvo Moskovskogo Universiteta, 1983, p. 74-82. In Russian. refs

Experimental results are presented concerning the formation of separated flows at the surfaces of blunt axisymmetric bodies with different geometries: at main-flow Mach numbers of 3-10. Four types of models were investigated; (1) conical models with a semiapex angle of 2-15 deg and with a spherical-segment tip; (2) cylindrical models with a spherical-segment tip; (3) segmented-conical models consisting of a combination of a spherical segment and a cone joined at their bases; and (4) a segmented-conical model consisting of a combination of an ellipsoid of revolution and an elliptical cone joined at their bases. Results indicate that the following types of flows arise on blunt axisymmetric bodies placed at angle of attack in supersonic flow; (1) unseparated flow; (2) flow with vortex-layer-type separation; (3) flow with separation in the form of a closed region of reverse flow; and (4) a combination of the latter two flows. An analysis of correlations shows a qualitatively similar dependence of maximum heat flux in the reattachment region on the Reynolds number. B.J.

A85-28382
VARIATIONAL PROBLEMS OF GAS DYNAMICS - FORMULATIONS, METHODS OF SOLUTION, AND THE RELATIONSHIP BETWEEN EXACT AND APPROXIMATE APPROACHES [VARIATSIONNYE ZADACHI GAZOVOI DINAMIKI, POSTANOVKI, METODY RESHENIIA, SOOTNOSHENIE TOCHNYKH I PRIBLIZHENNYKH PODKHODOV]
A. N. KRAIKO IN: Problems of contemporary mechanics. Part 1 . Moscow, Izdatel'stvo Moskovskogo Universiteta, 1983, p. 90-100. In Russian. refs

Consideration is given to the formulation and solution of variational problems of gas dynamics and aerodynamics; methods for the derivation of optimality conditions; and the design of optimal configurations. Particular attention is given to the problem of configuring the front part of a two-dimensional or axisymmetric minimum-drag body in supersonic flow and the divergent part of a maximum-thrust nozzle. The effectiveness and heuristic value of Chernyi's (1950) contour-variation approach are demonstrated on a number of examples. The suitability of combining exact approaches (based on the full equations of gas dynamics and the corresponding set of optimality conditions) and approximate methods is emphasized. B.J.

A85-28387
INVESTIGATION OF DRAG AND HEAT TRANSFER FOR NONUNIFORM SUPERSONIC FLOW PAST A BODY IN THE CASES OF LAMINAR AND TURBULENT REGIMES [ISSLEDOVANIE SOPROTIVLENIIA I TEPLOOBMENA TELA DLIA LAMINARNOGO I TURBULENTNOGO REZHIMOV TECHENIIA PRI NERAVNOMERNOM SVERKHZVUKOVOM OBTEKANII]
I. G. EREMEITSEV and N. N. PILIUGIN IN: Problems of contemporary mechanics. Part 2 . Moscow, Izdatel'stvo Moskovskogo Universiteta, 1983, p. 28-35. In Russian. refs

A theoretical analysis of the supersonic flow of a hot gas past an axisymmetric blunt body is presented. The local heat flux and shear stress on the surface of the body at large freestream Reynolds numbers (greater than 100,000) are determined on the basis of the local-similarity hypothesis using numerical and experimental results for laminar and turbulent flows in the boundary layer. The nonuniform gas flow past a spherically blunt body is considered as an example. Conditions under which a peak heat flux is achieved in turbulent flow are determined along with the

friction drag coefficient for laminar and turbulent flows in the boundary layer. B.J.

A85-28389
AERODYNAMIC CHARACTERISTICS AND FLOW PATTERNS FOR A NUMBER OF BLUFF BODIES IN SUBSONIC GAS FLOW [AERODINAMICHESKIE KHARAKTERISTIKI I OBTEKANIE NEKOTORYKH PLOKHOOBTEKAEMYKH TEL DOZVUKOVYM POTOKOM GAZA]
O. P. PEROV, G. S. ULIANOV, and M. P. FALUMIN IN: Problems of contemporary mechanics. Part 2 . Moscow, Izdatel'stvo Moskovskogo Universiteta, 1983, p. 54-70. In Russian. refs

Experimental results for subsonic flow past a number of porous and nonporous bluff bodies (disks, hemispheres, and stiff parachute models) in a wind tunnel are reported primarily in the form of visualizations of flow patterns. Flow velocity in the 0.2-0.8 Mach range is found to have significant effect of body drag, while the orientation of the bodies in the flow (in the range from -4 to +24 deg) is found to have a significant effect on the lift variation and to deform the flow pattern. The degree of porosity (W = 0-0.51) produces significant changes in the flow near the body and in the aerodynamic characteristics. B.J.

A85-28390
OPTIMAL AERODYNAMIC CONFIGURATIONS IN A TWISTED HYPERSONIC GAS FLOW [OPTIMAL'NYE AERODINAMICHESKIE FORMY V ZAKRUCHENNOM GIPERZVUKOVOM POTOKE GAZA]
N. A. OSTAPENKO IN: Problems of contemporary mechanics. Part 2 . Moscow, Izdatel'stvo Moskovskogo Universiteta, 1983, p. 71-80. In Russian.

The variational problem concerning a minimum-wave-drag body in a twisted hypersonic flow is formulated. It is shown that the solution of this problem is equivalent to the solution of a problem concerning a minimum-wave-drag body with a prescribed moment of forces with respect to its longitudinal axis and with an additional isoperimetric condition. The variational problem is solved for a class of bodies with similar transverse cross sections and a linear longitudinal contour. It is shown that the thrust coefficient of an optimal body in twisted hypersonic flow with a 'singular' transverse contour can be significantly high. B.J.

A85-28394
THEORY OF HYPERSONIC JETS [K TEORII GIPERZVUKOVYKH STRUI]
M. M. GILINSKII and L. I. ZAK IN: Problems of contemporary mechanics. Part 2 . Moscow, Izdatel'stvo Moskovskogo Universiteta, 1983, p. 104-111. In Russian. refs

Zak's (1960) analytical approach is extended to the study of flows in overexpanded and underexpanded hypersonic jets. Particular attention is given to the flow of a hypersonic gas jet into an oncoming supersonic flow, gas flow from a conical nozzle, and the flow of an underexpanded hypersonic jet into a supersonic wake flow. B.J.

A85-28396
AERODYNAMIC CHARACTERISTICS OF DELTA PLANES [AERODINAMICHESKIE KHARAKTERISTIKI DEL'TAPLANOV]
V. I. VORONIN and A. I. SHVETS IN: Problems of contemporary mechanics. Part 2 . Moscow, Izdatel'stvo Moskovskogo Universiteta, 1983, p. 128-132. In Russian. refs

Theoretical and experimental results are presented on the aerodynamic characteristics of triangular delta planes with sweep angles of 40, 50, and 60 deg. Experimental results were obtained in a supersonic wind tunnel at Mach numbers of 0.4, 0.6, and 0.8; and numerical results were obtained with the discrete-vortex method. An analysis was made of flow patterns near thin delta planes with flow separation from the leading edge on the basis of a method that satisfies the Chaplygin-Joukowski condition at the edges and makes it possible to calculate separated flow past wings of arbitrary planform in a wide range of angles of attack. Results are presented on head drag, lift coefficient, and lift-drag ratio. B.J.

A85-28441
CONICAL FLOWS NEAR EDGE BREAKS OF SURFACES DIVIDING THE SUPERSONIC WAKE FLOWS OF AN IDEAL GAS [KONICHESKIE TECHENIIA V OKRESTNOSTIAKH IZLOMOV KROMOK POVERKHNOSTEI, RAZDELIAIUSHCHIKH SPUTNYE SVERKHZVUKOVYE POTOKI IDEAL'NOGO GAZA]
A. N. KRAIKO and V. E. MAKAROV Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza (ISSN 0568-5281), Jan.-Feb. 1985, p. 119-127. In Russian. refs

A theoretical analysis is made of the conical flows which arise in the flow of an ideal gas past 'end' edges of surfaces with breaks separating the 'outer' and 'inner' flows with velocity vectors parallel to the intersection line of the surfaces. Such flows occur, for example, near breaks of the outlet edge of a nozzle of rectangular cross section with a straight or oblique section for certain regimes of the outflow of a supersonic jet into a supersonic wake flow. A linear analysis is used to construct flow patterns that correspond to different flow interaction regimes and edge geometric characteristics; and a similarity law is formulated. The validity of the results obtained in this way is confirmed by the numerical solution of the full nonlinear system of Euler equations. B.J.

A85-28442
SUPERSONIC FLOW PAST BLUNT POROUS SCREENS [SVERKHSVUKOVOE OBTEKANIE ZATUPLENNYKH PERFORIROVANNYKH EKRANOV]
S. V. GUVERNIUK, K. G. SAVINOV, and G. S. ULIANOV Akademiia Nauk SSSR, Isvestiia, Mekhanika Zhidkosti i Gaza (ISSN 0568-5281), Jan.-Feb. 1985, p. 143-149. In Russian. refs

Experimental results are presented on flow past thin porous metallic disks and square plates at high angles of attack (75-90 deg), Mach numbers of 2.0-3.0, and Reynolds numbers of (2-4) x 10 to the 6th in a supersonic wind tunnel. The features characterizing flow past such screens are found to be determined by intense self-sustaining gas injection into the base region. The dependence of the aerodynamic characteristics on the porosity coefficient of the screen is studied for a freestream Mach number of 3. B.J.

A85-28443
INVESTIGATION OF THE INDUCTION OF SUBSONIC WIND TUNNELS WITH AN AXISYMMETRIC WORKING PART [ISSLEDOVANIE INDUKTSII DOZVUKOVYKH AERODINAMICHESKIKH TRUB S OSESIMMETRICHNOI RABOCHEI CHAST'IU]
O. IU. STARIKOV Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza (ISSN 0568-5281), Jan.-Feb. 1985, p. 150-154. In Russian. refs

The axisymmetric boundary value problem concerning subsonic flow past a thin body of revolution within porous walls is solved for small velocity perturbations at the flow boundary in a subsonic wind tunnel. The boundary condition connects the tangential and normal (to the wall) components of the perturbed velocity, and has a general form for the whole boundary. The optimal wall porosity for which the distortion of the pressure coefficient on the model surface is minimal compared with unbounded flow is determined from the solution obtained. B.J.

A85-28445
FLOW PAST V-WINGS WITH A BREAK IN THE LEADING EDGE [OBTEKANIE LAMBDA-KRYL'EV S IZLOMOM PEREDNEI KROMKI]
A. I. SHVETS Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza (ISSN 0568-5281), Jan.-Feb. 1985, p. 171-175. In Russian. refs

Published theoretical and experimental results on V-shaped wings of triangular shape consisting of plane surfaces and on V-wings with a break in the leading edge are reviewed. Attention is given to calculations of the lift-drag ratio of a triangular V-wing consisting of plane surfaces on the basis of oblique-shock equations' and experimental data of pressure-distribution

measurements and balance tests. Results indicate that the V-wing has a higher lift-drag ratio than a triangular plane wing. B.J.

A85-28465
A COMPUTER SIMULATION OF SEPARATED FLOW PAST A ROTATING CYLINDER AND THE MAGNUS FORCE REVERSAL [MODELIROVANIE NA EVM OTRYVNOGO OBTEKANIIA VRASHCHAIUSHCHEGOSIA TSILINDRA I REVERSA SILY MAGNUSA]
S. M. BELOTSERKOVSKII, V. N. KOTOVSKII, M. I. NISHT, and R. M. FEDOROV Inzhenerno-Fizicheskii Zhurnal (ISSN 0021-0285), vol. 48, Feb. 1985, p. 244-250. In Russian. refs

A mathematical model describing unsteady separated flow past a rotating cylinder is developed on the basis of the synthesis of the discrete vortex method in boundary layer theory. Results of numerical studies of unsteady separated flow past a smooth cylinder are presented for a specified Reynolds number and various rotation velocities. It is shown that the lifting force acting on the cylinder increases with the rotation velocity (the Magnus effect). However, a reversal of the lifting force can occur under certain flow conditions. V.L.

A85-28466
AN ANALYSIS OF THE RESISTANCE OF TWO DISKS IN TURBULENT FLOW OF AN INCOMPRESSIBLE FLUID [RASCHET SOPTOTIVLENIIA DVUKH DISKOV V TURBULENTNOM POTOKE NESZHIMAEMOI ZHIDKOSTI]
S. A. ISAEV (Leningradskii Mekhanicheskii Institut, Leningrad, USSR) Inzhenerno-Fizicheskii Zhurnal (ISSN 0021-0285), vol. 48, Feb. 1985, p. 251-256. In Russian. refs

The resistance of two disks in developed turbulent flow is analyzed by using an integrointerpolation scheme of the first order of approximation for solving Reynolds equations and a two-parameter turbulence model. It is shown that the lower resistance of two disks in comparison with the single-disk case is due to the formation of a low-pressure zone between the disks. An increase in the radius of the first disk leads to a decrease in pressure between the disks to a value that is a factor of 1.5 less than pressure behind a single disk. The results obtained are found to agree with experimental data to within 5 percent. V.L.

A85-28899*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FEEDBACK IN SEPARATED FLOWS OVER SYMMETRIC AIRFOILS
H. M. ATASSI (NASA, Lewis Research Center, Cleveland, OH; Notre Dame, University, Notre Dame, IN) American Institute of Aeronautics and Astronautics and NASA, Aeroacoustics Conference, 9th, Williamsburg, VA, Oct. 15-17, 1984. 14 p. NASA-USAF-supported research. Previously announced in STAR as N84-31091. refs
(AIAA PAPER 84-2297)

For a flow over an airfoil with laminar separation, a feedback cycle may exist whereby a Kelvin-Helmholtz instability wave emanating from the separation point on the airfoil surface grows along the shear layer and is diffracted as it interacts with the sharp trailing edge of the airfoil, causing acoustic radiation which , in turn, propagates upstream and regenerates the initial instability wave. The analysis is restricted to the high frequency limit. Solutions to the boundary-value problem are obtained using the slowly varying approximation and the method of matched asymptotic expansions. Resonant solutions exist for certain discrete values of the Reynolds and Strouhal numbers. The results are discussed and compared with available data. Author

A85-29004
CAVITATION MODELS OF SEPARATED FLOW OF A LOW-VISCOSITY FLUID PAST WING PROFILES [KAVITATSIONNYE MODELI OTRYVNOGO OBTEKANIIA KRYLOVYKH PROFILEI MALOVIAZKOI ZHIDKOST'IU]
G. IU. STEPANOV (Moskovskii Gosudarstvennyi Universitet, Moscow; Voennaia Akademiia Bronetankovykh Voisk, USSR) IN: Selected problems in contemporary mechanics. Part II . Moscow, Izdatel'stvo Moskovskogo Universiteta, 1982, p. 76-86. In Russian. refs

Separated flows can be calculated, in principle, on the basis of the global asymptotic theory of laminar flows for Re tending to infinity and of the theory of separated turbulent flow using semiempirical models of turbulent friction and local separation. Such an analysis, however, involves considerable difficulties and has been implemented so far only for the simplest cases. Here, the possibility of using simpler jet (cavitation) schemes for the approximate description of separated flows without a detailed analysis of the boundary layer, separation and reconnection regions, and of the wake is examined. A simple refined version of the Tulin-Terentev scheme is proposed. V.L.

A85-29047
A COMPARISON OF DIFFERENT CALCULATION METHODS FOR AXISYMMETRIC FIELDS IN CONVERGENT-DIVERGENT NOZZLES
I. TEIPEL and A. WIEDERMANN (Hannover, Universitaet, Hanover, West Germany) Zeitschrift fuer Flugwissenschaften und Weltraumforschung (ISSN 0342-068X), vol. 9, Jan.-Feb. 1985, p. 29-33. refs

It is pointed out that the two-dimensional flow field in a convergent-divergent nozzle depends very strongly on the geometry in the vicinity of the throat. The present investigation is concerned with the problems involved in obtaining reliable information regarding the pressure distribution and the mass flux. The main problem arising in connection with the numerical treatment of steady transonic flow fields is related to the different behavior of the governing equations in the subsonic and supersonic regimes. Attention is given to a numerical technique for the computation of the flow field, three different analytical techniques for the calculation of the inviscid flow in convergent-divergent nozzles, and the results obtained with the aid of the considered analytical and numerical procedures. It is found that methods using series expansions for the flow variables are capable to provide useful information within certain limits. G.R.

A85-29076*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
VISCID/INVISCID INTERACTION ANALYSIS OF SEPARATED TRAILING-EDGE FLOWS
V. N. VATSA (NASA, Langley Research Center, Hampton, VA; United Technologies Research Center, East Hartford, CT) and J. M. VERDON (United Technologies Research Center, East Hartford, CT) AIAA Journal (ISSN 0001-1452), vol. 23, April 1985, p. 481-489. Previously cited in issue 06, p. 707, Accession no. A84-17985. refs
(Contract N62271-82-M-2797)

A85-29077*# McDonnell-Douglas Research Labs., St. Louis, Mo.
MEASUREMENTS OF A ZERO-PRESSURE-GRADIENT BOUNDARY LAYER BLOWN BY AN ASYMMETRIC JET
K. R. SARIPALLI (McDonnell Douglas Research Laboratories, St. Louis, MO; Southern Methodist University, Dallas, TX) and R. L. SIMPSON (Virginia Polytechnic Institute and State University, Blacksburg, VA; Southern Methodist University, Dallas, TX) AIAA Journal (ISSN 0001-1452), vol. 23, April 1985, p. 490, 491. Abridged.
(Contract NSG-1548)

Measurements were made in a two-dimensional wall jet submerged under a thick upstream boundary layer and advancing into a zero-pressure-gradient flow with the ratios of jet velocity to the freestream velocity confined to a practical range (less than

2). The effect on the flow development of an asymmetric wall-jet velocity profile with a relatively higher concentration of momentum away from the wall was investigated. The flow was computed using an existing method for blown boundary layers, and the results show good agreement with experimental data. Author

A85-29078*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
MONOTONE SWITCHES IN IMPLICIT ALGORITHMS FOR POTENTIAL EQUATIONS APPLIED TO TRANSONIC FLOWS
P. M. GOORJIAN (NASA, Ames Research Center, Moffett Field, CA), M. E. MEAGHER, and R. VAN BUSKIRK (Informatics General Corp., Palo Alto, CA) AIAA Journal (ISSN 0001-1452), vol. 23, April 1985, p. 492-498. Previously cited in issue 05, p. 585, Accession no. A83-16677. refs

A85-29080*# Science Applications, Inc., Princeton, N.J.
ANALYSIS OF TURBULENT UNDEREXPANDED JETS. I - PARABOLIZED NAVIER-STOKES MODEL, SCIPVIS
S. M. DASH, D. E. WOLF (Science Applications, Inc., Propulsion Gas Dynamics Div., Princeton, NJ), and J. M. SEINER (NASA, Langley Research Center, Acoustics and Noise Reduction Div., Hampton, VA) AIAA Journal (ISSN 0001-1452), vol. 23, April 1985, p. 505-514. refs
(Contract NAS1-16535)

A new computational model (SCIPVIS) is described which predicts the multiple-cell wave/shock structure in underexpanded or overexpanded turbulent jets. SCIPVIS solves the parabolized Navier-Stokes jet-mixing equations utilizing a shock-capturing approach in supersonic regions of the jet and a pressure-split approach in subsonic regions. Turbulence processes are represented by the solution of compressibility-corrected two-equation turbulence models. SCIPVIS presently analyzes jets exhausting into a quiescent or supersonic external stream for which a single-pass spatial-marching solution can be obtained. The features of SCIPVIS are reviewed, and calculations are described exhibiting the influence of turbulence modelling, jet temperature, and flight velocity on the jet shock structure. Author

A85-29082#
MACH REFLECTION FLOWFIELDS ASSOCIATED WITH STRONG SHOCKS
H. MIRELS (Aerospace Corp., Aerophysics Laboratory, El Segundo, CA) AIAA Journal (ISSN 0001-1452), vol. 23, April 1985, p. 522-529. refs
(Contract F04701-82-C-0083)

The Mach reflection associated with the passage of a shock wave over a wedge is treated in the limit of an ideal gas and a strong shock. In this limit, flow properties are functions only of wedge angle (theta) and the ratio of specific heats (gamma). Numerical results are presented for gamma = 9/7, 7/5, and 5/3. Wedge angles are noted at which the transition from regular to double-Mach, complex-Mach, and simple-Mach reflection occurs. Characteristic velocities in the recirculation region associated with double-Mach reflection are estimated. Local surface-pressure maxima at the upstream and downstream edges of the recirculation region are also estimated. The scale of the recirculation region increases with decreases in gamma, in accord with experimental observations. The present results provide a convenient characterization of Mach-reflection flowfields associated with wedge flows. Author

A85-29084#
A FIELD PANEL/FINITE DIFFERENCE METHOD FOR POTENTIAL UNSTEADY TRANSONIC FLOW
M. H. L. HOUNJET (Nationaal Lucht- en Ruimtevaartlaboratorium, Amsterdam, Netherlands) AIAA Journal (ISSN 0001-1452), vol. 23, April 1985, p. 537-545. Research supported by the Royal Netherlands Air Force. Previously cited in issue 17, p. 2444, Accession no. A83-37190. refs

A85-29085#
RELATIVE EFFECTS OF REYNOLDS NUMBER AND FREESTREAM TURBULENCE IN TRANSONIC FLOW
S. RAGHUNATHAN (Belfast, Queen's University, Belfast, Northern Ireland) and R. J. W. MCADAM (Short Brothers, Ltd., Belfast, Northern Ireland) AIAA Journal (ISSN 0001-1452), vol. 23, April 1985, p. 546-550. Previously cited in issue 17, p. 2445, Accession no. A83-37212. refs

A85-29087*# New York Univ., New York.
AUTOMATIC ADAPTIVE GRID REFINEMENT FOR THE EULER EQUATIONS
M. J. BERGER (New York University, New York, NY) and A. JAMESON (Princeton University, Princeton, NJ) AIAA Journal (ISSN 0001-1452), vol. 23, April 1985, p. 561-568. Previously announced in STAR as N84-17977. refs
(Contract DE-AC02-76ER-03077; N00014-81-K-0379; NAG1-186)

A method of adaptive grid refinement for the solution of the steady Euler equations for transonic flow is presented. Algorithm automatically decides where the coarse grid accuracy is insufficient, and creates locally uniform refined grids in these regions. This typically occurs at the leading and trailing edges. The solution is then integrated to steady state using the same integrator (FL052) in the interior of each grid. The boundary conditions needed on the fine grids are examined and the importance of treating the fine/coarse grid interface conservatively is discussed. Numerical results are presented. DOE

A85-29088#
TRANSONIC FLOW CALCULATIONS USING TRIANGULAR FINITE ELEMENTS
R. B. PELZ (MIT, Cambridge, MA; Princeton University, Princeton, NJ) and A. JAMESON (Princeton University, Princeton, NJ) (Computational Fluid Dynamics Conference, 6th, Danvers, MA, July 13-15, 1983, Collection of Technical Papers, p. 253-260) AIAA Journal (ISSN 0001-1452), vol. 23, April 1985, p. 569-576. Previously cited in issue 18, p. 2635, Accession no. A83-39376. refs

A85-29089#
UNSTEADY LAMINAR BOUNDARY-LAYER SEPARATION ON OSCILLATING CONFIGURATIONS
W. GEISSLER (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Institut fuer Aeroelastik, Goettingen, West Germany) AIAA Journal (ISSN 0001-1452), vol. 23, April 1985, p. 577-582. refs

A finite-difference procedure is developed to calculate unsteady two-dimensional laminar boundary layers on oscillating configurations. The method works in regions of reversed flow without numerical difficulties. The oscillating flat plate is investigated as a first test case to prove the validity and efficiency of the calculation procedure. The method is then applied to the more interesting case of an airfoil with pitching oscillations. Three incidence cases for the NACA 0012 airfoil are treated: alpha(0) = 0, 8, and 16 deg with alpha(1) = 8 deg oscillation amplitude and various reduced frequencies. Special emphasis is placed on the investigation of the flow behavior close to boundary-layer separation. The results of the unsteady boundary-layer calculation give the input necessary to model unsteady separated flows. Author

A85-29090*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
EULER AND NAVIER-STOKES SOLUTIONS FOR SUPERSONIC SHEAR FLOW PAST A CIRCULAR CYLINDER
A. KUMAR and M. D. SALAS (NASA, Langley Research Center, Hampton, VA) AIAA Journal (ISSN 0001-1452), vol. 23, April 1985, p. 583-587. Previously cited in issue 06, p. 709, Accession no. A84-18032. refs

A85-29093*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
NUMERICAL STUDY OF A RAMJET DUMP COMBUSTOR FLOWFIELD
J. P. DRUMMOND (NASA, Langley Research Center, High-Speed Aerodynamics Div., Hampton, VA) AIAA Journal (ISSN 0001-1452), vol. 23, April 1985, p. 604-611. Previously cited in issue 05, p. 585, Accession no. A83-16704. refs

A85-29126*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
REVIEW - COMPUTATIONAL METHODS FOR INTERNAL FLOWS WITH EMPHASIS ON TURBOMACHINERY
W. D. MCNALLY and P. M. SOCKOL (NASA, Lewis Research Center, Cleveland, OH) ASME, Transactions, Journal of Fluids Engineering (ISSN 0098-2202), vol. 107, March 1985, p. 6-22. Previously announced in STAR as N82-13113. refs

Current computational methods for analyzing flows in turbomachinery and other related internal propulsion components are presented. The methods are divided into two classes. The inviscid methods deal specifically with turbomachinery applications. Viscous methods, deal with generalized duct flows as well as flows in turbomachinery passages. Inviscid methods are categorized into the potential, stream function, and Euler approaches. Viscous methods are treated in terms of parabolic, partially parabolic, and elliptic procedures. Various grids used in association with these procedures are also discussed. Author

A85-29253#
AN ANALYTICAL AND EXPERIMENTAL INVESTIGATION OF ANNULAR PROPULSIVE NOZZLES
R. R. CONLEY (McDonnell Douglas Astronautics Co., St. Louis, MO), J. D. HOFFMAN, and H. D. THOMPSON (Purdue University, West Lafayette, IN) Journal of Aircraft (ISSN 0021-8669), vol. 22, April 1985, p. 270-276. Previously cited in issue 06, p. 707, Accession no. A84-17996. refs
(Contract F33615-80-C-2029)

A85-29256*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
FLOWFIELD INVESTIGATION OF A SUPERCRUISE FIGHTER MODEL
D. E. REUBUSH, E. A. BARE, S. F. YAROS (NASA, Langley Research Center, Transonic Aerodynamics Div., Hampton, VA), and J. A. YETTER (Boeing Military Airplane Co., Seattle, WA) Journal of Aircraft (ISSN 0021-8669), vol. 22, April 1985, p. 289-295. Previously cited in issue 16, p. 2277, Accession no. A84-35175. refs

A85-29259*# Pennsylvania State Univ., University Park.
COMPUTATION OF THREE-DIMENSIONAL VISCOUS FLOWS USING A SPACE-MARCHING METHOD
K. N. S. MURTHY and B. LAKSHMINARAYANA (Pennsylvania State University, University Park, PA) Journal of Aircraft (ISSN 0021-8669), vol. 22, April 1985, p. 311-317. Previously cited in issue 17, p. 2418, Accession no. A84-36971. refs
(Contract NSG-3266)

A85-29261#
EULER SOLUTIONS OF TRANSONIC VORTEX FLOWS AROUND THE DILLNER WING
A. RIZZI (Flygtekniska Forsoksanstalten, Bromma; Kungl. Tekniska Hogskolan, Stockholm, Sweden) Journal of Aircraft (ISSN 0021-8669), vol. 22, April 1985, p. 325-328. Research supported by the Control Data Corp. Previously cited in issue 21, p. 2989, Accession no. A84-44201. refs

A85-29262#
DYNAMICS OF FOREBODY FLOW SEPARATION AND ASSOCIATED VORTICES
L. E. ERICSSON and J. P. REDING (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA) Journal of Aircraft (ISSN 0021-8669), vol. 22, April 1985, p. 329-335. Previously cited in issue 19, p. 2793, Accession no. A83-41943. refs

A85-29263*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
MEASURED AND CALCULATED AIRLOADS ON A TRANSPORT WING MODEL
W. E. MCCAIN (NASA, Langley Research Center, Loads and Aeroelasticity Div., Hampton, VA) Journal of Aircraft (ISSN 0021-8669), vol. 22, April 1985, p. 336-342. Previously cited in issue 06, p. 708, Accession no. A84-18008. refs

A85-29265#
A THEOREM ON SWIRL LOSS IN PROPELLER WAKES
C. W. MCCUTCHEN (National Institutes of Health, Laboratory of Cell Biology and Genetics, Bethesda, MD) Journal of Aircraft (ISSN 0021-8669), vol. 22, April 1985, p. 344-346.

It is noted that if the longitudinal component of velocity for a high speed aircraft propeller is uniform across the propeller's wake, the swirl energy in the wake is commensurate with the work accomplished by wake suction. In the case of a lightly loaded propeller rotor, whose longitudinal velocity is characteristically uniform, the present relation between swirl energy and wake suction is a good approximation. Either swirl energy or wake suction may be used to measure swirl losses, but not both, since this value cannot be their sum. O.C.

A85-29301#
THREE-DIMENSIONAL NONEQUILIBRIUM VISCOUS FLOW OVER THE SHUTTLE ORBITER WITH CATALYTIC SURFACE EFFECTS
M. D. KIM (Virginia Polytechnic Institute and State University, Blacksburg, VA) and C. H. LEWIS Journal of Spacecraft and Rockets (ISSN 0022-4650), vol. 22, Mar.-Apr. 1985, p. 97-103. Previously cited in issue 15, p. 2120, Accession no. A883-34903. refs

A85-29303#
SURFACE PRESSURE MEASUREMENTS ON A TRANSONIC SPINNING PROJECTILE
M. C. MILLER (U.S. Army, Chemical Research and Development Center, Aberdeen Proving Ground, MD) Journal of Spacecraft and Rockets (ISSN 0022-4650), vol. 22, Mar.-Apr. 1985, p. 112-118. Research supported by the Sandia National Laboratory and U.S. Army. Previously cited in issue 17, p. 2456, Accession no. A83-38667. refs

A85-29323#
EFFECTS OF AN S-INLET ON THE FLOW IN A DUMP COMBUSTOR
J. A. SCHETZ, J. GURUSWAMY, and J. F. MARCHMAN, III (Virginia Polytechnic Institute and State University, Blacksburg, VA) Journal of Spacecraft and Rockets (ISSN 0022-4650), vol. 22, Mar.-Apr. 1985, p. 221-224. Research supported by the Atlantic Research Corp.

An important part of the studies involved in the design of a combustion chamber is related to a flowfield analysis. The flow pattern in the burner is affected by a number of system components. The present investigation is concerned with changes in flow pattern which occur due to the use of an S-inlet instead of a straight inlet. S-inlets are employed in situations in which a conventional straight inlet cannot be used, taking into account cruise missiles and certain jet aircraft. The experiments conducted in the investigation involved the use of a combustion chamber model made of Plexiglas pipe. A contoured nozzle was fitted to the end of the model. Tap water from a tank was pumped to the test section. Attention is given to a flow pattern with S-inlet and swirl, a flow pattern obtained in the case of a straight inlet with swirl, water tests and air tests, turbulence relations, and velocity measurements. The significance of the results is discussed. G.R.

A85-29672#
JOINED WING - CHILD OF THE COMPUTER
R. DEMEIS Aerospace America (ISSN 0740-722X), vol. 23, April 1985, p. 70-73.

Since the early 1970s, progress has been made in the development of vortex lattice computer programs for aerodynamic analyses, and finite element codes for structural design, which are critical for the successful implementation of tip-joined wing aircraft configurations. These computational tools render the interplay between aerodynamics and structural aeroelasticity, and interactions between fore and aft wings, fully tractable. Tip-joined wings weigh 80 percent as much as a conventional wing, but offer lower induced drag, better winglet structural support, and greater trim moments in virtue of the greater distance of control surfaces from the center of gravity. O.C.

A85-29692#
CALCULATION OF AERODYNAMIC CHARACTERISTICS OF WINGLETS AND EXPERIMENTAL VERIFICATION
R. ZHOU (Nanjing Aeronautical Institute, Nanjing, People's Republic of China) Acta Aeronautica et Astronautica Sinica, vol. 5, Sept. 1984, p. 261-266. In Chinese, with abstract in English. refs

The aerodynamic parameters of swept wings with one, two, or five winglets mounted on the wingtip at various angles are investigated analytically and experimentally. The lift, induced drag, and pitching and bending moments are computed using a constant-roll-angle vortex-lattice method and a combined-flow-field approach. The results are presented in tables and graphs and shown to be in good agreement with the results of wind-tunnel tests on a half model. T.K.

A85-29693#
A TYPE-DEPENDENT SPLITTING SCHEME WITH VARIABLE PARAMETERS FOR THE LONGITUDINAL LARGE-DISTURBANCE POTENTIAL EQUATION
S. LUO (Chinese Academy of Sciences, Computing Centre, People's Republic of China) Acta Aeronautica et Astronautica Sinica, vol. 5, Sept. 1984, p. 267-271. In Chinese, with abstract in English. refs

A steady-state transonic potential equation with large disturbance in the longitudinal direction is solved by using a type-dependent splitting scheme with variable parameters, in which different splitting schemes are adopted in supersonic or subsonic region. Selection rules for parameters are also discussed. Some numerical examples of transonic flows over NACA 0012 airfoil are presented. The results are compared with the available data. The results indicate that the present scheme is reliable and its convergence is comparatively fast. Author

A85-29700#
TURBULENT VORTICES AND BIONICS IN TURBOJET
H. NING and G. GAO (Beijing Institute of Aeronautics and Astronautics, Beijing, People's Republic of China) Acta Aeronautica et Astronautica Sinica, vol. 5, Sept. 1984, p. 333-337. In Chinese, with abstract in English. refs

The generation, development, and decay of turbulent vortices (TVs) in turbojets are investigated analytically, with a focus on orderly-coherent flow patterns, intermittency, and energy inversions which are incompatible with Kolmogoroff energy-spectrum theory. Viscous-dissipation and dispersion effects are considered simultaneously by combining the Burger and Korteweg-de Vries equations to obtain a canonical expression which is used to derive new momentum equations of turbulent flow. The results of sample computations on a tail-vortex flow and an orderly-coherent flow are compared with those obtained using a k-epsilon model and with the experimental data of Fujii et al. (1978) in graphs and found to be in good agreement. The application of the procedure to the design of turbojets, with the aim of utilizing the positive effects of TVs and reducing such negative TV effects as pressure loss, low efficiency, narrow range of stable operation, compressor stalling and surging, high-altitude relighting difficulty, and overheating or oscillation in combustors, is suggested. T.K.

A85-29964
THE EFFECT OF A SMALL BLOWING ON VORTEX-BREAKDOWN OF A SWIRLING FLOW
K. KARASHIMA (Tokyo, University, Tokyo, Japan) and S. KITAMA (National Space Agency of Japan, Tokyo, Japan) IN: Computational techniques and applications: CTAC-83; Proceedings of the International Conference, Sydney, Australia, August 28-31, 1983 . Amsterdam, North-Holland, 1984, p. 553-564. refs

A numerical study of an interaction between a swirling flow and a coaxial jet is developed to clarify aerodynamic mechanism and feasibility on control of vortex-breakdown by means of a small blowing. Applications of the blowing to a broken vortex-flow having a bubble induces an amount of leeward movement and shrinking of the bubble simultaneously, because it enhances the vortex core to depress considerably the axial deceleration of the rotating flow. It is concluded that the blowing can offer a significant improvement in breakdown characteristics of the swirling flow. Author

A85-29989
CONDENSATION PHENOMENA IN SUPERSONIC NOZZLES
W. FRANK (Karlsruhe, Universitaet, Karlsruhe, West Germany) Acta Mechanica (ISSN 0001-5970), vol. 54, March 1985, p. 135-156. refs

The heat addition in a Laval-nozzle flow and in a Prandtl-Meyer corner expansion caused by condensation of water vapor in moist air is investigated. In both flow fields at the onset of condensation density, pressure and temperature increase due to the release of the latent heat of vaporization. Experiments show that the energy addition is related to a relaxation process, and that the changes of the flow parameters can be expected in three different forms. In steady flow the thermodynamic state may change smoothly or it is discontinuous. At high rates of heat addition the flow becomes unsteady and it follows a repetitive cycle. The comparison of steady and unsteady flow fields allows the extraction of simple similarity rules by a dimensional analysis in conjunction with the laws of gasdynamic. Author

A85-29992
THE THEORY OF OSCILLATING THICK WINGS IN SUBSONIC FLOW LIFTING LINE THEORY
L. DRAGOS (Bucuresti, Universitatea, Bucharest, Rumania) Acta Mechanica (ISSN 0001-5970), vol. 54, March 1985, p. 221-238. refs

A theory of oscillating thick wings in subsonic flow is presented based on a previously developed fundamental solution method. The solution for the perturbation caused by an oscillating force applied at a point is obtained and used to derive the general solution for the perturbation produced by a wing in subsonic flow as a continuous superposition. C.D.

A85-30108
MOTION OF A FLEXIBLE WING AT SUPERSONIC VELOCITY UNDER THE EFFECT OF A RANDOM GUST [DVIZHENIE GIBKOGO KRYLA SO SVERKHZVUKOVOI SKOROST'IU PRI DEISTVII SLUCHAINOGO PORYVA]
B. A. ERSHOV Leningradskii Universitet, Vestnik, Matematika, Mekhanika, Astronomiia (ISSN 0024-0850), no. 1, 1985, p. 59-63. In Russian.

A theoretical analysis is presented of the random oscillations of an elastic wing with an infinite span in an ideal compressible fluid under the effect of a turbulent flow which is modeled as a random vertical gust. A coupled aeroelasticity scheme is used in which the flow-induced deformation of the wing produces, in turn, a change in the flow. The two-dimensional problem is reduced to an integrodifferential equation with partial derivatives, and expressions are obtained for the correlation function and spectral density of wing deformation. B.J.

A85-30109
SELF-OSCILLATIONS IN A JET IMPINGING ON A BARRIER [OB AVTOKOLEBANIIAKH V STRUE, NABEGAIUSHCHEI NA PREGRADU]
V. E. KUZMINA Leningradskii Universitet, Vestnik, Matematika, Mekhanika, Astronomiia (ISSN 0024-0850), no. 1, 1985, p. 63-69. In Russian.

Godunov's difference scheme is used to analyze the interaction of a self-oscillating supersonic axisymmetric jet with a flat plate placed perpendicular to the jet axis. The flow pattern in the interaction region is studied in detail for a nozzle-section Mach number of 2, and data on the qualitative flow pattern obtained in the numerical experiment are used to construct a physical model of self-oscillations in the impinging jet. The model is characterized by the presence of additional feedback through the peripheral gas flow downstream of the reflected shock wave. Also examined are data on a possible lateral opening of the central region and the dependence of peripheral peak pressure on the location of the central shock wave. B.J.

A85-30110
EQUATION ASSOCIATED WITH THE THEORY OF LOCAL INTERACTION IN A RAREFIED GAS [URAVNENIE, ASSOTSIIROVANNOE S TEORIEI LOKAL'NOGO VZAIMODEISTVIIA V RAZREZHENNOM GAZE]
R. N. MIROSHIN Leningradskii Universitet, Vestnik, Matematika, Mekhanika, Astronomiia (ISSN 0024-0850), no. 1, 1985, p. 69-73. In Russian. refs

The hypothesis of local interaction is used in the aerodynamic design of hypersonic vehicles. The present study derives a second-order partial differential equation of mixed type, whose solution in the hyperbolic region is the solution of a power moment problem for a sequence of form functions of local-interaction theory. Goursat's problem is formulated for this equation in the hyperbolic region, and its solution is represented as a single integral. Flow past a circular cone is considered as an example. B.J.

A85-30170
INVESTIGATIONS OF THE INFLUENCE OF TAPER ON THE CHARACTERISTIC VALUES OF ROTATING ANNULAR TURBINE CASCADES IN THE TRANSONIC FLOW REGIME [UNTERSUCHUNGEN ZUM EINFLUSS DER KONIZITAET AUF DIE KENNWERTE ROTIERENDER TURBINEN-RINGGITTER IM TRANSSONISCHEN GESCHWINDIGKEITSBEREICH]
W. BRAEUNLING VDI-Forschungsheft (ISSN 0015-7899), no. 627, 1985, p. 1-56. In German. Research supported by the Bundesministerium fuer Wirtschaft. refs

To determine the influence of taper on both the characteristic cascade values and the profile pressure distributions, two geometrically distinct cascade configurations for rotating annular cascades were experimentally investigated. Measurements in the upstream and downstream flow field of a hub-section cascade with high deflection and a tip-section cascade with low deflection were performed based on approximated axisymmetric stream surfaces. Surface pressure measurements on the test wheel blades were used to obtain information about the spatial structure of the flow within the cascade passages. Characteristic cascade data are plotted against downstream Mach number and taper angle. Some of the results are compared with simple theoretical calculations, and pressure distribution measurements are compared with calculations by a numerical computer code based on a three-dimensional time marching method for Euler equations. C.D.

A85-30171
AN ASYMPTOTIC ANALYSIS OF TRANSONIC WIND-TUNNEL INTERFERENCE BASED ON THE FULL POTENTIAL THEORY
Y. Y. CHAN (National Aeronautical Establishment, High Speed Aerodynamics Laboratory, Ottawa, Canada) Zeitschrift fuer angewandte Mathematik und Physik (ISSN 0044-2275), vol. 36, Jan. 1985, p. 89-104. refs

The transonic flow over an airfoil in a wind tunnel with perforated walls has been analyzed asymptotically based on the full potential equation. By matching the flow regions about the airfoil and near the wall, the analysis yields explicitly the effects of wall constraints and transonic nonlinearity on the flow in the tunnel. The analysis indicates that in general the wall interference is uncorrectable. However, it is also shown that if a limit wall control is applied, the interference becomes correctable and the resulting corrections are given implicitly. Author

A85-30175* Virginia Polytechnic Inst. and State Univ., Blacksburg.
VORTEX INDUCED LIFT ON A FLAT PLATE WITH A CURVED FORWARD-FACING FLAP
S. TANVEER (Virginia Polytechnic Institute and State University, Blacksburg, VA; California Institute of Technology, Pasadena, CA) Studies in Applied Mathematics (ISSN 0022-2526), vol. 72, April 1985, p. 173-187. Navy-supported research. refs
(Contract NAG3-179)

Free streamline solutions are obtained for two-dimensional inviscid incompressible flow past a flat plate with a forward-facing curved flap. It is shown that it is possible to shape the curved flap to make the adverse pressure gradient on top of the flap less severe than for a straight flap and thus increase the prospects of making the flow experimentally realizable. Author

A85-30201#
LIFTING SURFACE APPROACH OF OSCILLATING WINGS IN WEAK SHEAR FLOW
M. KOBAYAKAWA (Kyoto University, Kyoto, Japan) IN: International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2. New York, American Institute of Aeronautics and Astronautics, 1984, p. 600-606. refs

The importance of investigating unsteady wing problems in shear flow is increasing. However, the nonpotential property of the flow prevents using a perturbation velocity potential. A theory of wings which are oscillating in a weak shear flow is presented. The flow is assumed to be incompressible and inviscid; and the nonuniform velocity distribution is normal to the wing surface. The potential lifting-surface theory is extended into the shear-flow case by the method of successive approximations. The integral equation for the lift distribution to the first-order approximation is derived by the double-Fourier transform, and it is solved numerically by the mode function method. Calculations regarding oscillating rectangular wings with heaving and pitching modes in a shear flow are presented as examples. Generalized forces which can be easily related with unsteady lift forces and moments are obtained. Results show that the shear flow decreases all forces in amplitudes. Author

N85-19923*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NOISE CONSTRAINTS EFFECTING OPTIMAL PROPELLER DESIGNS
C. J. MILLER and J. P. SULLIVAN 1985 15 p refs To be presented at the Soc. of Automotive Engr. Gen. Aviation Aircraft Meeting and Exposition, Wichita, Kan., 16-19 Apr. 1985
(NASA-TM-86967; E-2449; NAS 1.15:86967) Avail: NTIS HC A02/MF A01 CSCL 01A

A preliminary design tool for advanced propellers was developed combining a fast vortex lattice aerodynamic analysis, a fast subsonic point source noise analysis, and an optimization scheme using a conjugate directions method. Twist, chord and sweep distributions are optimized to simultaneously improve both the aerodynamic performance and the noise observed at a fixed relative position. The optimal noise/performance tradeoffs for straight and advanced concept blades are presented. The techniques used include increasing the blade number, blade sweep, reducing the rotational speed, shifting the spanwise loading and diameter changes. E.A.K.

N85-19925*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
WIND-TUNNEL INVESTIGATION OF A FULL-SCALE CANARD-CONFIGURED GENERAL AVIATION AIRPLANE
L. P. YIP Mar. 1985 81 p refs
(NASA-TP-2382; L-15744; NAS 1.60:2382) Avail: NTIS HC A05/MF A01 CSCL 01A

An investigation was conducted in the Langley 30- by 60-Foot Tunnel to determine the aerodynamic characteristics of a powered, full-scale model of a general aviation airplane employing a canard. Although primary emphasis of the investigation was placed on evaluating the aerodynamic performance and the stability and control characteristics of the basic configuration, tests were also conducted to study the following effects of varying the basic configuration: effect of Reynolds number; effect of canard; effect of outboard wing leading-edge droop; effect of center-of-gravity location; effect of elevator trim; effect of landing gear; effect of lateral-directional control; effect of power; effect of fixed transition; effect of water spray; effects of canard incidence, canard airfoil section, and canard position; and effects of winglets and upper winglet size. Additional aspects of the study were to determine the boundary-layer transition characteristics of airfoil surfaces and the effect of fixing the boundary layer to be turbulent by means of a transition strip near the leading edge. The tests were conducted at Reynolds numbers from 0.60 x 10 to the 6th power to 2.25x10 to the 6th power, based on the wing mean aerodynamic chord, at angles of attack from -4.5 deg to 41.5 deg, and at angles of sideslip from -15 deg to 15 deg. Author

N85-19933# Sandia Labs., Albuquerque, N. Mex. Aerothermodynamics Div.
LOVEL-84: A LOW-VELOCITY AERODYNAMIC HEATING CODE FOR FLAT PLATES, WEDGES, AND CONES
A. L. THORNTON May 1984 57 p refs
(Contract DE-AC04-76DP-00789)
(DE85-002604; SAND-84-0457) Avail: NTIS HC A04/MF A01

The LOVEL computer program calculates the cold-wall heat transfer in subsonic and supersonic flow over wedge and conical (sharp and blunt body) geometries for freestream Mach numbers (M/sub infinity/) less than 6.0. Fluid properties used to compute the cold-wall heat-transfer rates are lased on Eckert's reference enthalpy correlation. The theory used in the computation of the cold-wall heat-transfer rates and the input/output format for the LOVEL computer program are described. Program output includes freestream conditions, boundary-layer edge conditions, cold-wall heat-transfer rates, plots of heating rates, and punched-card output for use in ablation and in-depth transient heat-conduction computer codes. DOE

N85-19935# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Direction de l'Aerodynamique.
EXPERIMENTAL INVESTIGATION OF A BREAKDOWN CRITERION FOR A VORTEX IN AN INCOMPRESSIBLE FLOW Final Report [RECHERCHE EXPERIMENTALE DUN CRITERE DECLATEMENT POUR UN TOURBILLON EN ECOULEMENT INCOMPRESSIBLE]
J. L. SOLIGNAC Jul. 1984 50 p refs In FRENCH
(Contract DRET-83.95.003)
(ONERA-RT/27/1147/AY) Avail: NTIS HC A03/MF A01

A breakdown limit curve for delta wing vortices was derived. The parameters involved, vortex intensity and the amplitude of the pressure gradient to which it is subjected were determined experimentally. Although not a precise criterion, the curve defines breakdown in breakdown boundary conditions. Author (ESA)

N85-19937# European Space Agency, Paris (France).
FLIGHT MECHANICS ANALYSIS OF DYNAMIC DERIVATIVES OF THE DORNIER VARIABLE WIND TUNNEL MODEL
D. ALTENKIRCH Oct. 1984 124 p refs Transl. into ENGLISH of "Flugmech. Anal. der dyn. Derivative des Dornier-Variationsmodells', DFVLR, Brunswick Rept. DFVLR-FB-83-38, Nov. 1983 Original language document previously announced as N84-24541
(ESA-TT-854; DFVLR-FB-83-38) Avail: NTIS HC A06/MF A01; original German version available from DFVLR, Cologne 38

Wind-tunnel measurements with a fighter aircraft model on a dynamic balance are discussed. The principal fuselage with closed engine inlets was combined with swept back wing, rhombic wing and delta wing and additional horizontal and vertical stabilizer modifications. A strake could be added. The influence of wing shape, stabilizer configuration and strake on the dynamic derivatives of the longitudinal and lateral motion were measured and compared with theoretical computations. Comparison shows that existing theoretical methods can not describe physical phenomena which occur at higher angles of attack.
Author (ESA)

N85-20191# Joint Publications Research Service, Arlington, Va.
A FAST ALGORITHM OF THE FINITE DIFFERENCE METHOD FOR COMPUTATION OF THE TRANSONIC FLOW PAST AN ARBITRARY AIRFOIL WITH THE CONSERVATIVE FULL-POTENTIAL EQUATION Abstract Only
M. HUANG *In its* China Rept.: Sci. and Technol. (JPRS-CST-84-026) p 22 18 Sep. 1984 Transl. into ENGLISH from Kongqidonglixue Xuebao (Mianyang, China), no. 2, 1984 p 19-24
Avail: NTIS HC A03/MF A01

Based on the methods developed by Jameson and Holst, a computer program was developed for computating the transonic flow past an arbitrary airfoil, by the finite difference method. A conformal mapping is applied to map the exterior of the airfoil onto the interior of a circle. By a radical transformation reducing the effects of the singularity at the center of the circle, the use of the perturbation velocity potential is avoided. The governing equation, simpler than those used by Jameson and Holst, is approximated by a finite difference equation, which is then solved by AF2 iteration scheme in computing plane. The computations of the pressure distribution over the airfoil of NACA 0012 for subcritical and supercritical cases show the results are in excellent agreement with those by Holst's method. Author

N85-20194# Joint Publications Research Service, Arlington, Va.
A STUDY FOR CALCULATING ROTOR LOADS USING FREE VORTEX CONCEPT Abstract Only
T. RUAN, Q. HAN, R. LI, and X. SHEN *In its* China Rept.: Sci. and Technol. (JPRS-CST-84-026) p 25 18 Sep. 1984 Transl. into ENGLISH from Kongqidonglixue Xuebao (Mianyang, China), no. 2, 1984 p 50-60
Avail: NTIS HC A03/MF A01

A rotor discrete free wake geometry and the blade airloads at each instant were obtained using a procedure of step-by-step iteration through a process similar to the start-up of a rotor in a free stream. It is not until the wake has steadied down that the calculating can come to a stop. After the steady vortex wake is obtained, the wake-induced downwash on each point interested and on the rotor can be computed. The theory of the thin airfoil and an appoximate formula for lift and drag coefficient (resulting for experimentation) suitable for the overall rangle of angle of attack that the blades would encounter when operating, are used to determine get the blades' airloads and their responses. There is good agreement between the first four harmonics airloads resulting from calculation and loads obtained from flight test.
A.R.H.

N85-20195# Joint Publications Research Service, Arlington, Va.
EXPERIMENTAL INVESTIGATION OF HEAT TRANSFER TO BLUFF CYLINDERS AND CONES IN HYPERSONIC RAREFIED GAS FLOW Abstract Only
W. HUA *In its* China Rept.: Sci. and Technol. (JPRS-CST-84-026) p 26 18 Sep. 1985 Transl. into ENGLISH from Kongqidonglixue Xuebao (Mianyang, China), no. 2, 1984 p 61-65
Avail: NTIS HC A03/MF A01

The heat transfer to bluff cylinders and sharp 10-deg half-angle cone at an angle of attack of 0 deg. was investigated in the low-density, hypersonic wind tunnel. Stagnation point and surface heat transfer data are obtained over a range of test conditions: Mach numbers at 12 and 24, and unit Reynolds numbers from 1000 to 7000 per centimeter. The approximation formulae of the heat transfer are set up in rarefied transitional regimes. Previously published experimental results and calculations from these approximations formulae are compared. Author

N85-20212# Joint Publications Research Service, Arlington, Va.
A LOCALLY LINEARIZED PANEL METHOD FOR TRAN-/SUBSONIC FLOW PAST AN OSCILLATING WING Abstract Only
B. TONG, L. ZHUANG, and X. LI *In its* China Rept.: Sci. and Technol. (JPRS-CST-84-039) p 129 3 Dec. 1984 Transl. into ENGLISH from Kongqidonglixue Xuebao (China), no. 3, 1984 p 20-27
Avail: NTIS HC A08/MF A01

The down wash integral equation for the small perturbation transonic potential flow past an oscillating wing is established based on the local linearization concept. The method for calculating the tran-/subsonic kernel function is discussed in detail. To calculate the unsteady pressure or an oscillating rectangular wing in the tran-/subsonic flow, the generalized-doublet-lattice-method is used. The results show that the locally linearized panel method is more accurate than the usual linearized methods, but further work is needed to obtain a numerical method for calculating the tran-/supersonic flows. Author

N85-20213# Joint Publications Research Service, Arlington, Va.
TRANSONIC PRESSURE DISTRIBUTION COMPUTATIONS OF A FLEXIBLE WING Abstract Only
K. SHEN and X. ZHANG *In its* China Rept.: Sci. and Technol. (JPRS-CST-84-039) p 130 3 Dec. 1984 Transl. into ENGLISH from Kongqidonglixue Xuebao (China), no. 3, 1984 p 28-33
Avail: NTIS HC A08/MF A01

An iteration method is used for computing the transonic pressure distribution on a flexible wing. The aerodynamic force is solved with the second order approximation method for transonic small disturbance potential flow. The structural deflection is computed using the one dimensional simple beam theory or a two dimensional flexibility matrix method. The typical computations for the M6 flexible wing indicate that the iteration number for flexible wing computation is only slightly more than that for a rigid one, and that the influences of the structural deflection on the airload and shock strength are important. Author

N85-20214# Joint Publications Research Service, Arlington, Va.
ON RELAXATION OF TRANSONIC FLOWS AROUND ZERO-LIFT AIRFOILS AND CONVERGENCE OF SELF-CORRECTING WING TUNNELS Abstract Only
X. LIU and S. LUO *In its* China Rept.: Sci. and Technol. (JPRS-CST-84-039) p 131 3 Dec. 1984 Transl. into ENGLISH from Kongqidonglixue Xuebao (China), no. 3, 1984 p 34-41
Avail: NTIS HC A08/MF A01

The steady transonic potential flow around a symmetric airfoil at a zero angle of attack is computed by the mixed difference method with the assumption of small transverse velocity components. After some numerical experiments on the stability of various possible schemes of iteration in the relaxation, a table scheme is found and used to verify the convergence of two kinds of transonic self correcting wind tunnels which are based on the pressure distribution along (1) two control surfaces and (2) one control surface and the airfoil. Author

N85-20216# Joint Publications Research Service, Arlington, Va.
FINITE DIFFERENCE COMPUTATION OF THE FLOW AROUND AIRFOILS IN TWO-DIMENSIONAL TRANSONIC SLOTTED WALL WIND TUNNEL Abstract Only
N. ZHANG *In its* China Rept.: Sci. and Technol. (JPRS-CST-84-039) p 134 3 Dec. 1984 Transl. into ENGLISH from Kongqidonglixue Xuebao (China), no. 3, 1984 p 104-109
Avail: NTIS HC A08/MF A01

The transonic flow around NACA 0012 and RAE 104 airfoils in a slotted wall transonic wind tunnel is calculated with the finite difference method. A two dimensional small disturbance velocity potential equation is adopted in this computation. The transonic airfoil wind tunnels at the Institute of Aerodynamics and Gasdynamics of Stuttgart University and at the Institute of Aerodynamics of Northwestern Polytechnical University in Xian were chosen as two computational examples. Only the solid blockage interference at zero angle of attack is calculated in this paper. The pressure distributions of the airfoil surface and the slotted wall along the streamwise direction, the additional lift coefficient due to the nonsymmetrical set up of the model in the test section are computed. The calculated results of the NACA 0012 and RAE 104 airfoils are compared with the experimental results of the Langley Research Center and those of the National Physical Laboratory in England respectively. The pressure distributions of the airfoil surface were simulated to equal those of the experiments for the selected Mach numbers. Author

N85-20792# Joint Publications Research Service, Arlington, Va.
PARACHUTE INFLATION DYNAMICS Abstract Only
S. M. BELOTSEROVSKIY, I. V. DNEPROV, A. T. PONOMAREV, and O. V. RYSEV *In its* USSR Rept.: Phys. and Math. (JPRS-UPM-85-001) p 5 9 Jan. 1985 Transl. into ENGLISH from Izv. Akad. Nauk SSSR: Mekhanika Tverdogo Tela (Moscow), no. 3, May-Jun. 1984 p 174-179 Original language document was announced as A84-47390
Avail: NTIS HC A03/MF A01

The parachute opening process is investigated by combining numerical methods of nonlinear aerodynamics with elasticity theory. The approach, which involves joint integration of the equations of unsteady nonlinear aerodynamics and elasticity relationships of the kind proposed by Rakhmatulin (1975), has been implemented in computer software. The aerodynamic load is determined by using the Cauchy-Lagrange integral with allowance for the flow and parachute deformation history. V.L.

N85-21109# Joint Publications Research Service, Arlington, Va.
CURRENT DEVELOPMENT, APPLICATIONS OF AIRSHIPS IN USSR
Y. GOLTSMAN *In its* USSR Rept.: Transportation (JPRS-UTR-85-004) p 95-97 27 Feb. 1985 Transl. into ENGLISH from Mosk. Pravda (Moscow), 18 Dec. 1984 p 3
Avail: NTIS HC A06

A half-century ago many scientists and engineers were convinced that airships soon would take their place among the museum exhibits. Today, they are being referred to as promising transportation in the near future. The rebirth of the airship in the U.S.S.R. as a viable means of transportation is discussed. The revival of the airship is primarily connected with the relative economy of this type of structure. B.W.

N85-21110*# National Aeronautics and Space Administration, Washington, D. C.
UNSTEADY AERODYNAMIC CHARACTERIZATION OF A MILITARY AIRCRAFT IN VERTICAL GUSTS
A. LEBOZEC and J. L. COCQUEREZ Feb. 1985 44 p refs Transl. into ENGLISH of Colloq. paper AAAF-NT-83-16 from Assoc. Aeron. et Astron. de France, Toulouse, 47 p Presented at the 20th Appl. Aerondyn. Colloq., Toulouse, 8-10 Nov. 1983 Original language doc. was announced in IAA as A84-32484
(NASA-TM-77810; NAS 1.15:77810; AAAF-NT-83-16) Avail: NTIS HC A03/MF A01 CSCL 01A

The effects of 2.5-m/sec vertical gusts on the flight characteristics of a 1:8.6 scale model of a Mirage 2000 aircraft in

free flight at 35 m/sec over a distance of 30 m are investigated. The wind-tunnel setup and instrumentation are described; the impulse-response and local-coefficient-identification analysis methods applied are discussed in detail; and the modification and calibration of the gust-detection probes are reviewed. The results are presented in graphs, and good general agreement is obtained between model calculations using the two analysis methods and the experimental measurements. Author

N85-21111*# National Aeronautics and Space Administration, Washington, D. C.

THREE-DIMENSIONAL UNSTEADY LIFTING SURFACE THEORY IN THE SUBSONIC RANGE

H. G. KUESSNER Feb. 1985 37 p refs Transl. into ENGLISH of "Dreidimensionale instationaere tragflaechentheorie im unterschellgebiet" Goettingen, West Germany, 1956 Presented at 2nd European Aeron. Congr., Scheveningen, Netherlands, 25-29 Sep. 1956 Transl. by Corporate Word, Pittsburgh Original document prepared by Max-Planck-Inst. of Flow Research, Goettingen, West Germany

(Contract NASW-4006)

(NASA-TM-77812; NAS 1.15:77812) Avail: NTIS HC A03/MF A01 CSCL 01A

The methods of the unsteady lifting surface theory are surveyed. Linearized Euler's equations are simplified by means of a Galileo-Lorentz transformation and a Laplace transformation so that the time and the compressibility of the fluid are limited to two constants. The solutions to this simplified problem are represented as integrals with a differential nucleus; these results in tolerance conditions, for which any exact solution must suffice. It is shown that none of the existing three-dimensional lifting surface theories in subsonic range satisfy these conditions. An oscillating elliptic lifting surface which satisfies the tolerance conditions is calculated through the use of Lame's functions. Numerical examples are calculated for the borderline cases of infinitely stretched elliptic lifting surfaces and of circular lifting surfaces. Out of the harmonic solutions any such temporal changes of the down current are calculated through the use of an inverse Laplace transformation. M.G.

N85-21112*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

RECONSTRUCTION OF A 3-DIMENSIONAL TRANSONIC ROTOR FLOW FIELD FROM HOLOGRAPHIC INTERFEROGRAM DATA

Y. H. YU, J. K. KITTLESON, and F. BECKER (Max-Planck Inst. fuer Stroemungsforschung, Goettingen, West Germany) Mar. 1985 29 p refs

(NASA-TM-86690; REPT-85147; NAS 1.15:88690; USAAVSCOM-TR-85-A-1) Avail: NTIS HC A03/MF A01 CSCL 01A

Holographic interferometry and computer-assisted tomography (CAT) are used to determine the transonic velocity field of a model rotor blade in hover. A pulsed ruby laser recorded 40 interferograms with a 2-ft-diam view field near the model rotor-blade tip operating at a tip Mach number of 0.90. After digitizing the interferograms and extracting fringe-order functions, the data are transferred to a CAT code. The CAT code then calculates the perturbation velocity in seeral planes above the blade surface. The values from the holography-CAT method compare favorably with previously obtained numerical computations in most locations near the blade tip. The results demonstrate the technique's potential for three-dimensional transonic rotor flow studies. Author

N85-21113*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

TRANSONIC INTERACTIONS OF UNSTEADY VORTICAL FLOWS

W. J. MCCROSKEY and G. R. SRINIVASAN (JAI Associates, Mountain View, Calif.) Dec. 1984 16 p refs Sponsored in part by Army

(NASA-TM-86658; REPT-85075; NAS 1.15:86658; USAAVSCOM-TM-84-A-10) Avail: NTIS HC A02/MF A01 CSCL 01A

Unsteady interactions of strong concentrated vortices, distributed gusts, and sharp-edged gusts with stationary airfoils were analyzed in two-dimensional transonic flow. A simple and efficient method for introducing such vortical disturbances was implemented in numerical codes that range from inviscid transonic small disturbance to thin-layer Navier Stokes. The numerical results demonstrate the large distortions in the overall flow field and in the surface air loads that are produced by various vortical interactions. The results of the different codes are in excellent qualitative agreement, but, as might expected, the transonic small-disturbance calculations are deficient in the important region near the leading edge. M.G.

N85-21114*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

PRELIMINARY ANALYSIS OF TONE-EXCITED TWO-STREAM JET VELOCITY DECAY

U. H. VONGLAHN 1985 22 p refs Presented at the 109th Meeting of the Acoustical Society of America, Austin, Tex., 8-12 Apr. 1985

(NASA-TM-86951; E-2473; NAS 1.15:86951) Avail: NTIS HC A02/MF A01 CSCL 01A

Acoustic research related to jet flows has established that sound, by amplifying the naturally occuring large-scale structures in turbulent shear layers, can cause a more rapidly decay of the jet plume velocity and temperature and an increase in jet spreading rate. One possible application of this sound-flow interaction phenomenon is to future STOL aircraft that may require modified jet plume characteristics in order to reduce the loads and temperatures on the deflected flaps during take-off and landing operations. The tone-excitation effect on the velocity decay of model-scale, two-stream jet plumes is analyzed. Measured data are correlated in terms of parameters that include excitation sound level and outer-to-inner stream velocity ratio. The effect of plume tone-excitation on far-field jet noise is examined and its implication for large-scale two-stream jets is discussed. A.R.H.

N85-21115*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

ADVANCED LINER-COOLING TECHNIQUES FOR GAS TURBINE COMBUSTORS

C. T. NORGREN and S. M. RIDDLEBAUGH 1985 21 p refs Proposed for presentation at the 21st Joint Propulsion Conf., Monterey, Calif., 8-10 Jul. 1985; sponsored by AIAA, SAE and ASME

(NASA-TM-86952; E-2475; NAS 1.15:86952) Avail: NTIS HC A02/MF A01 CSCL 21E

Component research for advanced small gas turbine engines is currently underway at the NASA Lewis Research Center. As part of this program, a basic reverse-flow combustor geometry was being maintained while different advanced liner wall cooling techniques were investigated. Performance and liner cooling effectiveness of the experimental combustor configuration featuring counter-flow film-cooled panels is presented and compared with two previously reported combustors featuring: splash film-cooled liner walls; and transpiration cooled liner walls (Lamilloy). Author

N85-21116*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
MEASURED UNSTEADY TRANSONIC AERODYNAMIC CHARACTERISTICS OF AN ELASTIC SUPERCRITICAL WING WITH AN OSCILLATING CONTROL SURFACE
D. A. SEIDEL, M. C. SANDFORD, and C. V. ECKSTROM Feb. 1985 10 p refs Presented at the AIA/ASME/ASCE/AHS 26th Struct., Struct. Dyn. and Mater. Conf., Orlando, Fla., 15-17 Apr. 1985
(NASA-TM-86376; NAS 1.15:86376; AIAA-85-0598-CP) Avail: NTIS HC A02/MF A01 CSCL 01A

Transonic steady and unsteady aerodynamic data were measured on a large elastic wing in the NASA Langley Transonic Dynamics Tunnel. The wing had a supercritical airfoil shape and a leading-edge sweepback of 28.8 deg. The wing was heavily instrumented to measure both static and dynamic pressures and deflections. A hydraulically driven outboard control surface was oscillated to generate unsteady airloads on the wing. Representative results from the wind tunnel tests are presented and discussed, and the unexpected occurrence of an unusual dynamic wing instability, which was sensitive to angle of attack, is reported. M.G.

N85-21117*# Cornell Univ., Ithaca, N.Y. School of Mechanics and Aerospace Engineering.
A THEORY OF POST-STALL TRANSIENTS IN MULTISTAGE AXIAL COMPRESSION SYSTEMS Final Report
F. K. MOORE and E. M. GREITZER Washington NASA Mar. 1985 115 p refs Prepared in cooperation with M.I.T., Cambridge)
(Contract NAG3-34; NSG-3208)
(NASA-CR-3878; NAS 1.26:3878) Avail: NTIS HC A06/MF A01 CSCL 01A

A theory is presented for post stall transients in multistage axial compressors. The theory leads to a set of coupled first-order ordinary differential equations capable of describing the growth and possible decay of a rotating-stall cell during a compressor mass-flow transient. These changing flow features are shown to have a significant effect on the instantaneous compressor pumping characteristic during unsteady operation, and henace on the overall system behavior. It is also found from the theory that the ultimate mode of system response, stable rotating stall or surge, depends not only on the B parameter but also on other parameters, such as the compressor length-to-diameter ratio. Small values of this latter quantity tend to favor the occurrence of surge, as do large values of B. A limited parametric study is carried out to show the impact of the different system features on transient behavior. Based on analytical and numerical results, several specific topics are suggested for future research on post-stall transients. M.G.

N85-21118*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
FLIGHT-MEASURED LAMINAR BOUNDARY-LAYER TRANSITION PHENOMENA INCLUDING STABILITY THEORY ANALYSIS
C. J. OBARA (Kentron International, Inc.) and B. J. HOLMES Apr. 1985 40 p refs
(NASA-TP-2417; L-15804; NAS 1.60:2417) Avail: NTIS HC A03/MF A01 CSCL 01A

Flight experiments were conducted on a single-engine turboprop aircraft fitted with a 92-in-chord, 3-ft-span natural laminar flow glove at glove section lift coefficients from 0.15 to 1.10. The boundary-layer transition measurement methods used included sublimating chemicals and surface hot-film sensors. Transition occurred downstream of the minimum pressure point. Hot-film sensors provided a well-defined indication of laminar, laminar-separation, transitional, and turbulent boundary layers. Theoretical calculations of the boundary-layer parameters provided close agreement between the predicted laminar-separation point and the measured transition location. Tollmien-Schlichting (T-S) wave growth n-factors between 15 and 17 were calculated at the predicted point of laminar separation. These results suggest that for many practical airplane cruise conditions, laminar separation (as opposed to T-S instability) is the major cause of transition in predominantly two-dimensional flows. Author

N85-21119*# Texas A&M Univ., College Station.
PROPELLER PROPULSION SYSTEM INTEGRATION: STATE OF TECHNOLOGY SURVEY Final Report
S. J. MILEY and E. VONLAVANTE Washington Mar. 1985 186 p
(Contract NAG1-214)
(NASA-CR-3882; NAS 1.26:3882) Avail: NTIS HC A09/MF A01 CSCL 01B

A literature survey was performed to identify and review technical material applicable to the problem area of propeller propulsion system integration. The survey covered only aerodynamic interference aspects of the problem, and was restricted primarily to propeller effects on the airframe. The subject of airframe aerodynamic interference on the propeller was limited to the problem of vibration due to nonuniform inflow. The problem of airframe effects on propeller performance was not included. A total of 1121 references are given. The references are grouped into the subject areas of Aircraft Stability, Propulsive Efficiency, Aerodynamic Interference, Aerodynamic Interference-Propeller Vibration, and Miscellaneous. Author

N85-21120*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SEMIANALYTIC MODELING OF AERODYNAMIC SHAPES
R. L. BARGER and M. S. ADAMS Apr. 1985 20 p refs
(NASA-TP-2413; L-15879; NAS 1.60:2413) Avail: NTIS HC A02/MF A01 CSCL 01A

Equations for the semianalytic representation of a class of surfaces that vary smoothly in cross-sectional shape are presented. Some methods of fitting together and superimposing such surfaces are described. A brief discussion is also included of the application of the theory in various contexts such as computerized lofting of aerodynamic surfaces and grid generation. Author

N85-21121# National Research Council of Canada, Ottawa (Ontario).
A STUDY OF TRANSONIC FLUTTER OF A TWO-DIMENSIONAL AIRFOIL USING THE U-G AND P-K METHODS
B. H. K. LEE Nov. 1984 70 p refs
(LR-615; NRC-23959) Avail: NTIS HC A04/MF A01

Transonic flutter of a NACA64A006 airfoil undergoing plunging and pitching oscillations is studied using the U-g and p-k methods. The aerodynamic coefficients are calculated using an improved version of an ONERA unsteady transonic aerodynamics code which include the second time derivation term of the velocity potential in the governing equation. Comparisons with LTRAN2-NLR show good agreement up to and in some cases exceeding K sub c = 0.4 except for the pitching moment curves at the transonic dip Mach number of 0.85. All flutter results are presented for M = 0.85. The p-k method gives flutter speeds identical to those from the U-g method. Subcritical damping ratios using the U-g method with Frueh's and Miller's damping formula are quite close to those obtained from the p-k method, especially for large values of the airfoil-air mass ratio. Response of the airfoil to externally applied forces and moments is studied using the p-k method and a viscous damping model for coupled motions. Author

N85-21122# Aeronautical Research Labs., Melbourne (Australia).
DESCRIPTION OF A TECHNIQUE TO MEASURE SPRAY DISTRIBUTION IN AN AIR STREAM
J. C. PAYNE Feb. 1984 16 p
(AD-A149780; ARL-AERO-PROP-TM-417) Avail: NTIS HC A02/MF A01 CSCL 14B

This Australian report describes a technique for the measurement of the distribution of introduced liquid mist within an air flow in an annular duct. These measurements were required as part of a program to develop a system for injecting a mixture of water and methanol into the compressor of a small gas turbine. GRA

N85-21123# Grumman Aerospace Corp., Bethpage, N.Y.
AN INVESTIGATION OF TURBULENCE MECHANISMS IN V/STOL UPWASH FLOW FIELDS Annual Report, 15 Mar. 1983 - 15 Jun. 1984
B. L. GILBERT 31 Aug. 1984 59 p
(Contract F49620-82-C-0025)
(AD-A149786; RE-688; AFOSR-84-1197TR) Avail: NTIS HC A04/MF A01 CSCL 20D

This study investigated the two-dimensional upwash region formed by collision of opposed two-dimensional wall jets. Extensive measurements were made in the 2-D wall jet to establish the starting conditions of the upwash. Evaluation of these measurements showed classical wall jet behavior, and fully developed mean and turbulence profiles at the collision zone. A unique set of velocity profiles was obtained at seven upwash locations. Two components of the velocity were found simultaneously using an X-probe anemometer. By rotating the probe and repeating the profiles, all three velocity components were measured. While mixing layer growth rates were larger than those found in a free two-dimensional jet, these values were less than those previously reported. These data are presented in similarity form. Higher moments and some of the terms in the turbulence kinetic energy equation were also measured. As part of the study of the effect of various initial conditions, a series of measurements was taken in the upwash formed by collision of unequal wall jets. These are compared to a very simple theory. By choosing a coordinate system aligned with the upwash, these data can be characterized in a pattern similar to the equal wall jet case. Obstacles of various heights were placed at the collision point of equal wall jets. Away from the influences of the obstacle's wake, the upwash exhibited increasing decay rates with decreasing obstacle heights. This behavior asymptotes to the no-obstacle case for small obstacles and to twice the wall jet growth for large obstacles. GRA

N85-21124# Flow Research, Inc., Kent, Wash.
UNSTEADY FLOWS AROUND 3-DIMENSIONAL WINGS Final Technical Report, 1 May 1983 - 30 Sep. 1984
M. GAD-EL-HAK 1 Oct. 1984 90 p
(Contract F49620-82-C-0020)
(AD-A149993; FRC-RR-305; AFOSR-84-1243TR) Avail: NTIS HC A05/MF A01 CSCL 20D

Time-dependent flows around rectangular, swept or delta wings undergoing harmonic pitching motions were investigated using flow visualization techniques. The wings were towed in an 18-m water channel at chord Reynolds numbers up to 350,000. Fluorescent dye layers were excited with a sheet of laser light and used to mark the flow in the separation region around the lifting surface, the wake region and the potential flow away from the wing. The flow field around each wing depends to a large degree on wing planform, leading edge contour, and the reduced frequency of oscillation. The results can be mostly explained in terms of the mutual induction between the leading edge separation vortex and the trailing edge shedding vortex. For steady state flow around the delta wing (constant angle of attack and constant speed), the present visualization experiments revealed the existence of a shear layer near the leading edge that rolls up and form discrete vortices parallel to the leading edge. These vortices were observed to pair at least once as they were convected downstream. Similar phenomena were observed in the unsteady case, except that the vortices shed from the leading edge were modulated and altered by the unsteady motion which was an order of magnitude lower in frequency. In general, the unsteadiness delayed separation and promoted hysteresis similar to results obtained in unsteady two-dimensional airfoils. Keywords include: Unsteady separated flows; Three-dimensional wings, Pitching wings, and Supermaneuverability. GRA

N85-21125# National Aeronautical Establishment, Ottawa (Ontario).
SKIN FRICTION MEASUREMENTS FOR 2 RELATIVELY THICK AIRFOIL SECTIONS AT HIGH REYNOLDS NUMBER Aeronautical Note
G. M. ELFSTROM Nov. 1984 86 p
(AD-A150021; NAE-AN-23; NRC-23941) Avail: NTIS HC A05/MF A01 CSCL 20D

This Canadian report describes an experimental investigation of turbulent skin friction for two airfoil sections under conditions of high Reynolds number. Data are presented for an NACA 0020 section at a Mach number of 0.30 and chord Reynolds numbers between 5 and 20 million, and for a 16% thick supercritical section at a Mach number of 0.74 and chord Reynolds numbers between 15 and 25 million. Together with estimates of boundary layer transition location, these data are integrated to determine the skin friction component of total drag. The results are then discussed in terms of observed variation of total drag with Reynolds number. GRA

N85-21126# Flow Research, Inc., Kent, Wash. Research and Technology Div.
PSEUDOSPECTRAL CALCULATIONS OF TWO-DIMENSIONAL TRANSONIC FLOW (TASK 1). NUMERICAL INVESTIGATION OF VTOL AERODYNAMICS (TASK 2) Final Progress Report, 22 Dec. 1981 - 21 Dec. 1983
W. H. JOU and R. W. METCALFE Sep. 1984 98 p
(Contract F49620-82-C-0022; AF PROJ. 2307)
(AD-A150123; TN-215; TN-216; AFOSR-84-1174TR) Avail: NTIS HC A05/MF A01 CSCL 20D

The status of the research performed under this AFOSR contract is reported in two Flow Research Technical Notes. The formulation of the problem, the method of solution, and numerically obtained results are presented for each case. GRA

N85-21127# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho.
TECHNIQUES TO ANALYZE VEHICLE COASTDOWN DATA
J. R. VENHUIZEN Oct. 1984 41 p refs
(Contract DE-AC07-76ID-01570)
(DE85-005159; EGG-ED-6725) Avail: NTIS HC A03/MF A01

Vehicle coastdown tests were used for some time to generate data for estimating aerodynamic drag and tire rolling resistance. In spite of the numerous methods and techniques written up in the literature, the data taken do not represent measurements of the parameters of interest, rather, these parameters must be estimated from the measured data using some type of parameter estimation methodology. A method is presented which uses least squares parameter estimation techniques to estimate the aerodynamic drag and rolling resistance coefficients from velocity versus time data taken during the coastdown. Central to any parameter estimation problem is a model of the process that contains the parameters of interest. A model is developed to describe the coastdown process, and an example problem presented to show the computational methods developed for the data reduction process. DOE

N85-21128# Sandia Labs., Albuquerque, N. Mex.
TAILORED AIRFOILS FOR VERTICAL AXIS WIND TURBINES
P. C. KLIMAS Nov. 1984 13 p refs
(Contract DE-AC04-76DP-00789)
(DE85-004628; SAND-84-1062) Avail: NTIS HC A02/MF A01

The evolution of a family of airfoil sections designed to be used as blade elements of a vertical axis wind turbine (VAWT) is described. This evolution consists of extensive computer simulation, wind tunnel testing and field testing. The process reveals that significant reductions in system costs-of-energy and increases in fatigue lifetime may be expected for VAWT systems using these blade elements. DOE

N85-21129# Technische Hochschule, Darmstadt (West Germany). Fachgebeit Aerodynamik und Messtechnik.
DETERMINATION OF THE DRAG OF FREE FLYING PARTICLES IN SUPERSONIC FLOW WITH A PULSED LASER Thesis [WIDERSTANDSBESTIMMUNG VON FREI FLIEGENDEN PARTIKELN IN UEBERSCHALLSTROEMUNGEN MIT EINEM GEPULSTEN LASER]
A. BLOCH 1984 15 p refs In GERMAN
Avail: NTIS HC A02/MF A01

A system to determine the drag of indicator particles used in contactless velocity measurements with lasers was developed. The measuring method and the laser-stroboscope-anemometer are described. The evaluation of the measuring data takes Mach and Reynolds number effects into account, and allows the suitability of particles as indicators for velocity determination to be judged.
Author (ESA)

N85-21130# National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.
NUMERICAL INTEGRATION OF THE UNSTEADY FULL-POTENTIAL EQUATION WITH APPLICATIONS TO TRANSONIC FLOW ABOUT A TWO-DIMENSIONAL AIRFOIL
H. SCHIPPERS 3 Dec. 1984 12 p refs Presented at 5th IMACS Intern. Symp. on Computer Methods for Partial Differential Equations, Bethlehem, Penn., 19-21 Jun. 1984
(NLR-MP-84022-U; B8478513) Avail: NTIS HC A02/MF A01

The numerical integration of the unsteady full-potential equation in generalized coordinates in strong conservation form is described for the computation of unsteady transonic flows. Nonlinear truncation errors are minimized by time-linearizing the full-potential equation up to second order accuracy. The resulting second order hyperbolic equation is integrated numerically by the method of fractional steps. A noniterative time-marching procedure is obtained. The full-potential equation is discretized in space by fully conservative finite difference schemes employing mass-flux splitting for the capture of shocks. Numerical results for unsteady transonic flow about a NACA 64A010 airfoil and an ONERA-M6 airfoil are presented. Author (ESA)

N85-21423# Joint Publications Research Service, Arlington, Va.
A CALCULATION OF SLENDER DELTA WING WITH LEADING-EDGE SEPARATION BY QUASI-VORTEX-LATTICE METHOD Abstract Only
S. XIONG *In its* China Rept.: Sci. and Technol. (JPRS-CST-85-008) p 92 27 Mar. 1985 Transl. into ENGLISH from Kongqidonglixue Xuebao (China), no. 4, 1984 p 21-26
Avail: NTIS HC A07/MF A01

The quasi-vortex-lattice method (QVLM) which was used to calculate the thin wing with separation was extended to calculate the slender delta wing with leading-edge separation. The advantage of this method is that the leading-edge boundary condition can be satisfied exactly. It can be used to predict aerodynamic characteristics of wings having partial leading-edge separation. A calculation was for a slender delta wing with complete leading-edge separation and the results are compared with those of the experimental data. The comparison shows that QVLM can give satisfactory or reasonable results. Author

N85-21424# Joint Publications Research Service, Arlington, Va.
CALCULATION OF THE FLOW AROUND THICK WINGS WITH SEPARATION VORTICES Abstract Only
P. ZHU *In its* China Rept.: Sci. and Technol. (JPRS-CST-85-008) p 93 27 Mar. 1985 Transl. into ENGLISH from Kongqidonglixue Xuebao (China), no. 4, 1984 p 27-33
Avail: NTIS HC A07/MF A01

A panel method predicting the nonlinear aerodynamic loads on thick wings with separation vortices is developed. The model used is simple and visual. The method can be used for arbitrary planform wings with different profiles. A planar quadrilateral panel and a panel that consists of a parallelogram and four triangles are used. In order to obtain a high degree of accuracy, the wing is represented by piecewise continuous quadratic doublet sheet distributions. The computed aerodynamic loads on the rectangular and sweepback wings agree well with experimental tests and other theories. Author

N85-21426# Joint Publications Research Service, Arlington, Va.
AN EXPERIMENTAL INVESTIGATION OF FLAP TURBULENT HEAT TRANSFER AND PRESSURE CHARACTERISTICS IN HYPERSONIC FLOW Abstract Only
R. GAO *In its* China Rept.: Sci. and Technol. (JPRS-CST-85-008) p 95 27 Mar. 1985 Transl. into ENGLISH from Kongqidonglixue Xueabo (China), no. 4, 1984 p 56-60
Avail: NTIS HC A07/MF A01

Experimental results are given of flap heat transfer and pressure characteristics on a blunt cone in a shock tunnel. Effects of flap deflection angle, angle of attack, Mach number and unit Reynolds number are discussed. Results show that the flap deflection angle and Mach number are decisive factors which considerably affect the flap heating, pressure characteristics and control effectiveness. A correlation between peak heating and peak pressure is given as well as an empirical formula for estimating peak heating.
Author

03

AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

A85-27364#
ELECTROIMPULSE DEICING NEARS OPERATION
R. DEMEIS Aerospace America (ISSN 0740-722X), vol. 23, March 1985, p. 40-42, 44.

Coils distributed in an air gap behind a wing leading edge and fed EM pulses offer a 99 percent reduction in energy consumption compared to engine bleed-air deicers. The electroimpulse coils, fed from a high-voltage capacitor bank, generate rising and falling EM fields which induce eddy currents in the metal skin. A 1000 g repulsive force arises between the skin and coils, lasts 0.5 msec, moves the skin 0.004 in., and shatters ice. Coils can be refired after a 3-5 sec recharge and detach the cracked ice. Metal doublers must be attached inside composite wing leading edges. NASA tests have indicated that the pulses must be tuned to the second natural mode of the skin to achieve positive results. Electroimpulse deicers have been successfully tested on small private aircraft, a 767 wing, helicopter rotors and an engine nacelle inlet. M.S.K.

A85-27366#
SOLVING THE PILOT'S WIND-SHEAR PROBLEM
R. F. STENGEL (Princeton University, Princeton, NJ) Aerospace America (ISSN 0740-722X), vol. 23, March 1985, p. 82-85.

New data gathering, treatment and communications equipment are needed to alert pilots to the presence of microbursts, which present pilots with situations which often require counter-intuitive actions in order to maintain control of an aircraft. Microburst phenomena comprise complex wind shear and velocity time-derivative features that affect the aeroelastic and flight-path responses of an aircraft. Data collected during the JAWS meteorological experiment contain sufficient definition to establish an expert data base for recognizing the onset of microbursts and other combined wind shear/heavy rain situations, and comparing their severity with a set of criteria for the aircraft's flight envelope. Further research is needed on characterizing the appropriate control laws to implement when the microbursts are detected and providing a pilot wiht a recommended sequence of actions.
M.S.K.

A85-27529#
COCKPIT REQUIREMENTS FOR WEATHER INFORMATION AND DATA LINK MESSAGES
P. W. CLYNE (Air Line Pilots Association International, Washington, DC) IN: Radio Technical Commission for Aeronautics, Annual Assembly Meeting and Technical Symposium, Washington, DC, November 15-17, 1983, Proceedings . Washington, DC, Radio Technical Commission for Aeronautics, 1984, p. 107-115.

The present investigation is concerned with the weather information needed by a pilot who attempts to operate in aircraft beyond the traffic pattern of his local airport, in other than perfect C-A-V-U (clear above - visibility unlimited) weather. Weather conditions which cause problems to pilots are considered, taking into account the limitations of present detection and information systems. Such weather conditions can be related to convective weather, orographically generated turbulence both high and low altitude, and low level wind shear and terminal area problems. Attention is given to the danger zones in the case of operation in or near a thunderstorm, the aid provided by the development of the Next Generation Doppler Weather Radar (NEXRAD) to pilots in their attempts to avoid dangerous weather, mountain wave, high and low altitude CAT, details regarding the weather information available to pilots, and the display of weather information on a screen in new aircraft. G.R.

A85-28028#
OVERVIEW OF ICING RESEARCH AT ONERA
D. P. GUFFOND, J. J. CASSAING, and L. S. BRUNET (ONERA, Chatillon-sous-Bagneux, Hauts-de-Seine, France) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 23rd, Reno, NV, Jan. 14-17, 1985. 8 p. refs
(AIAA PAPER 85-0335; ONERA, TP NO. 1985-4)

The state-of-the-art in ONERA numerical modeling and wind tunnel experimentation on airfoil icing-deicing is outlined. Two-dimensional codes have been developed to calculate impingement in terms of air velocity on an airfoil with singularities and in the form of a finite element method which includes spherical droplets acting independent of drag forces. Singularities are also considered in three-dimensional flowfield modeling, particularly when the predictions can be matched with data from aircraft nose probes. Ice growth is computed as a function of thermodynamic balances. The models reduce the need for flight tests of aircraft with electrical deicers. Wind tunnels have been used to study ice shapes, temperature, velocity, liquid water content and rotation effects on ice formation on helicopter blades and the effects of the ice on the aerodynamic coefficients. Finally, ultrasonic and microwave sensors are being developed to measure ice thickness at a given moment. M.S.K.

A85-28640
LEAR FAN MODEL 2100 EMERGENCY EGRESS SYSTEM
G. S. HARRISON (Lear Fan, Ltd., Reno, NV) IN: Flight testing today: Innovative management and technology; Proceedings of the Fourteenth Annual Symposium, Newport Beach, CA, August 15-19, 1983 . Lancaster, CA, Society of Flight Test Engineers, 1983, p. 3.2-1 to 3.2-5.

This paper describes the flight crew emergency egress system developed for the Lear Fan Model 2100 developmental flight test program. Because of the extensive use of composite materials for primary structure, a radically unconventional propulsion system and unique 'Y' tail, pusher propeller configuration, conventional general aviation provisions for flight crew escape from a damaged or out-of-control airplane were considered to be inadequate. After establishing design objectives and criteria and considering several alternative systems, a rocket extraction system was selected, designed, tested and installed in prototype airplanes. Author

A85-28642
NATURAL ICING FLIGHT TESTS OF THE BEECH MODEL F90-1 PROTOTYPE
B. E. MEE (Beech Aircraft Corp., Wichita, KS) IN: Flight testing today: Innovative management and technology; Proceedings of the Fourteenth Annual Symposium, Newport Beach, CA, August 15-19, 1983 . Lancaster, CA, Society of Flight Test Engineers, 1983, p. 3.4-1 to 3.4-9.

A description is presented of the results of flight tests conducted in natural icing conditions with the prototype Model F90-1 King Air S/N LA-91. These flight tests were needed to certify the new pitot cowling and PT6A-135A engine installation for flight into icing conditions. For the performance of these tests, the test aircraft was modified to the F90-1 configuration by installing pitot cowlings. Pylons were designed and built to mount the particle measuring equipment, ice detector, and liquid water content sensor below the wings. Ice depth gages were mounted on each wing tip outboard of the wing deice boots. The test aircraft was equipped with standard airframe equipment for flight into icing conditions. Attention is given to the instrumentation, the procedures used during the test, and the results. It was found that the ice protection equipment, including the heated inlet lips and electrically actuated ice vanes, satisfactorily performed their intended function. G.R.

A85-28645
COMMUNITY NOISE TESTING - NEW TECHNIQUES AND EQUIPMENT
M. H. BORFITZ and B. M. GLOVER (Boeing Commercial Airplane Co., Seattle, WA) IN: Flight testing today: Innovative management and technology; Proceedings of the Fourteenth Annual Symposium, Newport Beach, CA, August 15-19, 1983 . Lancaster, CA, Society of Flight Test Engineers, 1983, p. 4.3-1 to 4.3-8.

It is pointed out that all new and derivative large transport aircraft must comply with community noise standards established by the FAA and the ICAO. The aircraft must be tested under prescribed conditions which include specific weather criteria plus aircraft performance and position limits. The aircraft is flown on a planned flight path over an array of microphones. The present investigation is concerned with the development and operation of a community noise testing system of an American aircraft manufacturer, taking into account the utilization of this system in connection with the community noise testing of two airliners built by this manufacturer. The greatly increased use of computer technology has made it possible to obtain a revolutinary upgrade in efficiency of operations and data quality. Attention is given to the test aircraft, the upper atmosphere weather system, the ground station, and the test operation. G.R.

A85-28898*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THE UH-1H HELICOPTER ICING FLIGHT TEST PROGRAM - AN OVERVIEW
R. J. SHAW and G. P. RICHTER (NASA, Lewis Research Center, Cleveland, OH) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 23rd, Reno, NV, Jan. 14-17, 1985. 25 p. Previously announced in STAR as N85-15702. refs
(AIAA PAPER 85-0338)

An ongoing joint NASA/Army program to study the effects of ice accretion on unprotected helicopter rotor aerodynamic performance is discussed. This program integrates flight testing, wind tunnel testing, and analytical modeling. Results are discussed for helicopter flight testing in the Canadian NRC hover spray rig facility to measure rotor aero performance degradation and document rotor ice accretion characteristics. The results of dry wind tunnel testing of airfoil sections with artificial ice accretions and predictions of rotor performance degradation using available rotor performance codes and the wind tunnel data are presented. An alternative approach to conducting future helicopter icing flight programs is discussed. Author

A85-29264#
A 73-FT CROSS PARACHUTE FOR CARGO DELIVERY
W. B. PEPPER, H. LUCERO, P. C. KLIMAS, R. A. KLEIN (Sandia National Laboratory, Albuquerque, NM), and H. E. ANTKOWIAK (U.S. Army, Natick Research and Development Laboratories, Natick, MA) Journal of Aircraft (ISSN 0021-8669), vol. 22, April 1985, p. 343, 344. Army-supported research. Previously cited in issue 11, p. 1498, Accession no. A84-26559.
(Contract DE-AC04-76DP-00789)

A85-30192*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ICING FLIGHT RESEARCH - AERODYNAMIC EFFECTS OF ICE AND ICE SHAPE DOCUMENTATION WITH STEREO PHOTOGRAPHY
K. L. MIKKELSEN, R. C. MCKNIGHT, R. J. RANAUDO (NASA, Lewis Research Center, Cleveland, OH), and P. J. PERKINS, JR. (Sverdrup Technology, Inc., Middleburg Heights, OH) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 23rd, Reno, NV, Jan. 14-17, 1985. 31 p. Previously announced in STAR as N85-18049. refs
(AIAA PAPER 85-0468)

Aircraft icing flight research was performed in natural icing conditions. A data base consisting of icing cloud measurements, ice shapes, and aerodynamic measurements is being developed. During research icing encounters the icing cloud was continuously measured. After the encounter, the ice accretion shapes on the wing were documented with a stereo camera system. The increase in wing section drag was measured with a wake survey probe. The overall aircraft performance loss in terms of lift and drag coefficient changes were obtained by steady level speed/power measurements. Selective deicing of the airframe components was performed to determine their contributions to the total drag increase. Engine out capability in terms of power available was analyzed for the iced aircraft. It was shown that the stereo photography system can be used to document ice shapes in flight and that the wake survey probe can measure increases in wing section drag caused by ice. On one flight, the wing section drag coefficient (c sub d) increased approximately 120 percent over the uniced baseline at an aircraft angle of attack of 6 deg. On another flight, the aircraft drag coefficient (c sub d) increased by 75 percent over the uniced baseline at an aircraft lift coefficient (c sub d) of 0.5. Author

N85-19938# PEER Consultants, Inc., Rockville, Md.
WILDLIFE HAZARDS TO AIRCRAFT CONFERENCE AND TRAINING WORKSHOP: PROCEEDINGS
M. J. HARRISON, ed., S. A. GAUTHREAUX, JR., ed., and L. A. ABRON-ROBINSON, ed. Washington FAA May 1984 363 p refs In ENGLISH; partly in FRENCH Conf. held in Charleston, S.C., 22-25 May 1984
(Contract DTFA01-83-R-11287)
(AD-A148330; FAA/AAS/84-1) Avail: NTIS HC A16/MF A01 CSCL 01B

A wide range of views on how to control wildlife, particularly birds, which create safety hazards are presented. Information is provided on wildlife hazards in both the United States and internationally. Bird strike statistics, airworhtiness of aircraft and engines, identification and tracking of birds, wildlife control techniques, landscaping and airport site selection considerations, compatible land use, solid waste site bird hazards, and case studies in wildlife control are presented.

N85-19939# Thurlow and Associates Environmental Control Consultants Ltd., Ottawa (Ontario).
BIRDS AND AVIATION
V. E. F. SOLMAN *In* PEER Consultants, Inc. Wildlife Hazards to Aircraft Conf. and Training Workshop p 1-7 May 1984 refs
(AD-P004177) Avail: NTIS HC A16/MF A01 CSCL 01C

Bird collisions have caused serious damage to aircraft and loss of human life. Turbine engines are more easily damaged than piston engines. The extent of damage in a collision increases rapidly as speed increases. Environmental management helps reduce the attractions of airports to birds. Bird movement can be studied by radar and periods of birds in the air can be avoided or minimized. B.G.

N85-19940# Federal Aviation Administration, Washington, D.C. Office of Airport Standards.
AVOIDING SERIOUS BIRD STRIKE INCIDENTS
M. J. HARRISON *In* PEER Consultants, Inc. Wildlife Hazards to Aircraft Conf. and Training Workshop p 9-12 May 1984
(AD-P004178) Avail: NTIS HC A16/MF A01 CSCL 01C

Bird hazards to aircraft can create serious inflight emergency conditions if the pilot and crew are not prepared to handle the situation. Aspects of bird strike hazards are examined. A bird-hazard checklist is also included. B.G.

N85-19941# Naval Facilities Engineering Command, Philadelphia, Pa. Applied Biology Program.
DON'T FOWL OUT
H. A. SHULTZ *In* PEER Consultants, Inc. Wildlife Hazards to Aircraft Conf. and Training Workshop p 13-23 May 1984
(AD-P004179) Avail: NTIS HC A16/MF A01 CSCL 01C

Bird strike hazard reports prepared after collisions between birds and Naval aircraft indicate that there are many measures available to pilots which can reduce the risk of future collisions. These include: scheduling flights around peaks of bird activity, avoiding bird habitats, restricting speed at low altitudes, lookout vigilence, visor discipline, aircraft to aircraft and aircraft to control tower communication, preflight briefings, bird strike avoidance training, development of a Bird Aircraft Strike Reduction Plan for each air facility, and good reporting. Author

N85-19942# Civil Aviation Authority, Redhill (England). Safety Data and Analysis Unit.
ACCIDENTS AND SERIOUS INCIDENTS TO CIVIL AIRCRAFT DUE TO BIRSTRIKES
J. THORPE *In* PEER Consultants, Inc. Wildlife Hazards to Aircraft Conf. and Training Workshop p 25-35 May 1984
(AD-P004180) Avail: NTIS HC A16/MF A01 CSCL 01C

Histories of accidents and serious incidents such as double engine ingestion, and holed airframes, for the years 1981 to 1983 are detailed. A summary of all fatal accidents due to bird strikes between 1912 and 1980 is attached. Three groups are included: (1) transport airplanes over 5700 kg (12,500 lb) and executive jets; (2) airplane below 5700 kg; and (3) helicopters. No attempt was made to analyze the information although it is apparent for transport aircraft the critical area is engines and for light aircraft and helicopters the windshield may be critical. B.G.

N85-19943# Civil Aviation Authority, Redhill (England). Safety Data and Analysis Unit.
ANALYSIS OF BIRD STRIKES REPORTED BY EUROPEAN AIRLINES, 1976 - 1980
J. THORPE *In* PEER Consultants, Inc. Wildlife Hazards to Aircraft Conf. and Training Workshop p 37-48 May 1984
(AD-P004181) Avail: NTIS HC A16/MF A01 CSCL 01C

Birdstrikes reported world-wide between 1976 and 1980 by European airlines from 14 countries were analyzed. The analysis of over 7500 strikes includes the annual strike rate for each country, for aircraft types and airports, all based on aircraft movements. It also covers bird species and weights, part of aircraft struck, effect of strike, and cost. Gulls were involved in over 40% of the incidents where the type of bird was known, and that only 1% of bird strikes involves birds of over 4 lbs. The major effects were damage to over 330 engines and the loss of a Boeing 737 aircraft (value $4.5 million). Engineering costs are estimated to be about 16 million US dollars excluding the Boeing 737. Author

N85-19944# Air Force Engineering and Services Center, Tyndall AFB, Fla.
1983 AIR FORCE BIRD STRIKES
R. C. KULL, JR. *In* PEER Consultants, Inc. Wildlife Hazards to Aircraft Conf. and Training Workshop p 49-58 May 1984
(AD-P004182) Avail: NTIS HC A16/MF A01 CSCL 01C

Since 1975, the Air Force Bird/Aircraft Strike Hazard (BASH) Team, located at Tyndall AFB FL, was responsible for maintaining all Air Force bird/aircraft strike data. Information for 1983 was compiled and trends determined in order to better define the extent of the bird/aircraft strike hazard potential. During the 1983 reporting period, there were over 2300 reported bird strikes costing more than $4 million. In addition, one major and several minor personnel injuries resulted from windshield/canopy penetrations by birds. Trends in the Air Forces' bird strike occurrences are identified and the continual need for reporting all bird strikes are emphasized. Author

N85-19945# German Board for Birdstrike Prevention, Traben-Trarbach (West Germany).
WORLDWIDE BIRDSTRIKE STATISTICS OF LUFTHANSA GERMAN AIRLINES
J. HILD *In* PEER Consultants, Inc. Wildlife Hazards to Aircraft Conf. and Training Workshop p 59-70 May 1984 refs
(AD-P004183) Avail: NTIS HC A16/MF A01 CSCL 01C

Lufthansa German Airlines register an average number of 328 birdstrikes yearly. The costs of repairs, disregarding subsequent costs due to flight plan changes or cancellations, amount to 1 Mio DM yearly. According to a preliminary estimate damage costs are increasing strongly at the moment. During 1983 the costs amounted to nearly 6.0 Mio DM. Author

N85-19946# Thurlow and Associates Environmental Control Consultants Ltd., Ottawa (Ontario).
BIRDS AND AIRCRAFT ENGINE STRIKE RATES
V. E. F. SOLMAN *In* PEER Consultants, Inc. Wildlife Hazards to Aircraft Conf. and Training Workshop p 71-76 May 1984 refs
(AD-P004184) Avail: NTIS HC A16/MF A01 CSCL 01C

A recent Canadian study involving the years 1977 to 1982 inclusive relates engine bird strike rates to different aircraft types and to different engine locations on similar-sized aircraft. Incidents of engine damage, including simultaneous multi-engine strikes are related to aircraft types and engine locations. The data presented suggest high vulnerability to bird strikes, bird ingestion and related damage in the case of large, quiet, underwing-mounted engines. Much lower strike, ingestion and damage rates are suggested for small, noisy, rear-mounted engines. Where the same engines are used in both locations the strike rates are more than four times greater in the underwing location. Author

N85-19947# Federal Aviation Administration, Washington, D.C. Office of Airport Standards.
REVIEW OF ENGINE INGESTIONS TO WIDE BODY TRANSPORT AIRCRAFT
M. J. HARRISON *In* PEER Consultants, Inc. Wildlife Hazards to Aircraft Conf. and Training Workshop p 77-84 May 1984
(AD-P004185) Avail: NTIS HC A16/MF A01 CSCL 01C

In January 1981, the Federal Aviation Administration's (FAA) Northwest Region raised the issue of dual engine ingestion hazards to large, high bypass turbofan twin engine powered transport aircraft. The issue was whether dual engine failure was likely due to bird ingestions on twin engine aircraft equipped with high bypass turbofan engines. The Northwest Region, whose responsibility is certification of transport category aircraft, initiated a survey through air carriers worldwide, identifying damaging engine ingestions. The FAA's New England Region, who has responsibility for engine certification, initiated a reveiw of engine ingestion data. In April 1981, an ad hoc team was formed to collect and analyze ingestion data. Some of the data are presented and some considerations offered on how bird strike data should be collected and analyzed. Author

N85-19949# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
BIRD IMPACT EVALUATION OF THE F/RF-4 TRANSPARENCY SYSTEM
R. SIMMONS and G. J. STENGER (Dayton Univ., Ohio) *In* PEER Consultants, Inc. Wildlife Hazards to Aircraft Conf. and Training Workshop p 95-105 May 1984 refs Previously announced as N84-26631
Avail: NTIS HC A16/MF A01 CSCL 01C

Birdstrikes to the crew enclosures of USAF F/RF-4 aircraft resulted in major aircraft damages coupled with severe fatal pilot injuries. Analysis of operational bird impact statistical data indicates that the trend of damaging bird impacts of the F-4 is continuing to rise. Impacts to the F-4 transparency system also continue to rise resulting in a continued flight safety risk to the aircraft and the aircrew. A program was started to develop a transparency system for the F-4 aircraft which has four pound, 500 knot bird impact capability. The first step in this program was to experimentally determine the existing transparency system capability by bird impact testing full scale flight hardware. Right impact locations on the windshield and forward canopy were tested to failure with four pound birds. Tests on experimental, laminated windshield side panels were also conducted to investigate the capability of the windshield frame. The baseline birdstrike test results are presented through the use of post test photographs and an impact capability diagram. R.J.F.

N85-19950# Amsterdam Univ. (Netherlands). Inst. for Taxonomic Zoology.
MICROSCOPIC IDENTIFICATION OF FEATHERS IN ORDER TO IMPROVE BIRDSTRIKE STATISTICS
T. G. BROM *In* PEER Consultants, Inc. Wildlife Hazards to Aircraft Conf. and Training Workshop p 107-119 May 1984 refs
(AD-P004187) Avail: NTIS HC A16/MF A01 CSCL 01C

In the period 1960-1983, 1132 bird remains resulting from collisions with aircraft were sent to the Zoological Museum Amsterdam. Before 1978, these remains were identified macroscopically by comparing them with feathers from bird skins. During this period the results strongly depended on the skill of the examiner and on the condition of the feather remains. On average, 26, mostly large remains, were sent annually to the museum, of which 80% could be recognized. The remains received represented roughly 30% of the total number of reported birdstrikes. Thus birdstrike statistics could be easily biased by over-representation of nearly complete bird corpses. In order to improve the existing identification method, a microscopic key to the determination of feather remains was developed, and used in combination with macroscopic methods from 1978 on. From 1976, airfield personnel were convinced of the importance of collecting even the smallest bird remains in and on aircraft. Consequently, the total number of remains sent to the museum strongly increased to some 110 per year. Identification results from 1960-1977 are compared with those from 1978-1983, and the effect of the introduction of the microscopic key on birdstrike statistics is discussed. Author

N85-19951# Clemson Univ., S.C. Dept. of Biological Sciences.
THE USE OF SMALL MOBILE RADARS TO DETECT, MONITOR, AND QUANTIFY BIRD MOVEMENTS
S. A. GAUTHREAUX, JR. *In* PEER Consultants, Inc. Wildlife Hazards to Aircraft Conf. and Training Workshop p 121-132 May 1984 refs
(AD-P004188) Avail: NTIS HC A16/MF A01 CSCL 01C

A mobile research laboratory that was developed for the Electric Power Research Institute (EPRI) to monitor local and migratory movements of birds near transmission lines during the day and at night is described. The mobile laboratory has two small marine radars: a fixed-beam type that can be directed vertically to measure the altitude of migrating birds and a surveillance type that can be used to examine the geographical patterns of movement within a range of a few kilometers. The laboratory is also equipped with an image intensifier for visual studies of bird movements at night.

A closed circuit television system and a video cassette recorder are used to record information from the fixed-beam radar and the image intensifier. A 16-mm movie camera with an electronic shutter control is used to record the display of the surveillance radar. Although the mobile laboratory was designed to study bird movements in the vicinity of transmission lines, it can also be used to gather valuable information on the patterns of bird movements in the vicinity of airports that have potential bird strike problems. R.J.F.

N85-19952# Royal Netherlands Air Force, The Hague. Flight Safety Div.
ON THE ALTITUDINAL DISTRIBUTION OF BIRDS AND BIRD STRIKES IN THE NETHERLANDS
L. S. BUURMA *In* PEER Consultants, Inc. Wildlife Hazards to Aircraft Conf. and Training Workshop p 133-148 May 1984 refs
(AD-P004189) Avail: NTIS HC A16/MF A01 CSCL 01C

Bird strikes, radar observations and visual counts are discussed and used to reconstruct altitudinal distributions of bird movements over the Netherlands. Bird density curves, particularly for the lowest 1000 ft., are urgently needed with respect to solving the problem of a recent rapid increase of bird strike rates due to the intensification of low level training by fighter aircraft. The long range surveillance radars, presently in use to provide data for bird migration warning systems in several West European countries, fail to cover the lowest air layers. This gap may be filled up by field observers and/or small radars. Parallel to visual observations and time lapse film recordings at the long range surveillance radar in NW Holland, a series of altitude measurements was collected. This preliminary study with a tracking radar of the type Flycatcher provided the data to illustrate the problem and its possible solutions. R.J.F.

N85-19953# Fish and Wildlife Service, Sandusky, Ohio.
BLACKBIRDS AND STARLINGS: POPULATION ECOLOGY AND HABITS RELATED TO AIRPORT ENVIRONMENTS
R. A. DOLBEER *In* PEER Consultants, Inc. Wildlife Hazards to Aircraft Conf. and Training Workshop p 149-160 May 1984 refs
(AD-P004190) Avail: NTIS HC A16/MF A01 CSCL 01C

The Red-winged Blackbird (Agelaius phoeniceus) is the most abundant bird in North America today. It is often joined in roosting assemblages by Common Grackles (Quiscalus quiscula), Brown-headed Cowbirds (Molothrus ater), and Starlings (Sturnus vulgaris). The combined populations of these 4 species exceed 500 million birds during the winter roosting season and increase to over 1 billion birds after the young are fledged in summer. In spite of their abundance, they are involved in only about 6% of the bird strikes to aircraft, less than 1/7 the number of strikes caused by the less abundant gulls (Larus spp.). However, the rather infrequent collisions between aircraft and blackbirds or Starlings can be catastrophic, even though these species have less than 10% the weight of most gull species. Because blackbirds and Starlings are prolific and well adapted to modern land-use practices, attempts to eradicate populations at airports through killing will provide only temporary relief. The key to reducing blackbird and Starling activity in the vicinity of airports lies in the elimination of preferred roost sites through habitat modifications and in the reduction of food supplies through changes in agriculture. Author

N85-19955# Service Technique de la Navigation Aerienne, Aix-en-Provence (France).
BIRDS ON AIRPORTS: THE REASON FOR THEIR PRESENCE
M. LATY *In* PEER Consultants, Inc. Wildlife Hazards to Aircraft Conf. and Training Workshop p 171-174 May 1984
Avail: NTIS HC A16/MF A01 CSCL 01C

The factors that make airports attractive to birds are discussed. Food sources, shelter, relative peace, and meteorological conditions are discussed. R.J.F.

N85-19956# Service Technique de la Navigation Aerienne, Aix-en-Provence (France).
THE USE OF FALCONRY AS MEAN TO PERSUADE THE BIRDS TO STAY OUT OF THE AIRPORT VICINITY
M. LATY *In* PEER Consultants, Inc. Wildlife Hazards to Aircraft Conf. and Training Workshop p 175-182 May 1984 In FRENCH
Avail: NTIS HC A16/MF A01 CSCL 01C

Results obtained using the goshawk (Accipiter gentilis) against the herring gulls (Larus argentatus) at the Istre le Tube Airport and the peregrine falcon (Falco pergrinus) against the lapwing at the Toulouse-Blagnac Airport show that falconry can be used with success as a method of discussion around an airport. This is possible on condition that its application takes into account the particular case of the airport considered and the type of undesirable bird. Transl. by A.R.H.

N85-19957# Thurlow and Associates Environmental Control Consultants Ltd., Ottawa (Ontario).
CONTROL OF MAMMALS AT AIRPORTS
N. S. NOVAKOWSKI *In* PEER Consultants, Inc. Wildlife Hazards to Aircraft Conf. and Training Workshop p 183-186 May 1984 refs
(AD-P004192) Avail: NTIS HC A16/MF A01 CSCL 01C

Airport designers and planners, when considering the natural environment within and around the airport, have two options. Those options are: to create as sterile an environment as possible thereby excluding fauna, or to create an aesthetically pleasing environment. Design considerations can be devised to include landscaping models which exclude some mammals and meet aesthetic requirements. Technological means to eliminate or repel mammals from airports such as trapping, chemical repellents, removal of attractants, aversive conditioning, and mechanical or electronic scaring devices are now available and their relative value is reviewed. If the above-mentioned technology is employed, ad hoc measures such as human intervention (patrols) may be considered. This method tends to be costly in terms of man-power and time and is somewhat unreliable as well. The problem of control of mammals exists in many airports, particularly in more isolated areas or in the environs of high productivity wildlife areas. It is a problem which cannot be ignored and whose solution would benefit both human and wildlife interests. R.J.F.

N85-19970# Directorate of Civil Aviation, Copenhagen (Denmark).
THE BIRD STRIKE SITUATION AND ITS ECOLOGICAL BACKGROUND IN THE COPENHAGEN AIRPORT, KASTRUP
In PEER Consultants, Inc. Wildlife Hazards to Aircraft Conf. and Training Workshop p 287-290 May 1984
(AD-P004203) Avail: NTIS HC A16/MF A01 CSCL 01C

The measures taken at Copenhagen Airport to reduce the bird strike problem during the last 20 years are described. Apart from shooting and otherwise scaring away the birds, the ecological countermeasures are presented. They include a change of the agricultural areas of the airport into grass fields with the grass cut to a length of about 20 cm, a close down of a large dump west of the airport, and measures against a very large breeding colony on the island of Saltholm. The measures at the island include spraying of the nests in the colony with an emulsion of oil and water with the result that the colony production of young birds has diminished. Further, it includes killing of the birds. The use of long grass has caused an increase in mice and as a result hereof an increase in kestrels involved in bird strikes. R.S.F.

N85-19971# Greater Orlando Aviation Authority, Fla.
BIRD CONTROL PROGRAM ORLANDO INTERNATIONAL AIRPORT
E. T. GONZALEZ *In* PEER Consultants, Inc. Wildlife Hazards to Aircraft Conf. and Training Workshop p 291-300 May 1984
(AD-P004204) Avail: NTIS HC A16/MF A01 CSCL 01C

Orlando International Airport's bird problem is explained along with a solution to that problem from an airport operations viewpoint. It should be of interest to airport operators with a bird problem

who are considering formulating a bird control program and/or are interested in a program at a large hub airport. A shotgun patrol was established as a scaring technique. R.S.F.

N85-19972# Air Force Engineering and Services Center, Tyndall AFB, Fla.
STAFF ASSISTANCE TO BASES FOR BIRD HAZARDS
R. C. KULL, JR. *In* PEER Consultants, Inc. Wildlife Hazards to Aircraft Conf. and Training Workshop p 301-308 May 1984 refs
(AD-P004205) Avail: NTIS HC A16/MF A01 CSCL 01C

One of the primary functions of the Air Forces' bird/aircraft strike wazard (BASH) team is to assist bases worldwide with their bird hazards. Due to the wide variety of environments of bases, as well as the diverse missions of the aircraft, in-depth staff assistance proves to be a real challenge. Coupled with these difficulties is the added problem of personnel reassignment which does not allow for corporate memory to exist for an extended period of time. To combat these problems, the BASH team has written a BASH guidance package, a base self-inspection checklist, and the handbook on bird management and control. In addition to these publications, the team provides on-site assistance for specific and more difficult situations. Each of these items are described in detail herein. Author

N85-19973# Military Airlift Command, Scott AFB, Ill.
BIRD STRIKE AVOIDANCE SYSTEM FOR DOVER AFB, DELAWARE
P. DESAULNIERS *In* PEER Consultants, Inc. Wildlife Hazards to Aircraft Conf. and Training Workshop p 309-314 May 1984
(AD-P004206) Avail: NTIS HC A16/MF A01 CSCL 01C

The Traffic Control and Landing System (TRACALS) Directorate, Military Airlift Command (MAC/DCF) developed, tested, and implemented an innovative bird strike advisory system for aircraft operations at Dover AFB, DE. With the support and participation of representatives from HQ Air Force Systems Command (AFSC), HQ Air Force Communications Command (AFCC), Rome Air Development Center (RADC), Air Force Engineering and Services Center (AFESC), and the USAF Airlift Center (USAFALCENT), HQ MAC/DCF successfully conducted problem analyses and the evaluation of solution alternatives to alleviate a severely critical instrument flight rule (IFR) safety hazard. The resultant procedures have greatly contributed to diminishing the bird strike hazard in the Dover flying area, and achieved establishment of an effective bird detection/advisory system. System limitations have been identified and are being addressed through equipment enhancements and local community cooperation. Author

N85-19974# Directorate of Civil Aviation, Copenhagen (Denmark).
BIRD STRIKE COMMITTEE EUROPE
In PEER Consultants, Inc. Wildlife Hazards to Aircraft Conf. and Training Workshop p 315-318 May 1984
(AD-P004207) Avail: NTIS HC A16/MF A01 CSCL 01C

The activities of the bird strike committee Europe (BSCE) are summarized. The focuses of the following six working groups of the committee are presented: aerodrome, analysis, bird movement, radar and other sensors, communications, and structural testing of airframes. R.S.F.

N85-19977# Illinois Natural History Survey, Urbana. Section of Wildlife Research.
THE POTENTIAL OF THE NEXRAD RADAR SYSTEM FOR WARNING OF BIRD HAZARDS
R. P. LARKIN *In* PEER Consultants, Inc. Wildlife Hazards to Aircraft Conf. and Training Workshop p 369-379 May 1984 refs
(AD-P004210) Avail: NTIS HC A16/MF A01 CSCL 01C

Flying birds pose a dangerous and costly problem for aviation. Warning pilots of hazardous movements of birds could be available with the next generation weather radar (NEXRAD) currently being developed cooperatively by three U.S. government agencies. For several kinds of bird hazards, it should be feasible to develop computer algorithms to provide automated hazard warnings in real time. Reflectivity, Doppler speed, and differential reflectivity data taken with a prototype 10-cm NEXRAD radar establish the usefulness of NEXRAD for obtaining information on birds. Author

N85-21131# Committee on Science and Technology (U. S. House).
ULTRALIGHT AIRCRAFT TECHNOLOGY AND PUBLIC SAFETY
Washington GPO 1984 159 p refs Hearing before the Subcomm. on Transportation, Aviation and Mater. of the Comm. on Sci. and Technol., 98th Congr., 2nd Sess., No. 111, 21 May 1984
(GPO-38-948) Avail: Subcommittee on Transportation, Aviation and Materials

Regulations of ultralight aircraft (for safety or other purposes) was nonexistent at first and even now is extremely limited. Pilot licenses are not needed and manufacturers of such aircraft are not required to prove that their products are safe, a factor that has kept costs down and led to enhanced appeal to ultralights. Freedom from regulation is a cause for concern because of numerous accidents, apparently due to lack of pilot training or because of structural inadequacies, but mixing ultralights with other traffic in the national airspace clearly constitutes a hazard. The FAA, for its part, recently promulgated regulations to define what ultralights are and to keep them separated from other traffic. But without licensing, there is no way to assure that pilots know about these restrictions. The industry has made some commendable efforts at self regulation. But these are limited in terms of the number they reach and also because they are voluntary. Whether such efforts are enough or whether some more extensive form of federal regulation is needed is considered. And if so, can this be done without ruining a very popular activity? A.R.H.

N85-21132# Committee on Public Works and Transportation (U. S. House).
LEGISLATION TO IMPROVE AIRLINE SAFETY
Washington GPO 1984 602 p refs Hearings on H. R. 1333, H. R. 2088, H. R. 2142, H. R. 2636, H. R. 3264, H. R. 3793, H. R. 5428, H. R. 5518, and S. 197 before the Subcomm. on Aviation of the Comm. on Public Works and Transportation, 98th Congr., 2nd Sess., 26 Jul. and 1-2 Aug. 1984
(GPO-38-222) Avail: Subcommittee on Aviation

Hearings were conducted and testimony heard concerning legislation to impose standards for aircraft passenger and crew safety. Topic considered are: (1) standard measures of quantity of fresh air per person and overhaul air quality, quantity and quality of humidification, air conditioning limits, emergency breathing equipment, fire extinguishing, smoke and toxic fume removal with safe pressurized limits, and safe pressurization; (2) the deployment and use of on-craft emergency medical equipment and supplies, to include drugs, and their administration by qualified personnel; and (3) the requirement that all commercial aircraft provide high-buoyancy life vests. Various experts were heard and their testimony considered. G.L.C.

N85-21133# Federal Aviation Agency, Atlantic City, N.J.
SUPPRESSION AND CONTROL OF CLASS C CARGO COMPARTMENT FIRES Final Report, Aug. 1983 - Jun. 1984
D. R. BLAKE Feb. 1985 32 p refs
(FAA/CT-84-21) Avail: NTIS HC A03/MF A01

A total of 23 fire tests were conducted in a 2357-cubic foot simulated class C cargo compartment. Various lining materials, fire sources, loading configurations, and smoke detectors were used to determine the ability of class C cargo compartments to control fires. The simulated class C cargo compartment did not successfully control the test fires in all cases. The major conclusion is that the 45 deg bunsen burner test specified in FAR 25.855 does not assure that cargo liners will not burn through when subjected to realistic fires. R.J.F.

N85-21134# National Transportation Safety Board, Washington, D. C. Bureau of Safety Programs.
ANNUAL REVIEW OF AIRCRAFT ACCIDENT DATA: US AIR CARRIER OPERATIONS CALENDAR YEAR 1981
1 Feb. 1985 107 p
(NTSB/ARC-85/01) Avail: NTIS HC A06/MF A01

A record of aviation accidents involving revenue operations of U.S. Air Carriers for calendar year 1981 are presented. Accidents involving commuter air carriers and on demand air taxis are included in this publication. In 1979 and prior years, these accidents were reported in annual reviews of general aviation accidents. Reporting is divided into two sections, according to the federal regulations under which the flight was conducted--14 CFR 121 or 14 CFR 135. For 14 CFR 135 accidents, the reporting is divided further by the type of service provided - scheduled or nonscheduled. In each section, tables are presented to describe the losses and characteristics of 1981 accidents to enable comparison with prior years. Author

N85-21135*# National Aeronautics and Space Administration, Washington, D. C.
AEROSPACE SAFETY ADVISORY PANEL Annual Report, 1983
Jan. 1984 80 p
(NASA-TM-87428; NAS 1.15:87428) Avail: NTIS HC A05/MF A01 CSCL 13L

An assessment of NASA's safety performance for 1983 affirms that NASA Headquarters and Center management teams continue to hold the safety of manned flight to be their prime concern, and that essential effort and resources are allocated for maintaining safety in all of the development and operational programs. Those conclusions most worthy of NASA management concentration are given along with recommendations for action concerning; product quality and utility; space shuttle main engine; landing gear; logistics and management; orbiter structural loads, landing speed, and pitch control; the shuttle processing contractor; and the safety of flight operations. It appears that much needs to be done before the Space Transportation System can achieve the reliability necessary for safe, high rate, low cost operations. A.R.H.

04

AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

A85-26428#
THE ENIGMA OF FALSE BIAS DETECTION IN A STRAPDOWN SYSTEM DURING TRANSFER ALIGNMENT
I. Y. BAR-ITZHACK (Technion - Israel Institute of Technology, Haifa, Israel) and Y. VITEK (Rafael Armament Development Authority, Haifa, Israel) (Guidance and Control Conference, Seattle, WA, August 20-22, 1984, Technical Papers, p. 1-8) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 8, Mar.-Apr. 1985, p. 175-180. Previously cited in issue 21, p. 2991, Accession no. A84-43402. refs

A85-26440#
DIGITAL HOMING GUIDANCE - STABILITY VS PERFORMANCE TRADEOFFS
F. W. NESLINE, JR. and P. ZARCHAN (Raytheon Co., Missile Systems Div., Bedford, MA) (Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, Collection of Technical Papers, p. 30-38) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 8, Mar.-Apr. 1985, p. 255-261. Previously cited in issue 19, p. 2795, Accession no. A83-41663. refs

A85-26606
SPECTRAL CHARACTERISTICS OF RADAR ECHOES FROM AIRCRAFT-DISPENSED CHAFF
W. J. ESTES, R. H. FLAKE (Texas, University, Austin, TX), and C. C. PINSON (Pinson Associates, Inc., Austin, TX) IEEE Transactions on Aerospace and Electronic Systems (ISSN 0018-9251), vol. AES-21, Jan. 1985, p. 8-20. refs
(Contract DAAD07-82-C-0230)

Experimental amplitude and phase measurements of radar echoes from chaff both in the wake of the dispersing aircraft (new chaff) and after the aircraft has left the area (mature chaff) are described. UHF and X-band coherent radars are used to obtain experimental data for both continuously-dispensed chaff and discrete chaff units. The mean radial velocity nu-0 and the velocity standard deviation sigma-nu of the chaff cloud are estimated from complex-envelope spectral density estimates. For mature chaff, sigma-nu ranges from 0.3 to 1.2 per ms. For new chaff, both sigma-nu and nu-0 depend on the position in the wake. At 150 m behind the aircraft, sigma-nu varies from 2.0 to 2.7 per ms and at 450 m, sigma-nu varies from 0.8 to 1.5 per ms. No apparent correlation between the magnitude of sigma-nu and either radar frequency or chaff type is found. An expression is derived which shows the effect of conical scanning on the complex envelope spectral density. Author

A85-26609
AN ALGEBRAIC SOLUTION OF THE GPS EQUATIONS
S. BANCROFT (King Radio, Olathe, KS) IEEE Transactions on Aerospace and Electronic Systems (ISSN 0018-9251), vol. AES-21, Jan. 1985, p. 56-59.

Ordinarily, the global positioning system (GPS) equations are solved by means of a procedure involving an application of Newton's method or a variant of this method. The present investigation is concerned with a new method of solution which is algebraic. User and satellite position coordinates in a convenient earth-centered Cartesian coordinate system are considered along with the pseudorange measurements taken by the user from each of the n satellites. Attention is given to the definition of 1 x 4 column data vectors (a), the definition of the Minkowski functional for four-space, the matrix A, the generalized inverse B, the weighting matrix W, the solution of a quadratic, the solution of the GPS problem, and an approach for distinguishing the actual solution. G.R.

A85-26678
OVERVIEW OF WEAPON ASSESSMENTS IN AN ELECTROMAGNETIC ENVIRONMENT
W. G. DUFF and C. B. SYKES (Atlantic Research Corp., Alexandria, VA) IN: International Symposium on Electromagnetic Compatibility, 25th, Arlington, VA, August 23-25, 1983, Symposium Record . New York, Institute of Electrical and Electronics Engineers, Inc., 1983, p. 231-236.
(Contract F30602-82-C-0122; F30602-80-C-0191)

This paper provides an overview of an approach that may be used to provide a realistic assessment of the vulnerability of an electronically guided weapon system to the electromagnetic environment, both friendly and hostile, that may be encountered in the performance of various intended missions. An overall approach to the vulnerability assessment problem is presented. The approach described is based on forecasts of the electromagnetic environment, measurements of the susceptibility of weapon systems to electromagnetic radiation, and weapon systems flight simulation. Author

A85-26679#
EMV ASSESSMENT METHODOLOGY FOR NAVY GUIDED WEAPONS
R. A. AMADORI and O. M. CORDER, JR. (U.S. Navy, Naval Surface Weapons Center, Dahlgren, VA) IN: International Symposium on Electromagnetic Compatibility, 25th, Arlington, VA, August 23-25, 1983, Symposium Record . New York, Institute of Electrical and Electronics Engineers, Inc., 1983, p. 241-245.

It is pointed out that the purpose of a system level electromagnetic vulnerability (EMV) test is to evaluate the ability of the system to operate in its tactical launch-to-target electromagnetic environment (EME). The test involves the exposure of the system to the threat level free space environment while its electronics are being exercised. The basic elements of the EMV evaluation facility considered include a shielded anechoic test chamber, sources of RF interference, targets, and an instrumentation system. The instrumentation system consists primarily of a telemetry ground station, strip chart recorders, an analog recorder, a computer system, and other support instruments. A worst case approach is used during the conduction of an EMV test program. G.R.

A85-26806
MAINTENANCE TEST REQUIREMENTS OF SPREAD SPECTRUM CNI SYSTEMS
M. B. MODROW (Rockwell International Corp., Collins Government Avionics Div., Cedar Rapids, IA) IN: AUTOTESTCON '83; Proceedings of the Conference, Fort Worth, TX, November 1-3, 1983 . New York, Institute of Electrical and Electronics Engineers, Inc., 1983, p. 222-225.

The test requirements of several spread-spectrum Communications-Navigation Identification (CNI) systems, presently in use or scheduled for deployment during the next decade, are examined. Particular attention is given to performing intermediate level maintenance using a minimum of unique test equipment resources. Various test configurations are presented, and several methods for reducing test equipment complexity are suggested. V.L.

A85-27510
DUAL CONTROL GUIDANCE FOR SIMULTANEOUS IDENTIFICATION AND INTERCEPTION
K. BIRMIWAL and Y. BAR-SHALOM (Connecticut, University, Storrs, CT) Automatica (ISSN 0005-1098), vol. 20, Nov. 1984, p. 737-749. refs
(Contract AF-AFOSR-80-0098)

An adaptive dual-control guidance algorithm is presented for intercepting a moving target in the presence of an interfering target (decoy) in a stochastic environment. Two sequences of measurements are obtained at discrete points in time; however, it is not certain which sequence came from the target of interest and which from the decoy. Associated with each track, the interceptor also receives noisy, state-dependent feature measurements. The optimum control for the interceptor which is given by the solution of the stochastic dynamic programming equation is not numerically feasible to obtain. An approximate solution of this equation is obtained by evaluating the value of the future information gathering. This is done through the use of preposterior analysis - approximate prior probability densities are obtained and used to describe the future learning and control. In this way, the interceptor control is used for information gathering in order to reduce the future target and decoy inertial measurement errors and enhance the observable target/decoy feature differences for subsequent discrimination between the true target and the decoy. Simulation studies have shown the effectiveness of the scheme. Author

A85-27528#
THE PLAN FOR AN INTEGRATED FAA SURVEILLANCE AND WEATHER SYSTEM
N. A. BLAKE (FAA, Washington, DC) IN: Radio Technical Commission for Aeronautics, Annual Assembly Meeting and Technical Symposium, Washington, DC, November 15-17, 1983, Proceedings . Washington, DC, Radio Technical Commission for Aeronautics, 1984, p. 89-105.

It is pointed out that the Federal Aviation Administration's 'National Airspace System Plan' established a number of commitments relating to the modernization of the FAA surveillance and weather systems. The key commitments include a replacement of the Air Traffic Control Radar Beacon System (ATCRBS) by the mode S beacon system, a new weather radar network for the ATC system, the implementation of the Automated Flight Service Station System, direct pilot access to weather information, and the implementation of Automated Weather Observing System (AWOS) at a number of airports. A description of the current surveillance and weather system is presented. Improvement of the current system will involve development of a nationwide network of surveillance and weather radars. By 1990, the number of joint-use civil-military radars providing information to FAA ATC facilities will be expanded. The major elements of the future surveillance and weather systems are considered, giving attention to air route surveillance radars, terminal Doppler radar, and flight service station automation. G.R.

A85-27533#
FUTURE COMMUNICATIONS/NAVIGATION/SURVEILLANCE REQUIREMENTS FOR DEPARTMENT OF DEFENSE AIR TRANSPORT OPERATIONS
R. D. DELAUER (U.S. Department of Defense, Washington, DC) IN: Radio Technical Commission for Aeronautics, Annual Assembly, Meeting and Technical Symposium, Washington, DC, November 15-17, 1983, Supplement . Washington, DC, Radio Technical Commission for Aeronautics, 1984, p. 5, 7-12.

The present paper is concerned with requirements falling in three broad areas. One area involves constraints arising in the DOD in relation to an adaptation to civil aviation initiatives. Some of these constraints are common to civil users and define to a large extent the time required to move to new systems. A second area is concerned with the capabilities which DOD would like to see in the future communications, navigation, and surveillance architecture. Finally, contributions are addressed which the Department of Defense can and is making in these areas. The principal constraints are related to interoperability, wartime utility, and affordability. The advantages of civil/military agreement is considered, taking into account the support of DOD for the civil Microwave Landing system and the use of GPS for solving civil navigation needs. DOD feels that it can and does make major contributions to fulfilling civil communications, navigation, and surveillance requirements. G.R.

A85-27605
INTEGRATION OF ADVANCED DISPLAYS, FMS, SPEECH RECOGNITION AND DATA LINK
R. R. NEWBERY (Royal Aircraft Establishment, Bedford, England) Journal of Navigation (ISSN 0020-3009), vol. 38, Jan. 1985, p. 37-49. refs

Recent results achieved by the UK research program on civil avionics at RAE Bedford are reviewed. Attention is given to: the development of quantitative standards for navigation accuracy; the integration of color CRT displays in onboard flight management systems (FMS); and refinements in time recognition and speech control techniques. The main components of an advanced data-link for future FMS on the ground and on the air are described, including: computer confirmation of ATC clearance; position, velocity and bank angle data; identification of Navaids, and the estimation of meteorological data for an entire route. A series of photographs of current CRT navigation displays is provided. I.H.

A85-27606
FMS AIRLINE EXPERIENCE TO DATE
T. C. R. GUEST (British Airways, Hounslow, Middx., England) Journal of Navigation (ISSN 0020-3009), vol. 38, Jan. 1985, p. 49-52; Discussion, p. 52-55.

Current flight management systems (FMS) computer technology incorporated into aircraft in the United Kingdom is considered. The integration with other hardware on the TriStar, 747, and 757 aircraft is described. The benefits of FMS systems are discussed, with reference to the professional experience of several commercial aircraft pilots. Among the benefits identified are: decreased pilot workload; improved navigational accuracy, and reduced fuel consumption. I.H.

A85-27607
SATELLITE NAVIGATION SYSTEMS FOR THE USSR MERCHANT MARINE
A. IAKUSHENKOV (Marine Research Institute, Leningrad, USSR) Journal of Navigation (ISSN 0020-3009), vol. 38, Jan. 1985, p. 118-122.

The application of satellite navigation aids in the USSR merchant marine fleet is discussed. The economic advantages of a satellite navigation system for merchant marine vessels are examined with respect to running-time savings; fuel economy; and reductions in the number of accidents. The low-orbiting satellite navigation systems currently in use in the USSR merchant marine are the Tsikada system and the Skhuna system. The operational frequencies and time references of the systems are given. The possible applications of middle-orbiting satellites to merchant marine navigation are also discussed. I.H.

A85-27832
DESIGN OF A NEW AIRPORT SURVEILLANCE RADAR (ASR-9)
J. W. TAYLOR, JR. and G. BRUNINS (Westinghouse Defense and Electronics Systems Center, Baltimore, MD) IEEE, Proceedings (ISSN 0018-9219), vol. 73, Feb. 1985, p. 284-289. refs

The 'ASR-9' marks a significant departure from earlier airport surveillance radar (ASR) designs. Major operational benefits are realized by applying modern digital technology and advanced processing concepts. It is evolutionary in that it retains the desirable features of its predecessors. This paper will focus on the principal characteristics that make its design unique, including: aircraft detection in clutter, range resolution, azimuth resolution, weather contouring, and remote performance monitoring and control characteristics. Author

A85-27833
AIRPORT SURFACE DETECTION EQUIPMENT
C. E. SCHWAB and D. P. ROST (Cardion Electronics, Woodbury, NY) IEEE, Proceedings (ISSN 0018-9219), vol. 73, Feb. 1985, p. 290-300. FAA-sponsored research. refs

A special-purpose, high-resolution, radar that maps the airport surface has proved a useful tool to monitor aircraft movements under conditions of poor visibility. Such radars are referred to as ASDE (Airport Surface Detection Equipment). The rationale for the design and critical parameter selection for the ASDE-3 is presented. Key features of the chosen design are a rotodome with variable focus antenna, frequency-agile TWT transmitter, and a digital scan converter. Each feature brought specific and significant improvement to the system performance and these improvements are discussed in some depth. Author

A85-27834
MEDIUM PRF FOR THE AN/APG-66 RADAR
W. H. LONG, III and K. A. HARRIGER (Westinghouse Defense and Electronics Systems Center, Baltimore, MD) IEEE, Proceedings (ISSN 0018-9219), vol. 73, Feb. 1985, p. 301-311.

This paper discusses the medium pulse repetition frequency (PRF) pulse doppler mode of the AN/APG-66, the multimode fire control radar for the F-16A/B aircraft. This radar is currently in production and as of January 1984 over 1700 have been delivered. Included is a discussion of the three PRF types: high, low, and medium PRF, leading to the conclusion that for an airborne, look-down application the medium PRF waveform is the best choice. System tradeoffs between a high peak power and a low peak power transmitter are discussed which show that when only a medium PRF waveform is required, the high peak power transmitter yields better performance. Some system design considerations concerning the PRF selection and sidelobe clutter are also included. Finally, the radar mechanization is presented. The AN/APG-66 radar in general, and its medium PRF mode in particular, have undergone extensive operational evaluation and the results have been excellent. The radar has met or exceeded its performance design specifications and the field reliability has been outstanding. For example, for the year 1983 the MTBF was 102.9 h based on 64,204 operating hours from two operational air bases. Author

A85-27835
AIRBORNE EARLY WARNING RADAR
J. CLARKE (Royal Signals and Radar Establishment, Malvern, Worcs., England) IEEE, Proceedings (ISSN 0018-9219), vol. 73, Feb. 1985, p. 312-324. refs

Airborne Early Warning (AEW) Radar meets the operational requirement of detection and tracking of both low- and high-flying aircraft. The important and fundamental radar parameters of RF, PRF, pulse length, and transmitter power are discussed together with a number of factors relating to the antenna. An overview of the modern fixed-wing systems Nimrod AEW, E-2C Hawkeye, and E-3A AWACS currently in service is given together with a description of other AEW systems, including the Sea King helicopter AEW. Some speculation on topics of relevance to AEW radar in the future is given. Author

A85-27837
MULTIFUNCTION ROTATING ELECTRONICALLY SCANNED RADAR (RESR) FOR AIR SURVEILLANCE
D. A. ETHINGTON, P. J. KAHRILAS, and G. D. WRIGHT (Hughes Aircraft Co., Ground Systems Group, Fullerton, CA) IEEE, Proceedings (ISSN 0018-9219), vol. 73, Feb. 1985, p. 340-354. refs

The system technical features of a new class of multifunction rotating electronically scanned radar systems (RESRs), that electronically scan in both azimuth and elevation while rotating in azimuth, are described in terms of satisfying modern air defense needs. A brief comparison to classical radar solutions is followed by use of an illustrative example to indicate quantitatively as well as qualitatively the advantages inherent in an RESRS design. The concluding portion of the paper contains descriptions and photographs of a modern class of recently fielded RESRSs for tactical air surveillance. Author

A85-27845
AUTOMATED TESTING SPEEDS EW RECEIVER EVALUATION
K. J. ALLEN and J. B. Y. TSUI (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) Microwaves & RF (ISSN 0745-2993), vol. 24, March 1985, p. 113-116, 118.

The manual evaluation of radar intercept receivers is very laborious and requires much time, while the obtained information is often of marginal value. For this reason, the present study is concerned with the development of an automated test system and associated test procedures which drastically reduce the time required for testing, with no loss of accuracy. The parameters evaluated by the automated system include accuracy. The parameters evaluated by the automated system include accuracy of frequency measurement, pulse amplitude accuracy, pulse width accuracy, sensitivity, one-signal spur-free dynamic range, two-signal spur-free dynamic range, and two-signal instantaneous dynamic range. G.R.

A85-27847
THE INTERCEPTOR RADAR EVOLVES AS A SENSOR
P. W. SPOONER (GEC Avionics, Ltd., Milton Keynes, Bucks., England) Microwaves & RF (ISSN 0745-2993), vol. 24, March 1985, p. 127-130. Research supported by the Ministry of Defence (Procurement Executive) of England.

It is pointed out that despite significant advances in infrared and laser techniques, radar is still the key sensor in air defense. The airborne interceptor radar considered in the present investigation is an integral part of a complete weapon system which generally includes medium-range radar-guided missiles, short-range infrared or heat-seeking missiles, and a gun. The air defense task is concerned with a threat which comprises numerous all-altitude, well-armed, agile aircraft. Normally, these aircraft will approach at very low altitude to avoid detection by ground-based radar. The approach will occur at high speed in an effort to penetrate the defensive cordon before it can react. It will, therefore, be necessary for the airborne interceptor radar to detect low-flying aircraft at the longest range possible, normally 50 to 100 naut. mi. The functions of the radar and their implementation are considered, taking into account variations on mission, changing roles, and the emergence of the concept of reconfigurable subsystems. G.R.

A85-27848
DESIGN DECISIONS GUIDE AIRBORNE RADAR
J. F. ROULSTON (Ferranti, PLC, Radar Systems Dept., Edinburgh, Scotland) Microwaves & RF (ISSN 0745-2993), vol. 24, March 1985, p. 131-135. refs

For a long time, the designers of pulse-Doppler airborne radar had to make a choice between required and desired features on the one hand, and available and affordable technology on the other. In the early seventies, systems with more advanced capabilities became possible as a result of developments related to digital processing, array antennas, integrated microwave circuits, and travelling-wave amplifier tubes. The operational roles of multimode radar expanded to include close aerial combat, reconnaissance and navigation, air-to-surface weapon delivery, and flight direction and control. The multimode radar concept was consolidated as a result of technological advances in the early eighties. It is pointed out that today the architecture of the multimode radar sensor is firmly established as a transducer-computer combination. Attention is given to details regarding the design of the multimode radar sensors, the operation of the pulse-Doppler radar, air-to-air and air-to-ground modes, and subsystems' requirements. G.R.

A85-28604
DIGITAL SIMULATION OF ADAPTIVE GUIDANCE AND CONTROL SYSTEM OF A HOMING MISSILE
C.-F. LIN (Wisconsin, University, Madison, WI) IN: Summer Computer Simulation Conference, 15th, Vancouver, Canada, July 11-13, 1983, Proceedings. Volume 1 . La Jolla, CA, Society for Computer Simulation, 1983, p. 224-229. Research supported by the University of Wisconsin. refs

In this paper, new high-performance surface-to-air and air-to-air missile systems are designed using symmetric configuration with bank-to-turn (BTT) concept and ramjet or even the integrated rocket and ramjet (IRR) engines in the analysis of the missile airframe propulsion systems. The design includes advanced guidance and control concepts and innovative applications of modern control theory such as optimal control, adaptive control and estimation algorithms, to tactical and strategic rocket-powered and ramjet-powered BTT missiles. On-line parameter identification and state estimation algorithms are included in the missile adaptive guidance and control system. Author

A85-28607
MODELING AND SIMULATION IN MISSILE TARGET TRACKING
C.-F. LIN (Wisconsin, University, Madison, WI) IN: Summer Computer Simulation Conference, 15th, Vancouver, Canada, July 11-13, 1983, Proceedings. Volume 1 . La Jolla, CA, Society for Computer Simulation, 1983, p. 293-295. Research supported by the University of Wisconsin. refs

Today, missile targets are becoming more intelligent. They employ optimal evasive maneuvers to escape from tracking missiles and may even deceive the missiles through electronic countermeasures (ECM). This paper discusses the missile target tracking system in relation to its environment, i.e., targets and clutter, and the necessary steps to take in modeling and simulating a tracking scenario involving missile dynamics, multiple targets and their signal returns, radio frequency (RF) environment, ECM, and clutter. In addition, the paper discusses the various target tracking methods and makes comparisons of their tracking efficiency. Author

A85-28794
INVESTIGATION OF MODERN FLIGHT-CONTROL PROBLEMS WITH REGARD TO MINIMAL FUEL CONSUMPTION, WITH CONSIDERATION OF ARRIVAL-TIME LIMITATIONS, AIR-TRAFFIC DENSITY, AND ONBOARD REAL-TIME COMPUTATION [UNTERSUCHUNG MODERNER FLUGFUEHRUNGSPROBLEME IM HINBLICK AUF MINIMALEN TREIBSTOFFVERBRAUCH UNTER BERUECKSICHTIGUNG VON ENDZEITSCHRANKEN, LUFTVERKEHRSDICHTE UND ANBORD-ECHTZEITBERECHNUNG]
P. PAGLIONE Muenchen, Technische Universitaet, Fakultaet fuer Maschinenwesen, Dr.-Ing. Dissertation, 1984, 169 p. In German. Research supported by the Instituto Tecnologico de Aeronautica. refs

Computer algorithms for the real-time onboard determination of optimal flight trajectories are developed to permit commercial jet aircraft to minimize fuel consumption from the point at which the airport ATC facility informs the pilot of the time delay required (due to airport capacity overload) to the beginning of the final approach. The energy-change approach of Barman and Erzberger (1976) is used to identify a set of cost-optimal trajectories for the given distance, and the trajectory with the appropriate arrival time is then selected, avoiding the time and memory-intensive two-point boundary-value problem. Sample results are presented in graphs, and the program printouts are included in appendices. T.K.

A85-29124
GLIDESLOPE DESCENT-RATE CUING TO AID CARRIER LANDINGS
G. LINTERN (Illinois, University, Savoy, IL; Canyon Research Group, Orlando, FL), C. E. KAUL (U.S. Naval Air Engineering Center, Lakehurst, NJ), and S. C. COLLYER (U.S. Naval Training Equipment Center, Orlando, FL) Human Factors (ISSN 0018-7208), vol. 26, Dec. 1984, p. 667-675. refs

Landing performance of experienced naval aviators was tested in a simulator with a conventional Fresnel Lens Optical Landing System (FLOLS) and also with a modified FLOLS that provided descent-rate error information. The FLOLS, used for guidance during carrier approaches, normally provides only glidescope displacement information. Aircraft dynamics can create substantial lags between an incorrect control input and the resulting FLOLS error indication. Addition of descent-rate error to the FLOLS was intended to compensate for that lag. Two algorithms were tested with the rate displays, and both improved glidescope tracking throughout the approach. Lineup was not adversely affected. Differences between the two experimental displays favored one driven by an algorithm based on the weighted sum of glidescope displacement and descent-rate error versus one driven by an algorithm based on descent-rate error only. Author

A85-29697#
AN INVESTIGATION OF ASSOCIATION REGION IN MANEUVERING MULTI-TARGET TRACKING
H. ZHOU (Chinese Aeronautical Establishment, People's Republic of China) Acta Aeronautica et Astronautica Sinica, vol. 5, Sept. 1984, p. 296-304. In Chinese, with abstract in English. refs

The statistical properties of the innovation-vector norm in the correlation region in one-site multiple-maneuvering-target tracking are investigated by means of Monte Carlo simulations, comparing the performance of three different state models at various target maneuvering accelerations and state-noise variance levels. The results are presented graphically, and the model of Zhou (1983) is found to produce relatively stable innovation-vector-norm mean and mean-square values under all conditions and to be more capable of adapting to target maneuvers than the model of Singer (1970) or the two-state model used by Reid (1979), Singer et al. (1984), and Bar-Shalom and Marcus (1980). T.K.

A85-29873
GENERAL AVIATION AVIONICS - AN OVERVIEW
D. J. HOLT Aerospace Engineering (ISSN 0736-2536), vol. 5, April 1985, p. 10-23.

Microprocessor-based electronic systems are applied to control increasingly larger portions of aircraft flight systems and, in combination with CRT displays, to simplify the pilot workload and cockpit complexity. Aircraft functions such as level flight, navigation and communication formerly, and still to some extent, controlled manually have since 1910 been progressively operated by autopilots, radionavigation beacons, automatic direction finders, computerized measurements of distances to waypoints, electronically sensed compass headings, and instrument landing systems. Digitized data processing permits integration of flight status, weather, aircraft systems status and navigation displays with pushbutton selection of the desired mode. Near-term expected advances are automated interfaces with microwave landing systems and the GPS. M.S.K.

N85-21136# Lincoln Lab., Mass. Inst. of Tech., Lexington.
COLLISION AVOIDANCE FOR NAVAL TRAINING AIRCRAFT
J. W. ANDREWS, R. R. LAFREY, and J. D. WELCH 8 Mar. 1985 38 p Sponsored in part by FAA
(Contract F19628-85-C-0002)
(FAA/PM-84-4; ATC-125) Avail: NTIS HC A03/MF A01

The feasibility of using the FAA's Traffic Alert and Collision Avoidance System (TCAS)1 concept is evaluated. The results of a brief study and flight test activity conducted to that end are discussed. The nature of the mid-air collision problem at the Naval Air Training Center is reviewed. This is followed by a brief analysis of a set of documented collisions and near-miss encounters involving aircraft of Navy Training Air Wing 5 at Whiting Naval Air Station in Florida in 1982 and 1983. Experience gained from flight tests of similar encounters is reviewed and applied to the Navy encounter data base. An aircraft equipped with a TCAS Experimental Unit (TEU) was flown to Whiting Field to evaluate the ability of TCAS I equipment to perform reliable surveillance in the naval training environment. Flight test results show that the environment is quite unlike typical civil environments, but that the TCAS surveillance design would be capable of providing a significant degree of protection to Naval trainers. B.W.

N85-21137# Royal Signals and Radar Establishment, Malvern (England).
THE EVOLUTION OF METHODS OF AIR TRAFFIC CONTROL
P. T. HUMPHREY 1984 14 p
(AD-A149606; RSRE-MEMO-3724; DRIC-BR-93761) Avail: NTIS HC A02/MF A01 CSCL 17G

This Memo proposes a means whereby ATC methods could evolve to take advantage of developments in civil airline avionics and the opportunity of an ATC air-ground data link.
Author (GRA)

N85-21139# Computer Technology Associates, Inc., Englewood, Colo.
OPERATIONS CONCEPT FOR THE ADVANCED AUTOMATION SYSTEM MAN-MACHINE INTERFACE Final Report
M. D. PHILLIPS, K. TISCHER, H. A. AMMERMAN, G. W. JONES, and G. V. KLOSTER 10 Aug. 1984 565 p
(Contract DT-FA01-83-Y-10554)
(AD-A149797; FAA/AP-84-16) Avail: NTIS HC A24/MF A01 CSCL 09B

The 'Operations Concept for the AAS Man-Machine Interface' documents a concept for ACF operations, the tasks of the Controller at various types of sectors, his information processing requirements, and the definition of his dialogue with the system. As such, these represent the operational requirements for the Advanced Automation System (AAS) Controller man-machine interface (MMI). These requirements are defined from the Controller's point of view. Controller tasks are described in terms of message inputs, outputs, dialogue requirements, and operational performance attributes. An assessmment of Controller workload is provided within the framework of human information-processing tasks and associated performance levels by Controller position. The information-processing tasks are considered to include logical (cognitive and perceptual components. These components will of necessity have an impact on the subsequent formation of information coding/presentation requirements, interaction techniques, and high-level dialogue descriptions. The primary objective of this document is to decompose Controller tasks to the level of detail such that the Controller's job is described in terms of: (1) sequences of tasks which respond to a given ATC event; (2) the conceptual dialogue between the Controller and his workstation; (3) interactions with other Controllers, Pilots, Supervisory, and Metering/Flow Control personnel; and (4) information needed by the Controller to successfully execute tasks accurately and in a timely fashion. GRA

N85-21145# Electronic System G.m.b.H., Munich (West Germany).
PROGRAM INNAVSAT: GLOBAL POSITIONING SYSTEM (GPS): TEST AND DEMONSTRATION PROGRAM Final Report, Jan. 1983
V. HELD and J. WEGSCHEIDER Bonn Bundesministerium fuer Forschung und Technologie Dec. 1984 113 p In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-W-84-047; ISSN-0170-1339) Avail: NTIS HC A06/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 24

A test program for Global Positioning System (GPS) receivers is considered. The requirements of potential user groups were examined, and test environments for land, water, and aircraft were set up. Examples of users are the automobile and offshore industries, airline companies, and the administration. A test program and a receiver specification are under elaboration. Author (ESA)

N85-21146# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Abteilung Steuerung und Regelung.
ALGORITHMS FOR AUTOMATIC FOUR-DIMENSIONAL AIRCRAFT GUIDANCE, CONSIDERING THE MOMENTARY WIND SITUATION
W. LECHNER Sep. 1984 101 p refs In GERMAN; ENGLISH summary Original will also be announced as translation (ESA-TT-908)
(DFVLR-FB-84-40; ISSN-0171-1342) Avail: NTIS HC A06/MF A01; DFVLR, Cologne DM 34

An automatic four dimensional navigation mode covering a terminal maneuvering area was developed and flight tested for the automatic digital flight control system of the HFB 320 test aircraft. Algorithms for the computation of the flight path take into account the current wind situation. Techniques for wind measurement, filtering and prediction were developed. The results of the flight trials are discussed. It is shown that temporal error limits of +or- 5 sec are obtained under the most differing wind

situations. The aircraft-oriented wind prediction extrapolation system based Kalman filtering techniques is very efficient.
Author (ESA)

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AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

A85-26444*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SEPARATION OF TIME SCALES IN AIRCRAFT TRAJECTORY OPTIMIZATION
M. D. ARDEMA (NASA, Ames Research Center, Moffett Field, CA) and N. RAJAN (Stanford University, Stanford, CA) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 8, Mar.-Apr. 1985, p. 275-278. Previously cited in issue 19, p. 2799, Accession no. A83-41958. refs

A85-26480
TOMORROW'S AIR CARGO - COMBIS, CONVERTIBLES, OR ALL-FREIGHTERS?
J. H. BRAHNEY Aerospace Engineering (ISSN 0736-2536), vol. 5, March 1985, p. 22-29.

An evaluation is made of novel configurational alternatives under consideration by major U.S. cargo aircraft manufacturers for their next-generation designs, which have as their goals a significant increase in payload weight and/or volume and enhanced aerodynamic and propulsive efficiencies. In addition to the turbofan, turboprop, and projected propfan powerplants of most designs considered, one configuration features a transverse flow fan mounted spanwise at the trailing edge of the wings. Spanloading all-wing and delta designs, canard configurations, and two-fuselage aircraft are assessed from aerodynamic efficiency and technology development risk standpoints. O.C.

A85-26552
M61A1 GUNFIRE ENVIRONMENTAL EFFECTS ON F-14 AIRCRAFT STRUCTURE AND EQUIPMENT
J. J. POPOLO (Grumman Aerospace Corp., Bethpage, NY) IN: Institute of Environmental Sciences, Annual Technical Meeting, 29th, Los Angeles, CA, April 19-21, 1983, Proceedings . Mount Prospect, IL, Institute of Environmental Sciences, 1983, p. 29-35.

The objective of this program is to define and assess the environmental effects of the F-14 aircraft structure and avionic equipment due to the firing of the M61A1 rapid-fire gun. An initial assessment was made using acoustic and vibration data obtained from a ground test article which consisted of a mock-up of the forward fuselage of the aircraft, with the gun and simulated equipment installed cantilevered from a strong back. The final assessment and verification of M61A1/F-14A compatibility was obtained from vibration measurements and observation of system performance during firing of the gun in a production aircraft, both on the ground and inflight. The F-14A M61A1 gun blast tube, gas diffuser, and support structure were specifically designed to withstand the gun blast and recoil loads. The M61A1 acoustic and vibration input to the equipment was attenuated by the installation of an absorptive acoustic liner and damping tape applied to the equipment shelves. Author

A85-26757*# Mississippi State Univ., Mississippi State.
A METHOD FOR FLIGHT-TEST DETERMINATION OF PROPULSIVE EFFICIENCY AND DRAG
G. BULL and P. D. BRIDGES (Mississippi State University, Mississippi State, MS) Journal of Aircraft (ISSN 0021-8669), vol. 22, March 1985, p. 200-207. Previously cited in issue 02, p. 131, Accession no. A84-12338. refs
(Contract NAG1-3)

A85-26763*# Kentron International, Inc., Hampton, Va.
WING DESIGN WITH ATTAINABLE LEADING-EDGE THRUST CONSIDERATIONS
H. W. CARLSON (Kentron International, Inc., Hampton, VA), B. L. SHROUT, and C. M. DARDEN (NASA, Langley Research Center, High-Speed Aerodynamics Div., Hampton, VA) Journal of Aircraft (ISSN 0021-8669), vol. 22, March 1985, p. 244-248. Previously cited in issue 20, p. 2850, Accession no. A84-41346. refs

A85-26764#
CONTINUOUS FILAMENT WOUND COMPOSITE CONCEPTS FOR AIRCRAFT FUSELAGE STRUCTURES
A. D. REDDY, R. R. VALISETTY, and L. W. REHFIELD (Georgia Institute of Technology, Atlanta, GA) Journal of Aircraft (ISSN 0021-8669), vol. 22, March 1985, p. 249-255. Research supported by the Lockheed-Georgia Co. refs
(AIAA PAPER 84-0869)

Design studies have been performed on continuous filament wound grid-stiffened composite structural concepts for aircraft fuselages. Stability equations based on a Donnell-type theory, which includes transverse shear deformation in the unidirectional composite ribs, have been developed for a general grid-stiffened circular cylindrical shell. Three candidate design concepts - isogrid, orthogrid, and generalized orthogrid were compared. The loading cases considered were uniaxial compression and combined axial compression and torsion. All three concepts are weight competitive. The isogrid concept, however, is the most attractive due to its demonstrated damage tolerance characteristics. Author

A85-27172
CANARDS - DESIGN WITH CARE
B. R. A. BURNS (British Aerospace, PLC, Weybridge, Surrey, England) Flight International (ISSN 0015-3710), vol. 127, Feb. 23, 1985, p. 19-21.

Canards, if properly integrated into aircraft design, add stability to general aviation aircraft and enhanced maneuverability to military aircraft. The flight quality influences are attributable to the balances between the center of gravity (COG) and the aerodynamic center (AC), the latter being dependent on the presence or absence of a tail or canards, wing location, and the number of control surfaces and their configurations. The designer's task is to achieve a correct design with the first model because changes in any one flight surface will thereafter require alterations in the postitions, areas, lengths, etc., of all other control surfaces. Two guiding criteria are to ensure that canards reach stall before the wing, and to place the AC forward of the COG to maintain stability (for civil aircraft) or behind the COG for digital fly-by-wire military aircraft, which are artificially stabilized. M.S.K.

A85-27367#
DESIGNING AN RPV - THE LOCKHEED AQUILA
R. DEMEIS Aerospace America (ISSN 0740-722X), vol. 23, March 1985, p. 86-89.

The complexity of the U.S. Army radio-controlled RPV Aquila is explored to illustrate the reasons for its high cost. Performance requirements have moved the design closer to a drone than a throwaway unit. Aquila can fly at 100 kt at 10,000 ft altitude and carry a 60 lb payload. It can also fly at low altitudes through hostile EW environments and locate electronically-protected targets in European winter night conditions. An antijam circuit is used for controlling and receiving data from the Aquila, which can fly autonomously for up to 20 min. A laser illuminater provides a homing beacon for laser-guided weapons. Targets can also be selected from television or IR data gathered by Aquila. All optics function through one lens system. Aquila cannot be detected by IR sensors and has a coating and air frame shape and materials which decrease its radar profile. Flight guidance and net recovery have been computerized and simplified to permit operation by personnel with minimal training. M.S.K.

A85-27449
IMPROVING THE FLYING QUALITIES OF YOUR AEROPLANE
D. STINTON (Civil Aviation Authority, Airworthiness Div., Redhill, Surrey, England) Aerospace (UK) (ISSN 0305-0831), vol. 12, March 1985, p. 5-17.

Areas of aircraft design which have a critical impact on the flying qualities are identified. Pitot tubes must be calibrated and situated to supply only unmodified dynamic pressure data for true airspeed readings. The weight-carrying capabilities of the aircraft must be accurately known, as must be the center of gravity location, the latter being crucial for pilot elevator trim selection. Excessive drag must be eliminated alog with complex or possibly hazardous control connections to control surfaces. For ultralights, rods are recommended instead of connecting wires. Numerous instances of the causes of failure of each control component are cited, together with design, maintenance and maneuvering remedies. M.S.K.

A85-27450
THE EVOLUTION OF SHORTS RANGE OF LIGHT TRANSPORT AIRCRAFT
P. FOREMAN (Short Brothers, Ltd., Belfast, Northern Ireland) Aerospace (UK) (ISSN 0305-0831), vol. 12, March 1985, p. 18-25.

The Short Brothers aircraft company made an initial excursion into the commercial markets in 1963 after a history of producing military aircraft only. The Skyvan, a 12,500 lb vehicle, required several re-engining efforts and, due to its large cargo-bearing space, proved a good seller in remote and developing nations markets. The width of the Skyvan, 6 ft, permitted development of a stretch version with 30 seats as a commuter aircraft selling below $1 million in the U.S. The 330 design included split, dual tail fins which proved decisive in the sale of units equipped with back doors to the U.S.A.F. The large cabin space also proved a selling point in terms of passenger comfort. Eventually, the 330 was again stretched and became the 360, which was provided with more powerful engines, 36 seats, composite materials for 14 components, a single tail fin, and improved airfoil section metal propellers. The progressive designs have become company policy and a conservative, but optimistic view is being taken of near-term innovations such as pusher propfans and greater use of composites. M.S.K.

A85-27501
AIRWORTHINESS TECHNOLOGY
T. FORD Aircraft Engineering (ISSN 0002-2667), vol. 57, Feb. 1985, p. 11-14.

A British study has noted that the fatal accident rate for large helicopters is approximately five times greater than that of commercial transport aircraft on a flight-hourly basis, and that a much higher proportion of notifiable helicopter accidents is attributable to airworthiness-related causes. The principal source of critical failure is identified as the rotor-transmission system, and this is in turn held to be due to design shortcomings which escaped identification during development testing. Also identified as a significant cause of helicopter failure and unreliability is fatigue, whose high frequency component has rotor loading as its primary cause. The high levels of vibration in helicopters is also a major concern. Attention is given to the EH 101 helicopter, which typifies the ways in which next-generation helicopter designs will address these issues. O.C.

A85-27604
FUEL ECONOMIES EFFECTED BY THE USE OF FMS IN AN ADVANCED TMA
V. ATTWOOLL (Civil Aviation Authority, London, England) and A. BENOIT (European Organization for the Safety of Air Navigation, Brussels, Belgium) Journal of Navigation (ISSN 0020-3009), vol. 38, Jan. 1985, p. 19-37. refs

A flight management system designed to reduce fuel consumption at commercial and military air terminals is discussed. The concept of an advanced Terminal Area (TMA) is introduced which expands the current definition of aircraft terminal to encompass the area necessary for maximum control flexibility. It is shown that under coordinated control by onboard and ground-based flight management computers, an advanced TMA concept could reduce current average fuel losses for DC-10 aircraft by 63 percent. The different computational tasks of the onboard and ground based computer systems are discussed in detail. I.H.

A85-27625
ELECTROMAGNETIC SHIELDING BY A CFC AIRCRAFT FUSELAGE
H. J. V. KANABAR (Marconi Research Centre, Chelmsford, Essex, England) GEC Journal of Research (ISSN 0264-9187), vol. 2, no. 4, 1984, p. 256-262. refs

With the increasing use of carbon fiber composites (CFC) in aircraft, it is necessary to assess the effect this may have on the electromagnetic properties of an aircraft fuselage. The lower conductivity of CFC, as compared to conventional aircraft construction materials, has led to doubts about the effectiveness of carbon composite structures in shielding avionics equipment from electrical interference. This paper describes a theoretical treatment of a purpose-built fighter-representative CFC fuselage. Currents induced in internal conductors as a result of electromagnetic radiation falling on the fuselage are calculated, and comparison is made with experimental findings. Author

A85-27660
PILOT REPORT - AFTI/F-16
D. MCMONAGLE (USAF, Edwards AFB, CA) Air Force Magazine (ISSN 0730-6784), vol. 68, April 1985, p. 68-73.

The U.S. Air Force's Advanced Flight Technology Integration (AFTI) F-16 flight test aircraft incorporates next-generation fighter control technology that encompasses the use of pilot voice command, data cartridges for mission plan 'tailoring', a helmet-mounted laser targeting sight, and such unprecedented 'decoupled' maneuvering modes as vertical translation without pitching, pitch changes without path alteration, lateral translation, and direct sideforce. These maneuvering modes permit fire control and bomb and missile delivery with greater accuracy than conventional modes. O.C.

A85-27839
MIG-2000
R. D. WARD (General Dynamics Corp., Fort Worth, TX) Air Force Magazine (ISSN 0730-6784), vol. 68, March 1985, p. 64-70, 73.

An evaluation of Soviet air superiority fighter design trends is the basis of a series of projections concerning aircraft configuration, powerplant performance and weapons capabilities for the next-generation MiG design bureau aircraft that is expected to enter service by the year 2000. The predictions made extend to Mach number operation range, takeoff gross weight, wing loading and turning rate, and thrust-to-weight ratio. A twin-engined, delta canard/delta main wing configuration is envisioned which incorporates advanced cycle turbofan engines that are essentially simplifications of Western designs, and which feed two-dimensional thrust vectoring and reversing nozzles. O.C.

A85-27840
FROM HIND TO HAVOC
S. SIKORSKY (United Technologies Corp., Sikorsky Aircraft Div., Stratford, CT) Air Force Magazine (ISSN 0730-6784), vol. 68, March 1985, p. 88-92, 95.

A development history is presented for the military helicopter design bureau established in 1947 by Michael Mil, whose most recent products are the 'flying tank' Mi-24 (NATO code name 'Hind') and its successor, the Mi-28 ('Havoc') attack helicopters. Attention is given to the expansion of attack helicopter capabilities from those of troop transports armed with infantry support weapons to antitank air-to-ground weapon platforms, and most recently, in the Mi-28, to an air-to-air combat capability encompassing both helicopter and low altitude fixed wing aircraft target. O.C.

A85-28605* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THE N/REV PHENOMENON IN SIMULATING A BLADE-ELEMENT ROTOR SYSTEM
R. E. MCFARLAND (NASA, Ames Research Center, Moffett Field, CA) IN: Summer Computer Simulation Conference, 15th, Vancouver, Canada, July 11-13, 1983, Proceedings. Volume 1 . La Jolla, CA, Society for Computer Simulation, 1983, p. 279-286. Previously announced in STAR as N83-22622.

When a simulation model produces frequencies that are beyond the bandwidth of a discrete implementation, anomalous frequencies appear within the bandwidth. Such is the case with blade element models of rotor systems, which are used in the real time, man in the loop simulation environment. Steady state, high frequency harmonics generated by these models, whether aliased or not, obscure piloted helicopter simulation responses. Since these harmonics are attenuated in actual rotorcraft (e.g., because of structural damping), a faithful environment representation for handling qualities purposes may be created from the original model by using certain filtering techniques, as outlined here. These include harmonic consideration, conventional filtering, and decontamination. The process of decontamination is of special interest because frequencies of importance to simulation operation are not attenuated, whereas superimposed aliased harmonics are. S.L.

A85-28633
IMPACTS OF AUTOMATION - AUTOMATION AND FLIGHT TEST ENGINEERING
W. DIJKSHOORN (Fokker, Schiphol, Netherlands) IN: Flight testing today: Innovative management and technology; Proceedings of the Fourteenth Annual Symposium, Newport Beach, CA, August 15-19, 1983 . Lancaster, CA, Society of Flight Test Engineers, 1983, p. 1.2-1 to 1.2-6. refs

The technical consequences of automation in flight test programs are examined, taking into account variations in workload, requirements for the transportation of data, and aspects of on-board computation. Developments in automation with respect to flight test measurement are investigated. The flight test management considered can be characterized by five phases, including logistics, preparations, test, presentation, and generalization. A description is provided of an automated system which highly improves the flexibility and efficiency in managing the flight tests. Attention is also given to coherence in test activities, the rewards of adequate result prediction, and the prerequisites of automation. G.R.

A85-28634
THE USE OF ENGINEERING SIMULATION TO SUPPORT AIRCRAFT FLIGHT TESTING AT THE U.S. AIR FORCE FLIGHT TEST CENTER
R. A. WOOD (USAF, Flight Test Center, Edwards AFB, CA) IN: Flight testing today: Innovative management and technology; Proceedings of the Fourteenth Annual Symposium, Newport Beach, CA, August 15-19, 1983 . Lancaster, CA, Society of Flight Test Engineers, 1983, p. 1.3-1 to 1.3-7.

The engineering simulator has become an integral part of the flight test tools to analyze flight test results and increase the knowledge gained from the flight tests themselves. The test team has been forced to closely scrutinize their weapon system and the spectrum of possible tests to determine the minimum tests required, determine the most important tests to fly, and to get the most from each flight hour. The engineering simulator provides an inexpensive means to closely scrutinize the weapon system and the proposed test plan. The U.S. Air Force Flight Test Center has successfully used the engineering simulator to educate test personnel, determine flight test envelopes, optimize test plans, enhance command and control procedures, develop modifications to flight control systems, investigate unexpected test results, investigate accidents, develop math models for training simulators, and provide practice flying for test pilots. Aircraft simulated have included the Space Shuttle, X-2, Dynasoar, lifting bodies, SR-71, C-133, A-7, F-5, F-15, F-16, and AFTI/F-16. Author

A85-28635
GETTING A PARTNERSHIP INTO THE AIR - TESTING OF THE SAAB-FAIRCHILD 340
T. SIGBJORNSSON (Saab-Scania AB, Linkoping, Sweden) IN: Flight testing today: Innovative management and technology; Proceedings of the Fourteenth Annual Symposium, Newport Beach, CA, August 15-19, 1983 . Lancaster, CA, Society of Flight Test Engineers, 1983, p. 1.4-1 to 1.4-8.

A Swedish aerospace company entered into a partnership with an American company for a joint project, involving the design, manufacture, and marketing of a commuter type aircraft in the 30-40 passenger class. The main characteristics of the new airliner are related to low fuel consumption, low noise, long life, low maintenance costs, and flexible interior layout. A new type of low drag wing profile has been designed, and the airliner is the first aircraft to use designs of the new generation of compact and highly fuel efficient turboprop engines. Attention is given to aspects of certification, the test concept, the flight test program, the test equipment, and a status report. G.R.

A85-28637
767 FLIGHT TEST PROGRAM OVERVIEW
J. W. DEEDS (Boeing Commercial Airplane Co., Seattle, WA) IN: Flight testing today: Innovative management and technology; Proceedings of the Fourteenth Annual Symposium, Newport Beach, CA, August 15-19, 1983 . Lancaster, CA, Society of Flight Test Engineers, 1983, p. 2.3-1 to 2.3-6.

The considered aircraft is a new technology two engine commercial jet transport. It has a design range of between 2900 and 3475 nautical miles, and carries 211 passengers in a mixed class two aisle configuration. A description of program statistics is presented with the aim to provide an overview of the 767 flight test program. Attention is given to flight test instrumentation, the onboard data system, 767 flight test program highlights, a configuration development summary, a 767 certification summary, and details regarding the production status. It is pointed out that as of August 1, 1983, 61 aircraft have been delivered to 11 customers. Current orders are for a total of 174 aircraft with five remaining customer introductions. G.R.

A85-28638
THE AUTOMATED KC-135R TEST PROGRAM
D. A. FLETCHER and J. T. HIGGS (Boeing Military Airplane Co., Wichita, KS) IN: Flight testing today: Innovative management and technology; Proceedings of the Fourteenth Annual Symposium, Newport Beach, CA, August 15-19, 1983 . Lancaster, CA, Society of Flight Test Engineers, 1983, p. 2.5-1 to 2.5-9.

The KC-135 Stratotanker was originally built by an American aerospace company over 20 years ago. Since the original production, advances in technology have led to engines with increasing thrust, and decreasing fuel consumption and noise levels. For this reason, in 1978, a reengining program was proposed to the Air Force with the aim to extend the useful life of the KC-135 fleet well into the 21st century. A high bypass ratio turbofan engine was selected for the reengining program. The new engine weighs only 380 pounds more than the engine which it replaces. It produces, however, 9,000 pounds more thrust, while consuming approximately 25 percent less fuel. The present investigation is concerned with the Developmental Test and Evaluation/Operational Test and Evaluation segment of the test program conducted to quantify the effects of the added and modified systems in the aircraft. The automated test planning, tracking, and visibility system developed for the tests demonstrated a significant increase in test engineering productivity. G.R.

A85-28643
DEVELOPMENT AND QUALIFICATION TESTING OF S-76 HELICOPTER TAKEOFF AND LANDING PROCEDURES FOR REDUCED FIELD LENGTH
J. L. COLE (United Technologies Corp., Sikorsky Aircraft Div., West Palm Beach, FL) IN: Flight testing today: Innovative management and technology; Proceedings of the Fourteenth Annual Symposium, Newport Beach, CA, August 15-19, 1983 . Lancaster, CA, Society of Flight Test Engineers, 1983, p. 3.6-1 to 3.6-9.

In 1974, an American aerospace company initiated the S-76 program with the objective to develop a modern, high performance, twin engine light helicopter for commercial applications. Initial FAA and CAA transport category certification approvals were granted in 1978 and 1979 respectively. In order to improve the suitability of the S-76A for European commercial applications, an expansion of CAA certification approval to include reduced field length takeoff and landing procedures was considered. In July 1981, a development and qualification program was initiated to demonstrate the potential of S-76A helicopter operation up to 9,000 pounds gross weight within the shortest possible field length bounds achievable. Attention is given to the employed instrumentation, the test procedures, the vertical takeoff technique deployment, and aspects of landing technique development. G.R.

A85-28644
IN-FLIGHT FLOW VISUALIZATION - A FLUID APPROACH
N. BELEVTSOV, R. E. BRUMBY, and J. P. HUGHES (Douglas Aircraft Co., Long Beach, CA) IN: Flight testing today: Innovative management and technology; Proceedings of the Fourteenth Annual Symposium, Newport Beach, CA, August 15-19, 1983 . Lancaster, CA, Society of Flight Test Engineers, 1983, p. 4.2-1 to 4.2-7.

In connection with programs for improving the performance of the MD-80 aircraft, detailed studies have been conducted of the airflow about the aft end of the aircraft. The areas of concern included the aft fuselage, the pylon/engine, and horizontal stabilizer/vertical fin intersections. Results of a tuft survey showed that while the use of tufts generally yields satisfactory information on the air flow characteristics for regions of uncomplicated flow, the tuft method as a flow visibility technique has two limitations. The tuft patterns have to be observable from a chase aircraft during the specific flight conditions of interest, and tufts located in areas of unusual airflow yield obscure or inadequate surface airflow information. It was, therefore, necessary to employ a different flow visualization technique for the required studies. Attention is given to the utilization of an in-flight fluid flow visualization method for the study of flow pattern development, taking into account details of fluid selection. G.R.

A85-28646
THE FLYOVER NOISE TEST MONITORING SYSTEM (FONTMS)
C. R. HOGSTEDT (Douglas Aircraft Co., Long Beach, CA) IN: Flight testing today: Innovative management and technology; Proceedings of the Fourteenth Annual Symposium, Newport Beach, CA, August 15-19, 1983 . Lancaster, CA, Society of Flight Test Engineers, 1983, p. 4.4-1 to 4.4-8. refs

Flyover noise testing of a new commercial jet transport aircraft is an important factor for assuring the public acceptability of the aircraft. Flyover noise testing requires extensive and complex techniques and equipment to control, record, and monitor the test procedures and data. Since all tests are conducted at remote sites, all equipment must be mobile. The equipment is usually in a vehicle which is towed to the test site. The sources and methods used before FONTMS was developed to transmit data to the Noise Test Center (NTC) for recording and monitoring are shown in a graph. At that time, the evaluation procedure required much work related to manual tabulation of voice-radio transmitted readings, manual strip-chart noise readings, and hand plotting of the relationships. These difficulties were overcome by the development of FONTMS on the basis of refinements in desktop computer technology, engineering instrumentation interfacing, and telemetry transmission. The design and the operation of FONTMS are discussed in detail. G.R.

A85-28647
FIGHTER AIRCRAFT DYNAMIC PERFORMANCE
W. M. OLSON and Y. L. SELL (USAF, Flight Dynamics Div., Edwards AFB, CA) IN: Flight testing today: Innovative management and technology; Proceedings of the Fourteenth Annual Symposium, Newport Beach, CA, August 15-19, 1983 . Lancaster, CA, Society of Flight Test Engineers, 1983, p. 4.5-1 to 4.5-7.

Flight test data obtained during an Air Force Flight Test Center flight test program are described. The data are taken during roller coaster, split-s, and wind-up turn maneuvers monitored with on-board INS recorders. The instrumentation consists of two gyroscopes and three accelerometers with outputs sampled 50 times/second. Tests performed on YF-16, SR-71 and STOL aircraft have generated data used to calculate the lift and drag forces, accelerations and velocities. Dynamic maneuvers are employed to examine the engine thrust and fuel flow characteristics over a wide range of conditions while maintaining a steady Mach number. Finally, a formerly classified wind algorithm is documented. M.S.K.

A85-28648
THE EVOLUTION OF FLUTTER EXCITATION AT MCDONNELL AIRCRAFT
J. J. MEANY (McDonnell Douglas Corp., St. Louis, MO) IN: Flight testing today: Innovative management and technology; Proceedings of the Fourteenth Annual Symposium, Newport Beach, CA, August 15-19, 1983 . Lancaster, CA, Society of Flight Test Engineers, 1983, p. 4.6-1 to 4.6-11. refs

McDonnell Aircraft in-flight flutter tests began with stick raps and rudder kicks for impulse excitation of flutter. The technique was employed in the XF-88, F2H, F3H, F101 and the early F-4. Variable frequency electrical signals were input to the rudder servo in the XF3H-1 in 1952 to study limit-cycle buzz in transonic conditions. Electronic function generators for exciting the ailerons and stabilizer were introduced into the F-4 tests in the mid-1960s. The system was controlled by the pilot with switches and potentiometers on the front panel. The advent of flutter margin analysis modeling occurred with development of the F-15. The model predictions, based on subcritical flight speed data, were tested with electronically activated systems controlled through ICs. Microprocessor-based flutter excitation systems are presently installed on test F-18 and AV-88 aircraft. M.S.K.

A85-29254*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
APPROACH AND LANDING TECHNOLOGIES FOR STOL FIGHTER CONFIGURATIONS
D. W. BANKS and J. W. PAULSON, JR. (NASA, Langley Research Center, Hampton, VA) Journal of Aircraft (ISSN 0021-8669), vol. 22, April 1985, p. 277-282. Previously cited in issue 06, p. 720, Accession no. A84-18027. refs

A85-29260*# Columbia Univ., New York.
THEORETICAL DESIGN OF ACOUSTIC TREATMENT FOR NOISE CONTROL IN A TURBOPROP AIRCRAFT
R. VAICAITIS (Columbia University, New York, NY) and J. S. MIXSON (NASA, Langley Research Center, Hampton, VA) Journal of Aircraft (ISSN 0021-8669), vol. 22, April 1985, p. 318-324. Previously cited in issue 01, p. 3, Accession no. A85-10872. refs
(Contract NSG-1450; NAS1-16117)

A85-29799
F-16 - INTO THE 1990S
B. SWEETMAN Interavia (ISSN 0020-5168), vol. 40, March 1985, p. 251-253.

The technology development programs underway for F-16 fighter fleet modernization into the 1990s are discussed, with a view to their impact on program costs and performance improvements. In the immediate future, an advanced radar that is compatible with the next-generation Advanced Medium Range Air to Air Missile will be incorporated, together with an engine bay that accommodates either the current F-100 or the upcoming F-110

engine. Attention is given to the longer-term F-16XL development proposal, for which two flight test aircraft employing the F-110 engine have already been constructed. O.C.

A85-29800
AVTEK 400 - WHAT IS IT?
M. LAMBERT Interavia (ISSN 0020-5168), vol. 40, March 1985, p. 275-277.

Attention is given to the design features and performance capabilities of the Avtek 400 general aviation aircraft, which incorporates two pusher turboprop engines in an unconventional, canard configuration. Outstanding fuel economy has been noted in the course of prototype flight testing, with turbojet/turbofan-like climb performance and a 37,000-ft cruise altitude. On 500-1000 nm flights, the Avtek 400 will consume only one-fourth the fuel of comparable six-passenger jet aircraft, and will be able to employ runways which are inaccessible to jet aircraft. Nomex honeycomb/Kevlar cloth sandwich shells are the basis of all primary structures, which do not retain the familiar features of metallic frame-and-stringer structures. O.C.

A85-29861
SIMULATION OF AIRCRAFT CONTROL SYSTEMS ON FLIGHT SIMULATORS [SIMULACE SOUSTAV RIZENI LETOUNU NA PILOTNICH SIMULATORECH]
V. BEZANYI (Rudy Letov, Prague, Czechoslovakia) Zpravodaj VZLU (ISSN 0044-5355), no. 6, 1984, p. 335-338. In Czech.

The simulation of aircraft control systems on flight simulators is examined with emphasis on the relation between the pilot and the control system as an important factor in achieving true simulation of the static and dynamic characteristics of the control system. By using a hybrid control system as an example, a method is demonstrated for the methematical modeling of nonlinear systems subjected to external forces. The mathematical modeling of the control system is supplemented by a block diagram of an electrohydraulic force simulator for implementation on a digital computer with a hybrid system of overload simulation. V.L.

A85-30162
MODE TEST OF A WING PAIR OF THE HARM MISSILE
S. S. STRESAU (Texas Instruments, Inc., Lewisville, TX) IN: Recent advances in experimental characterization of composites; Proceedings of the Fall Meeting, Salt Lake City, UT, November 6-10, 1983 . Brookfield Center, CT, Society for Experimental Stress Analysis, 1983, p. 84-89.

A modal test performed on a wing pair of the high-speed antiradiation missile (HARM) is described. The results are compared to the results of a finite element model of the wing pair. Problems with fixtures and nonlinearities are discussed. Author

A85-30163
DESIGN VERIFICATION TESTING OF THE X-29 GRAPHITE/EPOXY WING COVERS
G. CONCANNON (Grumman Aerospace Corp., Bethpage, NY) IN: Recent advances in experimental characterization of composites; Proceedings of the Fall Meeting, Salt Lake City, UT, November 6-10, 1983 . Brookfield Center, CT, Society for Experimental Stress Analysis, 1983, p. 96-102.

The coupon, element, subcomponent and full-scale component testing performed to validate the design of the X-29 Forward Swept Wing Demonstrator graphite/epoxy wing covers is described in this report. Results from 200 bolted joint coupon and element tests are presented and correlated with analysis. Parameters studied include: laminate orientations and thicknesses, fastener type and size, substructure material and thickness, bolt load to passing load ratio and relative orientation, tension/compression, and environment (temperature/moisture). Also discussed are two subcomponents, a box-beam and a re-entrant corner specimen, used to confirm analytical load distribution and strength predictions in the critical and complex re-entrant corner region of the wing. Finally, the planned full-scale proof test of the wing is described. Author

N85-19978*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Business Group.
STUDY OF ADVANCED FUEL SYSTEM CONCEPTS FOR COMMERCIAL AIRCRAFT
G. A. COFFINBERRY Jan. 1985 256 p refs
(Contract NAS3-23267)
(NASA-CR-174751; NAS 1.26:174751; R85AEB166) Avail: NTIS HC A12/MF A01 CSCL 01C

An analytical study was performed in order to assess relative performance and economic factors involved with alternative advanced fuel systems for future commercial aircraft operating with broadened property fuels. The DC-10-30 wide-body tri-jet aircraft and the CF6-8OX engine were used as a baseline design for the study. Three advanced systems were considered and were specifically aimed at addressing freezing point, thermal stability and lubricity fuel properties. Actual DC-10-30 routes and flight profiles were simulated by computer modeling and resulted in prediction of aircraft and engine fuel system temperatures during a nominal flight and during statistical one-day-per-year cold and hot flights. Emergency conditions were also evaluated. Fuel consumption and weight and power extraction results were obtained. An economic analysis was performed for new aircraft and systems. Advanced system means for fuel tank heating included fuel recirculation loops using engine lube heat and generator heat. Environmental control system bleed air heat was used for tank heating in a water recirculation loop. The results showed that fundamentally all of the three advanced systems are feasible but vary in their degree of compatibility with broadened-property fuel. B.W.

N85-19979*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
PARAMETRIC STUDY OF A CANARD-CONFIGURED TRANSPORT USING CONCEPTUAL DESIGN OPTIMIZATION
P. D. ARBUCKLE and S. M. SLIWA Mar. 1985 28 p refs
(NASA-TP-2400; L-15856; NAS 1.60:2400) Avail: NTIS HC A03/MF A01 CSCL 01C

Constrained-parameter optimization is used to perform optimal conceptual design of both canard and conventional configurations of a medium-range transport. A number of design constants and design constraints are systematically varied to compare the sensitivities of canard and conventional configurations to a variety of technology assumptions. Main-landing-gear location and canard surface high-lift performance are identified as critical design parameters for a statically stable, subsonic, canard-configured transport. Author

N85-19980*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
OVER THE WING PROPELLER Patent Application
J. L. JOHNSON, JR. and E. R. WHITE, inventors (to NASA) (Kentron International, Inc., Hampton, Va.) 16 Oct. 1984 12 p
(NASA-CASE-LAR-13134-1; NAS 1.71:LAR-13134-1; US-PATENT-APPL-SN-661478) Avail: NTIS HC A02/MF A01 CSCL 01C

An aircraft system for increasing the lift drag ratio over a broad range of operating conditions is described. The system positions the engines and nacelles over the wing in such a position that gains in propeller efficiency is achieved simultaneously with increases in wing lift and a reduction in wing drag. Adverse structural and torsional effects on the wings are avoided by fuselage mounted pylons which attach to the upper portion of the fuselage aft of the wings. Similarly, pylon wing interference is eliminated by moving the pylons to the fuselage. Further gains are achieved by locating the pylon surface area aft of the aircraft center of gravity, thereby augmenting both directional and longitudinal stability. This augmentation has the further effect of reducing the size, weight and drag of empennage components. The combination of design changes results in improved cruise performance and increased climb performance while reducing fuel consumption and drag and weight penalties. NASA

N85-19981*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
REMOTE PIVOT DECOUPLER PYLON: WING/STORE SUPPRESSION Patent Application
J. M. HASSLER, JR., inventor (to NASA) 10 Jan. 1985 16 p
(NASA-CASE-LAR-13173-1; NAS 1.71:LAR-13173-1;
US-PATENT-APPL-SN-690274) Avail: NTIS HC A02/MF A01
CSCL 01C

A device for suspending a store from an aerodynamic support surface, such as an aircraft wing, and more specifically, for improving upon singlet pivot decoupler pylons by reducing both frequency of active store, alignment and alignment system space and power requirements. Two links suspend a lower pylon/rack section, and releasable attached store from an upper pylon section mounted under wing. The links allow the lower pylon section to rotate in pitch about a remote pivot point. A leaf spring connected between the lower section and electrical alignment system servomechanism provides pitch alignment of the lower section/store combination. The servomechanism utilizes an electric servomotor to drive gear train and reversibly move the leaf spring, thereby maintaining the pitch attitude of store within acceptable limits. Damper strokes when lower section rotates to damp large oscillations of store. NASA

N85-19982# European Space Agency, Paris (France).
FIRST STAGE OF EQUIPPING A DO 28 AS A RESEARCH AIRCRAFT FOR ICING, AND FIRST RESEARCH RESULTS
H. E. HOFFMANN and J. DEMMEL Jul. 1984 63 p refs
Transl. into ENGLISH of "Erste Ausruestungsstufe einer Do 28 zum Vereisungsforschungsflugzeug u. erste Untersuchungsergebnisse', DFVLR, Oberpfaffenhofen, West Ger. Rept. DFVLR-FB-83-40, Nov. 1983 Original language document previously announced as N84-24571
(ESA-TT-855; DFVLR-FB-83-40) Avail: NTIS HC A04/MF A01; original German version available from DFVLR, Cologne DM 22.50

A Do 28 aircraft was equipped for measuring liquid water content, LWC (2 types of instrument), temperature, relative humidity, backscatter coefficient, and ice accretion (on 3 different standard cylinders). During winter flights, the thickness of ice accretion on the standard cylinders increases linearly with LWC between an LWC of 0.06 and 0.30 g/cum; the thinner the cylinder, the thicker the ice accretion; ice accretion increases significantly with a drop in temperature of only a few degrees; good agreement is shown between 2 different types of instruments for measuring LWC.
Author (ESA)

N85-20186# Joint Publications Research Service, Arlington, Va.
AIRBUS FATIGUE TESTS Abstract Only
In its West Europe Rept.: Sci. and Technol. (JPRS-WST-85-006) p 37 11 Feb. 1985 Transl. into ENGLISH from L'Usine Nouvelle (Paris), 22 Nov. 1984 p 15
Avail: NTIS HC A05/MF A01

The Airbus A 310 has successfully undergone many fatigue, aging and fracture tests. Thus, at the Toulouse Aeronautical Testing Center (CEAT), the aircraft structure withstood a load equal to 1.67 times the load the aircraft might have to bear under the worst possible operating conditions. On the verge of breaking, its wings then assumed an impressive curvature. According to Airbus Industrie, this result shows the high quality level of the engineering departments which designed the A 310. An aircraft is not expected to have a safety factor in excess of 1.5. At the same time, an Airbus A 310 structure withstood 90,000 fatigue cycles (one cycle simulates a complete flight, including takeoff, flying proper and landing). The aircraft, which has a expected life time of 20 years, should not have to go through more than 40,000 cycles. Author

N85-21147* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
EXTENDED MOMENT ARM ANTI-SPIN DEVICE Patent
R. D. WHIPPLE, inventor (to NASA) 29 Jan. 1985 8 p Filed 27 Jun. 1983 Supersedes N83-29173 (21 - 18, p 2867)
(NASA-CASE-LAR-12979-1; NAS 1.71:LAR-12979-1;
US-PATENT-4,496,122; US-PATENT-APPL-SN-508371;
US-PATENT-CLASS-244-75R; US-PATENT-CLASS-244-139;
US-PATENT-CLASS-244-147) Avail: US Patent and Trademark Office CSCL 01C

A device which corrects aerodynamic spin is provided in which a collapsible boom extends an aircraft moment arm and an anti-spin parachute force is exerted upon the end of the moment arm to correct intentional or inadvertent aerodynamic spin. This configuration effects spin recovery by means of a parachute whose required diameter decreases as an inverse function of the increasing length of the moment arm. The collapsible boom enables the parachute to avoid the aircraft wake without mechanical assistance, retracts to permit steep takeoff, and permits a parachute to correct spin while minimizing associated aerodynamic, structural and in-flight complications.
Official Gazette of the U.S. Patent and Trademark Office

N85-21148 Department of the Air Force, Washington, D.C.
INTEGRATED PARATROOP DOOR Patent
J. G. BACKLUND and D. L. GIBLER, inventors (to Air Force) 13 Nov. 1984 5 p
(AD-D011507; US-PATENT-4,482,113;
US-PATENT-APPL-SN-586893; US-PATENT-CLASS-586-893)
Avail: US Patent and Trademark Office CSCL 13M

A deployable platform for use in conjunction with an outwardly opening hinged door on the body structure of a vehicle is described. It is comprised of a hydraulically or pneumatically actuated platform pivotally mounted to the vehicle at the doorway opening and connected to the door by an over center linkage member pivotally connected at one end to the door and at the other to the platform whereby the platform may be deployed and releasably locked into place simultaneously with the opening of the door.
Author (GRA)

N85-21149*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A LAGRANGE-D'ALEMBERT FORMULATION OF THE EQUATIONS OF MOTION OF A HELICOPTER CARRYING AN EXTERNALLY SUSPENDED LOAD
J. M. WEBER and R. K. GREIF Feb. 1985 64 p refs
(NASA-TM-85864; A-9468; NAS 1.15:85864) Avail: NTIS HC A05/MF A01 CSCL 01C

The exact nonlinear equations of motion are derived for a helicopter with an extenal load suspended by fore and aft, rigid-link cables. Lagrange's form of D'Alembert's principle is used. Ten degrees of freedom are necessary to represent the motion of this system in an inertial reference frame: six for the helicopter relative to inertial space and four for the load relative to the helicopter.
Author

N85-21151# Aeronautical Research Labs., Melbourne (Australia).
ON THE APPLICATION OF COMPATIBILITY CHECKING TECHNIQUES TO DYNAMIC FLIGHT TEST DATA
R. A. FEIK Jun. 1984 34 p refs
(ARL-AERO-R-161; AR-003-931) Avail: NTIS HC A03/MF A01

Matters related to the application of instrument compatibility checking techniques to flight test data were considered. A previously developed Maximum Likelihood program has been used to study the effects of the presence of scale errors, accelerometer offsets and measurement time lags using simulated data. Some additional information on the effects of noise levels has also been obtained. The results have led to a suggested method for determination of center of gravity location from flight data. The effects of measurement lags have been shown to have a major influence on extracted instrument parameters and a systematic procedure for the determination of relative phases has been

devised and applied successfully to simulated data. These techniques have also been applied to flight from a roller coaster maneuver and a set of relative lag values clearly identified. G.L.C.

N85-21152# Aeronautical Research Labs., Melbourne (Australia).
FATIGUE CRACK PROPAGATION IN MIRAGE 1110 WING MAIN SPAR SPECIMENS AND THE EFFECTS OF SPECTRUM TRUNCATION ON LIFE
J. Y. MANN, R. A. PELL, and A. S. MACHIN Jul. 1984 59 p refs
(ARL-STRUC-R-405; AR-003-937) Avail: NTIS HC A04/MF A01

As part of an investigation into the life extension and safe operation of the wings of the Mirage III0 aircraft, a fatigue testing program and extensive fractographic examination was undertaken on specimens representing the critical section of the spar to assess the effects of truncating the maximum positive loads of the spectrum and provide information relating to fatigue crack propagation rates. Under the fighter type load spectrum adopted, truncation of the maximum load from +7.5g to +6.5g or to +5 g did not result in an increase in fatigue life, presumably because of the loss of the crack retardation potential of this rarely occurring high positive load. G.L.C.

N85-21153# National Aeronautical Establishment, Ottawa (Ontario). Structures and Materials Lab.
A HISTORY OF FULL-SCALE TESTING OF AIRCRAFT STRUCTURES AT THE NATIONAL AERONAUTICAL ESTABLISHMENT
R. L. HEWITT Jan. 1985 83 p refs
(NAE-AN-24; NRC-24089; AD-A151881) Avail: NTIS HC A05/MF A01

An historical review of the work of the Structures and Materials Laboratory of the National Aeronautical Establishment (NAE) in the area of full scale testing of large aircraft structures is given. The period from 1941 to 1984 is covered, starting with a static strength test of a molded wood Anson fuselage and finishing with a fatigue test of a Grumman Tracker wing. Brief details of the loading arrangements and test results are included for each test component and these are used to trace the development of the laboratory from the use of rulers and shot bags to computer-controlled servo-hydraulic actuators. R.J.F.

N85-21154# Loughborough Univ. of Technology (England). Dept. of Transport Technology.
ANALYTICALLY REDUNDANT OUTPUT FEEDBACK SCHEME FOR REDUCTION OF STRUCTURAL LOADS OF A FLEXIBLE TRANSPORT AIRCRAFT
D. MCLEAN Apr. 1983 91 p refs
(TT-8303) Avail: NTIS HC A05/MF A01

The results of a research investigation into the provision of an analytical redundancy scheme suitable for use with a structural load allevation control system for a large transport aircraft are presented. The design was based on the use of observer theory and the corresponding self-repairing controller was implemented on a microprocessor. Simulation results are shown to demonstrate the effectiveness of the proposed scheme in maintaining safe and excellent feedback control in the presence of severe and unpredictable failures in motion sensors and feedback control channels. M.G.

N85-21155# Villanova Univ., Pa.
AEROSTRUCTURE NONDESTRUCTIVE EVALUATION BY THERMAL FIELD DETECTION. PHASE 2: TECHNIQUE REFINEMENT AND QUANTITATIVE DETERMINATION OF FLAW DETECTION CAPABILITIES Final Report
P. V. MCLAUGHLIN, JR. and M. G. MIRCHANDANI Lakehurst, N.J. Naval Air Engineering Center 14 Dec. 1984 203 p
(Contract N68335-81-C-5142; F41-460)
(AD-A149622; NAEC-92-181) Avail: NTIS HC A10/MF A01 CSCL 11D

This report describes the second phase of a program to evaluate and develop methods of flaw detection in laminated fiber composites using infrared radiation detection techniques with application to inspection of aerovehicle structures. Analytical heat transfer studies and experiments were conducted on graphite/epoxy, glass/epoxy and glass/polyester laminates containing simulated delaminations and impact damage. The externally applied thermal field (EATF) technique uses a radiant heater to create hot spots on a composite laminate surface above thermal breaks caused by delaminations and other flaws. The stress-generated thermal field (SGTF) technique requires heat to be generated near flaws by cyclic stressing. GRA

N85-21156# Aeronautical Research Labs., Melbourne (Australia).
DEFLECTION MODEL OF A CT4-A UNDERCARRIAGE
M. HELLER and D. G. FORD Jul. 1984 50 p
(AD-A149778; ARL-STRUC-TM-384) Avail: NTIS HC A03/MF A01 CSCL 01C

In this Australian report, a relationship between applied loads and corresponding bending moment for a CT4-A undercarriage is determined to enable appropriate fatigue test loads to be evaluated. A mathematical model is derived to determine the significant deflection parameters of a loaded CT4-A undercarriage, which is represented as an eccentrically loaded tapered beam mounted at a torsional restraint. A general computer program was written to implement the analysis. Results for the undercarriage were then obtained for a range of loading cases. An empirical equation relating fatigue test loads to bending moment for the undercarriage was fitted. GRA

N85-21157# Advisory Group for Aerospace Research and Development, Paris (France).
TECHNICAL EVALUATION REPORT ON THE FDP SYMPOSIUM ON FLIGHT TEST TECHNIQUES
F. N. STOLIKER (Computer Sciences Corp., Camarillo, Calif.) Dec. 1984 24 p refs
(AGARD-AR-208; ISBN-92-835-1481-5) Avail: NTIS HC A02/MF A01

The rapidly advancing technologies of integrated flight and fire control, all weather and night attack systems, digital multimode controls, wide field of view head-up displays, system/subsystem simulation, and rapidly increasing instrumentation acquisition, processing, and display capabilities led to the need for this symposium. The papers presented were concerned with three major subject areas: (1) Performance and flying qualities; (2) Systems testing; and (3) Instrumentation and facilities. Information on these topics in flight testing and instrumentation techniques was shared with the AGARD community. E.R.

06

AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

A85-26839
THE F-16 A/C-ATE CENTRALIZED DATA SYSTEM
F. R. PRUETT, V. F. VUTECH (Dynamics Research Corp., Wilmington, MA), and R. L. DESANTY (USAF, Air Force Logistics Command, Wright-Patterson AFB, OH) IN: AUTOTESTCON '83; Proceedings of the Conference, Fort Worth, TX, November 1-3, 1983 . New York, Institute of Electrical and Electronics Engineers, Inc., 1983, p. 457-462.

Dynamics Research Corporation (DRC) along with the F-16 System Program Office (F-16 SPO) at Wright-Patterson AFB have been involved since 1979 in designing, developing, and implementing an automated maintenance data collection system for the F-16 aircraft. What has evolved since 1979 is described. A history of the evolution of the CDS is presented along with a detailed description of this state-of-the-art data collection system. An in-depth study of the flow of information from the time an F-16 begins its taxi for a sortie through all three levels of maintenance to the interim contractors and back down the chain is described. Also presented are the endless analysis tools available to each manager associated with the F-16, such as the local base analysis section, logistics systems managers and F-16 SPO personnel. And finally, a view of the extensive communications network required to tie in all F-16 locations throughout the world are presented. Author

A85-28650
NOSEBOOM POSITION ERROR PREDICTION DATA BASE UPDATE
J. P. FUEHNE and D. K. TIPPEY (McDonnell Aircraft Co., St. Louis, MO) IN: Flight testing today: Innovative management and technology; Proceedings of the Fourteenth Annual Symposium, Newport Beach, CA, August 15-19, 1983 . Lancaster, CA, Society of Flight Test Engineers, 1983, p. 5.3-1 to 5.3-5.

A data base update has been made to a NACA-developed algorithm for the prediction of noseboom static pressure position error. The original NACA study had used data obtained from small models; the update used data from actual flight test aircraft/noseboom installations. In addition, the algorithm was extended to include not only subsonic and transonic data, but supersonic data as well. Software was developed which allows easy data base creation, modification and enlargement. Additional software was written to predict position error curves for given aircraft/noiseboom installations. The accuracy of the new data base and algorithm was confirmed by the use of an independent test case. Author

A85-28651
TAKEOFF PERFORMANCE DATA USING ONBOARD INSTRUMENTATION
H. K. CHENEY (Douglas Aircraft Co., Long Beach, CA) IN: Flight testing today: Innovative management and technology; Proceedings of the Fourteenth Annual Symposium, Newport Beach, CA, August 15-19, 1983 . Lancaster, CA, Society of Flight Test Engineers, 1983, p. 5.4-1 to 5.4-7. refs

A method has been developed to obtain velocity, distance, height, wind, and ambient temperature for takeoff performance calculations using self-contained instrumentation onboard a test aircraft. Space position data are obtained using an inertial navigation system. The headwind at the aircraft is determined using pitot total pressure, tracking altitude, and tracking velocity. Ambient field temperature is determined using the measured total temperature prior to rotation. The only information required from ground systems is the runway slope. The resulting performance data, corrected to zero wind conditions, are equivalent or superior to data obtained using external tracking, wind, and temperature measuring systems. Using the INS space position data, it is practical to calculate indicated instantaneous drag and rolling coefficients. Author

A85-28652
PADDS - A PORTABLE AIRBORNE DIGITAL DATA SYSTEM
J. NIXON (Boeing Co., Seattle, WA) IN: Flight testing today: Innovative management and technology; Proceedings of the Fourteenth Annual Symposium, Newport Beach, CA, August 15-19, 1983 . Lancaster, CA, Society of Flight Test Engineers, 1983, p. 5.5-1 to 5.5-6.

The physical size of data acquisition and reduction equipment, while rapidly shrinking, has not kept pace with the demands for the quick response required for in-service testing and troubleshooting. In order to meet these requirements, Boeing built a system called the Portable Airborne Digital Data System, or PADDS. This system quickly interfaces with new generation aircraft digital avionics systems, acquires and records selected information from the Airborne Radio Incorporated 429 (ARINC 429) standard buses. It allows for the playback of the data (after the flight) in an office-type environment. It has the ability to obtain analog strip charts of the data. This paper describes the PADDS, its uses, and future plans. Author

A85-28653
767/757 INSTRUMENTATION SYSTEM
T. E. SMIDT (Boeing Co., Seattle, WA) IN: Flight testing today: Innovative management and technology; Proceedings of the Fourteenth Annual Symposium, Newport Beach, CA, August 15-19, 1983 . Lancaster, CA, Society of Flight Test Engineers, 1983, p. 6.1-1 to 6.1-6.

The capabilities of the flight data acquisition, monitoring, storage and analysis system devised to handle simultaneous flight tests of the 757 and 767 aircraft are described. The aircraft were instrumented with analog transducers whose signals underwent PCM treatment and were digitized before entering an upgraded version of the data acquisition system originally used with the 747 SP aircraft. ARINC 429 data from new digital avionics required conversion before input. The 767 program generated 256,000 words of data per second for 2136 hr of tests. An on-board computer was accessed by accompanying flight test engineers to calibrate the test conditions in situ. Actual flight data were telemetered to ground-based mainframes, which possessed a calibration data base for comparisons with sensor inputs. A mobile acquisition and analysis system was transported between Montana and California to aid in the process when the tests were flown at remote sites. M.S.K.

A85-28655
USES OF A DIGITAL ELECTRONIC THEODOLITE SYSTEM IN A WEAPON SEPARATION PROGRAM
J. G. TURNER (McDonnell Aircraft Co., St. Louis, MO) IN: Flight testing today: Innovative management and technology; Proceedings of the Fourteenth Annual Symposium, Newport Beach, CA, August 15-19, 1983 . Lancaster, CA, Society of Flight Test Engineers, 1983, p. 6.3-1 to 6.3-6.

A system employing two digital electronic surveying telescopes (theodolites) linked to a minicomputer for identifying vertical and horizontal angles of target weapons store points are detailed. The system is implemented in flight tests for establishing the weapons release envelope. A triangle is formed with vertices at the theodolites and the target and the weapon position is fixed by triangulation, then stored automatically. The system software corrects for lens aberrations and generates a digitized curve of the target displacement values. Sample calculations are reported for the movement of a released missile's center of gravity over time. M.S.K.

A85-28656
CONTINUED DEVELOPMENT OF DISTANCE MEASURING EQUIPMENT FOR REAL-TIME SPATIAL POSITIONING IN MILITARY AIRCRAFT TESTING
R. G. ALLEN, J. W. KING, and M. J. SMITH (Lockheed-Georgia Co., Marietta, GA) IN: Flight testing today: Innovative management and technology; Proceedings of the Fourteenth Annual Symposium, Newport Beach, CA, August 15-19, 1983 . Lancaster, CA, Society of Flight Test Engineers, 1983, p. 6.4-1 to 6.4-7.

This paper discusses the development of a cost-effective microwave spatial positioning system by Lockheed-Georgia Company. The program is an ongoing effort to develop space positioning techniques and real-time spatial data processing applicable to existing performance, stability and control, and systems flight test programs. A cost-effective research and development program has been implemented by exploiting recent advances in microwave positioning technology and utilizing in-house advances in microprocessor applications. Results from ground calibrations and accuracy testing have been very encouraging, although several major problems were encountered. The feasibility of a portable, ground crew independent, real-time spatial positioning system has been successfully demonstrated. Actual Takeoff and Landing (TOL) testing using a laser tracker as a baseline revealed that utilization of the calibration techniques can significantly improve the accuracy of a microwave positioning system. Current and future development will continue in the areas of transformation error minimization and antenna characteristics analysis. This paper relates the cost-effective techniques used in developing this spatial positioning system, while attempting to achieve the highest possible accuracies. Author

N85-19983# Naval Ocean Research and Development Activity, Bay St. Louis, Miss.
ADAPS (AIRBORNE DATA ACQUISITION AND PROCESSING SYSTEM) OPERATION AND MAINTENANCE MANUAL
R. T. MILES Mar. 1984 155 p
(AD-A149297; NORDA-TN-265) Avail: NTIS HC A08/MF A01 CSCL 08J

In the summer of 1982, an Airborne Data Acquisition and Processing System (ADAPS) was developed. The ADAPS is a user-programmable data acquisition system for use aboard RP-3A aircraft operated by the U.S. Naval Oceanographic Office. It is designed for rapid collection, editing and storage of data from aircraft launched expendable bathythermographs (AXBT's) and from various aircraft meteorological sensors. This manual describes the installation, functional operation, interconnections for system set-up and operating software programs of the developed system. The system is very flexible in that the user can easily modify any of the software programs provided with the system or develop new programs which tailor system performance to specific needs. The system electronics are modularly designed so that failures can be corrected by rapid replacement of printed circuit cards. Installation and use of ADAPS has resulted in the automation of many airborne survey tasks which were previously accomplished in a more time consuming manner. Ocean thermal profile data can now be provided to fleet interests on a more timely basis, and post processing of survey data for research purposes is improved due to availability of both thermal profiles and meteorological data along with time and position information all on one storage media. GRA

N85-21158# Naval Air Development Center, Warminster, Pa. Aircraft and Crew Systems Technology Directorate.
A SAFETY EVALUATION OF THE RELOCATION OF THE ACM (AIR COMBAT MANEUVER) PANEL IN THE F-14 ( )/AIP (AVIONICS INTEGRATION PROGRAM) Final Report
G. FRISCH and K. MILLER 14 May 1984 26 p
(AD-A149596; NADC-84076-60) Avail: NTIS HC A03/MF A01 CSCL 01B

A goal of the F-14 Avionics Integration Program (AIP) is to increase the field-of-view of the pilot's Head-up Display (HUD). One way to accomplish this would be to move the HUD closer to the pilot. However, if this were done, the Air Combat Maneuvering Panel (ACM), which is located on the face of the HUD housing, would either intrude, by approximately 1.25 inches, into the ejection envelope or the ACM panel functions would have to be redistributed throughout the F-14 cockpit. A computer simulation of ejection clearance was performed using a digitized representation of the F-14 cockpit with the relocated HUD. This study was complemented by three live subject ejection tower tests using a foam board representation of the revised ACM panel position. Both the analytical study and the tower tests indicate that the relocation of the ACM panel poses little risk of causing interference during ejection. However, extensive testing, using optimum fidelity seat performance and simulated cockpit structure, would be required to qualify the revised configuration if this option were to be implemented. GRA

N85-21160# Naval Air Test Center, Patuxent River, Md.
PROCEEDINGS OF THE 6TH ADVANCED AIRCREW DISPLAY SYMPOSIUM
16 May 1984 217 p Proc. held at Patuxent River, Md., 15-16 May 1984 Original contains color illustrations
(AD-A150044) Avail: NTIS HC A10/MF A01 CSCL 01D

The recent proliferation of new color display applications can be traced to two interrelated trends: (1) a growing interest in the potential advantages of a color information display for enhancing human performance in complex man-machine systems; and (2) the availability of a rapidly evolving display technology to support advanced color display concepts. Table of Contents: A Systematic Program for the Development and Evaluation of Airborne Color Display Systems by L. Silverstein, Airborne Electronic Color Displays - A Review of UK Activity Since 1981 by R. Caldow, Color CRT in the F-15 by J. Turner and H. H Waruszewski, Integration of Sensor and Display Subsystems by D. Bohrer and P. Jenkins, Modernizing Engine Displays by E. Schneider and E. Enevoldson, Colored Displays for Combat Aircraft by C. Maureau, Display Technology and the Role of Human Factors by S. Roscoe, J. Tatro, and E. Trujillo, Pictorial Format Program: Past, Present, and Future by G. Lizza, J. Reising, and L. Hitchcock, The Command Flight Path Display - All Weather, All Missions by G. Hoover, S. Shelley, V. Cronauer, and S. Filarsky, Sensor-Coupled Vision Systems by T. Stinnett, An Argument for Standardization in Modern Aircraft Crew Stations by V. Devino. GRA

07

AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and on-board auxiliary power plants for aircraft.

A85-26755#
COMPUTATION OF WIND TUNNEL WALL EFFECTS IN DUCTED ROTOR EXPERIMENTS
A. L. LOEFFLER, JR. (Grumman Aerospace Corp., Bethpage, NY) and J. S. STEINHOFF (Tennessee, University, Tullahoma, TN) Journal of Aircraft (ISSN 0021-8669), vol. 22, March 1985, p. 188-192. Previously cited in issue 06, p. 723, Accession no. A84-17969. refs

A85-26768#
WAVE ROTOR TURBOFAN ENGINES FOR AIRCRAFT
R. T. TAUSSIG (Mathematical Sciences Northwest, Inc., Bellevue, WA) Mechanical Engineering (ISSN 0025-6501), vol. 106, Nov. 1984, p. 60-66. refs

Attention is given to the design features and performance capabilities of a novel aircraft turbofan powerplant which incorporates a 'wave rotor' in its core section. In this turbomachine, the compression and exhaust processes are accomplished purely by gasdynamic wave phenomena rather than the motion of solid surfaces. Performance efficiency comparisons are made with the

compound diesel, eccentric high pressure compressor, heat recuperating, and conventional turbofan cycles that are expected to arouse the greatest design interest for reduced fuel consumption in next-generation engines. Pressure exchanger wave rotor-turbofan and wave rotor/turbine-turbofan configurational alternatives are considered. O.C.

A85-27094#
POWERPLANTS FOR LONG-DURATION UNMANNED AIRCRAFT
J. E. BORETZ (TRW, Inc., Applied Technology Div., Redondo Beach, CA) Journal of Propulsion and Power (ISSN 0748-4658), vol. 1, Mar.-Apr. 1985, p. 126-130. Previously cited in issue 16, p. 2285, Accession no. A84-35216. refs

A85-27099#
A COMPARISON OF SCRAMJET INTEGRAL ANALYSIS TECHNIQUES
G. A. SULLINS and P. J. WALTRUP (Johns Hopkins University, Laurel, MD) Journal of Propulsion and Power (ISSN 0748-4658), vol. 1, Mar.-Apr. 1985, p. 156-158. refs

Two integral analysis methods are compared in order to establish their relative effectiveness in estimating the performance characteristics of a scramjet engine. While the first method is a two-step process that assumes constant ara combustion followed by constant Mach number combustion, the second is a one-step process in which combustion is assumed to follow a Crocco presure-area relationship. Results indicate that the constant property process underpredicts the expected engine performance, especially at the end-of-boost-phase Mach number of 3.5. O.C.

A85-28636* National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
FLIGHT TESTING THE DIGITAL ELECTRONIC ENGINE CONTROL (DEEC) A UNIQUE MANAGEMENT EXPERIENCE
T. W. PUTNAM, F. W. BURCHAM, JR., and B. M. KOCK (NASA, Flight Research Center, Edwards, CA) IN: Flight testing today: Innovative management and technology; Proceedings of the Fourteenth Annual Symposium, Newport Beach, CA, August 15-19, 1983 . Lancaster, CA, Society of Flight Test Engineers, 1983, p. 2.2-1 to 2.2-6.

The concept for the DEEC had its origin in the early 1970s. At that time it was recognized that the F100 engine performance, operability, reliability, and cost could be substantially improved by replacing the original mechanical/supervisory electronic control system with a full-authority digital control system. By 1978, the engine manufacturer had designed and initiated the procurement of flight-qualified control system hardware. As a precursor to an integrated controls program, a flight evaluation of the DEEC system on the F-15 aircraft was proposed. Questions regarding the management of the DEEC flight evaluation program are discussed along with the program elements, the technical results of the F-15 evaluation, and the impact of the flight evaluation on after-burning turbofan controls technology and its use in and application to military aircraft. The lessons learned through the conduct of the program are discussed. G.R.

A85-29048
CALCULATION OF THE DISTURBANCE TO COMBUSTION CHAMBER FILM COOLING DUE TO AIR INJECTION THROUGH A ROW OF JETS
J. KOEHLER and H. BEER (Darmstadt, Technische Hochschule, Darmstadt, West Germany) Zeitschrift fuer Flugwissenschaften und Weltraumforschung (ISSN 0342-068X), vol. 9, Jan.-Feb. 1985, p. 34-42. Research supported by the Deutsche Forschungsgemeinschaft. refs

Approaches for improving the efficiency of modern gas turbines are based on a utilization of higher operational temperatures and pressures. The higher air pressures and temperatures involved lead to cooling problems, while the design of optimized cooling procedures requires an improved knowledge regarding the details of the cooling process. The present investigation is concerned with a theoretical study of the downstream adiabatic wall effectiveness 'eta', taking into account the interruption of a slot flow by the penetration of a row of jets. Eta is defined by an expression which contains the temperature of the mainstream, the film coolant, and the adiabatic wall. The film cooling process in the case of the combustion chamber walls is studied with the aid of a model. The model, which is based on the conservation equations, makes the calculation of the adiabatic wall temperature distribution possible. G.R.

A85-29342
NEW FIGHTER ENGINES - A REVIEW. I
B. GAL-OR (Technion - Israel Institute of Technology, Haifa, Israel) International Journal of Turbo and Jet-Engines (ISSN 0334-0082), vol. 1, no. 3, 1984, p. 183-194. refs

An evaluation is made of the development trends evident in state-of-the-art and next-generation fighter aircraft engines and their associated systems, such as two-dimensional thrust vectoring nozzles and full authority digital electronic control. Attention is given to the comparative capabilities of the F-100, F-404, and F-110 turbofans in current production, together with the PW-1128 turbofan and PW-1120 'leaky turbojet', which are undergoing tests. A tabulation is given for thrust/weight ratios, specific fuel consumptions, weights, and external dimensions. Critical areas for design development are identified to be parts commonality among engines of a family, single crystal high turbine inlet temperature blades and disks, and improvements over older engines in operability, durability, and survivability. O.C.

A85-29343
GAS TURBINE AIRBLAST ATOMIZERS - A REVIEW. I
A. K. JASUJA (Cranfield Institute of Technology, Cranfield, Beds., England) International Journal of Turbo and Jet-Engines (ISSN 0334-0082), vol. 1, no. 3, 1984, p. 195-208. Research supported by the Ministry of Defence of England. refs

This paper reviews the results of numerous investigations that have been conducted on airblast atomization as applied to gas turbine engines. Attention is focused upon such factors as atomizer scale, configuration, the nature of fuel preparation before exposure to air, etc., for the most commonly used pre-filming and plain-jet airblast atomizers. The experimental mean drop size data included in this paper has been obtained through the use of well-established laser light-scattering techniques over a wide range of conditions. The general conclusion drawn from the data is that the plain-jet airblast atomizers featuring multiple, transversely injected liquid jets into a swirling airstream yield spray quality comparable to that achieved by their pre-filming counterparts especially under high air pressure conditions. Author

A85-29344
DESIGNING FOR STABILITY IN ADVANCED TURBINE ENGINES
H. D. STETSON (United Technologies Corp., Government Products Div., West Palm Beach, FL) International Journal of Turbo and Jet-Engines (ISSN 0334-0082), vol. 1, no. 3, 1984, p. 235-245. refs

One of the most critical functional problems that a high technology turbine engine encounters is nonrecoverable stall. Presently, the only effective means of clearing the nonrecoverable stall is engine shutdown and subsequent airstart, potentially impacting the effectiveness of the weapon system. This paper addresses the design improvements that are required to make the system more tolerant to the operational environment. This paper also deals with establishing design criteria to be applied in the preliminary engine design phase to ensure resistance/avoidance of nonrecoverable stalls while ensuring adequate engine operability in the form of airstart capability and engine throttle response. This paper will identify the mechanisms of rotating stall, the design improvements to resist/avoid rotating stall, their projected effectiveness in reducing operational problems, and engine test results of some of these design improvements. Author

A85-29345
FACTORS INFLUENCING HEAT TRANSFER TO THE PRESSURE SURFACES OF GAS TURBINE BLADES
B. W. MARTIN and A. BROWN (University of Wales Institute of Science and Technology, Cardiff, Wales) International Journal of Turbo and Jet-Engines (ISSN 0334-0082), vol. 1, no. 3, 1984, p. 247-257. refs

It is suggested that heat transfer through the laminar boundary layer flowing over the concave pressure surface of a turbine blade is strongly influenced by the presence of Taylor-Goertler vortices, as well as by mainstream turbulence. Transition occurs when these factors in concert outweigh the tendency of the boundary layer to remain laminar in the favorable pressure gradients characteristic of flow over pressure surfaces. Author

A85-29346
THE CONTROL OF ANNULAR COMBUSTOR EXIT TEMPERATURE PROFILES
A. I. RASPUTNIS and B. GAL-OR (Technion - Israel Institute of Technology, Haifa, Israel) International Journal of Turbo and Jet-Engines (ISSN 0334-0082), vol. 1, no. 3, 1984, p. 259-271. refs

The control of radial and circumferential temperature profiles at the combustor exit of developmental turbofan engines allows optimization of the temperature field at the turbine inlet, thereby reducing the stresses on turbine blade roots; this, in turn, permits the test operator to increase thrust and/or engine life. Attention is presently given to a methodology and combustor model associated with the improvement of liner cooling and the optimization of the number, distribution, and shape of combustion and dilution holes, as well as to the research facility employed. Local temperature coefficient maps are presented. O.C.

A85-29566#
UNCERTAINTY OF TURBINE ENGINE PERFORMANCE MEASUREMENTS IN ALTITUDE GROUND TEST FACILITIES
R. E. SMITH, JR. and S. WEHOFER (Sverdrup Technology, Inc., Arnold Air Force Station, TN) IN: International Instrumentation Symposium, 29th, Albuquerque, NM, May 2-6, 1983, Proceedings . Research Triangle Park, NC, Instrument Society of America, 1983, p. 323-348. refs

Techniques for evaluating the level of uncertainty in direct-connect-type ground tests of turbine-engine aerothermodynamic performance under simulated steady-state flight conditions are developed on the basis of the method of Abernethy and Thompson (1973) and demonstrated. The test configuration employed is described; measurement systems based on airflow, tailpipe continuity/momentum balance, component-performance stacking, scale force, and fuel metering are characterized; and uncertainty analyses for thrust, fuel flow, and overall performance are presented in extensive tables and graphs. Recommendations for improving the uncertainty of tests are included. T.K.

A85-29695#
DESIGN AND EXPERIMENTAL INVESTIGATION OF A HIGH-LOADED TRANSONIC AXIAL MODEL TURBINE
J. SHI, J. HAN, Y. PAN, Y. ZHUANG (Nanhua Powerplant Institute, People's Republic of China), S. ZHOU, M. ZHU, and H. LI (Shenyang Aircraft Engine Institute, Shenyang, People's Republic of China) Acta Aeronautica et Astronautica Sinica, vol. 5, Sept. 1984, p. 280-287. In Chinese, with abstract in English. refs

The design and performance of an experimental aircraft-engine transonic turbine stage with large-deflection blades and loading coefficient 2.4 are reported. The turbine is a modified version of a controlled-vortex test model and utilizes an advanced low-solidity blade-profile design to balance aerodynamic-performance, strength, weight, and cooling requirements. The results of two-dimensional cascade and stage tests are presented in tables and graphs and shown to be in good agreement with the design predictions. T.K.

A85-29775
INSPECTION OF GAS-TURBINE ENGINE BLADES UNDER OPERATING CONDITIONS
F. A. ZHISLIN and M. E. KHURGIN (Gosudarstvennyi Nauchno-Issledovatel'skii Institut Grazhdanskoi Aviatsii, Moscow, USSR) (Defektoskopiia, Aug. 1984, p. 60-65) Soviet Journal of Nondestructive Testing (ISSN 0038-5492), vol. 20, no. 8, April 1985, p. 542-547. Translation.

Ultrasound and eddy-current transducers have been developed for inspecting the edges of compressor and turbine blades. A series of schematic diagrams of the devices is presented. The methods devised for conveying the transducer heads through air intake windows in gas turbine engines are briefly described. I.H.

A85-29886
THE DYNAMIC STRESSED STATE OF THE CANTILEVER TURBOCOMPRESSOR BLADES OF GAS-TURBINE ENGINES [DINAMICHESKAIA NAPRIAZHENNOST' KONSOL'NYKH LOPATOK TURBOKOMPRESSOROV GTD]
V. M. KAPRALOV Problemy Prochnosti (ISSN 0556-171X), March 1985, p. 108-113. In Russian. refs

A method for determining the vibrational stress of turbocompressor blades is presented which involves computer processing of test data and plotting histograms of the distribution of variable mechanical stress amplitudes. Data are presented on the vibrational stress of the cantilever guide vanes of an axial-flow compressor under conditions of a rotating stall and for the rotor blades of a turbine over the operating range of rotation speeds. Various methods are proposed for calculating equivalent harmonic stresses from the histograms to obtain statistical estimates of the safety factor. V.L.

A85-30193#
NOISE TESTING OF AN ADVANCED DESIGN PROPELLER IN THE BOEING ANECHOIC TEST CHAMBER WITH A RELATIVE VELOCITY FREE JET
E. I. PLUNKETT, P. C. TOPNESS, and C. D. SIMCOX (Boeing Commercial Airplane Co., Noise Technology Laboratory, Seattle, WA) American Institute of Aeronautics and Astronautics and NASA, Aeroacoustics Conference, 9th, Williamsburg, VA, Oct. 15-17, 1984. 6 p.
(AIAA PAPER 84-2262)

Noise tests were recently conducted in a large anechoic test chamber on the NASA SR-6 advanced design propeller (ADP) both with and without relative velocity. High quality data were recorded for a wide range of helical tip speeds and disk loadings at Mach numbers up to .25. The results of the testing are presented with particular attention given to evaluation of SR-6 directivities and nearfield/farfield boundaries. Comparisons are offered of the SR-6 noise signature in an anechoic chamber/free-jet environment and an acoustically treated wind tunnel for specific dynamic conditions. A solution to the problem of providing relative velocity in an anechoic environment is presented and the application of traversing microphone measurement techniques is discussed. Author

N85-21161 Department of the Air Force, Washington, D.C.
FLAMEHOLDER WITH INTEGRATED AIR MIXER Patent
J. L. KINSEY, inventor (to Air Force) 1 Jan. 1985 4 p Supersedes AD-D010228
(AD-D011549; US-PATENT-4,490,973;
US-PATENT-APPL-SN-484329; US-PATENT-CLASS-60-261)
Avail: US Patent and Trademark Office CSCL 21E

A flameholder in an afterburner incorporates an improved mixer which includes a small duct for capturing a small percent of hot gas stream flow and routing the same outwardly along the gutter of the flameholder for producing a localized increase of the air temperature in the cool fan air stream flow. The mixer also includes a deflector plate for deflecting the hot gas exiting from the duct into the cool air stream flow. GRA

N85-21163*# John Deere Technologies International, Inc., Wood-Ridge, N.J. Rotary Engine Div.
STRATIFIED CHARGE ROTARY AIRCRAFT ENGINE TECHNOLOGY ENABLEMENT PROGRAM Final Report
P. R. BADGLEY, C. E. IRION, and D. M. MYERS 31 Jan. 1985 110 p refs
(Contract NAS3-23056)
(NASA-CR-174812; NAS 1.26:174812; JDTI-RED-85-1) Avail: NTIS HC A06/MF A01 CSCL 21E

The multifuel stratified charge rotary engine is discussed. A single rotor, 0.7L/40 cu in displacement, research rig engine was tested. The research rig engine was designed for operation at high speeds and pressures, combustion chamber peak pressure providing margin for speed and load excursions above the design requirement for a high is advanced aircraft engine. It is indicated that the single rotor research rig engine is capable of meeting the established design requirements of 120 kW, 8,000 RPM, 1,379 KPA BMEP. The research rig engine, when fully developed, will be a valuable tool for investigating, advanced and highly advanced technology components, and provide an understanding of the stratified charge rotary engine combustion process. E.A.K.

N85-21164*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMBUSTION RESEARCH FOR GAS TURBINE ENGINES
E. J. MULARZ and R. W. CLAUS 1985 19 p refs To be presented at the 7th Intern. Symp. on Air Breathing Engines, Peking, 2-6 Sep. 1985
(NASA-TM-86963; E-2490; NAS 1.15:86963) Avail: NTIS HC A02/MF A01 CSCL 21E

Research on combustion is being conducted at Lewis Research Center to provide improved analytical models of the complex flow and chemical reaction processes which occur in the combustor of gas turbine engines and other aeropropulsion systems. The objective of the research is to obtain a better understanding of the various physical processes that occur in the gas turbine combustor in order to develop models and numerical codes which can accurately describe these processes. Activities include in-house research projects, university grants, and industry contracts and are classified under the subject areas of advanced numerics, fuel sprays, fluid mixing, and radiation-chemistry. Results are high-lighted from several projects. Author

N85-21165*# Massachusetts Inst. of Tech., Cambridge. Dept. of Aeronautics and Astronautics.
ADVANCED STRESS ANALYSIS METHODS APPLICABLE TO TURBINE ENGINE STRUCTURES Final Report
T. H. H. PIAN Mar. 1985 44 p refs
(Contract NAG3-33)
(NASA-CR-175573; NAS 1.26:175573) Avail: NTIS HC A03/MF A01 CSCL 21E

Advanced stress analysis methods applicable to turbine engine structures are investigated. Constructions of special elements which containing traction-free circular boundaries are investigated. New versions of mixed variational principle and version of hybrid stress elements are formulated. A method is established for suppression of kinematic deformation modes. semiLoof plate and shell elements are constructed by assumed stress hybrid method. An elastic-plastic analysis is conducted by viscoplasticity theory using the mechanical subelement model. B.W.

N85-21169*# National Aeronautics and Space Administration, Washington, D. C.
TOWARDS A RENEWAL OF THE PROPELLER IN AERONAUTICS
D. BERGER and P. JACQUET Feb. 1985 32 p Transl. into ENGLISH of Conf. Paper AAF-Paper-NT-82-01 from Assoc. Aeron. et Astron. de France, Marseille, 30 p. Presented at the 19th Colloq. d'Aeron. Appliquee, Marseille Original language doc. was announced in IAA as A83-33159 Transl. by The Corporate Word, Inc., Pittsburgh,
(Contract NAAS-4006)
(NASA-TM-77803; NAS 1.15:77803; AAF-PAPER-NT-82-01)
Avail: NTIS HC A03/MF A01 CSCL 01A

The reasons for reconsidering the propeller for aircraft propulsion, the areas of application, and necessary developments are considered. Rising fuel costs and an increasing theoretical and experimental data base for turboprop engines have demonstrated that significant cost savings can be realized by the use of propellers. Propellers are well-suited to powering aircraft traveling at speeds up to Mach 0.65. Work is progressing on the development of a 150 seat aircraft which has a cruise speed of Mach 0.8, powered by a turboprop attached to an engine of 15,000 shp. Aeroelasticity analyses ae necessary in order to characterize the behavior of thin profile propfan blades, particularly to predict the oscillations through the entire functional range. High-power reducers must be developed, and the level of cabin noise must be controlled to less than 90 dB. Commercial applications are predicted for turboprops in specific instances. M.S.K. (IAA)

N85-21170# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
AN EXPERIMENTAL INVESTIGATION OF AN UNDEREXPANDED RECTANGULAR JET EJECTOR Interim Report
Y. HSIA, A. KROTHAPALLI, D. BAGANOFF, and K. KARAMCHETI Apr. 1984 123 p
(Contract F49620-79-C-0189)
(AD-A149656; SU-JIAA-TR-53; AFOSR-84-1196TR) Avail: NTIS HC A06/MF A01 CSCL 21E

An experimental investigation was carried out on a rectangular ejector (constant area mixing duct) with an underexpanded rectangular jet as primary flow. This study investigated the mixing behavior of the ejector flow in general and attempted to identify the effects of the screech tones on the mixing and performance of the ejector. The quantities measured include frequency and amplitude of the screech tone, surface pressure on the ejector duct wall, and the mean flow velocity at the ejector exit in the two central planes of the primary jet. Schlieren flow visualization was made in the plane containing the short dimension of the primary nozzle. The screech tone frequency of the ejector depends not only on the primary jet pressure ratio but also on the ejector duct width. Variations of the screech tone frequency with both the pressure ratio and the duct width show staging behavior. For a given duct width, each screech tone stage matches with one of the transverse modes of the duct. The ejector performance, as determined from the static pressure distribution on the walls, shows irregular variation with pressure ratio, and is found to be related to the screech tone stages. GRA

N85-21171# Physics Lab. RVO-TNO, The Hague (Netherlands). Research Group 2: Far Infrared.
THE INFLUENCE ON IR EMISSION OF ENGINE PARAMETERS FOR AN AFTERBURN CASE. A SENSITIVITY STUDY ON NATO INFRARED AIR TARGET MODEL (NIRATAM) VERSION: 0.0
J. BAARS Oct. 1984 32 p refs
(Contract A82/KLU/081)
(AD-B089311L; PHL-1984-62; TDCK-79703) Avail: NTIS HC A03/MF A01

The effects of mass flow ratio, exhaust gas temperature, and gas velocity on NATO Infrared Air Target Model calculations of turbojet aircraft plume structure following afterburn were studied. The greatest difference in emission is obtained by changing the concentration of gas species. A smaller effect is produced by

variations in exhaust gas temperatures. For variations in the exhaust gas velocities negligible radiation changes are noticed.
Author (ESA)

08

AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

A85-26429#
A DESIGN METHODOLOGY FOR PITCH POINTING FLIGHT CONTROL SYSTEMS
K. M. SOBEL and E. Y. SHAPIRO (Lockheed-California Co., Burbank, CA) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 8, Mar.-Apr. 1985, p. 181-187. refs

A methodology is developed for designing pitch pointing flight control laws by using eigenstructure assignment and command generator tracking. Eigenvalues are chosen to obtain desired damping and rise time, and eigenvectors are chosen to decouple the pitch attitude and flight path angle. Feedforward gains are computed which ensure steady-state tracking of the pilot's command. The design methodology is illustrated by application to an AFTI F-16 aircraft. Author

A85-26430#
DESIGN AND FLIGHT TESTING OF DIGITAL DIRECT SIDE-FORCE CONTROL LAWS
S. L. GRUNWALD (USAF, Washington, DC) and R. F. STENGEL (Princeton University, Princeton, NJ) (Guidance and Control Conference, San Diego, CA, August 9-11, 1982, Collection of Technical Papers, p. 143-151) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 8, Mar.-Apr. 1985, p. 188-193. Previously cited in issue 19, p. 2980, Accession no. A82-38941. refs
(Contract N00014-78-C-0257)

A85-26431*# Purdue Univ., Lafayette, Ind.
MODAL ANALYSIS OF FLEXIBLE AIRCRAFT DYNAMICS WITH HANDLING QUALITIES IMPLICATIONS
D. K. SCHMIDT (Purdue University, West Lafayette, IN) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 8, Mar.-Apr. 1985, p. 194-200. Previously cited in issue 19, p. 2805, Accession no. A83-41911. refs
(Contract NAG1-254)

A85-26442#
STATUS AND CONCERNS FOR BANK-TO-TURN CONTROL OF TACTICAL MISSILES
A. ARROW (Johns Hopkins University, Laurel, MD) (Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, Collection of Technical Papers, p. 236-244) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 8, Mar.-Apr. 1985, p. 267-274. Previously cited in issue 19, p. 2802, Accession no. A83-41683. refs
(Contract N00024-83-C-5301)

A85-26447#
MEASUREMENTS OF DESPIN AND YAWING MOMENTS PRODUCED BY A VISCOUS LIQUID
M. C. MILLER (U.S. Army, Chemical Research and Development Center, Aberdeen Proving Ground, MD) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 8, Mar.-Apr. 1985, p. 282-284. refs

Attention is given to laboratory measurements of liquid fill-induced yawing and despin moments generated by the viscous liquid contained in a cylindrical canister, when it is simultaneously subjected to spinning and coning motion. These data furnish experimental evidence of a direct relation between the destabilizing yawing moment and the despin moment generated by the viscous liquid fill. O.C.

A85-26449#
A RELATION BETWEEN LIQUID ROLL MOMENT AND LIQUID SIDE MOMENT
C. H. MURPHY (U.S. Army, Ballistics Research Laboratories, Aberdeen Proving Ground, MD) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 8, Mar.-Apr. 1985, p. 287, 288. refs

The characteristic association of a large despin moment with a large coning motion for a projectile with a moving payload can be used as a diagnostic tool. The linearized Navier-Stokes equations have been used to develop a relationship between the liquid side moment and the liquid roll moment, and this relationship can in turn be used to predict the side moment from a measured roll moment. Such predictions are presently illustrated by yawsonde data that has been analyzed by Pope (1983). O.C.

A85-27795
VECTOR OPTIMIZATION OF AIRCRAFT DECELERATION IN AIR [O VEKTORNOI OPTIMIZATSII PROTSESSA TORMOZHENIIA LETATEL'NOGO APPARATA V VOZDUKHE]
B. IA. LOKSHIN, V. A. PRIVALOV, and V. E. RYZHOVA Moskovskii Universitet, Vestnik, Seriia 1 - Matematika, Mekhanika (ISSN 0579-9368), vol. 1, Jan.-Feb. 1985, p. 67-70. In Russian.

A solution is presented for the problem of the vector optimization of the deceleration of heavy aircraft in air. The deceleration is achieved due to aerodynamic drag and an additional control force acting in the direction that is opposite to the direction of the aircraft velocity vector. It is shown that the optimum control force is a single-step function. V.L.

A85-28477#
CRITERIA FOR LOW-SPEED LONGITUDINAL HANDLING QUALITIES OF TRANSPORT AIRCRAFT WITH CLOSED-LOOP FLIGHT CONTROL SYSTEMS
H. A. MOOIJ Delft, Technische Hogeschool, Doctor in de Technische Wetenschappen Thesis, 1984, 163 p. Research supported by the Nederlands Instituut voor Vliegtuigontwikkeling en Ruimtevaart and Rijksluchtvaartdienst. refs

After developing the equations of motion for the dynamics of an airframe/engine system, and deriving from these the associated transfer functions, attention is given to the development history of closed loop flight control systems using nonmechanical signal transmission, the dynamics of the human pilot as part of the closed loop pilot/aircraft system, and criteria that have been developed for longitudinal handling qualities. An evaluation is then conducted of both ground and flight simulation experiments for various aircraft configurations. Pilot judgments concerning these configurations are expressed in the form of ratings and comments, although a statistical approach to the analysis of certain performance variables is also employed. Attention is given to the prediction of handling qualities. O.C.

A85-28608
APPLICATION OF MODERN CONTROL TO BANK-TO-TURN GUIDANCE USING DIGITAL SIMULATION
D. J. RODDY and G. W. IRWIN (Belfast, Queen's University, Belfast, Northern Ireland) IN: Summer Computer Simulation Conference, 15th, Vancouver, Canada, July 11-13, 1983, Proceedings. Volume 1 . La Jolla, CA, Society for Computer Simulation, 1983, p. 296-301. Research supported by the Department of Education of Northern Ireland and Short Brothers, Ltd. refs

It is pointed out that command-to-line-of-sight (CLOS) guidance is one approach to controlling a missile in short-medium range engagements. The acceleration commands sent to the missile may be either Cartesian or polar. A bank-to-turn missile receives polar commands and implements them by means of two sets of control surfaces, including elevators and ailerons. Balbirnie et al. (1975) have employed a simple model for the design of a controller which works for a limited range of engagement geometries. The present investigation is concerned with a wider range of

engagement geometries, taking into account a more realistic model. As simulation is an invaluable tool in the study of the considered system, it is used extensively as an integral part of the design process. This approach makes it possible to apply linear control theory to a problem which is grossly nonlinear. The detailed testing of the design is also performed with the aid of simulation. G.R.

A85-28641
QUANTIFYING AFTI/F-16 GUST ALLEVIATION CHARACTERISTICS USING FREQUENCY RESPONSE ANALYSIS
R. B. CROMBIE (USAF, Edwards AFB, CA) IN: Flight testing today: Innovative management and technology; Proceedings of the Fourteenth Annual Symposium, Newport Beach, CA, August 15-19, 1983 . Lancaster, CA, Society of Flight Test Engineers, 1983, p. 3.3-1 to 3.3-7. refs

The AFTI/F-16 multi-mode flight control laws are task-tailored to include gust alleviation of normal acceleration or pitch rate response to turbulence. A new data analysis method was developed to compare the four different control laws in terms of the cockpit vibration environment, ride quality, pitch response and control surface activity in rough air. Results for one flight condition clearly show the effects of the different control law architectures. The maneuver enhancement (decoupled control law) architecture was found to be the most effective in terms of gust alleviation obtained from a given level of control surface activity. Author

A85-29049
FLIGHT TIME ENHANCEMENT ON THE BASIS OF A CYCLICALLY CONTROLLED DYNAMIC DURATION FLIGHT [FLUGZEITSTEIGERUNG DURCH ZYKLISCH GESTEUERTEN DYNAMISCHEN DAUERFLUG]
G. SACHS (Muenchen, Technische Universitaet, Munich, West Germany) Zeitschrift fuer Flugwissenschaften und Weltraumforschung (ISSN 0342-068X), vol. 9, Jan.-Feb. 1985, p. 42-52. In German. refs

Questions regarding the maximum time of flight obtainable with an aircraft on the basis of a given amount of fuel are related to one of the most important problems in the area of flight performance. This problem has been solved for steady-state flight conditions. Studies have also been conducted for nonsteady-state flight conditions, taking into account, however, only the flight range. The present investigation is concerned with an extension of these studies to questions regarding the time of flight. Model concepts are developed to obtain a basis for an analytical consideration of the involved problems. This approach provides explicit solutions for deriving a number of results. A new method of dynamic duration flight makes it possible to achieve significant enhancements in flight time in comparison to the optimum value of steady-state duration flight. The type of aircraft propulsion (propeller drive, turbofan, etc.) is of crucial significance for the improvement possibilities. Attention is given to the altitude ranges required for the achievement of the absolute optimal values. G.R.

A85-29125
AIRCRAFT CONTROL SYSTEMS - A PROJECTION TO THE YEAR 2000
D. C. FRASER (Charles Stark Draper Laboratory, Inc., Cambridge, MA) IEEE Control Systems Magazine (ISSN 0272-1708), vol. 5, Feb. 1985, p. 11-13.

Advances in aircraft control systems technology expected to take place by the year 2000 are outlined. An emphasis is placed on the role of integrated aerodynamic, structural, and propulsion systems controls, as well as information systems, mainly in the context of military aircraft application. Consideration is also given to the ultrafault-tolerant and reliable systems and fly-by-wire control systems with integrated redundant sensor subsystems with embedded fault reconfiguration. Finally, pilot/vehicle interface is examined with respect to the systems, design, simulation, and real-time scheduling capability. L.T.

A85-29195
SUPERNORMAL FLIGHT MAY CHANGE BATTLE FLIGHT CONCEPTS INTO THE INDEFINITE FUTURE
D. LEE Defense Systems Review and Military Communications, vol. 3, no. 2, 1985, p. 58-60.

By employing maneuvers that involve 'supernormal' attitudes, with angles-of-attack approximating 90 deg, future fighter pilots may profoundly affect such combat tactics as those envisioned by the 'AirLand Battle' doctrine. Supernormal flight (SNF) encompasses stall survivability enhancement, spin retention and recovery, short landings, increased turn rates, rapid deceleration, and improved aiming and pointing. An SNF development program is being conducted at NASA's Ames Research Center. O.C.

A85-29255*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
DISCONTINUOUS WING LEADING EDGE TO ENHANCE SPIN RESISTANCE
D. J. DICARLO, K. E. GLOVER, E. C. STEWART, and H. P. STOUGH (NASA, Langley Research Center, Low-Speed Aerodynamics Div., Hampton, VA) Journal of Aircraft (ISSN 0021-8669), vol. 22, April 1985, p. 283-288. Previously cited in issue 06, p. 725, Accession no. A84-19261. refs

A85-29864
PROBLEMS IN THE SIMULATION OF THE AUTOMATIC FLIGHT CONTROL SYSTEMS OF AIRCRAFT [K PROBLEMATICE SIMULACE SYSTEMU AUTOMATICKEHO RIZENI LETU LETADEL]
Z. PECH (Ceske Vysoke Uceni Technicke, Prague, Czechoslovakia) Zpravodaj VZLU (ISSN 0044-5355), no. 6, 1984, p. 353-355. In Czech.

The flight control systems of aircraft are briefly characterized and classified in accordance with the extent of automation and control priority. A mathematical model for the closed-loop control system aircraft-autopilot is developed which can be implemented in real time using a digital computer. By using linearized equations of state for the control and controlled systems, equations of state are obtained for the combined system which can be solved numerically. The usefulness of the approach proposed here is demonstrated for the case of the two-dimensional automatic stabilization in the pitch control system. V.L.

N85-19985* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
LEADING EDGE FLAP SYSTEM FOR AIRCRAFT CONTROL AUGMENTATION Patent
D. M. RAO, inventor (to NASA) (Old Dominion Univ.) 4 Dec. 1984 9 p Filed 12 Aug. 1983 Continuation of abandoned US Patent Appl. SN-301078, filed 10 Sep. 1981 Sponsored by NASA (NASA-CASE-LAR-12787-2; NAS 1.71:LAR-12787-2; US-PATENT-4,485,992; US-PATENT-APPL-SN-5226628; US-PATENT-APPL-SN-301078; US-PATENT-CLASS-244-90R; US-PATENT-CLASS-244-214) Avail: US Patent and Trademark Office CSCL 01C

Traditional roll control systems such as ailerons, elevons or spoilers are least effective at high angles of attack due to boundary layer separation over the wing. This invention uses independently deployed leading edge flaps on the upper surfaces of vortex stabilized wings to shift the center of lift outboard. A rolling moment is created that is used to control roll in flight at high angles of attack. The effectiveness of the rolling moment increases linearly with angle of attack. No adverse yaw effects are induced. In an alternate mode of operation, both leading edge flaps are deployed together at cruise speeds to create a very effective airbrake without appreciable modification in pitching moment. Little trim change is required.

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

N85-19986# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
ROBUSTNESS OF DISCRETE-TIME DYNAMICAL SYSTEMS: APPLICATION TO THE MULTIVARIABLE DIGITAL CONTROL OF COMBAT AIRCRAFT Ph.D. Thesis - Inst. Industriel du Nord, Lille
Y. JOANNIC 1984 130 p refs In FRENCH; ENGLISH summary Report will also be announced as translation (ESA-TT-906) 2 Vol.
(ONERA-NT-1984-2; ISSN-0078-3781) Avail: NTIS HC A07/MF A01

A method to compute optimal feedback laws, capable of maintaining accurate tracking despite constantly acting disturbances, is developed and applied to the flight control problem of a combat aircraft. A formalism reduces robustness to preservation of stability of a properly augmented system, providing results which quantify the generalized structural robustness of a recurrent nonlinear multiloop system. Having extended the Lyapounov criterion to systems having a dynamical feedback, classical concepts of stability margin and gain and phase margins are generalized to the multivariable discrete case. Analytical expressions allow measurement of the margins when dynamical or nonlinear disturbances affect the feedback channels. In linear-quadratic regulators, the margins are linked to penalty matrices of the cost function, allowing optimization of margins, while taking into account the algebraic structure of expected multiplicative perturbations. By application of external stability theorems to a recurrent system, admissible additive disturbances which do not destabilize the controlled system are measured.
Author (ESA)

N85-19987# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Direction des Etudes de Synthese.
ROBUSTNESS OF CONTINUOUS MULTIVARIABLE FLIGHT CONTROLS Final Report [ROBUSTESSE DES REGULATEURS DE PILOTAGE MULTIVARIABLES CONTINUS]
O. L. MERCIER 26 Jun. 1984 27 p refs In FRENCH
(Contract DRET-81.34.369)
(ONERA-RT/12/7224/SY) Avail: NTIS HC A03/MF A01

Theoretical results on the robustness of controllers are discussed with focus on tolerance of additive and multiplicative perturbations and conditions of robustness bearing on the matrix of the difference of feedback. General recommendations are given for the establishment of a robust controller as well as for the case of a linear quadratic controller. The establishment of aircraft flight controller at two levels is discussed. Transl. by A.R.H.

N85-19988# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Direction des Etudes de Synthese.
ROBUSTNESS OF CONTINUOUS MULTIVARIABLE FLIGHT CONTROLS [ROBUSTESSE DES REGULATEURS DE PILOTAGE MULTIVARIABLES]
O. L. MERCIER 26 Jun. 1984 152 p refs In FRENCH
(Contract DRET-81.34.369)
(ONERA-RT/11/7224/SY) Avail: NTIS HC A08/MF A01

The state of the art of robust multivariable control is reviewed, and frequency domain flight control systems are described. A two level flight control for a combat aircraft is presented. A program which improves flyability and optimizes control robustness is outlined. Author (ESA)

N85-19989# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Abt. Flaechenflugzeuge.
IN-FLIGHT INVESTIGATION OF THE EFFECTS OF TIME DELAY IN CONTROL SYSTEM ON FLYING QUALITIES IN LANDING APPROACH
K. WILHELM and D. ALTENKIRCH Oct. 1984 92 p refs
(DFVLR-FB-84-35; ISSN-0171-1342) Avail: NTIS HC A05/MF A01; DFVLR, Cologne DM 30

An in-flight flight simulator was used to investigate the influence of time delay in control system on the landing approach flying qualities of a business jet aircraft. Time delay in the longitudinal and lateral control system was varied from 0 to 1300 msec. Three pilots flew 10 configurations in a total of 128 ILS approaches under different atmospheric conditions. Cooper-Harper pilot ratings and special effort ratings, as well as statistical values computed from measured performance data of the pilot-aircraft system are presented as a function of time delay and turbulence intensity. The flight results were compared with handling qualities criteria. Results show that flying qualities in pitch and roll are highly affected by control system time delays, especially the lateral axis.
Author (ESA)

N85-21172 Department of the Air Force, Washington, D.C.
TRANSLATING RUDDER PEDAL SYSTEM Patent
G. W. LARSON, W. E. LEE, and E. N. LEWIS, JR., inventors (to Air Force) 27 Nov. 1984 6 p Supersedes AD-D009708 (AD-D011510; US-PATENT-4,484,722;
US-PATENT-APPL-SN-393834) Avail: US Patent and Trademark Office CSCL 01D

A translating rudder pedal system which includes a rudder pedal assembly and a reclinable, translationally moveable, seat operably connected to the pedal assembly, with both the pedal assembly and the seat mounted in a vehicle, such as an aircraft is described. The system ensures that, irrespective of the movement and positioning of the seat, the feet of the user seated in the seat always remain in contact with the control pedals of the rudder pedal assembly. Author (GRA)

N85-21174*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ANALYTICAL AND FLIGHT INVESTIGATION OF THE INFLUENCE OF ROTOR AND OTHER HIGH-ORDER DYNAMICS ON HELICOPTER FLIGHT-CONTROL SYSTEM BANDWIDTH
R. T. N. CHEN and W. S. HINDSON (Stanford Univ., Calif.) Feb. 1985 20 p refs Presented at Ist Ann. Forum of the Intern. Conf. on Basic Rotorcraft Res., Research Triangle Park, N. C., 19-21 Feb. 1985
(NASA-TM-86696; A-85153; NAS 1.15:86696) Avail: NTIS HC A02/MF A01 CSCL 01C

The increasing use of highly augmented digital flight-control systems in modern military helicopters prompted an examination of the influence of rotor dynamics and other high-order dynamics on control-system performance. A study was conducted at NASA Ames Research Center to correlate theoretical predictions of feedback gain limits in the roll axis with experimental test data obtained from a variable-stability research helicopter. Feedback gains, the break frequency of the presampling sensor filter, and the computational frame time of the flight computer were systematically varied. The results, which showed excellent theoretical and experimental correlation, indicate that the rotor-dynamics, sensor-filter, and digital-data processing delays can severely limit the usable values of the roll-rate and roll-attitude feedback gains. R.J.F.

N85-21175# Cranfield Inst. of Tech., Bedford (England). Coll. of Aeronautics.
SOME ASPECTS OF THE DESIGN OF A FLY-BY-WIRE FLYING CONTROL SYSTEM FOR A SUPERSONIC V/STOL FIGHTER AIRCRAFT
J. P. FIELDING and X. Z. MENG Mar. 1984 68 p refs
(COLL-AERON-8413) Avail: NTIS HC A03/MF A01

Results of a student group project to design the flight control system of a supersonic vertical takeoff fighter aircraft are summarized. The original design is evaluated in terms of safety, mission reliabililty, and maintenance reliablity. Subsequent work concentrated on the investigation of the rudder pedal control systems in the cockpit with detailed design of the preferred scheme. The final phase of work concerned the design of the roll reaction control nozzle. The system evaluation showed the vital importance of adequate reliability calculations early in the design process. It also gave a good insight into how the system really works and how it might fail. M.G.

N85-21176*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Aerospace and Ocean Engineering.
OPTIMAL SYMMETRIC FLIGHT STUDIES Interim Report
A. R. WESTON, P. K. A. MENON, K. D. BILIMORIA, E. M. CLIFF, and H. J. KELLEY Feb. 1985 227 p refs
(Contract NAG1-203)
(NASA-CR-172508; NAS 1.26:172508) Avail: NTIS HC A11/MF A01 CSCL 01C

Several topics in optimal symmetric flight of airbreathing vehicles are examined. In one study, an approximation scheme designed for onboard real-time energy management of climb-dash is developed and calculations for a high-performance aircraft presented. In another, a vehicle model intermediate in complexity between energy and point-mass models is explored and some quirks in optimal flight characteristics peculiar to the model uncovered. In yet another study, energy-modelling procedures are re-examined with a view to stretching the range of validity of zeroth-order approximation by special choice of state variables. In a final study, time-fuel tradeoffs in cruise-dash are examined for the consequences of nonconvexities appearing in the classical steady cruise-dash model. Two appendices provide retrospective looks at two early publications on energy modelling and related optimal control theory. Author

N85-21177# Systems Control Technology, Inc., Dayton, Ohio.
INTEGRATED CONTROL SYSTEM ENGINEERING SUPPORT Final Report, Sep. 1979 - Apr. 1984
W. H. CLARK, R. L. BRAET, R. H. SMITH, R. E. BAILEY, and T. P. BARRY Dec. 1984 212 p
(Contract F33615-79-C-3614)
(AD-A149742; AFWAL-TR-84-3068) Avail: NTIS HC A10/MF A01 CSCL 01C

This report covers development, test, integration and documentation of software and specialized interfaces for use in the Flight Control Development Laboratory (AFWAL/FIGX); analysis of redundancy management for a multi-channel Flight Control System in the Digital Synthesis Flight Engineering Facility; support for the advanced development programs through analysis of multi-channel Flight Control Systems and the independent assessment of prime contractors efforts in the areas of control law development and coding; and software development for these and other programs on PD-11, AN/AYK-15, ROLM, and EAI machines and other equipment. Author (GRA)

09

RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tube facilities; and engine test blocks.

A85-26555
A REVIEW OF COMPLETE WEAPON VIBRATION TESTING TECHNIQUES
J. CONSIDINE (Cape Warwick, Ltd., Environmental Engineering Div., Warwick, England) IN: Institute of Environmental Sciences, Annual Technical Meeting, 29th, Los Angeles, CA, April 19-21, 1983, Proceedings . Mount Prospect, IL, Institute of Environmental Sciences, 1983, p. 56-60.

The vibration testing of complete weapons had developed in the U.K. almost exclusively governed by the knowledge and experience of the carriage of thick shell type structures. The necessity to vibrate a soft skinned store some three times the weight and length of a standard 1000 lb store necessitated the development of a new technique and a consideration of the difficulties associated with conducting realistic tests for design information and certification. The influence of flight measurement data on the tests completed to date is indicated and suggestions made for future integration of finite element modeling, modal analysis and ground testing. Author

A85-26759*# College of William and Mary, Williamsburg, Va.
A SLOTTED TEST SECTION NUMERICAL MODEL FOR INTERFERENCE ASSESSMENT
W. B. KEMP, JR. (College of William and Mary, Williamsburg, VA) Journal of Aircraft (ISSN 0021-8669), vol. 22, March 1985, p. 216-222. Previously cited in issue 09, p. 1188, Accession no. A84-24205. refs
(Contract NCC1-69)

A85-27721#
TEST LOADING OF AIRFIELD PAVEMENTS [OBCIAZENIE PROBNE NAWIERZCHNI LOTNISKOWYCH]
K. CZARNECKI and S. SZPINEK (Instytut Techniczny Wojsk Lotniczych, Warsaw, Poland) Technika Lotnicza i Astronautyczna (ISSN 0040-1145), vol. 39, June 1984, p. 12-14. In Polish.

Nondestructive techniques for evaluating the strength of airfield pavements are reviewed. In particular, attention is given to the impact and vibrational methods, commonly used to determine the load-supporting capacity and the wear resistance of various types of airfield pavements. V.L.

A85-27723#
PRINCIPLES OF THE DESIGN OF GROUND SUPPORT FACILITIES FOR AIR TRANSPORT [ZASADY PROJEKTOWANIA OBIEKTOW NAZIEMNEJ OBSLUGI TRANSPORTU LOTNICZEGO]
B. RZECZYNSKI (Akademia Ekonomiczna, Instytut Gospodarki Przestrzennej, Poznan, Poland) Technika Lotnicza i Astronautyczna (ISSN 0040-1145), vol. 39, Oct. 1984, p. 10-13. In Polish. refs

The principal requirements to be met when designing and building various airfield and air terminal facilities, including cargo depots, hangars, repair shops, and auxiliary buildings, are reviewed. The general layouts and functional schemes of the principal ground support facilities are presented; the classification of the facilities and the minimum space requirements are discussed. V.L.

A85-27768
A TEST SYSTEM FOR DETERMINING THE STRENGTH OF STRUCTURAL ELEMENTS EXPOSED TO A HIGH-TEMPERATURE GAS STREAM AND VIBRATIONAL LOADS [USTANOVKA DLIA ISSLEDOVANIIA PROCHNOSTI ELEMENTOV KONSTRUKTSII V USLOVIIAKH VOZDEISTVIIA VYSOKOTEMPERATURNOGO GAZOVOGO POTOKA I VIBRATSIONNYKH NAGRUZOK]
G. N. TRETIACHENKO, G. I. MELNICHENKO, and L. F. STAVTSEVA (Akademiia Nauk Ukrainskoi SSR, Institut Problem Prochnosti, Kiev, Ukrainian SSR) Problemy Prochnosti (ISSN 0556-171X), Feb. 1985, p. 109-112. In Russian. refs

A test stand and a test procedure are presented for determining the strength of thin-walled structural elements under vibrational loading in a high-temperature gas stream. The test system allows the testing of panels with a total area of up to 0.5 sq m in a subsonic gas stream at 2750 K, with frequencies of forced vibrations up to 2000 Hz. A schematic diagram of the system is included. V.L.

A85-28117#
INSTRUMENTING A VERY LARGE SCALE R&D FACILITY
J. R. RICKARD (USAF, Arnold Engineering Development Center, Arnold Air Force Station, TN) IN: SOUTHEASTCON '83; Proceedings of the Region 3 Conference and Exhibit, Orlando, FL, April 11-13, 1983 . New York, Institute of Electrical and Electronics Engineers, Inc., 1983, p. 439-443.

The new Aeropropulsion System Test Facility (ASTF) for complete real-time environmental and altitude testing of jet engines will include 24,000 instrumentation and control (I&C) devices. Engines can be tested in either of two 28 x 85 ft test cells which will accommodate thrusts up to 100,000 lb. The ASTF plant will draw a peak 670 MW of electricity. The plant systems will be

monitored extensively to heighten the efficiency of operations and thus lower the power demands wherever possible. Up to 4000 transducers will be available for engine monitoring, with data being filtered, then archived and displayed simultaneously. Initial data treatment will be carried out on a Cray 1S computer. Other control systems will permit engine function and atmospheric conditions alterations on-line. Many of the test sequences will be automated to cut down on technician expenses since the operational power demands are so high. All control systems will be configured to adapt to alterations in the total plant design. M.S.K.

A85-28639
GROUND SUPPORT FACILITIES - THE WAY TO EFFECTIVE AVIONICS FLIGHT TESTING
R. P. OETZEL (BDM Corp., Albuquerque, NM) IN: Flight testing today: Innovative management and technology; Proceedings of the Fourteenth Annual Symposium, Newport Beach, CA, August 15-19, 1983 . Lancaster, CA, Society of Flight Test Engineers, 1983, p. 2.6-1 to 2.6-8.

The increasing complexity and sophistication of modern avionic systems has led to a dramatic enhancement in the requirements for flight tests. In order to satisfy the need for testing the avionic systems as efficiently as possible, government and contractor ground support facilities (GSFs) are being developed to handle the integration and testing of the avionic systems prior to evaluation in flight. The Integration Facility for Avionic Systems Testing (IFAST) is an example of these facilities. IFAST will be an integration and simulation facility for both government and contractor personnel to support Development Test and Evaluation and Initial Operational Test and Evaluation of airborne avionic systems. Attention is given to a description of ground support facilities, the utilization of ground support facilities, and the test methodology for the GSF. G.R.

A85-28657
TIME-SPACE POSITION INFORMATION AT EDWARDS AIR FORCE BASE, CALIFORNIA
H. F. BUNCH and R. SIEGER (USAF, Computer Sciences Div., Edwards AFB, CA) IN: Flight testing today: Innovative management and technology; Proceedings of the Fourteenth Annual Symposium, Newport Beach, CA, August 15-19, 1983 . Lancaster, CA, Society of Flight Test Engineers, 1983, p. 6.5-1 to 6.5-3.

The components, capabilities and plans for improving the Edwards AFB Time-Space Position Information system for flight tests are discussed. A best estimate is calculated for trajectories and is finalized with errors of under 50 ft. Extended range coverage is obtained by the inclusion of data from tracking stations at other bases. The best accuracy thus far attained for flight speed measurements in low altitude positions has been 1.0 ft/sec. Three precision tracking radars, one airspace surveillance radar system and 12 cinetheodolites furnish data from take-off onward to an extended range (maximum FPS-16 radar range is 32,000 mi). Azimuth is determined to 0.1 mil and range to 6.0 ft. Efforts are being planned to upgrade the cinetheodolites to film which will be automatically digitized and read into memory for recall and analysis. M.S.K.

A85-29252*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
PROGRESS TOWARD MAGNETIC SUSPENSION AND BALANCE SYSTEMS FOR LARGE WIND TUNNELS
C. P. BRITCHER (NASA, Langley Research Center, Experimental Techniques Branch, Hampton, VA) Journal of Aircraft (ISSN 0021-8669), vol. 22, April 1985, p. 264-269. Research supported by the University of Southampton; Science and Engineering Research Council of England. Previously cited in issue 06, p. 726, Accession no. A84-18075. refs
(Contract SERC-GR/B/3691,5; NGG-7523; NAS1-1600; NAS1-17428)

A85-29567#
DEVELOPMENT OF A VELOCITY CONTROL ALGORITHM FOR CONTROLLING A 6-DOF CAPTIVE TRAJECTORY MODEL SUPPORT
D. W. HILL, JR. (Calspan Field Services, Inc., Arnold Air Force Station, TN) IN: International Instrumentation Symposium, 29th, Albuquerque, NM, May 2-6, 1983, Proceedings . Research Triangle Park, NC, Instrument Society of America, 1983, p. 353-367. USAF-sponsored research.

A velocity control algorithm for a computerized Captive Trajectory Support (CTS) system is described. The system is used for trajectory analysis of air-launched stores from aircraft. The computational scheme for the algorithm is given, and the hardware and software requirements of the trajectory and grid computer network are discussed. It is shown that the algorithm maximizes the velocity and movement efficiency of the CTS, and lowers the overall position error due to time lags. A flow diagram of the trajectory and grid control loop is provided. I.H.

A85-29862
TELEVISION SYSTEMS FOR FLIGHT SIMULATORS [TELEVIZNE RETAZCE PRE PILOTNE TRENAZERY]
L. SCHULTZ (Tesla, Orava, Czechoslovakia) Zpravodaj VZLU (ISSN 0044-5355), no. 6, 1984, p. 339-343. In Czech.

Recent developments in the design and production of flight simulators in Czechoslovakia are briefly reviewed, emphasizing the role of simulators in pilot training and research. The principal design considerations that have been used in developing TV systems for the flight simulators TL-39 and TL-410 are then examined. Block diagrams of these TV systems are presented. V.L.

A85-29863
SIMULATORS FOR TRAINING AIRCRAFT MAINTENANCE PERSONNEL [VYCVIKOVE TRENAZERY PRO TECHNICKY PERSONAL V UDRZBE LETADEL]
J. TUMA (Ceskoslovenske Aerolinie, Prague, Czechoslovakia) Zpravodaj VZLU (ISSN 0044-5355), no. 6, 1984, p. 345-349. In Czech. refs

Finding more efficient ways of training the ground support personnel becomes increasingly important as the requirements for the qualifications of such personnel become more stringent. The qualification of aircraft maintenance specialists directly affects the cost effectiveness of aircraft maintenance and flight safety. The use of simulators in training aircraft maintenance technicians is discussed, and the principal characteristics of such simulators are examined. V.L.

A85-29866
CURRENT TRENDS IN THE DEVELOPMENT OF FLIGHT SIMULATORS [SOUCASNE TRENDY ROZVOJE TECHNIKY LETECKYCH SIMULATORU]
J. HOLUSA (Rudy Letov, Prague, Czechoslovakia) Zpravodaj VZLU (ISSN 0044-5355), no. 6, 1984, p. 361-363. In Czech. refs

The evolution of flight simulators from simple and inexpensive substitutes for real aircraft to sophisticated training, design, and research tools accurately simulating actual flight conditions is reviewed.Current trends in flight simulation are examined, and it is noted that particular emphasis is placed on the realism of motor sensations and visual perception. The latest trends include the use of computer-generated images and extensive use of microprocessor control. V.L.

A85-29867
PROSPECTS FOR THE DEVELOPMENT OF FLIGHT SIMULATION EQUIPMENT [PERSPEKTIVY ROZVOJE OBORU TRENAZEROVE A SIMULATOROVE TECHNIKY]
J. LISKA (Rudy Letov, Prague, Czechoslovakia) Zpravodaj VZLU (ISSN 0044-5355), no. 6, 1984, p. 365-367. In Czech.

The principal advantages and disadvantages of the flight simulators that are currently manufactured in Czechoslovakia are briefly discussed. The principal objectives for the development of new types of flight simulators which would allow more efficient training are outlined. Particular emphasis is placed on the use of

computer-generated images focused to infinity by means of a collimating unit. V.L.

N85-19959# Thurlow and Associates Environmental Control Consultants Ltd., Ottawa (Ontario).
AIRPORT SITE SELECTION AND DESIGN
W. J. THURLOW *In* PEER Consultants, Inc. Wildlife Hazards to Aircraft Conf. and Training Workshop p 189-194 May 1984 refs
(AD-P004193) Avail: NTIS HC A16/MF A01 CSCL 01E

Airport site selection involves a compromise of many physical factors, and biological and physical factors that affect the wildlife use of an area. After site selection, the design of the airport including its drainage system, its buildings, and its ground cover is carried out in such a way that it minimizes the attraction to birds, and other animal species. Agriculture on land on the airport and on adjacent land is almost as attractive to birds as areas for food wastes disposals and sewage treatment products. It is concluded that almost any animal species can be a problem at airports; control techniques are available to eliminate or reduce these problems; and research is continuing to improve the ability to address hazards to aircraft caused by aircraft collision with birds and mammals. E.A.K.

N85-19960# German Board for Birdstrike Prevention, Traben-Trarbach (West Germany).
LANDSCAPE MANAGEMENT ON AIRPORTS FOR REDUCTION OF BIRD POPULATIONS
J. HILD *In* PEER Consultants, Inc. Wildlife Hazards to Aircraft Conf. and Training Workshop p 195-206 May 1984 refs
(AD-P004194) Avail: NTIS HC A16/MF A01 CSCL 01E

With the aid of landscape management the number of birdstrikes on German military airfields and civil airports was reduced. Measures taken are: (1) agricultural use and pasturing near airports is forbidden; (2) on grassland areas special methods of grass mowing are practiced; like long-grass procedure and/or use of growth inhibitors; (3) large areas were afforested with small woods with a high density; (4) heather and swamp areas were promoted and large birds took the place of small size birds. In the airport surroundings it was necessary to eliminate all areas which are attractive to birds, especially considering artificial lakes. Detailed provisions and landscape management is carried out to minimize bird-strike risk during approach and climbing. E.A.K.

N85-19961# Leadville Airport, Inc., Colo.
INEXPENSIVE MULTIPURPOSE LANDSCAPING
U. GILGULIN *In* PEER Consultants, Inc. Wildlife Hazards to Aircraft Conf. and Training Workshop p 207-208 May 1984
Avail: NTIS HC A16/MF A01 CSCL 01E

High altitude, small budget, limited staff and severe weather makes landscaping difficult. In Leadville, Colorado at Lake County Airport, elevation of 9,927 feet, 20 years after construction the fixed based operation, ramp and terminal areas looked like a forgotten incomplete construction site. The growing season is short and few things grow at all. The value of landscaping to enhance the environment is emphasized. By creating beds of rocks bordered with discarded railroad ties, various flotsam and jetsam from the forests and local mining dumps, visual impact is strong and the results attractive, durable and multipurpose. E.A.K.

N85-19962# Thurlow and Associates Environmental Control Consultants Ltd., Ottawa (Ontario).
REDUCING GULL USE OF SOME ATTRACTIONS NEAR AIRPORTS
V. E. F. SOLMAN *In* PEER Consultants, Inc. Wildlife Hazards to Aircraft Conf. and Training Workshop p 209-212 May 1984 refs
(AD-P004195) Avail: NTIS HC A16/MF A01 CSCL 01E

Gulls may visit airports to utilize the open space for loafing or other activities. They are more likely to do so if there are attractive feeding areas nearby. One of the more important food attractions are the areas in which large volumes of edible refuse are exposed. If gulls can be prevented from feeding in such areas they are much less likely to loaf on neighboring areas. The efficiency of widely spaced suspended, very fine wires and fine nylon monofilaments was demonstrated in discouraging gull feeding in areas over which the wires are stretched. The technique does not impose an easily visible physical barrier. The few birds that penetrate under the fine wire, when disturbed, appear to have no difficulty flying up and out through the wires. That is in contrast to the more than 80% of birds that will not penetrate the wired area from above to get at the food. It is suggested that the wires constitute psychological deterrent to landing, perhaps related to flight approach patterns and gull vision. E.A.K.

N85-19963# Federal Aviation Administration, Washington, D.C.
FAA POLICY REGARDING SOLID WASTE DISPOSAL FACILITIES
M. J. HARRISON *In* PEER Consultants, Inc. Wildlife Hazards to Aircraft Conf. and Training Workshop p 213-218 May 1984
(AD-P004196) Avail: NTIS HC A16/MF A01 CSCL 01E

The Federal Aviation Administration's (FAA) policy regarding solid waste disposal facilities on the near airports is based on bird strike data, accident information and aircraft performance. Distance criteria used in FAA Order 5200.5, FAA guidance concerning sanitary landfills on or near airports, coincides with distances specified in Federal Aviation Regulation (FaR) Part 77, Objects affecting navigable Airspace. Part 77 provides obstruction standards for use in several FAA safety programs designed to provide aircraft with proper clearance from objects. E.A.K.

N85-19964# PEER Consultants, Inc., Rockville, Md.
AIRPORT BIRD HAZARDS ASSOCIATED WITH SOLID WASTE DISPOSAL FACILITIES
D. W. LAKE *In its* Wildlife Hazards to Aircraft Conf. and Training Workshop p 219-230 May 1984 refs
(AD-P004197) Avail: NTIS HC A16/MF A01 CSCL 01E

All types of refuse disposal facilities that handle putrescible wastes have the potential to attack birds. When solid waste disposal facilities are located in the vicinity of airports, the probability of bird strikes is increased. Solid waste disposal facilities located in the vicinity of a airport may be incompatible with safe flight operations. The Federal Aviation Administration (FAA) and the Environmental Protection Agency (EPA) developed guidelines to identify and eliminate airport bird hazards associated with solid waste disposal facilities. The FAA Order 5200.5 is directed towards airport owners and managers to promote safe airport operations. The EPA criteria are directed towards the State agencies responsible for ensuring that solid waste disposal facilities are operated according to public health and safety standards. Commitment by both of these target groups to encourage and enforce compliance with the guidelines is required to successfully reduce airport bird hazards associated with solid waste disposal facilities. The bird hazard due to solid waste disposal facilities is reviewed and the Federal guidelines and programs to promote proper land use near airports with respect to these facilities are discussed. E.A.K.

N85-19969# Portland International Airport, Oreg.
DEVELOPMENT OF BIRD HAZARD REDUCTION FOR AIRPORT OPERATIONAL SAFETY
K. REZNICK *In* PEER Consultants, Inc. Wildlife Hazards to Aircraft Conf. and Training Workshop p 275-286 May 1984 refs
(AD-P004202) Avail: NTIS HC A16/MF A01 CSCL 01E

Portland International Airport established its bird hazard reduction program in November 1978. At that time, bird control was a fairly new area to public airports in the U.S. PIA was recognized by the FAA as having one of the worst bird strike hazard problems in the county by strike reports that they received and by aircraft damage reported. The bird hazard reduction program is considered to be an integral part of safety responsibility that has developed with airport operation at Portland over the past five years. The ways that solving the bird problem integrated into the airport's operation, the sources that were relied upon for technical assistance and cooperation, and those elements of the

program most valuable to its success are outlined from an airport operator's point of view. R.S.F.

N85-19975# Fish and Wildlife Service, Denver, Colo. Wildlife Research Center.
BIRDS AND AIRPORT AGRICULTURE IN THE CONTERMINOUS UNITED STATES: A REVIEW OF LITERATURE
R. T. STERNER, D. J. ELIAS, M. V. GARRISON, B. E. JOHNS, and S. R. KILBURN *In* PEER Consultants, Inc. Wildlife Hazards to Aircraft Conf. and Training Workshop p 319-330 May 1984 refs
(AD-P004208) Avail: NTIS HC A16/MF A01 CSCL 01E

Literature pertinent to the use of airport lands for agriculture in the conterminous United States is reviewed and analyzed. Articles are used that document bird utilization of 85 crops, rate the appropriateness of 15 farming activities for airports, and identify the North American bird species that utilize these crops and activities. Fifty-seven crops were documented as utilized by at least one species; no reports of bird use were found for 28 crops. Only non-pasture stock farming is suitable for practice within two miles of the airport center. Although numerous reports have designated gulls as the most hazardous species to air traffic, evidence suggests that certain species of blackbirds, waterfowl, and gallinaceous birds pose greater hazards. R.S.F.

N85-19976# Federal Aviation Administration, Washington, D.C. Accident Counsel Branch.
THE FAA GRANT-IN-AID ASSURANCES: FAR PART 139, AND AIRPORT HAZARDS
A. J. DILK *In* PEER Consultants, Inc. Wildlife Hazards to Aircraft Conf. and Training Workshop p 331-368 May 1984
(AD-P004209) Avail: NTIS HC A16/MF A01 CSCL 01E

The promises made to the FAA by airport operating authorities, which are found in grants-in-aid, or as a result of certification under 14 C.F.R. Part 139, are more than agreements for construction compliance. They can prove to be the basis of multi-million dollar lawsuits where hazards exist in the airport environment, and are found by courts to be the proximate cause of an aviation accident. Grants-in-aid and regulations are discussed in detail. Specific legal cases are also presented. R.S.F.

N85-19990* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
INFLIGHT IFR PROCEDURES SIMULATOR Patent
L. C. PARKER, inventor (to NASA) 25 Dec. 1984 9 p Filed 11 Jun. 1982 Supersedes N82-29331 (20 - 20, p 2791)
(NASA-CASE-KSC-11218-1; NAS 1.71:KSC-11218-1; US-PATENT-4,490,117; US-PATENT-APPL-SN-387649; US-PATENT-CLASS-434-35; US-PATENT-CLASS-434-49; US-PATENT-CLASS-434-242; US-PATENT-CLASS-434-243)
Avail: US Patent and Trademark Office CSCL 14B

An inflight IFR procedures simulator for generating signals and commands to conventional instruments provided in an airplane is described. The simulator includes a signal synthesizer which generates predetermined simulated signals corresponding to signals normally received from remote sources upon being activated. A computer is connected to the signal synthesizer and causes the signal synthesizer to produce simulated signals responsive to programs fed into the computer. A switching network is connected to the signal synthesizer, the antenna of the aircraft, and navigational instruments and communication devices for selectively connecting instruments and devices to the synthesizer and disconnecting the antenna from the navigational instruments and communication device. Pressure transducers are connected to the altimeter and speed indicator for supplying electrical signals to the computer indicating the altitude and speed of the aircraft. A compass is connected for supply electrical signals for the computer indicating the heading of the airplane. The computer upon receiving signals from the pressure transducer and compass, computes the signals that are fed to the signal synthesizer which, in turn, generates simulated navigational signals.
Official Gazette of the U.S. Patent and Trademark Office

N85-19991# Oak Ridge National Lab., Tenn.
LIGHT YOUR RUNWAYS AND TAXIWAYS WITHOUT ELECTRICITY
K. W. HAFF and J. A. TOMPKINS 25 Oct. 1984 26 p refs Presented at Workshop on the Manage. of Airfield Lighting, Clearwater Beach, Fla., 25 Oct. 1984
(Contract DE-AC05-84OR-21400)
(DE85-000269; CONF-8410152-1) Avail: NTIS HC A03/MF A01

The history of the radioluminescent light program at Oak Ridge National Laboratory is from the earliest use of radium through strontium-90, carbon-14, and krypton-85 to the present work with tritium. Field testing of radioluminescent lights and safety and quality control are discussed. DOE

N85-19992# Community Planning and Development Inst., Washington, D.C.
INTERNATIONAL AIRPORT STUDY: HOW TO IMPROVE THE EFFECT OF AIRPORTS ON TRADE AND ON EXPORT-RELATED INDUSTRIES Final Report
Apr. 1984 192 p refs
(Contract EDA-RED-798-G-82-15; EDA-99-7-13606)
(PB85-124923; EDA/RED-84-32) Avail: NTIS HC A09/MF A01 CSCL 01E

A two part study was conducted to: (1) identify and describe the promotional techniques used by international airports in the U.S. to enhance trade and tourism, and (2) to recommend for the consideration of Federal and local officials, airport administrators, and the business community ways in which trade and tourism through international airports can be increased. The study describes the economic benefits that have accrued in the tourism, trade, and export sectors of the communities where international airports are located. The study's recommendations are backed by case studies of the performances, needs, and plans of four international airports considered to be among the United States most promising for trade and tourism. It is recognized that, because of the expanding reliance on international air travel and transportation, airport facilities constitute an increasingly critical commercial and industrial link to growth. GRA

N85-19993# Office of Technology Assessment, Washington, D.C.
AIRPORT SYSTEM DEVELOPMENT
Aug. 1984 279 p
(PB85-127793; OTA-STI-84; LC-84-801101) Avail: NTIS HC A13/MF A01 CSCL 01E

Present conditions and future needs of the Nation's airports were examined, with emphasis on possible solutions to problems of operational capacity and air travel delay. The range of remedial actions considered included improved airport and air travel delay, air traffic control technology, revised procedures for airport and airspace use, economic and regulatory measures to reduce demand during peak periods and managerial approaches to make more efficient use of existing airport facilities. Special attention is given to issues of airport planning and funding methods at Federal, State and local levels. GRA

N85-21107# Joint Publications Research Service, Arlington, Va.
NEW FLIGHT SIMULATORS AT VNUKOVO PERMIT LESS IN-FLIGHT TRAINING
M. BLINOV and V. GURDZHIYANTS *In its* USSR Rept.: Transportation (JPRS-UTR-85-004) p 5-7 27 Feb. 1985 Transl. into ENGLISH from Vozdushnyy Transport (Moscow), 15 Jan. 1985 p 3
Avail: NTIS HC A06

The capabilities and advantages of the Vnukovo flight simulator are reported. The imitation of depth invision of the ground and surrounding objects makes it possible to provide training for crews in landing in dense fog and to master actions under particular flying conditions, bringing them as close as possible to real conditions. This simulator also permits less inflight training time. B.W.

N85-21108# Joint Publications Research Service, Arlington, Va.
NEW RUNWAY ENABLES IL-76 FLIGHTS TO TENKELI IN FAR NORTH
O. BORODIN *In its* USSR Rept.: Transportation (JPRS-UTR-85-004) p 8-9 27 Feb. 1985 Transl. into ENGLISH from Vozdushnyy Transport (Moscow), 8 Jan. 1985 p 1
Avail: NTIS HC A06

The construction of an airport runway at the Tenkeli airport is discussed. Increased economic development and the arctic-like climate are major factors contributing to the need for reliable transportation. B.W.

N85-21179# New Mexico Univ., Albuquerque. Engineering Research Inst.
RUNWAY RUBBER REMOVAL SPECIFICATION DEVELOPMENT FIELD EVALUATION PROCEDURES DEVELOPMENT
R. G. MCKEEN, L. R. LENKE, and R. A. GRAUL Washington, D.C. FAA Jul. 1984 134 p refs Sponsored in part by Air Force
(FAA-PM-84-27; ESL-TR-84-40) Avail: NTIS HC A07/MF A01

The phenomenon of runway touchdown zone rubber buildup is a potentially hazardous problem. Rubber buildup covers the runway surface and occludes the surface texture. This results in reduced wet friction coefficient between the runway pavement and the aircraft tires. Methods and equipment are available for evaluating the wet friction coefficient; however, these methods are expensive and require highly trained personnel. Therefore, most airport and airbase managers rely exclusively on visual impressions on rubber buildup in lieu of quantitative measurements. Nonetheless, quantitative evaluation techniques are desireable for evaluating rubber buildup. An extensive literature review suggests that pavement surface texture measurement techniques may be indicative of rubber buildup and resultant reduction in wet friction coefficient. Rubber buildup alters the texture properties of a runway as well as the frictional coefficient. A suggested field evaluation experiment is described to ascertain which of five selected texture measurement techniques are indicative of reduced friction values in pavement areas with rubber buildup. Author

N85-21180# Clemson Univ., S.C. Dept. of Civil Engineering.
FIELD VALIDATION OF STATISTICALLY-BASED ACCEPTANCE PLAN FOR BITUMINOUS AIRPORT PAVEMENTS. VOLUME 1: CORRELATION ANALYSIS OF MARSHALL PROPERTIES OF LABORATORY-COMPACTED SPECIMENS Final Report
J. L. BURATI, JR., G. D. BRANTLEY, and F. W. MORGAN May 1984 133 p refs
(Contract DTFA01-81-C-10057)
(FAA/PM-84-12-VOL-1) Avail: NTIS HC A07/MF A01

The laboratory phase of a three phase research effort conducted to field validate a multiple price adjustment system for bituminous airport pavements using the Marshall properties, stability, flow and air voids, is presented. The purpose of the laboratory phase was to identify whether correlations exist among the Marshall properties within individual tests. To consider the use of these properties in a multiple price adjustment system, it was first necessary to identify these correlations. The experimental design consisted of 4 different aggregate gradations and 6 different asphalt contents for a total of 24 combinations. A total of 12 replicates were tested for each combination for a total of 288 Marshall test specimens. A number of statistical analyses were conducted on the laboratory test results. An analysis of variance was conducted to determine whether time, i.e., order of testing, had an effect on the results. Correlation coefficients among the Marshall properties, i.e., stability with flow, stability with air voids and flow with air voids, were calculated for each of the 24 combinations. The results of the analysis indicate correlations that are consistent enough to violate an assumption of statistical independence among the properties. R.J.F.

N85-21181# Clemson Univ., S.C. Dept. of Civil Engineering.
FIELD VALIDATION OF STATISTICALLY-BASED ACCEPTANCE PLAN FOR BITUMINOUS AIRPORT PAVEMENTS. VOLUME 2: STATISTICAL ANALYSIS OF MARSHALL PROPERTIES OF PLANT-PRODUCED BITUMINOUS MATERIALS Final Report
J. L. BURATI, JR., J. D. SEWARD, JR., and H. W. BUSCHING May 1984 70 p refs
(Contract DTFA01-81-C-10057)
(FAA/PM-84-12-VOL-2) Avail: NTIS HC A04/MF A01

Two aspects concerning evaluation by the Marshall method of bituminous airport pavement construction were addressed. Results from field Marshall and extraction tests were analyzed to identify correlations among the Marshall properties - stability, flow, and air voids - and asphalt content and aggregate gradation. This was done to evaluate the implementation of a multiple price adjustment system based on Marshall properties, and for the development of mathematical models for estimating each property from the percent asphalt content and aggregate gradation. Data were obtained from 5 airport paving projects; however, two of these had such small tonnages that there were not sufficient data to prove meaningful. A moderately low negative correlation exists between stability and air voids, while no statistically significant correlation was found to exist between stability and flow. The flow and air voids correlations were not consistent among the two projects considered, with one suggesting a moderately low negative correlation, and the other no statistically significant one. The mathematical models developed for stability, flow, and air voids from extracted asphalt content and aggregate gradation were not good predictors of those properties. R.J.F.

N85-21182# Clemson Univ., S.C. Dept. of Civil Engineering.
FIELD VALIDATION OF STATISTICALLY-BASED ACCEPTANCE PLAN FOR BITUMINOUS AIRPORT PAVEMENTS. VOLUME 3: STATISTICAL ANALYSIS OF 3 METHODS FOR DETERMINING MAXIMUM SPECIFIC GRAVITY OF BITUMINOUS CONCRETE MIXTURES Final Report
J. L. BURATI, JR. and J. D. SEWARD, JR. May 1984 86 p refs
(Contract DTFA01-81-C-10057)
(FAA/PM-84-12-VOL-3) Avail: NTIS HC A05/MF A01

Five replicates of asphaltic concrete at five alphalt contents were produced and tested to compare maximum specific gravities determined by individual constituents, by solvent immersion, and by American Society for Testing and Materials (ASTM) D-2041. The effects of variations in asphalt content on the maximum specific gravities obtained by the three methods were also considered. A statistically significant difference was found to exist between the solvent immersion and ASTM D-2041 methods at all five asphalt contents; whereas, no significant difference was found between the solvent immersion and individual constituents methods. There was a significant difference between the ASTM D-2041 method and individual constituents methods. This difference varies with asphalt content. Since the solvent immersion and ASTM D-2041 methods provide statistically different results, it is not appropriate to allow the use of both methods in the same specification unless separate acceptance limits are used. It is recommended that the solvent immersion method be eliminated from use since the ASTM D-2041 procedures are much more commonly used. To avoid the use of a correction factor to convert the ASTM D-2041 values to equivalent individual constituents, as is currently done, it is recommended that the maximum specific gravity for job mix formula determination be established by the ASTM D-2041 method.
Author

N85-21183# Clemson Univ., S.C. Dept. of Civil Engineering.
FIELD VALIDATION OF STATISTICALLY-BASED ACCEPTANCE PLAN FOR BITUMINOUS AIRPORT PAVEMENTS. VOLUME 4: COMPUTER SIMULATION OF MULTIPLE ACCEPTANCE CRITERIA Final Report
S. NNAJI, J. L. BURATI, JR., and M. G. TARAKJI Aug. 1984 105 p refs
(Contract DTFA01-891-C10057)
(FAA/PM-84-12-VOL-4) Avail: NTIS HC A06/MF A01

The procedures and results of a computer simulation analysis conducted to investigate the performance of 7 methods for determining the payment factor for a lot of materials when 3 correlated acceptance properties, i.e., the Marshall stability, flow and air voids, are used for acceptance purposes are given. The methods investigated were based upon triple numerical integration of the three property values and using the smallest individual property value. Marshall test results from 15 runway paving projects were analyzed to determine mean, variance and correlation values obtained in field construction. Computer simulation was used to investigate the performance of the various methods for determining the payment factor for multiple acceptance properties. It is recommended that the average of the three payment factors for the individual Marshall properties be determined using the quality index approach currently employed by the FAA Eastern Region for density acceptance purposes. The payment factor for the Marshall properties can then be calculated as the average of the 3 individual property payment factors. R.J.F.

N85-21184# Clemson Univ., S.C. Dept. of Civil Engineering.
FIELD VALIDATION OF STATISTICALLY-BASED ACCEPTANCE PLAN FOR BITUMINOUS AIRPORT PAVEMENTS. VOLUME 5: SUMMARY OF VALIDATION STUDIES Final Report
J. L. BURATI, JR., H. W. BUSCHING, and S. NNAJI Sep. 1984 48 p refs
(Contract DTFA01-81-C10057)
(FAA/PM-84-12-VOL-5) Avail: NTIS HC A03/MF A01

A research project that was conducted to investigate the use of Marshall properties for acceptance purposes is summarized. Since the Marshall properties are physically related, they can be expected to be statistically correlated. It is therefore necessary to determine whether correlations exist among the properties, and how such correlations should be considered when developing acceptance plans. The research consisted of three major phases; a laboratory analysis, field data collection and computer simulation analyses. A laboratory analysis was conducted to establish whether correlations are present among asphalt content, gradation, and the Marshall values for stability, flow and air voids. Another aspect of the laboratory analysis investigated three methods for determining maximum specific gravity for air voids determination. Field data were also collected from five paving projects. Finally, computer simulation was used to evaluate the performance of seven methods for determining the payment factor for the Marshall properties. R.J.F.

N85-21185# Pacific Northwest Lab., Richland, Wash.
EXAMINATION OF THE FEASIBILITY FOR DEMONSTRATION AND USE OF RADIOLUMINESCENT LIGHTS FOR ALASKAN REMOTE RUNWAY LIGHTING Final Report
G. JENSEN, L. PERRIGO, L. LEONARD, and L. HEGDAL Jan. 1984 237 p refs
(Contract DE-AC06-76RL-01830; DE-SC06-83RL-10312)
(DE85-002503; PNL-5183) Avail: NTIS HC A11/MF A01

The use of radioluminescent (RL) lights to assist night landings of aircraft is a potentially valuable alternative to fireports or similar nonconventional lighting at many rural airports throughout Alaska. While RL airport illuminators are not yet available commercially, successful demonstrations suggest that a prototype design has been refined to a point where technology transfer to industry may be made in the near future. Preliminary cost estimates suggest that significant cost advantages could be possible for applications in rural Alaska compared to conventional lighting systems. Since the RL lights contain radiactive materials, there is some potential risk that their use will result in exposure to radiation doses to humans who come into contact with them. Under worst-case accident scenarios, It is possible that a significant dose greater than 5.0 rem could be received by a limited number of people. DOE

N85-21465# Army Missile Lab., Redstone Arsenal, Ala.
DEVELOPMENT OF A HIGH TEMPERATURE SINGLE IMPACT RAIN EROSION TEST CAPABILITY
K. N. LETSON and S. P. RISNER *In* Georgia Inst. of Technology Proc. of the Symp. on Electromagnetic Windows (17th), Part 2 p 195-206 1984
(AD-P004371) Avail: NTIS HC A12/MF A01 CSCL 17I

A single impact rain erosion test capability has been developed to obtain data on fiber loaded Teflon (e.g., Duroid) ablative radome materials at temperatures up to their ablating temperature (approx. 1250 F). This effort was undertaken as a result of the prior inability to: (1) obtain experimental data for single water droplet impacts on these materials at temperatures significantly above 400 F at velocities near Mach 5, and (2) identify a solid particle whose behavior is similar to or can be correlated to that of water droplets at all conditions of interest. This test capability allows one to dispense a stream of calibrated discrete water droplets in the path of aerodynamically heated samples on sleds at velocities up to 6000 ft/sec. GRA

10

ASTRONAUTICS

Includes astronautics (general); astrodynamics; ground support systems and facilities (space); launch vehicles and space vehicles; space transportation; spacecraft communications, command and tracking; spacecraft design, testing and performance; spacecraft instrumentation; and spacecraft propulsion and power.

A85-26446#
ANGULAR MOTION INFLUENCE ON RE-ENTRY VEHICLE ABLATION OR EROSION ASYMMETRY FORMATION
D. H. PLATUS (Aerospace Corp., Astrophysics Laboratory, El Segundo, CA) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 8, Mar.-Apr. 1985, p. 280-282. Previously cited in issue 19, p. 2811, Accession no. A83-41938. refs
(Contract F04701-83-C-0084)

A85-28275
CRC HANDBOOK OF SPACE TECHNOLOGY: STATUS AND PROJECTIONS
R. M. HORD (General Research Corp., McLean, VA) Boca Raton, FL, CRC Press, Inc, 1985, 296 p. refs

This volume presents trends and forecasts for figures of merit which may be used to characterize technological capabilities in the major discipline areas of space technology. The trends are based on historical data, and the forecasts represent the consensus opinions of experts who are active contributors in their respective fields. The major discipline areas included in this volume are: transportation systems; spacecraft systems; information systems; chemical propulsion; electric propulsion; aerothermodynamics; power; materials and structures; automation, guidance, control; sensors; communications; data processing; and human factors. The trends and forecasts presented generally consist of a graphical display for each relevant figure of merit, accompanied by a descriptive narrative. The projections show the expected improvement in each of the discipline areas over the next twenty years. C.D.

A85-28391
STRUCTURAL AND ALGORITHMIC ASPECTS OF THE DESIGN OF A MATHEMATICAL-MODELING SYSTEM FOR PROBLEMS OF BALLISTICS, CONTROL, AND NAVIGATION [STRUKTURNYE I ALGORITMICHESKIE ASPEKTY POSTROENIIA SISTEMY MATEMATICHESKOGO MODELIROVANIIA DLIA ZADACH BALLISTIKI, UPRAVLENIIA I NAVIGATSII]
A. A. GOLOVAN and IU. M. OKUNEV IN: Problems of contemporary mechanics. Part 2 . Moscow, Izdatel'stvo Moskovskogo Universiteta, 1983, p. 81-87. In Russian.

The structure of a mathematical-modeling system for the ballistics, control, and navigation of manned and unmanned flight vehicles is described. The system structure contains matched mathematical models of the vehicle and of the inertial navigation system, and a group of algorithms for onboard-computer control, navigation, and processing. Particular attention is given to the development, validation, and utilization of the algorithmic basis of the model system, consisting in a different-step scheme for the numerical integration of differential equations. B.J.

A85-28455
TIME-OPTIMAL DECELERATION OF THE ROTATION OF AN AXISYMMETRIC RIGID BODY NEAR THE CENTER OF MASS [K ZADACHE OPTIMAL'NOGO PO BYSTRODEISTVIIU TORMOZHENIIA VRASHCHENIIA OSESIMMETRICHNOGO TVERDOGO TELA OKOLO TSENTRA MASS]
M. Z. BORSHCHEVSKII and I. V. IOSLOVICH Prikladnaia Matematika i Mekhanika (ISSN 0032-8235), vol. 49, Jan.-Feb. 1985, p. 35-42. In Russian. refs

An analysis is made of the time-optimal deceleration of a rigid body with an axisymmetric ellipsoid of inertia (EOI) by means of three pairs of jet engines producing control moments directed along the principal axes of the EOI. The structure of optimal trajectories is investigated, and it is demonstrated that four rays lying in a plane perpendicular to the dynamic-symmetry axis are not only phase trajectories with a special control but also serve as main trajectories. The optimal trajectories, on entering onto the main trajectories, fill in phase space the outer region of two intersecting circular cones, surrounding the dynamic-symmetry axis. B.J.

A85-28488
EFFECT OF AERODYNAMIC MOMENT ON THE REGIME OF THE GRAVITY GRADIENT STABILIZATION OF THE SALYUT-6 - SOYUZ ORBITAL SYSTEM [VLIIANIE AERODINAMICHESKOGO MOMENTA NA REZHIM GRAVITATSIONNOI ORIENTATSII ORBITAL'NOGO KOMPLEKSA 'SALIUT-6' - 'SOIUZ']
V. A. SARYCHEV and V. V. SAZOROV Kosmicheskie Issledovaniia (ISSN 0023-4206), vol. 23, Jan.-Feb. 1985, p. 63-83. In Russian. refs

The equations of the rotational motion of the Salyut-6 - Soyuz system under the effect of gravitational and restoring aerodynamic moments admit a natural inclusion of a small parameter: the ratio of longitudinal to transverse moments of inertia. The Krylov-Bogoliubov method is used to construct the formal two-parameter integral surfaces of these equations describing the oscillations and rotations of the orbital system about the longitudinal axis, approximately directed along the local vertical. The motions belonging to these integral surfaces can be considered as nominal unperturbed motions of the system in the regime of gravity gradient stabilization (GGS). It is shown that these surfaces can be unstable due to the effect of the nonpotential component of the aerodynamic moment. Under an appropriate selection of initial conditions of motion, this instability is slight and does not disrupt the GGS, at least over several weeks. B.J.

A85-28621
RADIO FREQUENCY TEST FACILITY FOR EVALUATION OF MISSILE HARDWARE
P. F. BOHN (Johns Hopkins University, Laurel, MD) IN: Summer Computer Simulation Conference, 15th, Vancouver, Canada, July 11-13, 1983, Proceedings. Volume 1 . La Jolla, CA, Society for Computer Simulation, 1983, p. 878-881.

The hardware and accompanying computer software for support of the Guidance Systems Evaluation Laboratory (GSEL) for assessing missile in-flight guidance systems are described. GSEL is used to simulate the performance of semi-active missiles, i.e., those with CW radar and passive RF homing capabilities. The missile encounters jamming, chaff, sea and land reflections, and multiple targets en route. The equipment under test is placed in an anechoic chamber and target and ECM signals are generated in front of the seeker. Realistic dual target signals with appropriate range/rate characteristics are presented. Host minicomputers also furnish aerodynamic and kinematic inputs germane to various conditions, missions and mission phases. M.S.K.

A85-29257#
STUDIES OF CONVERTIBLE TURBOSHAFT/TURBOFAN ENGINES FOR HIGH-SPEED ROTORCRAFT
R. E. NEITZEL, R. HIRSCHKRON, and P. W. VINSON (General Electric Co., Lynn, MA) Journal of Aircraft (ISSN 0021-8669), vol. 22, April 1985, p. 296-302. Previously cited in issue 17, p. 2441, Accession no. A84-36967. refs

A85-29306#
ANALYTIC SOLUTION FOR A CRUISING PLANE CHANGE MANEUVER
R. T. CERVISI (Rockwell International Corp., Shuttle Orbiter Div., Downey, CA) Journal of Spacecraft and Rockets (ISSN 0022-4650), vol. 22, Mar.-Apr. 1985, p. 134-140. Previously cited in issue 19, p. 2810, Accession no. A83-41924. refs

N85-19995# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
ACTIVITIES IN FRENCH AEROSPACE Annual Report, 1983
18 May 1984 167 p refs Original contains color illustrations Avail: NTIS HC A08/MF A01

Aerospace research including a Spacelab upper atmosphere infrared absorption study; fighter aerodynamics research; military aircraft air intake study; analysis of sensitivity to turbulence and how to eliminate it; transport aircraft aerodynamics; high speed aircraft propeller design; flexible helicopter rotors; high resolution laser imaging system; and detection of aerosols blown up by helicopters is summarized. Test facilities and product developments are described. Author (ESA)

N85-20011# Technische Hogeschool, Delft (Netherlands). Dept. of Aerospace Engineering.
WINDOW ON SCIENCE VISIT TO THE USA, 21 MARCH - 22 APRIL, 1984
H. F. R. SCHOEYER and P. A. O. G. KORTING Apr. 1984 136 p refs Sponsored by US Office of Naval Research, Netherlands Foundation for Technical Research and Prins Maurits Laboratory TNO
(VTH-LR-426; PML-1984-C25; SFCC-PUBL-12) Avail: NTIS HC A07/MF A01

Dutch and American expertise in ramjet propulsion and combustion and solid propellant rocketry was discussed. A connected pipe facility for solid fuel ramjet combustion experiments; experiments with hybrid rocket motors and solid fuel ramjets; determination of the regression rate in solid fuel ramjets by ultrasonic pulse-echos; combustion of composite propellants at subatmospheric pressures; a model for the calculation of premixed flames; and low frequency oscillatory combustion are treated. Author (ESA)

N85-20176# Joint Publications Research Service, Arlington, Va.
FRG'S DFVLR READY FOR PARTICIPATION IN SPACE STATION
In its West Europe Rept.: Sci. and Technol. (JPRS-WST-85-008) p 3 19 Feb. 1985 Transl. into ENGLISH from Frankfurter Allgem. Zeitung (Frankfurt/Main), 3 Dec. 1984 p 10
Avail: NTIS HC A07/MF A01

Participation by West Germany in the space station with its anticipated share of eight billion dollars is discussed. The Transonic European Wind Tunnel and propfan technology are also examined. B.G.

N85-20352*# California Univ., San Diego, La Jolla.
CONSTELLATIONS
D. R. CRISWELL *In* NASA. Marshall Space Flight Center Appl. of Tethers in Space, Vol. 1 13 p Mar. 1985
Avail: NTIS HC A13/MF A01 CSCL 22B

Multiple spacecraft configurations which involve tethering are presented. Potential applications of such tethered systems are enumerated. Tethers are thought to provide a way to open up the utility of large masses in orbit, perhaps allowing for the reoptimization of the STS toward greater total mass and volume per launch. Significant materials reserves could also be held in orbit. R.S.F.

N85-20372*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
INSTRUMENTATION FOR APPLICATION NUMBER 1: MASS SPECTROMETRIC ANALYSIS OF THE BOUNDARY LAYER ASSOCIATED WITH THE TETHERED SATELLITE
G. M. WOOD *In* NASA. Marshall Space Flight Center Appl. of Tethers in Space, Vol. 2 18 p Mar. 1985 refs
Avail: NTIS HC A14/MF A01 CSCL 22B

Knowledge about the boundary layer associated with high enthalpy flow fields has mostly been derived from measurements of physical properties. To further this understanding, the chemistry of the gaseous layer must be studied as well. This requires that instrumentation and measurement methods be developed that can analyze the gases while having a minimal effect on the flow field and composition. Because of its sensitivity and ability to identify species, the mass spectrometer is the most promising instrument for this application, although other spectroscopic methods are being evaluated as well. There are, however, several non-trivial problems that must be solved in order to apply the mass spectrometer, including the obtaining of a representative sample from near the model surface. These problems are being addressed in a research program to develop qualitative and quantitative measurement methods to examine the gas chemistry in several large hot-gas blowdown facilities, and to study the aerodynamics of the boundary layer associated with models in these facilities and in instrumented hypersonic vehicles. These methods can also be applied to the tethered satellite, which will provide a unique opportunity to obtain aerothermodynamic data that is unaltered by effects from the test facility. M.G.

N85-20376*# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.
THE SATELLITE SAIL
J. PEARSON *In* NASA. Marshall Space Flight Center Appl. of Tethers in Space, Vol. 2 6 p Mar. 1985
Avail: NTIS HC A14/MF A01 CSCL 02B

It is proposed to suspend an airfoil from the Space Shuttle by a long tether into the upper atmosphere to provide a horizontal force on the Shuttle, thereby changing its orbital plane most efficiently. The airfoil would need high-temperature skin and tether, and remotely controlled flaps to adjust its angle of attack. The airfoil could also be used as a hypersonic facility to measure aerodynamic characteristics at extreme altitudes and velocities. This use would require a vertical lift force to counteract the drag force and prevent the Shuttle orbit from decaying too rapidly during the aerodynamic measurements. Author

11

CHEMISTRY AND MATERIALS

Includes chemistry and materials (general); composite materials; inorganic and physical chemistry; metallic materials; nonmetallic materials; and propellants and fuels.

A85-26481
ALUMINUM AND TITANIUM COMPARED
A. W. DEMMLER, JR. Aerospace Engineering (ISSN 0736-2536), vol. 5, March 1985, p. 30-38.

A comparative assessment is made of aircraft aluminum and titanium alloys with each other and with emerging primary structure-suitable composite materials, from the viewpoints of fabrication and assembly costs, mechanical strength and durability, and cost and availability. Attention is given to the prevalent aluminum and titanium alloys used in forged, sheet, cast, and superplastically formed products, as well as the performance and production cost improvements anticipated in Aramid-Aluminum Laminates, high lithium content aluminum alloys, and powder metallurgy alloys. Recent advances in titanium alloy formulations and fabrication methods are noted. O.C.

A85-26849
ADVANCED COMPOSITES
A. M. JAMES (Lockheed-California Co., Burbank, CA) and W. E. HARVILL, JR. (Lockheed-Georgia Co., Advanced Structures Dept., Marietta, GA) Lockheed Horizons, Feb. 1985, p. 30-43.

An evaluation is made of the performance and cost improvements obtained in the course of participation in NASA's Advanced Composite Aileron and Advanced Composite Vertical Fin programs, as well as the proprietary development of composite rudder for the Gulfstream III executive aircraft and of the graphite/epoxy center wing structure for the C-130 transport aircraft. By comparison to the aluminum alloy wing structure replaced, the composite design reduced weight by 25 percent, while achieving a 10-percent cost reduction. Attention is given to the long term development program by which the full implications of the C-130 center wing project for primary graphite/epoxy composite structure design will be assessed. O.C.

A85-27095#
EVALUATION OF CUMULATIVE DAMAGE MODELS FOR FATIGUE CRACK GROWTH IN AN AIRCRAFT ENGINE ALLOY
T. NICHOLAS (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH), G. K. HARITOS (USAF, Institute of Technology, Wright-Patterson AFB, OH), and J. R. CHRISTOFF (USAF, Armament Laboratory, Eglin AFB, FL) Journal of Propulsion and Power (ISSN 0748-4658), vol. 1, Mar.-Apr. 1985, p. 131-136. refs
(Contract AF PROJECT 2307P1)

Two models for evaluating crack growth in aircraft engine alloys under typical mission spectra were evaluated. Each model had the capability to determine the effects of frequency, stress ratio, temperature, and hold time on the crack growth rate. Data on an advanced alloy (AF115) were used to evaluate the hyperbolic sine (SINH) model and modified sigmoidal equation (MSE) model. Both models were found to have adequate capability and flexiblity in modeling crack growth behavior over a wide range of conditions. The SINH model has been much more fully developed than the MSE model and is easier to apply to new materials. Author

A85-27119
ALUMINUM-LITHIUM ALLOYS FOR AIRCRAFT STRUCTURE - AN OVERVIEW
W. E. QUIST, G. H. NARAYANAN, and A. L. WINGERT (Boeing Commercial Airplane Co., Seattle, WA) IN: Aluminum-lithium alloys II; Proceedings of the Second International Aluminum-Lithium Conference, Monterey, CA, April 12-14, 1983 . Warrendale, PA, Metallurgical Society of AIME, 1984, p. 313-334. refs

The use of lithium bearing aluminum alloys for aircraft structure began in 1957 with the use of alloy X2020 on the Navy RA-5C Vigilante. Since that initial application, production problems and concerns about brittle behavior thwarted further use of these alloys in the aircraft of western nations. However, the increasing need for more efficient airframes and improved materials of construction has rekindled interest in Al-Li type alloys, primarily because of the substantially lower density that these alloys offer. Serious research and development efforts have been underway since the early 1970's in the U.S. and Great Britain, and these studies have identified the primary technical reasons for the brittle behavior of aluminum-lithium type alloys and have also suggested solutions to this problem. Current prospects are bright for the near term development of several high strength lithium bearing aluminum alloys that will be suitable for aerospace applications and that should find a broad application in this industry. Author

A85-27120
DEVELOPMENT OF LITHIUM-CONTAINING ALUMINIUM ALLOYS FOR THE INGOT METALLURGY PRODUCTION ROUTE
W. S. MILLER, A. J. CORNISH, A. P. TITCHENER, and D. A. BENNETT (British Alcan Aluminium, Ltd., Gerrards Cross, Bucks., England) IN: Aluminum-lithium alloys II; Proceedings of the Second International Aluminum-Lithium Conference, Monterey, CA, April 12-14, 1983 . Warrendale, PA, Metallurgical Society of AIME, 1984, p. 335-362. Sponsorship: Ministry of Defence. refs
(Contract MOD-A91A/870)

A development program is reported whose objective was to produce, via the ingot metallurgy route, aluminum-lithium alloys that would possess the combination of service properties required for airframe construction. Of the alloys examined, the Al-Li-Cu-Mg system is found to combine attractive service properties with relative ease of manufacture into plate, sheet, extruded, and forged forms. Alloys of this system can be used as substitutes for the existing medium- and high-strength aluminum alloys for aircraft applications. Al-Mg-Li and Al-Li alloys may be also appropriate for certain aircraft applications but need to be further investigated.
V.L.

A85-27538
COATINGS FOR EROSION RESISTANCE
G. F. SCHMITT, JR. (USAF, Materials Laboratory, Wright-Patterson AFB, OH) IN: Mechanical properties, performance, and failure modes of coatings; Proceedings of the Thirty-seventh Meeting, Gaithersburg, MD, May 10-12, 1983 . Cambridge and New York, Cambridge University Press, 1984, p. 148-164. refs

Polyurethane and fluorocarbon elastomeric coatings for protection against rain and sand erosion are described. Combinations of properties required in these coatings to meet advanced Air Force needs including antistatic, thermal flash resistance, radar transmission, and camouflage color and the tradeoffs necessary to meet these complex and often mutually exclusive requirements are discussed. Hard transparent coatings for erosion protection of aircraft canopies and windshields are also discussed including their erosion behavior, ultraviolet effects on this behavior and the importance of processing and cleanliness in achieving good adhesion to transparent plastic substrates.
Author

A85-27814
ORIENTATION RELATIONSHIP BETWEEN ALPHA-PRIME TITANIUM AND SILICIDE S2 IN ALLOY TI-6AL-5ZR-0.5MO-0.25SI
C. RAMACHANDRA and V. SINGH (Banaras Hindu University, Varanasi, India) Metallurgical Transactions A - Physical Metallurgy and Materials Science (ISSN 0360-2133), vol. 16A, March 1985, p. 453-455. Research supported by the Ministry of Defence of India. refs

Orientation relationships between the silicide S2 and the matrix of alpha-prime platelets are established for the titanium alloy 685 (Ti-6Al-5Zr-0.5Mo-0.25Si), a near-alpha alloy designed for the high-temperature components of jet engines. A stereogram showing the parallel planes of alpha-prime and S2 is presented for the alloy in the water-quenched and aged condition. A table is also presented which lists the parallel planes of the matrix and the silicide along with the misfit parameters. The results obtained are compared with the orientation relationships reported in the literature. V.L.

A85-27905
POLYSULFIDE-POLYURETHANE INTERFACIAL ASPECTS
A. M. USMANI (University of Petroleum and Minerals, Dhahran, Saudi Arabia) IN: Adhesive joints: Formation, characteristics, and testing . New York, Plenum Press, 1984, p. 41-50. refs

Polyurethane coating aging was studied, and the interfacial integrity of a polyurethane coating/polysulfide sealant is determined using scanning electron microscopy. A rapid microspecimen hand-pulled peel test was developed that will find application in designing future aircraft sealants. Dynamic mechanical analysis was used to follow polyurethane aging. Author

A85-27913
AGEING OF STRUCTURAL FILM ADHESIVES - CHANGES IN CHEMICAL AND PHYSICAL PROPERTIES AND THE EFFECT ON JOINT STRENGTH
C. E. M. MORRIS, P. J. PEARCE, and R. G. DAVIDSON (Department of Defence, Materials Research Laboratories, Ascot Vale, Victoria, Australia) IN: Adhesive joints: Formation, characteristics, and testing . New York, Plenum Press, 1984, p. 231-246. refs

Epoxy-based film adhesives are extensively used in structural aircraft applications but although the one part nature of these materials has many advantages in terms of ease of use, the short shelf-life can be a serious disadvantage, especially when the material spends lengthy times in transit between manufacturer and user. Studies on a number of epoxy and nitrile-epoxy adhesives have shown that slow cure, hydrolysis of the resin and specific interactions between components can occur during storage which result in modification of various chemical and physical properties of the uncured adhesives. The relative importance of these reactions depends on the adhesive composition. These modifications are reflected in changes in the strength of joints made with aged adhesives. This paper presents examples of these effects drawn from the results of a number of ageing studies.
Author

A85-28035
A CHROMATOGRAPHIC METHOD FOR DETERMINING THE CONTENT OF AROMATIC HYDROCARBONS IN AVIATION GASOLINES [KHROMATOGRAFICHESKII METOD OPREDELENIIA SODERZHANIIA AROMATICHESKIKH UGLEVODORODOV V AVIATSIONNYKH BENZINAKH]
L. V. KRASNAIA, N. G. POSTNIKOVA, and V. N. ZRELOV Khimiia i Tekhnologiia Topliv i Masel (ISSN 0023-1169), no. 2, 1985, p. 38, 39. In Russian. refs

A85-28994
THE EFFECT OF MERCURY ON THE LOAD-BEARING CAPACITY OF THE STRUCTURAL ELEMENTS OF AIRCRAFT [VLIIANIE RTUTI NA NESUSHCHUIU SPOSOBNOST' ELEMENTOV KONSTRUKTSII SAMOLETOV]
A. I. RADCHENKO and N. V. KOSORUKOVA (Kievskii Institut Inzhenerov Grazhdanskoi Aviatsii, Kiev, Ukrainian SSR) Fiziko-Khimicheskaia Mekhanika Materialov (ISSN 0430-6252), vol. 21, Jan.-Feb. 1985, p. 91-93. In Russian.

The effect of mercury on the durability of 1.2-mm-thick plane specimens of D-16 AT Duralumin and typical riveted joints was investigated experimentally, and the results were processed statistically. It is found that the negative effect of mercury is particularly pronounced (a 60-percent reduction in fatigue life) in the case of riveted joints when the sealing ribbon between the joined elements is damaged or absent. The negative effect of mercury on skin elements with protective coatings is observed after exposures exceeding 45 days. Mercury can be effectively removed by using a cleanser based on potassium persulfate, thiourea, and benzene sulfamide. V.L.

A85-29728* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LIFE MODELING OF ATMOSPHERIC AND LOW PRESSURE PLASMA-SPRAYED THERMAL-BARRIER COATING
R. A. MILLER (NASA, Lewis Research Center, Cleveland, OH), P. ARGARWAL (Garrett Turbine Engines, Phoenix, AZ; General Electric Co., Aircraft Engine Group, Cincinnati, OH), and E. C. DUDERSTADT (General Electric Co., Aircraft Engine Group, Cincinnati, OH) Ceramic Engineering and Science Proceedings (ISSN 0196-6219), vol. 5, July-Aug. 1984, p. 470-478. refs

The cycles-to-failure vs cycle duration data for three different thermal barrier coating systems, which consist of atmospheric pressure plasma-sprayed ZrO2-8 percent Y2O3 over similarly deposited or low pressure plasma sprayed Ni-base alloys, are presently analyzed by means of the Miller (1980) oxidation-based life model. Specimens were tested at 1100 C for heating cycle lengths of 1, 6, and 20 h, yielding results supporting the model's value. O.C.

A85-29855
POWDER METALLURGY IN AERONAUTICS IN 1983 [LA METALLURGIE DES POUDRES DANS L'AERONAUTIQUE EN 1983]
J. P. HERTEMAN and A. LIBERGE (Toulouse, Centre d'Essais Aeronautique, Toulouse, France) Materiaux et Techniques (ISSN 0032-6895), vol. 72, Oct.-Nov. 1984, p. 381-385. In French.

The use of powder metallurgy (PM) to make PM alloys for aircraft structures and engines is discussed. Consideration is given to the metallurgical aspects and technological applications of powder metallurgy. The successive steps for processing the components, including casting of the starting metal, lamination and machining, melting and pulverization, powder conditioning (sifting, filtering, and container filling), densification and elimination of the containers, and forging, are described. The pulverization method used in industry involves gas-jet atomization nickel-based superalloys and rotating electrode centrifugation of titanium alloys. The wear properties of the products of powder metallurgy, particularly the stress behavior, are also examined. M.D.

A85-29875
AUTOGAS IN AIRPLANES?
J. H. BRAHNEY Aerospace Engineering (ISSN 0736-2536), vol. 5, April 1985, p. 46-50.

Increasing prices for 100 LL (low-lead) avgas for small general aviation aircraft led to tests of car fuel (autogas) in a Cessna 150 in 1979. Autogas is half as expensive as avgas and was judged suitable after 700 flight hours. The results encouraged acceptance testing with other light aircraft. Several hazards have since been discovered. No-lead autogas, specified by ASTM D-439, may contain alcohol as an octane booster and could cause engine cut-out in an aircraft. Autogas can be twice as volatile as avgas, which can ease cold ignition and then form bubbles in the fuel lines at higher altitudes and temperatures, a situation especially serious in low-wing aircraft which may experience failures in gravity-fed fuel supplies as the autogas vaporizes. Aircraft fueled with autogas and then left unused for a long period may develop gummed fuel lines. Despite the dangers, an estimated 13,000 aircraft are now fueled with autogas and have been flown successfully without encountering the hazards. M.S.K.

A85-29929#
EFFECTS OF MOISTURE ON HIGH PERFORMANCE LAMINATES
R. F. DICKSON, C. J. JONES, B. HARRIS, H. REITER, and T. ADAM (Bath, University, Bath, England) IN: International Symposium on Acoustic Emission from Reinforced Plastics, 1st, San Francisco, CA, July 19-21, 1983, Proceedings . New York, Society of the Plastics Industry, Inc., 1983, 14 p. Research supported by the Ministry of Defence (Procurement Executive) and Science and Engineering Research Council. refs

Acoustic emission (AE) techniques have been used to determine the effects of moisture on the tensile properties of 0/90 laminates of carbon, glass, and Kevlar fiber reinforced epoxy resin; resin composition, fiber volume fraction and manufacturing process were common to all three laminate types in order to ensure comparability of results. Both digital AE data and analog load signals were collected, and the interactive analysis of these data yielded families of AE event rate plots within given amplitude ranges as functions of stress. The Kevlar-reinforced samples are noted to exhibit very different dry responses from those of the carbon and glass ones, whose responses are similar. Water effects alter local failure mechanisms in a reproducible manner which can be explained in terms of resin softening. O.C.

A85-30151
RECENT ADVANCES IN EXPERIMENTAL CHARACTERIZATION OF COMPOSITES; PROCEEDINGS OF THE FALL MEETING, SALT LAKE CITY, UT, NOVEMBER 6-10, 1983
Meeting sponsored by the Society for Experimental Stress Analysis. Brookfield Center, CT, Society for Experimental Stress Analysis, 1983, 165 p. For individual items see A85-30152 to A85-30166.

Static and dynamic properties of composite materials, including their fracture mechanisms, stiffness, and tensile properties, are considered, and the techniques used for their nondestructive evaluation are outlined. The various evaluation approaches involve acoustic emission, and attenuation and backscattering measurements. Some of the materials in the discussion are graphite/epoxy, orthotropic materials, and fiber-reinforced plastic. Furthermore, various techniques for modal analysis and signal processing are presented, for application to such structures as a wing pair of the HARM missile, Shuttle engine nozzle, and X-29 graphite-epoxy wing covers. L.T.

N85-20057# Joint Publications Research Service, Arlington, Va.
HIGH-STRENGTH COMPOSITE MATERIALS FOR AIRCRAFT, BODY ARMOR Abstract Only
V. DOVIDENAS *In its* USSR Rept.: Mater. Sci. and Technol. (JPRS-UMS-84-005) p 15 18 Jul. 1984 Transl. into ENGLISH from Komsomolskaya Pravda (USSR), 12 May 1984 p 3
Avail: NTIS HC A04/MF A01

Progress in the USSR and abroad in applications of composite materials for transportation and industry is reported. Particular attention is devoted to the technical and economic advantages of extra-strong and lightweight glass-reinforced and carbon-fiber-reinforced plastics which have been developed for aircraft, spacecraft, ships and motor vehicles. Composite materials are being designed for the production of such key parts of aircraft as airplane fuselage frames and stern-propeller shafts of helicopters. Specific information is related on the use of composites in glider plane construction. A record-setting glider, the Letuva, which was first built in 1972, is said to be made almost entirely of composite materials. Wing spars up to 12 meters long for the Letuva are manufactured from a carbon-reinforced plastic at the Prenay Sports Aviation Experimental Plant, which has pioneered the introduction of all-plastic reinforced structures in the USSR.

The plant has special units for hardening composites at high pressures and temperatures. Also mentioned is the use of Kevlar fibers in bulletproof vests. B.W.

N85-20062# Joint Publications Research Service, Arlington, Va.
FORCED CORROSION TESTS OF CONSTRUCTION COMPONENTS OF PASSENGER AIRCRAFT FUSELAGES Abstract Only
A. V. KARLASHOV, R. G. GAYNUTDINOV, A. M. SVINTSITSKIY, A. M. VORONKIN, N. F. SADKOV, V. V. VORONOV, and Y. A. KRASNOV *In its* USSR Rept.: Mater. Sci. and Met. (JPRS-UMS-84-005) p 20 18 Jul. 1984 Transl. into ENGLISH from Fiz.-Khim. Mekhan. Mater. (USSR), v. 20, no. 1, Jan. - Feb. 1984 p 92-93
Avail: NTIS HC A04/MF A01

An attempt was made to determine the nature of changes in the coefficient of corrosion acceleration as dependent on test duration for V95 aluminum used in aircraft fuselages, taking into account both atmospheric and condensational factors that can provoke delamination. Tests with 1.0 g/1 potassium dichromate and 1.0 ml/1 hydrochloric acid indicated that this solution effectively reproduced the delaminating corrosion on fuselage stringers, as measured by loss of fatigue resistance. Results showed that natural condensate cut longevity by 57% in 20 days, while the accelerated solution cut it by 74%. In the next 20 days loss of useful life decreased by an additional 10% and 4%, respectively. Thus in general, results indicated that the coefficient of forced corrosion decreased with increasing duration of testing. This factor must be considered in assessing results received in accelerated corrosion tests. R.J.F.

N85-20119# Technische Hogeschool, Delft (Netherlands). Dept. of Aerospace Engineering.
CRACK GROWTH GEOMETRY IN ALUMINUM ALLOY SHEET MATERIAL UNDER FLIGHT SIMULATION LOADING. 1: A COMPARISON BETWEEN TWIST AND MINITWIST FALSTAFF AND SHORT FALSTAFF. 2: EFFECT OF TRUNCATING HIGH LOADS
J. SCHIJVE, A. M. VLUTTERS, ISCHAN, and J. C. PROVOKLUIT Sep. 1984 27 p refs
(VTH-LR-441) Avail: NTIS HC A03/MF A01

Crack propagation tests were carried out on 2024-T3 sheet specimens to study the effects of omitting low amplitude cycles from the the gust dominated TWIST load sequence (miniTWIST) and the removal of small load ranges from the maneuver dominated FALSTAFF load sequence (short FALSTAFF). High amplitude loads of TWIST and miniTWIST were truncated at different levels. Fatigue life under MiniTWIST loading is considerably larger than for TWIST. Low-amplitude cycles can contribute significant fatigue damage. Fatigue life under short FALSTAFF is the same as for FALSTAFF. Truncation of the TWIST and MiniTWIST load spectrum at a higher amplitude level implies a significantly slower crack growth in 2024-T3 material, due to significant crack growth retardation introduced by severe flights. An initially decreasing crack growth rate during increasing crack length is observed if high truncation levels are adopted. Author (ESA)

N85-20128*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
PROCESS FOR PREPARING ESSENTIALLY COLORLESS POLYIMIDE FILM CONTAINING PHENOXY-LINKED DIAMINES Patent Application
A. K. ST.CLAIR and T. L. ST.CLAIR, inventors (to NASA) 23 Aug. 1984 23 p
(NASA-CASE-LAR-13353-1; NAS 1.71:LAR-13353-1; US-PATENT-APPL-SN-643524) Avail: NTIS HC A02/MF A01 CSCL 11B

A polyimide film that is approximately 90% transparent at 500 nm, useful for thermal protective coatings and solar cells, and the processes for preparing the same by thermal and chemical conversion are disclosed. An essential feature for achieving maximum optical transparency films requires utilizing recrystallized and/or sublimated specific aromatic diamines and dianhydride monomers and introducing phenoxy or thiophenyl separator groupps and isomeric m,m'- or o,p'-oriented diamines into the polymer molecular structure. The incorporation of these groups in the polymer structure serves to separate the chromaphoric centers and reduce the formation of inter-chain and intra-chain charge transfer complexes which normally cause absorptions in the UV-visible range. The films may be obtained by hand, brushing, casting or spraying a layer of the polyamic acid solutions onto a surface and thermally converting the applied layer to the polyimide. In addition, the polyamic acid solution can be chemically converted to the polyimide, subsequentially dissolved in an organic solvent, and applied as a polyimide film layer with the solvent therein thermally removed. NASA

N85-20130# Argonne National Lab., Ill.
STRUCTURAL CERAMICS IN TRANSPORTATION: FUEL IMPLICATIONS AND ECONOMIC IMPACTS
A. P. S. TEOTIA and L. R. JOHNSON 1985 23 p refs Presented at the 64th Ann. Transportation Res. Board Meeting, Washington, 21 Jan. 1985
(Contract W-31-109-ENG-38)
(DE85-003024; CONF-850115-4) Avail: NTIS HC A02/MF A01

The potential application of structural ceramics in motor vehicle engines is described. The high temperature strength characteristic plus the properties of resistance to wear and corrosion make these high tech ceramics excellent candidates for the harsh environment of the advanced engine systems being considered for automobiles and trucks. The critical role of ceramics in the adiabatic diesel, gas turbine and Stirling engine is discussed, along with an indication of the fuel efficiency potential and multifuel capability of each engine. A market penetration analysis of the advanced engines is reviewed and forms the basis of developing two alternative commercialization scenarios for ceramic component engines - one with the United States dominating the market and the other with Japan dominating. Changes in major national economic indicators are noted after simulating the economy with a macroeconomic model. Strategic materials impacts are also noted. DOE

N85-20144# Naval Research Lab., Washington, D. C.
QUANTITATIVE DETERMINATION OF COMPOUND CLASSES IN JET TURBINE FUELS BY HIGH PERFORMANCE LIQUID CHROMATOGRAPHY/DIFFERENTIAL REFRACTIVE INDEX DETECTION: PART 2 Interim Report, Jun. 1983 - Jun. 1984
C. W. SINK, D. R. HARDY, and R. N. HAZLETT 31 Dec. 1984 16 p
(Contract Z03-88)
(AD-A149298; NRL-MR-5497-PT-2) Avail: NTIS HC A02/MF A01 CSCL 21D

Recent investigations demonstrated the usefulness of high performance liquid chromatography/differential refractive index detection (HPLC/DRI) as a method for quantitating compound classes present in jet fuels. The method is fast, precise and accurate when applied to mixtures of known compounds typical of each compound class encountered in a fuel. It is also accurate when the refractive index of the fuels class and the detector calibration standard are matched. This study assesses the accuracy of HPLC/DRI when the calibration standards are pure compound blends whose refractive index for each compound class is matched closely to that of the fuels being analyzed. The accuracy of analyses by this method of calibration was checked by analyzing test fuels of known refractive indices. The test fuels were prepared by recombination of previously separated fuels after measuring the refractive index of each fraction. The composition of fifteen fuels was also determined by the Fluorescent Indicator Absorption (FIA) method (ASTM-D-1319-77). In general the agreement between FIA and HPLC/DRI was quite good for many samples after conversion of the FIA aromatic content to weight percent. Four fuels, three of which have unusually high dicyclic aromatic content did not give good agreement between the two methods of analysis. The results demonstrate that it is possible to accurately calibrate the detector's response factors for each compound class by standards derived from pure compounds. To ensure that the accuracy of

the results falls within the limits of the electronic integrator's precision, one needs to match the refractive index of the saturate fraction to within approximately 0.004 RI units. GRA

N85-20145# Naval Surface Weapons Center, White Oak, Md.
CHEMICAL AND PHOTOGRAPHIC EVALUATION OF RIGID EXPLOSIVE TRANSFER LINES Interim Report, Jul. 1980 - May 1984
E. G. KAYSER May 1984 52 p Original contains color illustrations
(AD-A149303; NSWC/TR-84-66) Avail: NTIS HC A04/MF A01 CSCL 19A

This paper describes the chemical and photographic analyses performed on 112 explosive transfer lines used to initiate aircraft emergency escape systems for a variety of military and NASA aircraft. The purpose was to provide quantitative chemical data on in-service explosive transfer lines as affected by both age and heat treatment. These data are necessary in order to make reliable, responsible, and conservative estimations of inservice cord life extension. The approach was to: (1) develop a test methodology; (2) characterize the types of transfer lines in use in this country; (3) analyze these lines following a repeat of the thermal tests conducted in the original qualification; and (4) conduct a degradation investigation on the explosives currently in use. The results of this testing indicate that rigid explosive transfer lines are not adversely affected by age, service, or a repeat of the thermal qualification tests. Author (GRA)

N85-20150# Research Inst. of National Defence, Stockholm (Sweden). Dept. 2.
STUDY OF HTPB-BASED SOFRAM FUELS
R. ELIASSON Nov. 1984 53 p refs In SWEDISH; ENGLISH summary
(FOA-C-20563-D3; ISSN-0347-3694) Avail: NTIS HC A04/MF A01; Research Institute of National Defence, Stockholm KR 50

In a small Solid Fuel Ramjet (SOFRAM) test engine, burning rate and combustion efficiency for different HTPB - based fuels were studied, using tubular fuel charges with an external diameter of 72 mm. Ram air temperature and chamber pressure, simulating different flight conditions were varied, as well as chamber geometry. It is found that additions of aluminum (30 %), magnesium (30 %), or ammonium perchlorate (10 % to 30 %) to HTPB increase the burning rate; however high content of AP or addition of iron oxide (1 %) increases risk of pressure oscillations. Addition of carbon black (5 %) to HTPB decreases the burning rate. Combustion efficiency increases with chamber pressure or when the air flow through the engine increases at constant ram air temperature and constant chamber pressure. Author (ESA)

N85-21268*# Rensselaer Polytechnic Inst., Troy, N. Y. School of Engineering.
COMPOSITE STRUCTURAL MATERIALS Semiannual Progress Report, 30 Apr. - 30 Sep. 1984
G. S. ANSELL, R. G. LOEWY, and S. E. WIBERLEY Dec. 1984 152 p refs Sponsored in part by AF
(Contract NGL-33-018-003)
(NASA-CR-175515; NAS 1.26:175515; SAR-47) Avail: NTIS HC A08/MF A01 CSCL 11D

Progress is reported in studies of constituent materials composite materials, generic structural elements, processing science technology, and maintaining long-term structural integrity. Topics discussed include: mechanical properties of high performance carbon fibers; fatigue in composite materials; experimental and theoretical studies of moisture and temperature effects on the mechanical properties of graphite-epoxy laminates and neat resins; numerical investigations of the micromechanics of composite fracture; delamination failures of composite laminates; effect of notch size on composite laminates; improved beam theory for anisotropic materials; variation of resin properties through the thickness of cured samples; numerical analysis composite processing; heat treatment of metal matrix composites, and the RP-1 and RP2 gliders of the sailplane project. A.R.H.

N85-21273*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NONLINEAR ANALYSIS FOR HIGH-TEMPERATURE MULTILAYERED FIBER COMPOSITE STRUCTURES M.S. Thesis
D. A. HOPKINS Aug. 1984 120 p refs
(NASA-TM-83754; E-2242; NAS 1.15:83754) Avail: NTIS HC A06/MF A01 CSCL 11D

A unique upward-integrated top-down-structured approach is presented for nonlinear analysis of high-temperature multilayered fiber composite structures. Based on this approach, a special purpose computer code was developed (nonlinear COBSTRAN) which is specifically tailored for the nonlinear analysis of tungsten-fiber-reinforced superalloy (TFRS) composite turbine blade/vane components of gas turbine engines. Special features of this computational capability include accounting of; micro- and macro-heterogeneity, nonlinear (stess-temperature-time dependent) and anisotropic material behavior, and fiber degradation. A demonstration problem is presented to mainfest the utility of the upward-integrated top-down-structured approach, in general, and to illustrate the present capability represented by the nonlinear COBSTRAN code. Preliminary results indicate that nonlinear COBSTRAN provides the means for relating the local nonlinear and anisotropic material behavior of the composite constituents to the global response of the turbine blade/vane structure.
Author

N85-21349* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ELASTOMER TOUGHENED POLYIMIDE ADHESIVES Patent
A. K. ST.CLAIR and T. L. ST.CLAIR, inventors (to NASA) 5 Feb. 1985 7 p Filed 28 Jan. 1983 Supersedes N83-29390 (21 - 18, p 2900) Division of US Patent No. 4,389,504, US Patent Appl. SN-308201, filed 2 Oct. 1981
(NASA-CASE-LAR-12775-2; NAS 1.71:LAR-12775-2; US-PATENT-4,497,935; US-PATENT-APPL-SN-461788; US-PATENT-CLASS-525-181; US-PATENT-CLASS-525-182; US-PATENT-CLASS-525-183; US-PATENT-CLASS-525-184; US-PATENT-CLASS-525-474; US-PATENT-4,389,504; US-PATENT-APPL-SN-308201) Avail: US Patent and Trademark Office CSCL 11A

A rubber-toughened, addition-type polyimide composition is disclosed which has excellent high temperature bonding characteristics in the fully cured state and improved peel strength and adhesive fracture resistance physical property characteristics. The process for making the improved adhesive involves preparing the rubber-containing amic acid prepolymer by chemically reacting an amine-terminated elastomer and an aromatic diamine with an aromatic dianhydride with which a reactive chain stopper anhydride has been mixed, and utilizing solvent or mixture of solvents for the reaction.
Official Gazette of the U.S. Patent and Trademark Office

N85-21365# Southwest Research Inst., San Antonio, Tex.
A STUDY OF INTUMESCENT REACTION MECHANISMS Final Report, May 1983 - Jul. 1984
C. E. ANDERSON, JR., J. DZIUK, JR., and J. BUCKMASTER Warminster, Pa. Naval Air Development Center Aug. 1984 130 p
(AD-A149605; SWRI-7557; NADC-84170-60) Avail: NTIS HC A07/MF A01 CSCL 11C

An extensive experimental program has been conducted on intumescent systems where the components have been systematically varied. Small plates were coated with the various formulations, exposed to a heat source typical of aviation fuel fires, and the temperature-time history of the substrate recorded. Concurrently, a simplified mathematical model was developed for an intumescing system which has given insight to the fundamental mechanisms of intumescence. The model and the results of the experimental program demonstrated certain desirable features of intumescent systems and hold the promise of guiding the optimization of certain promising formulations to thermally protect Navy ordnance. GRA

N85-21368# Materials Research Labs., Ascot Vale (Australia).
INTERACTIONS BETWEEN F-111 FUSELAGE FUEL TANK SEALANTS. PART 2: VARIATION IN PERFORMANCE PROPERTIES OF POLYSULFIDES AFTER CONTACT WITH POLYESTER DEGRADATION PRODUCTS
P. J. HANHELA and D. B. PAUL Aug. 1984 39 p
(AD-A149777; MRL-R-658) Avail: NTIS HC A03/MF A01
CSCL 11A

Fuel leaks occur in F-111 aircraft from interactions between polysulfide sealants and the hydrolysis products of polyester sealants used to seal fuel cavities. Changes in properties of some polysulfides were examined following contact with degraded polyesters. Use of model degradation compounds indicated that ester groups cause swelling, alcohols suppress swelling when used with esters, and carboxylic acids both swell the polysulfides and harden exposed surfaces. Degraded polyesters cause swelling and embrittlement together with inner softening of the polysulfides. PR-1750, which has a high crosslink density, was the most resistant of the polysulfides examined. Studies with simulated fuel tank structures indicated that the polysulfides ruptured due to expansion pressures acting on a matrix weakened by swelling. Such pressures arise from swell of the polyester sealants and thermal expansion of their degradation products under aerodynamic heating. For small contact areas between polyester and polysulfide, adhesion was relatively unaffected. Broad sealant fillets were shown to be essential for effective resealing over extended periods.
Author (GRA)

N85-21401# SRI International Corp., Menlo Park, Calif.
OXIDATION AND GUM FORMATION IN JET FUELS Interim Report
F. R. MAYO 16 Nov. 1984 7 p
(Contract DAAG29-84-K-0161)
(AD-A149934; ARO-21165.1-EG; IR-1) Avail: NTIS HC A02/MF A01 CSCL 21D

Chapter 6 in the Russian book by E. T. Denisov and G. I. Kovalev, Oxidation and Stabilization of Jet Fuels, is reviewed. It deals with the effects of many metal and alloy surfaces on gum and deposit formation from a stable jet fuel (T-6) produced by hydrodearomatization. The metals affect oxidations mostly by assisting or retarding the initiation of a subsequent homogeneous oxidation. The effects of the metals and the differences among them are small to moderate. GRA

12

ENGINEERING

Includes engineering (general); communications; electronics and electrical engineering; fluid mechanics and heat transfer; instrumentation and photography; lasers and masers; mechanical engineering; quality assurance and reliability; and structural mechanics.

A85-26501
ADVANCES IN CRYOGENIC ENGINEERING. VOLUME 29 - PROCEEDINGS OF THE CRYOGENIC ENGINEERING CONFERENCE, COLORADO SPRINGS, CO, AUGUST 15-17, 1983
R. W. FAST, ED. (Fermi National Accelerator Laboratory, Batavia, IL) Conference supported by AIRCO, Inc., NBS, NSF, et al. New York, Plenum Press, 1984, 1071 p. For individual items see A85-26502 to A85-26527.

Applications of superconductivity are discussed, taking into account the thermal performance of the MFTF magnets, the design and testing of a large bore superconducting magnet test facility, the development of a 12-tesla multifilamentary Nb3Sn magnet, a superconducting magnet for solid NMR studies, advanced applications of superconductors, transition and recovery of a cryogenically stable superconductor, and finite-difference modeling of the cryostability of helium II cooled conductor packs. Other topics explored are related to resource availability, heat exchangers, heat transfer to He I, liquid nitrogen, heat transfer in He II, refrigeration for superconducting and cryopump systems, refrigeration of cryogenic systems, refrigeration and liquefaction, dilution and magnetic refrigeration, cryocoolers, refrigeration for space applications, cryogenic applications, cryogenic instrumentation and data acquisition, and properties of fluids. Attention is given to biomedical applications of cryogenics in China, long-term cryogen storage in space, and a passive orbital disconnect strut. G.R.

A85-26504* Jet Propulsion Lab., California Inst. of Tech., Pasadena.
KINETICS OF A GAS ADSORPTION COMPRESSOR
C. K. CHAN, E. TWARD, and D. D. ELLEMAN (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) IN: Advances in cryogenic engineering. Volume 29 - Proceedings of the Cryogenic Engineering Conference, Colorado Springs, CO, August 15-17, 1983 . New York, Plenum Press, 1984, p. 533-542. NASA-supported research. refs

Chan (1981) has suggested that a process based on gas adsorption could be used as a means to drive a Joule-Thomson (J-T) device. The resulting system has several advantages. It is heat powered, it has no sealing, there are no mechanical moving parts, and no active control is required. In the present investigation, a two-phase model is used to analyze the transients of a gas adsorption compressor. The modeling of the adsorption process is based on a consideration of complete thermal and mechanical equilibrium between the gaseous phase and the adsorbed gas phase. The experimental arrangement for two sets of kinetic tests is discussed, and data regarding the experimental results are presented in graphs. For a theoretical study, a two-phase model was developed to predict the transient behavior of the compressor. A computer code was written to solve the governing equations with the aid of a standard forward marching predictor-corrector method. G.R.

A85-26510
A FAST COOL-DOWN J-T MINICRYOCOOLER
J. K. XIE (Chinese Academy of Sciences, Shanghai Institute of Technical Physics, Shanghai, People's Republic of China) IN: Advances in cryogenic engineering. Volume 29 - Proceedings of the Cryogenic Engineering Conference, Colorado Springs, CO, August 15-17, 1983 . New York, Plenum Press, 1984, p. 621-627.

Design criteria for miniature open cycle Joule-Thomson (J-T) refrigerators were discussed by Geist and Lashmet (1960). Advantages of J-T minicryocoolers are related to compactness, low cost, and the ability to provide low temperatures very rapidly. Disadvantages include low efficiency and the requirement of a high-pressure gas source. The present investigation is concerned with a J-T minicryocooler which makes it possible to reach low temperatures very rapidly. The considered device has special design features, including a two-phase valve, a directly-wound fin tube, and a special combination of three heat exchangers. Attention is given to the thermodynamic cycle, a new heat exchanger for improving the capacity of minicryocoolers, and test data. G.R.

A85-26551
INSTITUTE OF ENVIRONMENTAL SCIENCES, ANNUAL TECHNICAL MEETING, 29TH, LOS ANGELES, CA, APRIL 19-21, 1983, PROCEEDINGS
Mount Prospect, IL, Institute of Environmental Sciences, 1983, 427 p. For individual items see A85-26552 to A85-26563.

Design criteria and evaluation and test techniques - in particular, environmental, dynamics, and climatic testing and evaluation of shock effects - are considered, for implementation in the analysis of aircraft and spacecraft structures and ground vehicles. Computer applications and automation methods in the field of simulation and testing are discussed. Finally, such topics as product reliability, contamination control, and energy and the environment are detailed. L.T.

A85-26641
EVALUATION OF AIRCRAFT MSS ANALYTICAL BLOCK ADJUSTMENT
J. C. MCGLONE (H. Dell Foster Associates, San Antonio, TX) and E. M. MIKHAIL (Purdue University, West Lafayette, IN) Photogrammetric Engineering and Remote Sensing (ISSN 0099-1112), vol. 51, Feb. 1985, p. 217-225. refs
(Contract NOAA-04-7-158-44128)

It is pointed out that most recent work on the geometric rectification of aircraft multispectral scanner (MSS) data has, except for a few instances, involved only single strips. Although there are often good reasons for using only single strips, there are also advantages for an employment of overlapping strips of data. The block adjustment of sidelapping MSS data essentially follows the standard photogrammetric technique of block adjustment. Details concerning the formulation of the adjustment procedure and the evaluation statistics are discussed along with MSS block adjustment tests. The test results are examined, taking into account the results of accuracy tests and precision tests. It is found that the number of sections into which the strips are divided has a significant effect on the accuracy and precision of the adjustment. G.R.

A85-26684#
A NEW APPROACH TO APPLYING ELECTROMAGNETIC TRANSIENT PROTECTION REQUIREMENTS TO AVIONIC AND ELECTRONIC EQUIPMENT
J. C. CORBIN and W. C. WEBB (USAF, Aeronautical Systems Div., Wright-Patterson AFB, OH) IN: International Symposium on Electromagnetic Compatibility, 25th, Arlington, VA, August 23-25, 1983, Symposium Record . New York, Institute of Electrical and Electronics Engineers, Inc., 1983, p. 360, 361.

Presently, separate and distinct electomagnetic (EM) transient protection requirements, test methods, and demonstrations are used for system-generated electromagnetic interference (EMI), lightning, and the nuclear electromagnetic pulse (NEMP) on Air Force aircraft. This lack of a common approach to applying EM transient protection requirements has resulted in inflated design costs and performance impacts. This paper describes a new approach to consolidate and combine requirements to reduce the cost and complexity of protecting avionics and electronics, define specific equipment sensitivity levels, and provide a common equipment-level hardness baseline. Author

A85-26754*# National Academy of Sciences - National Research Council, Washington, D. C.
IMPACT OF COMPUTATIONAL FLUID DYNAMICS ON DEVELOPMENT TEST FACILITIES
R. H. KORKEGI (National Research Council, Washington, DC) Journal of Aircraft (ISSN 0021-8669), vol. 22, March 1985, p. 182-187. NASA-USAF-sponsored research. Previously cited in issue 17, p. 2503, Accession no. A83-37234.

A85-26761#
SIDEWALL BOUNDARY-LAYER CORRECTIONS IN SUBSONIC, TWO-DIMENSIONAL AIRFOIL/HYDROFOIL TESTING
A. L. TREASTER, G. B. GURNEY (Pennsylvania State University, State College, PA), and P. P. JACOBS, JR. (USAF, Edwards AFB, CA) Journal of Aircraft (ISSN 0021-8669), vol. 22, March 1985, p. 229-235. Navy-supported research. Previously cited in issue 16, p. 2323, Accession no. A84-35195. refs

A85-26769#
CRYPTOSTEADY MODES OF ENERGY EXCHANGE
J. V. FOA and C. A. GARRIS (George Washington University, Washington, DC) Mechanical Engineering (ISSN 0025-6501), vol. 106, Nov. 1984, p. 68-75. refs

Cryptosteady modes of direct fluid-fluid energy exchange, as occurs in thrust augmenting ejectors and jet pumps, make use of the fact that a flow which is not uniform throughout can be steady in no more than one frame of reference. They thereby transform a steady flow interaction into a nonsteady one by the simple artifice of using it in a frame of reference other than the unique one in which it is steady. The reference frame is then given the benefit of pressure exchange, while retaining the control advantages of steady flow in the other one. Attention is given to rotary jet devices based on cryptosteady effects, as well as thrust augmentors based on the rotary jet. O.C.

A85-26797
A COST-EFFECTIVE INTEGRATED DIAGNOSTICS SUPPORT SYSTEM
R. K. WALKER (Northrop Corp., Aircraft Div., Hawthorne, CA) IN: AUTOTESTCON '83; Proceedings of the Conference, Fort Worth, TX, November 1-3, 1983 . New York, Institute of Electrical and Electronics Engineers, Inc., 1983, p. 164-167.

Today's maintenance test system must provide a cost-effective solution to the diagnostics problem. In a small-force environment, it is mandatory that training, publications, and maintenance considerations be included. This paper is the result of a study to identify a cost-effective alternative to existing automatic test equipment. The alternate support system identified is capable of supporting a small-force operator with very limited assets. It integrates the test system, a maintenance aid, a training device, and automated publications into a single support system. Audio and visual operator instructions are included plus operator interaction. Non-recurring, recurring, and life cycle costs are compared to existing support equipment, with descriptions of operational advantages. Author

A85-26800
THE EXPEDITIONARY TEST SET - A FRESH APPROACH TO AUTOMATIC TESTING
D. L. WILLIAMS and W. J. AUSTIN (McDonnell Aircraft Co., St. Louis, MO) IN: AUTOTESTCON '83; Proceedings of the Conference, Fort Worth, TX, November 1-3, 1983 . New York, Institute of Electrical and Electronics Engineers, Inc., 1983, p. 186-191.

This paper discusses the key design decisions and tradeoffs leading from the conceptual stage to the production version of the Expeditionary Test Set (ETS) for the USMC. This included a ten-month feasibility study program funded by the Naval Air Systems Command which culminated in the successful demonstration of a working tester model. The demonstration of the test set was preceded by a substantial re-thinking of conventional ATE test methods. Considerable discussion is devoted to the impact of test philosophy, both on the test set design and the overall effectiveness of avionic testing. Major architectural features of the test set are presented in some detail, and the many areas which break from traditional ATE design are emphasized. Author

A85-26804
THE RELATIONSHIP BETWEEN AN ADVANCED AVIONIC SYSTEM ARCHITECTURE AND THE ELIMINATION OF THE NEED FOR AN AVIONICS INTERMEDIATE SHOP (AIS)
S. J. ABRAHAM (General Dynamics Corp., Fort Worth, TX) IN: AUTOTESTCON '83; Proceedings of the Conference, Fort Worth, TX, November 1-3, 1983 . New York, Institute of Electrical and Electronics Engineers, Inc., 1983, p. 206-211. refs

While Avionics Intermediate Shops (AISs) have in the past been required for military aircraft, the emerging VLSI/VHSIC technology has given rise to the possibility of novel, well partitioned avionics system architectures that obviate the high spare parts costs that formerly prompted and justified the existence of an AIS. Future avionics may therefore be adequately and economically supported by a two-level maintenance system. Algebraic generalizations are presented for the analysis of the spares costs implications of alternative design partitioning schemes for future avionics. O.C.

A85-26809
ELECTRONIC WARFARE AUTOMATIC TEST EQUIPMENT CALIBRATION
D. O. JACOBY and A. E. MCKINNEY (Sanders Associates, Nashua, NH) IN: AUTOTESTCON '83; Proceedings of the Conference, Fort Worth, TX, November 1-3, 1983 . New York, Institute of Electrical and Electronics Engineers, Inc., 1983, p. 250-253.

The problems involved in deriving sufficient technical data for Category I Calibration/Measurement Requirements Summary (CMRS) for a multipurpose automatic test equipment (ATE) station are discussed. An approach is proposed for deriving CMRS data on the basis of the ATE testing specification rather than capabilities specification. Methods for updating the CMRS and the calibration implementation as new avionics support requirements are identified and added are also examined. Finally, the methods for calibration implementation in existing electronic warfare ATE and alternative approaches are discussed. V.L.

A85-26810
PORTABLE AUTOMATIC EYE-SAFE LASER AND FLIR TEST SET
J. D. FRANK and W. E. PETERSON (Hughes Aircraft Co., Long Beach, CA) IN: AUTOTESTCON '83; Proceedings of the Conference, Fort Worth, TX, November 1-3, 1983 . New York, Institute of Electrical and Electronics Engineers, Inc., 1983, p. 254-258.
(Contract F33657-82-C-2208)

The military using commands have needed a light-weight, portable, eye safe flight line laser and FLIR tester for many years. The only alternatives have been to remove the equipment from the aircraft (or other vehicles) and testing in a controlled area or fly to a controlled area. Otherwise, the pilot/WSO really doesn't know whether he has a good or bad laser until after engaging the target. Hughes Aircraft Company has developed a unique eye-safe, portable, flight line tester utilizing mostly proprietary components featuring folded type optics. This new device permits automatic end-to-end testing of E/O weapon systems. The design highlights the use of modules which permit reconfiguration of the tester to have multiweapon application. In this paper the basic testing concepts are described, and illustrations are presented to describe the testing procedures. Author

A85-26813
OPERATIONAL CONSIDERATIONS FOR THE DESIGN OF MILITARY FIBER OPTIC TEST EQUIPMENT
D. A. BURCHICK (DCS Corp., Alexandria, VA) and J. HENNESS (Fiberguide Instruments, Princeton, NJ) IN: AUTOTESTCON '83; Proceedings of the Conference, Fort Worth, TX, November 1-3, 1983 . New York, Institute of Electrical and Electronics Engineers, Inc., 1983, p. 267-272.

The importance of focusing on the integrated approach to testing fiber optics rather than on the engineering design tests, at this stage of the fiber optics technology, is discussed in the framework of military applications in avionics. Optical Time Domain Reflectometry is suggested to be a potential alternative to O-level testing; its deficiencies are also analyzed, centering on the nature of the information content of reflected pulses. Plastic fibers are considered as a solution to combat damages and excessive stresses. Finally, various aspects of I-level testing and built-in testing are analyzed. L.T.

A85-26825
THE AIR FORCE MODULAR AUTOMATIC TEST EQUIPMENT (MATE) MAINTENANCE CONCEPTS
J. STOUT (USAF, Aeronautical Systems Div., Wright-Patterson AFB, OH), D. PERSANS, and J. CAPORALE (Sperry Corp., Great Neck, NY) IN: AUTOTESTCON '83; Proceedings of the Conference, Fort Worth, TX, November 1-3, 1983 . New York, Institute of Electrical and Electronics Engineers, Inc, 345-354.

The Air Force has developed the Modular Automatic Test Equipment (MATE) system as a disciplined approach to the definition, acquisition, and support of automatic test equipment. The system is expressed in a series of guides regarding the hardware, computer program, human factors, and documentation required to implement the considered approach. The present investigation is concerned with the facet of the guidelines which addresses the MATE maintenance concepts. Attention is given to maintenance problems in the field, a MATE system maintenance concept overview, maintenance-oriented tests, integrated diagnostics, the MATE system operational/confidence test scenario, and a MATE system optional self-test. G.R.

A85-27235#
AN INVESTIGATION ON TURBULENT HEAT TRANSFER OF AN AXISYMMETRIC JET IMPINGING ON A FLAT PLATE
R. S. AMANO (Wisconsin, University, Milwaukee, WI) and S. SUGIYAMA (Nippon Kokan, Kawasaki, Japan) JSME, Bulletin (ISSN 0021-3764), vol. 28, Jan. 1985, p. 74-79. refs

A study is reported on the heat transfer characteristics of a flat plate when an axisymmetric air jet impinges normally on to the plate. The two-dimensional Navier-Stokes equations are solved by using the k approximately epsilon Boussinesq Viscosity Model (BVM). Refined wall function relations are used for the evaluation of the k-equation in the near wall region and the treatment is further applied to the epsilon-equation. The turbulence Prandtl number is proposed as a function of the local ratio of turbulent energy production to energy dissipation rate. Predictions by the present model show generally good agreement with the experimental data. Author

A85-27476
THE PERFORMANCE OF A SEALED SQUEEZE-FILM BEARING IN A FLEXIBLE SUPPORT STRUCTURE
R. HOLMES (Southampton, University, Southampton, England) and M. DOGAN (Black Sea Technical University, Trabzon, Turkey) Institution of Mechanical Engineers, Proceedings, Part C Mechanical Engineering Science (ISSN 0263-7154), vol. 199, no. C1, 1985, p. 1-9. Research supported by Rolls-Royce, Ltd. refs

In this paper attention is given to empirically modelling the hydrodynamics of a tightly sealed squeeze film bearing in a flexible support structure simulating an aeroengine assembly, with a view to assessing its damping performance. It is found that predictable experimental results are obtained by employing an end leakage factor which relates the outlet pressure around the bearing circumference to the corresponding 'long bearing' pressure. The present work complements that covered in an earlier paper of Holmes and Dogan (1982), which was concerned with the performance of an open ended or weakly sealed squeeze film bearing in a similar support structure. Author

A85-27479
AN ENERGY APPROACH TO LINEARIZING SQUEEZE-FILM DAMPER FORCES
E. J. HAHN (New South Wales, University, Kensington, Australia) (Institution of Mechanical Engineers, Conference on Vibrations in Rotating Machinery, York, England, Sept. 11-13, 1984) Institution of Mechanical Engineers, Proceedings, Part C Mechanical Engineering Science (ISSN 0263-7154), vol. 199, no. C1, 1985, p. 57-63. refs

Analyses of multi-degree of freedom rotor-bearing systems incorporating non-linear elements, such as squeeze-film dampers, generally necessitate time consuming transient solution. Consequently, it is often too expensive to carry out parametric design studies on such systems. This paper presents a general technique for linearizing the non-linear element forces using equivalent stiffness and damping coefficients with energy dissipation and energy storage-release concepts. The approach is illustrated and tested for both centrally preloaded squeeze-film dampers and for squeeze-film dampers without centralizing springs under a combination of unidirectional and unbalance loading. The results predicted by using such equivalent stiffness and damping coefficients agree quite well with those obtained from the full transient solution, even where the unidirectional load exceeds the dynamic load and the damper is operating at high eccentricity. An iterative procedure is proposed which, with the aid of such stiffness and damping coefficients, should significantly reduce the

computation time presently needed to carry out parametric design studies on general multi-degree of freedom systems incorporating non-linear elements such as squeeze-film dampers. Author

A85-27480
AN EXPLANATION FOR THE ASYMMETRY OF THE MODULATION SIDEBANDS ABOUT THE TOOTH MESHING FREQUENCY IN EPICYCLIC GEAR VIBRATION
P. D. MCFADDEN (Aeronautical Research Laboratories, Melbourne, Australia) and J. D. SMITH (Cambridge University, Cambridge, England) Institution of Mechanical Engineers, Proceedings, Part C Mechanical Engineering Science (ISSN 0263-7154), vol. 199, no. C1, 1985, p. 65-70. refs

The vibration spectra of epicyclic gears commonly exhibit considerable asymmetry of the modulation sidebands and even complete suppression of the component at the tooth meshing frequency. A model is proposed which explains these observations in terms of the relationship between the vibrations generated by each of the planet gears as they move relative to the transducer location. Comparisons of the predictions of the model with measured vibration spectra for several epicyclic gearboxes show good agreement. Author

A85-27530#
WEATHER INFORMATION IN THE USSR ATC SYSTEMS
G. N. GROMOV (All-Union Scientific Research Institute of Radio Equipment, USSR) IN: Radio Technical Commission for Aeronautics, Annual Assembly Meeting and Technical Symposium, Washington, DC, November 15-17, 1983, Proceedings . Washington, DC, Radio Technical Commission for Aeronautics, 1984, p. 121-134.

Developments related to weather radars are discussed, taking into account the diagnostic method and short-term hazardous weather forecasts with update information, the need for specialized weather radars, the installation of the first specialized weather radars in the USSR at airports approximately 20 years ago, the initiation of the production of new generation radars in 1975, data processing with statistic correlations between radio-echo intensity and hazardous phenomena, and the utilization of the multilevel display method for estimating highly intensive radio-echo areas. The sources of meteorological information for ATC systems are considered, giving attention to weather information presented on the controller's display. G.R.

A85-27532#
DEVELOPMENT OF A TERMINAL SENSOR FOR HAZARDOUS WEATHER AND WAKE TURBULENCE DETECTION
D. E. JOHNSON (FAA, Washington, DC) IN: Radio Technical Commission for Aeronautics, Annual Assembly Meeting and Technical Symposium, Washington, DC, November 15-17, 1983, Proceedings . Washington, DC, Radio Technical Commission for Aeronautics, 1984, p. 149-158.

It is pointed out that real time weather information for Federal Aviation Administration (FAA) air traffic control (ATC) purposes comes currently from ATC surveillance radars. However, existing surveillance radars have three severe limitations for weather detection use. One limitation is related to an optimization of the radars for aircraft detection, because such an optimization degrades the weather detection capability. The fan beam antenna of the surveillance radars causes inaccuracies in weather indications, while the third limitation is the restriction of the surveillance radars to the provision of reflectivity information. This situation has led the FAA to conduct research and development activities concerning the use of Doppler radars. Attention is given to the FAA weather radar requirements, activities in support of the Next Generation Weather Radar (NEXRAD), wind shear and wake turbulence detection, and aspects of data collection. G.R.

A85-27646
PHOTOGRAPHIC SURVEYING OF FLOW SPEED AND DIRECTION ADJACENT TO A SURFACE
R. V. BARRETT (Bristol, University, Bristol, England) Aeronautical Journal (ISSN 0001-9240), vol. 89, Jan. 1985, p. 1-9. refs

A flow surveying technique is described which provides a direct and quick output of either flow speed or direction. The computer based system enables 'contour plots' of these quantities to be obtained for fixed offset distances from a surface, using a series of surface contacting cylindrical probes. Pre-set values of the signal from the flow sensing system are used to switch a tri-coloured light source which traverses in unison with the probe, while a time exposure photograph is taken. For flow direction measurement, the signal activating the lights is computed from the pressure difference between yaw meter tappings on the cylinder in conjunction with the cylinder base pressure. Flow velocity is obtained from the base pressure alone, or alternatively from a hot wire probe. Results are presented to show that the method can provide useful and detailed data. It is seen mainly as a complement to other methods available for visualizing complex flows. Author

A85-27717#
THE USE OF COUNTERGRAVITY CASTING FOR PRODUCING COMPRESSOR BODY CASTINGS OF AK-7 ALLOY [ZASTOSOWANIE METODY ODLEWANIA Z PRZECIWCISNIENIEM DO PRODUKCJI ODLEWOW KADLUBA SPREZARKI ZE STOPU AK-7]
W. PTASZEK, H. PIWOWAR, and M. BLOTNICKI Technika Lotnicza i Astronautyczna (ISSN 0040-1145), vol. 39, Jan. 1984, p. 26-28. In Polish.

A countergravity casting process for producing 220-mm-diameter 80-mm-long compressor body castings of AK-7 alloy weighing 2.8 kg is described. Schematic diagrams of the casting machine and the mold are presented, and the optimum process parameters are given. V.L.

A85-27719#
REDUCTION GEARS OF GAS-TURBINE ENGINES FOR AIRCRAFT AND HELICOPTERS [PRZEKLADNIE REDUKCYJNE TURBINOWYCH SILNIKOW SMIGLOWYCH I SMIGLOWCOWYCH]
S. SZCZECINSKI (Wojskowa Akademia Techniczna, Warsaw, Poland) Technika Lotnicza i Astronauticzna (ISSN 0040-1145), vol. 39, March 1984, p. 10-13. In Polish.

The principles governing the selection of propeller speeds and reduction gear ratios are discussed, as are the most commonly used designs and kinematic schemes of aircraft and helicopter reduction gears. The reduction gears of six currently used aircraft engines are examined to illustrate various types of reduction gear design. V.L.

A85-27841
ADVANCED SAR SYSTEM MAPS ARCTIC REGIONS
A. NICHOLS, J. WILHELM, T. GAFFIELD (Michigan, Environmental Research Institute, Ann Arbor, MI), R. INKSTER, and S. LEUNG (Intera Technologies, Ltd., Calgary, Alberta, Canada) Microwaves & RF (ISSN 0745-2993), vol. 24, March 1985, p. 80, 81, 82, 85.

The STAR-1 (Sea and Ice Terrain Assessment Radar) system has been designed to provide high-quality fine-resolution Synthetic Aperture Radar (SAR) imagery for ice and terrain-surveillance applications. Other requirements were related to the possibility of an installation in a small aircraft, a wide-swath mapping capability, and the ability to process data on board the aircraft in order to minimize postflight data accessing time. Since 1983, the STAR-1 has been installed aboard a twin-engine turboprop aircraft operating in the Beaufort Sea. Impressive data have been obtained for oil exploration support and for navigation in the considered areas. Attention is given to the SAR imaging system, the aircraft serving as the platform for the SAR system, real-time results, the X-band radar, and a number of images obtained. G.R.

A85-27889#
QUANTITATIVE EXPLOITATION OF TRACER VISUALIZATION OBTAINED IN THE HYDRODYNAMIC TUNNELS OF ONERA [EXPLOITATION QUANTITATIVE DES VISUALISATIONS PAR TRACEURS OBTENUES DANS LES TUNNELS HYDRODYNAMIQUES DE L'ONERA]
H. WERLE (ONERA, Chatillon-sous-Bagneux, Hauts-de-Seine, France) (Colloque National de Visualisation et de Traitement d'Images, Nancy, France, Jan. 15-17, 1985) ONERA, TP, no. 1985-10, 1985, 9 p. In French. refs
(ONERA, TP NO. 1985-10)

Several examples of flow visualization and data generated in low speed experiments in ONERA's hydrodynamic channels are presented. Photographs and data are provided of transverse visualization of turbulence, separations and wake flows using small air bubbles and dye tracers. The dye selected was always the same density as the water. The samples include a flow around the leading edge of an airfoil, a jet, a swept wing, helicopter rotor blades, and a sphere. M.S.K.

A85-27890#
APPLICATIONS OF A PHOTOMULTIPLIER TO VISUALIZATION OF AERODYNAMIC FLOWS BY LASER TOMOGRAPHY [APPLICATIONS DE L'AMPLIFICATION DE LUMINANCE A LA VISUALISATION DES ECOULEMENTS AERODYNAMIQUES PAR TOMOSCOPIE LASER]
M. PHILBERT and J. P. FALENI (ONERA, Chatillon-sous-Bagneux, Hauts-de-Seine, France) (Colloque National de Visualisation et de Traitement d'Images, Nancy, France, Jan. 15-17, 1985) ONERA, TP, no. 1985-11, 1985, 10 p. In French.
(ONERA, TP NO. 1985-11)

Attempts were made to use a microchannel photomultiplier tube in ONERA wind tunnels as a means to increase the luminosity and quicken the rate of high speed photography of turbulent flows. The trials covered turbulent flow separation over a delta wing and over a body of revolution equipped with winglets. Images were recorded electronically at 1000 frames/sec while the flows were illumined by a sheet of laser light and seeded with tracers. The photomultiplier tube to which the images were transferred by optic fibers had a resolution of 22 line pairs/mm with an output to optic fibers. A luminance gain of 1700 was achieved at 650 V on a phosphor screen. Since the laser beam was spread through a half-cylindrical prism, rotating the prism changed the transverse cut of the image and permitted synthesis of a tomographic image of the flow turbulence. The apparatus was also used to take time-lapse photographs of the flow. M.S.K.

A85-27908
SURFACE CHARACTERIZATION OF ANODIC OXIDES ON ALUMINUM ALLOYS BY MEANS OF SURFACE POTENTIAL DIFFERENCE, SURFACE IMPEDANCE AND SURFACE MORPHOLOGY
A. KWAKERNAAK, R. EXALTO, and H. A. VAN HOOF (Fokker, Shiphol, Netherlands) IN: Adhesive joints: Formation, characteristics, and testing . New York, Plenum Press, 1984, p. 103-119. refs

The shape and impedance properties of the anodized surfaces of aluminum aircraft parts were analyzed using three non-destructive testing techniques: transmission electron microscopy (TEM); surface potential difference (SPD) measurements; and surface impedance (Z) measurements. On the basis of the measurements, the effects of anodizing on the surface potential, impedance, and surface morphology of the samples are discussed. A refined impedance analysis is proposed, in order to describe the effects of variations in the anodizing process on the impedance characteristics of the surfaces. An electron micrograph is presented which describes the surface potential, impedance and characteristics of a CrO3 part surface following anodizing at 40 V. I.H.

A85-27980#
IMPORTANCE OF PHASE MEASUREMENTS IN MECHANICAL FAULT DIAGNOSIS OF ROTATING MACHINERY
A. K. REDDY (Naval Dockyard, Bombay, India) Institution of Engineers (India), Journal, Mechanical Engineering Division (ISSN 0020-3408), vol. 65, July 1984, p. 10-13.

The use of vibration phase detection for accurate diagnoses of malfunctions in automatically monitored machinery is examined. Phase is defined as the path difference between two vectors and in rotating machinery is measured in two places to detect in- or out-of-phase behavior in two vibrating parts of the machine. The signals are picked up by vibration transducers, which yield signals which are compared to those of, e.g., key phasers, EM sensors, photoelectric probes or a stroboscope. The methods can be implemented to detect static, force coupled and dynamic imbalances. Sample applications for monitoring a bent or bowed shaft, loose supports, resonance conditions, structural vibrations and a shaft orbit of journal bearings are described. M.S.K.

A85-28374
THE EFFECT OF QUALITY OF GAS JET MIXING IN THE MIXING CHAMBER OF A SUBSONIC JET PUMP ON THE DIFFUSER PERFORMANCE [WPLYW STOPNIA WYMIESZANIA STRUMIENI GAZU W KOMORZE MIESZANIA STRUMIENICY PODDZWIEKOWEJ NA WSKAZNIKI PRACY DYFUZORA]
A. GOLISZEK and D. WERSZKO (Wroclaw, Politechnika, Wroclaw, Poland) Instytut Maszyn Przeplywowych, Prace (ISSN 0079-3205), no. 87, 1984, p. 41-56. In Polish. refs

The mechanism of losses occurring during compression of a gas jet in the diffuser of a single-phase subsonic jet pump has been analyzed. Factors characterizing the diffuser performance and its losses were determined experimentally for various geometrical and aerodynamic parameters of the jet pump. Formulas relating the process of compression in the diffuser to the quality of mixing of air jets in the jet pump mixing chamber are given. It is shown that better mixing of the jets in the chamber makes the diffuser more efficient, which results in an increase of all factors characterizing its performance. Author

A85-28376
PROBLEMS OF CONTEMPORARY MECHANICS. PARTS 1 & 2 [PROBLEMY SOVREMENNOI MEKHANIKI. PARTS 1 & 2]
L. I. SEDOV, ED. Moscow, Izdatel'stvo Moskovskogo Universiteta, 1983, Pt. 1, 149 p.; pt. 2, 151 p. In Russian. For individual items see A85-28377 to A85-28396.

Papers are presented on such topics as the dynamics and structure of the universe; the formation of a laser-active medium in a gas flow behind nonstationary shock waves; separated flows arising in supersonic and hypersonic flows past blunt bodies; variational problems of gas dynamics; and the use of a three-parameter model to study transition to turbulence in a boundary layer in the presence of high-intensity external disturbances. Consideration is also given to: radiative heat transfer and vaporization of a frontal surface in hypersonic flow; optimal aerodynamic configurations in swirling hypersonic flow; steady MHD flow past a nonconducting wedge; convective combustion of porous powder systems; the aerodynamic characteristics of delta planes; and equations of creep theory. B.J.

A85-28473
FLUID MOTION IN THE REGIONS OF ABRUPT EXPANSION OF THE CHANNELS OF ROTOR-COOLING SYSTEMS OF ENERGY-CONVERTING MACHINES [O DVIZHENII ZHIDKOSTI V OBLASTI VNEZAPNOGO RASSHIRENIIA KANALOV SISTEM OKHLAZHDENIIA ROTOROV ENERGETICHESKIKH MASHIN]
A. V. KUZMINSKII and E. M. SMIRNOV (Leningradskii Politekhnicheskii Institut, Leningrad, USSR) Energetika (ISSN 0579-2983), Feb. 1985, p. 83-86. In Russian. refs

A85-28479
PERMANENT FASTENERS FOR LIGHT-WEIGHT STRUCTURES
K. HOFFER Duesseldorf, West Germany, Aluminium-Verlag GmbH, 1984, 224 p.

A comprehensive inventory is presented of the mechanical fastening systems most frequently used in current aerospace lightweight structures, on the basis of specifications provided by system suppliers and aircraft manufacturers. The most frequently used joining method in aircraft construction is the solid aluminum rivet, which is primarily applicable to high strength aluminum alloy structures. Blind rivets of aluminum, Monel alloy or steel are used in inaccessible locations, although these have lower static and dynamic strengths than solid rivets. Special fasteners of steel, titanium, and high strength aluminum alloys are employed where high shear loads must be transmitted, or in heavy wall thickness structures. O.C.

A85-28609
FIXED STEP FRICTION MODEL
D. D. GIRARD (Raytheon Co., Missile Systems Div., Bedford, MA) IN: Summer Computer Simulation Conference, 15th, Vancouver, Canada, July 11-13, 1983, Proceedings. Volume 1 . La Jolla, CA, Society for Computer Simulation, 1983, p. 302-308.

The digital simulation of friction presents certain problems. A frequently used friction model involves a high clipped gain feeding back around the rate integrator. It is pointed out that this model, in addition to demanding small integration steps, can handle only problems where break-away and sliding friction are equal. The use of inaccurate models may be acceptable in systems in which friction has only a minor impact on performance. But in other systems, as, for instance, in the case of friction in the gimbal bearings of a high performance missile employing an electrically driven seeker head, a more accurate model is needed. The present investigation is concerned with a model, referred to as a Fixed Step model. The considered model is described and a friction logic flow diagram is presented. Attention is given to a moving block problem, a missile intercept problem, and an evaluation of the friction model. G.R.

A85-28792
THE BEHAVIOR OF TURBOCOMPRESSORS AND TURBOCOMPRESSOR INSTALLATIONS DURING THE PUMPING OF THE COMPRESSOR [ZUM VERHALTEN VON TURBOVERDICHTERN UND TURBOVERDICHTERANLAGEN WAEHREND DES PUMPENS DES VERDICHTERS]
K.-H. ROHNE Stuttgart, Universitaet, Fakultaet fuer Energietechnik, Dr.-Ing. Dissertation, 1984, 135 p. In German. refs

The present investigation is concerned with the transient operational behavior of a compressor system during pumping, taking into account experiments conducted with a standard radial compressor. Dynamic measurements of pumping oscillations were conducted for various piping systems and a number of rotational speeds. Three theoretical computational models with different characteristics were analyzed and employed in calculations of the pumping behavior. The computational results showed satisfactory agreement with the measured data. It is found that the transient characteristics of a compressor system can be calculated sufficiently accurately and without excessive computational effort by making use of an appropriate model. The change of the relative flow Mach number at the compressor inlet during pumping represents one of the most important parameters. A pumping cycle is essentially determined by the compressor characteristic and the magnitude of the volume of the system which is effective as storage space. G.R.

A85-28796#
NUMERICAL DETERMINATION OF DETACHED INTERNAL FLOW WITH THE EXAMPLE OF A RADIAL COMPRESSION TUNNEL [NUMERISCHE BERECHNUNG ABGELOESTER INNENSTROEMUNG AM BEISPIEL EINES RADIALVERDICHTERKANALS]
H. BECKER Stuttgart, Universitaet, Fakultaet fuer Energietechnik, Dr.-Ing. Dissertation, 1984, 214 p. In German. refs

The frictional, quasi-three-dimensional, stationary steady flow in a return tunnel is calculated by a numerical differential procedure based on Navier-Stokes and laminar and turbulent Reynolds equations. The tunnel boundary is taken to be of arbitrary shape: both curved walls and discontinuously broadened cross-sections are permitted. This calculative method forms the basis for a streamline-eddy procedure which is solved using the method of successive relaxations. The turbulence is evaluated with the help of the k-epsilon model. Various forms of secondary flow for irregular increases in the cross-section and return tunnel are considered. The results are compared with measurements from other authors and with turbulence measurements made during velocity fluctuations. C.D.

A85-28798
DETERMINATION OF LIQUID-FUEL PREVAPORIZATION AND PREMIXING IN GAS-TURBINE COMBUSTION CHAMBERS [EIN BEITRAG ZUR BESTIMMUNG DER VORVERDUNSTUNG UND VORMISCHUNG VON FLUESSIGEM BRENNSTOFF IN GASTURBINENBRENNKAMMERN]
J. MRUGALLA Bochum, Ruhr-Universitaet, Abteilung fuer Maschinenbau, Dr.-Ing. Dissertation, 1983, 173 p. In German. refs

A semiempirical mathematical model of the evaporation and distribution of liquid fuel in the prevaporization-premixing zone of a stationary gas turbine is developed, and the predictions obtained are compared with published experimental data and with the results of photographic, suction-probe, two-focus-laser-velocimeter, and light-scattering measurements on water sprays from 65-deg hollow-cone nozzles in a wind tunnel operating at 64 m/s. Good agreement is obtained, and the applicability of the model to the design of turbine combustion chambers giving lower NO(x) and CO emissions is indicated. T.K.

A85-28801
ITSC '83; PROCEEDINGS OF THE TENTH INTERNATIONAL THERMAL SPRAYING CONFERENCE, ESSEN, WEST GERMANY, MAY 2-6, 1983
Conference sponsored by the International Institute of Welding. Duesseldorf, West Germany, Deutscher Verlag fuer Schweisstechnik GmbH (DVS-Berichte. Volume 80), 1983, 283 p. In English and French. No individual items are abstracted in this volume.

Papers presented at the 10th International Thermal Spraying Conference are assembled. Among the topics discussed are: finishing processes and alternative coating materials; quality control and the safety aspects of thermal coatings; and basic and applied research concerned with coatings and processes. Consideration is also given to: thermal barrier coatings for gas turbine components; flame sprayed surfaces for corrosion protection of offshore structures; and low-pressure plasma spraying. Some additional topics include: fire barrier coatings for protection of aluminum surfaces; the development of arc-sprayed composite coatings for use in the 0-600 C temperature range; and the characterization of plasma-sprayed Y2O3-stabilized zirconia. I.H.

A85-28828
DEVELOPMENT OF A MICROPROCESSOR-CONTROLLED LASER SYSTEM FOR AUTOMATED PRECISION BALANCING
W. BESSLER and M. MARTIN (Mechanical Technology, Inc., Latham, NY) IN: Lasers '83; Proceedings of the International Conference, San Francisco, CA, December 12-16, 1983 . McLean, VA, STS Press, 1985, p. 45-49.

This paper describes the development and capabilities of a fully automated, microprocessor-controlled laser system for the

precision multiplane balancing of both rigid and flexible spinning rotors. The system computes all balance plane corrections simultaneously and then, under microprocessor supervision, uses a pulsed laser to precisely remove material as the part rotates. The operator and the user-friendly microprocessor software interact through a video screen and key pad. A closed-loop feedback logic that uses vibration sensors to automatically update laser commands is used to assure that residual imbalance is kept within operator-specified limits. Advantages of this approach over the conventional method of material removal (drilling or grinding) include increased precision and productivity and the elimination of rejected workpieces resulting from human error. The system is designed for retrofit to existing balance machines and for use with any type of laser, allowing an optimum selection for cost-effective material removal and balancing results. Author

A85-28900
ADVANCED RESEARCH INSTRUMENTATION FOR AIRCRAFT TURBOMACHINERY
W. H. ATKINSON, W. G. ALWANG, J. H. ELWOOD, H. P. GRANT, and M. C. WILLIAMS (United Technologies Corp., Pratt and Whitney Group, East Hartford, CT) Society of Automotive Engineers, Aerospace Congress and Exposition, Long Beach, CA, Oct. 15-18, 1984. 13 p. refs
(SAE PAPER 841502)

The preliminary results of a NASA-sponsored program to develop instrumentation for measurement of heat flux and metal temperature in aircraft turbomachinery are presented. Among the systems discussed are: a thin-film thermocouple system for engine component testing at temperatures of up to 2000 F; heat flux sensors for measurement under actual environmental conditions in combustor liners, turbine vanes and blades; and a Laser Doppler Velocimetry (LDV) system to provide detailed intrablade velocity mappings between airfoils and blade wakes. A series of cross-sectional drawings and wiring diagrams of the different devices is provided. I.H.

A85-29056
THE MOTION OF A SPHERICAL PARTICLE SUSPENDED IN A TURBULENT FLOW NEAR A PLANE WALL
M. A. RIZK and S. E. ELGHOBASHI (California, University, Irvine, CA) Physics of Fluids (ISSN 0031-9171), vol. 28, March 1985, p. 806-817. refs

Analytical solution of the equations of motion of a spherical particle suspended in a turbulent flow near a plane wall has been obtained. The equations include the lift force and wall effects on the drag force. The solution shows that the particle turbulent motion is affected by the wall presence in the following manner: (1) The wall augments the response of the particle to fluid turbulence. The ratio between the particle rms velocity fluctuation near the wall and that of an identical particle in an unbounded flow is always greater than unity. This ratio increases by increasing the particle density and diameter and decreasing the particle distance from the wall. (2) Wall effects in a direction normal to it are more pronounced than those in the parallel direction. This is attributed mainly to the lift force acting in the normal direction. (3) Effects of the drag force on particle intensity are confined close to the wall whereas the lift effects extend to larger distances. Author

A85-29091*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
STABILITY EXPERIMENTS IN THE FLOW OVER A ROTATING DISK
S. P. WILKINSON (NASA, Langley Research Center, High-Speed Aerodynamics Div., Hampton, VA) and M. R. MALIK (High Technology Corp., Hampton, VA) AIAA Journal (ISSN 0001-1452), vol. 23, April 1985, p. 588-595. Previously cited in issue 17, p. 2503, Accession no. A83-37232. refs
(Contract NAS1-16916)

A85-29092#
TRANSVERSE JET BREAKUP AND ATOMIZATION WITH RAPID VAPORIZATION ALONG THE TRAJECTORY
J. A. SCHETZ, M. SITU (Virginia Polytechnic Institute and State University, Blacksburg, VA), and P. W. HEWITT (Atlantic Research Corp., Alexandria, VA) AIAA Journal (ISSN 0001-1452), vol. 23, April 1985, p. 596-603. USAF-supported research. refs

Experiments for transverse injection of chilled Freon-12 into the Virginia Tech 23 x 23 cm blowdown wind tunnel were run at a freestream Mach number of 0.44 and freestream stagnation pressure and temperature of 2.5 atm and 298 K, respectively. The spray plume was documented with photographs and droplet measurements. The results showed a clear picture of the mechanisms of jet decomposition in the presence of rapid vaporization. Immediately after injection, a vapor cloud was formed in the jet plume, which then dissipated downsteam leaving droplets on the order of 8-10 microns in diameter. This represented a substantial reduction compared to baseline tests run at the same conditions with water, which had little vaporization. A simulation approach to studying hot-flow subsonic cross-stream fuel-injection problems in a less complex and costly cold-flow facility is proposed. The simulation parameters were developed and refined with the aid of a numerical solution for the simpler case of a rapidly evaporating laminar jet in a coaxial airstream. The experimental case was transformed (through two new similarity parameters involving injection and freestream properties) to a simulated case of a typical ramjet-combustion-chamber fuel-injection problem where ambient-temperature fuel (kerosene) is injected into a hot airstream. Author

A85-29140#
BOUNDARY LAYER FLOW OVER LONG CYLINDERS WITH SUCTION
B. BAR-HAIM and D. WEIHS (Technion - Israel Institute of Technology, Haifa, Israel) ASME, Transactions, Journal of Applied Mechanics (ISSN 0021-8936), vol. 52, March 1985, p. 203-207. refs

The possibility of using wall suction to reduce the drag in a flow over a semiinfinite cylinder is explored by means of an analytical approximation. The solution involves successive differentiation of the known Iglisch (1949) wall compatibility condition. The solution is applied to a zero-suction condition, exibiting good agreement with available sophisticated techniques. An optimal suction profile is found as a function of free-stream conditions and cylindrical fineness ratio. The analysis reveals that by withdrawing relatively small amounts of fluid from the boundary layer the flow can be kept laminar at high Reynolds numbers, resulting in considerable decreases in drag, with potential applications to aircraft fuselages and underwater vehicles. L.T.

A85-29142#
DESIGN OF AN ADHESIVE LAP JOINT
P. CZARNOCKI (Waterloo, University, Waterloo, Ontario, Canada) and K. PIEKARSKI ASME, Transactions, Journal of Applied Mechanics (ISSN 0021-8936), vol. 52, March 1985, p. 228, 229.

Shear stress distribution in an adhesive lap joint is calculated, for a joint in which the load on the laps is transferred through the adhesive layers to a semiinfinite plane. It is shown that the highest values of shear stress occur at the corners of the joint and along the edges, with the shear strain reversing its sign close to the free edge of the membrane. It is suggested that to improve the distribution of stress the lap should be shorter in the direction of the applied load and longer in the transverse direction; to reduce the stress concentration at the corners an elliptical shape of the joint is proposed. L.T.

A85-29147#
NATURAL MODE ANALYSIS OF N BLADES DISC COUPLED SYSTEM - MODAL SYNTHESIS OF SYMMETRIC STRUCTURE WITH CNV GROUP
Z. JIN (Beijing Aviation Institute, Beijing, People's Republic of China), W.-J. WANG (Fudan University, Shanghai, People's Republic of China), and X.-J. CHEN (Shanghai Changzheng Machinery Plant Shanghai, People's Republic of China) Acta Mechanica Solida Sinica, Dec. 1984, p. 469-481. In Chinese, with abstract in English. refs

Modal synthesis technique is combined with representative finite group theory in a proposed method for calculating the dominant and subdominant modes of a coupled system of symmetrically bladed disks with Cnv group. The superparametric annular element with two nodes and 12 degrees of freedom and the superparametric thick shell element with eight nodes and 40 degrees of freedom are used for the disk and blade discrete models respectively. Such finite element discrete models can also be employed in various bladed disk systems. Good agreement is obtained between numerical results and experimental data, showing that the present method is economical in computation and reliable in use. C.D.

A85-29251#
THE EFFECT OF ACOUSTIC/THERMAL ENVIRONMENTS ON ADVANCED COMPOSITE FUSELAGE PANELS
J. SOOVERE (Lockheed-California Co., Burbank, CA) (Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 2, p. 466-472) Journal of Aircraft (ISSN 0021-8669), vol. 22, April 1985, p. 257-263. Previously cited in issue 12, p. 1744, Accession no. A83-29857. refs

A85-29561
DESIGN REFINEMENTS IN MULTI-COMPONENT STRAIN GAGE BALANCES
H. B. EDWARDS (Howard B. Edwards Mechanical Design and Instrumentation, Hampton, VA) IN: International Instrumentation Symposium, 29th, Albuquerque, NM, May 2-6, 1983, Proceedings . Research Triangle Park, NC, Instrument Society of America, 1983, p. 227-235.

Because of increasingly severe conditions in wind tunnel testing, i.e., heavy loads on small models, high lift-to-drag ratios and cryogenic environment, three problems still plague strain gage balances: interactions, joints, and temperature gradients. Although interactions can be corrected by calibration and computing, they can be reduced by eliminating unsymmetrical cross section changes in the balance and by proper location of gages. While joints in balances can be eliminated by electrical discharge machining, the joints from model to balance, and balance to support, can be improved by isolating balance elements from fasteners and by use of orthogonal flat surfaces, requiring no dowels. Balances are routinely compensated for uniform temperatures, but temperature gradients must be compensated for by proper location of active and compensating gages. Author

A85-29568* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
PRESSURE MEASUREMENT SYSTEM FOR THE NATIONAL TRANSONIC FACILITY
M. MITCHELL (NASA, Langley Research Center, Hampton, VA) IN: International Instrumentation Symposium, 29th, Albuquerque, NM, May 2-6, 1983, Proceedings . Research Triangle Park, NC, Instrument Society of America, 1983, p. 369-381. refs

The electronically scanned pressure (ESP) measurement system concept was selected for application at the Langley Research Center's National Transonic Facility. This pressure measurement application required a complex system design to meet the pressure resolution, range, and accuracy requirements over this facility's wide operating pressure and temperature range of 1.38 x 10 to the 5th to 9.3 x 10 to the 5th N/sq m and 80 to 340 K, respectively. The design uses five ESP systems to measure the nearly 1000 channels of pressure located throughout the facility circuit. Pressure modules mounted inside the facility were housed in specially designed thermal enclosures, while the modules mounted outside the tunnel were mounted in pressure vessels. The unique features of this pressure measurement system design including a special ESP module pressure calibration unit are presented. Author

A85-29919
STRUCTURE AND CHARACTERISTICS OF TURBULENT SEPARATED FLOW IN A CAVITY [STRUKTURA I KHARAKTERISTIKI TURBULENTNOGO OTRYVNOGO TECHENIIA V POLOSTI]
I. M. VARFOLOMEEV, G. A. GLEBOV, IU. F. GORTYSHOV, A. N. SHCHELKOV, and R. A. IAUSHEV (Kazanskii Aviatsionnyi Institut, Kazan, USSR) Inzhenerno-Fizicheskii Zhurnal (ISSN 0021-0285), vol. 48, March 1985, p. 387-391. In Russian. refs

Flow characteristics in the separation region formed by a rectangular cavity are investigated experimentally for an external flow velocity of 29 m/s and Re = 290,000. The relative thickness of the boundary layer before the separation point is 0.08; the relative depths of the cavity, H/L, are 0.5 and 1.0 (for L = 150 mm). The mean velocity profiles are determined, and the turbulent structures in the mixing layer and in the wall boundary layer are identified. It is shown that the boundary layer velocity distribution deviates considerably from the universal logarithmic law. V.L.

A85-29938#
DEVELOPMENT OF ACOUSTIC EMISSION TECHNIQUES FOR QUANTITATIVE USE ON AEROSPACE C.F.R.P. STRUCTURES
G. S. WHALLEY (British Aerospace, PLC, Warton Div., Preston, Lancs., England) and P. T. COLE (Dunegan-Endevco, Royston, Yorks., England) IN: International Symposium on Acoustic Emission from Reinforced Plastics, 1st, San Francisco, CA, July 19-21, 1983, Proceedings . New York, Society of the Plastics Industry, Inc., 1983, 7 p.

Static testing is conducted for a carbon fiber-reinforced wing structure in order to assess the usefulness of acoustic emission methods. Attenuation checks were conducted at 10 and 30 cm radii from central points using three different filters, with a maximum distance between transducers of 65 cm. This is calculated to yield a system threshold of 30 dB. Composite attenuation plot graphs are presented. O.C.

A85-29967
MODELLING TURBULENT RECIRCULATING FLOWS IN COMPLEX GEOMETRIES
G. D. TONG (Computational Fluid Mechanics International Pty., Ltd.; South Australian Institute of Technology, The Levels, Australia) IN: Computational techniques and applications: CTAC-83; Proceedings of the International Conference, Sydney, Australia, August 28-31, 1983 . Amsterdam, North-Holland, 1984, p. 653-668. Research supported by the Hydraulics Research Station and University College of Swansea. refs

The essential features of modeling turbulent flows containing zones of recirculation are discussed. First, the requirement to adequately represent momentum transfer through a shear layer from a main-stream inducing flow to a recirculating (closed streamline) zone. The k-epsilon model is introduced as a minimum global length scale model for this complex flow type in which there is flow separation, a dominant internal shear layer, reattachment and redevelopment. The finite element method is then introduced as an appropriate numerical method with utilization of the natural boundary condition arising from the integral formulation and the potential to control artificial mixing (numerical diffusive and dispersive effects) by local grid refinement. Author

A85-29968
VIBRATION ANALYSIS OF A ROTATING BLADE USING DYNAMIC DISCRETIZATION
C. NORWOOD (Footscray Institute of Technology, Footscray, Victoria, Australia) IN: Computational techniques and applications: CTAC-83; Proceedings of the International Conference, Sydney, Australia, August 28-31, 1983 . Amsterdam, North-Holland, 1984, p. 795-802.

An analysis of the frequencies and modes of vibration of a rotating blade using dynamic discretization is presented. The method involves the discretization of the stiffness and mass properties of blade segments and the solution of the ensuing eigenvalue problem. Author

A85-29974
INTRODUCTION TO AEROSPACE STRUCTURAL ANALYSIS
D. H. ALLEN and W. E. HAISLER (Texas A&M University, College Station, TX) New York, John Wiley and Sons, 1985, 518 p. refs

Aerospace structures are defined as those whose usefulness significantly diminishes with increasing weight; among them may be counted not only aircraft and spacecraft structures, but those of bicycles, ships, and increasingly, those of automobiles. Safety factors are critical in the design of such minimum weight structures. Attention is given, in this comprehensive treatment of the subject for undergraduate students, to fundamental concepts of kinetics, stress, the uniaxial thermomechanical constitution of solids, the multiaxial constitution of elastic and thermoelastic solids, bending and shear in beams, torsion in thin walled closed sections, work and energy principles, the deformation and force analysis of aerospace structures, and finite element stiffness methods. O.C.

A85-30218* Stanford Univ., Calif.
FINITE ELEMENT METHODS FOR FIRST-ORDER HYPERBOLIC SYSTEMS WITH PARTICULAR EMPHASIS ON THE COMPRESSIBLE EULER EQUATIONS
T. J. R. HUGHES (Stanford University, Stanford, CA) and T. E. TEZDUYAR (Houston, University, Houston, TX) Computer Methods in Applied Mechanics and Engineering (ISSN 0045-7825), vol. 45, Sept. 1984, p. 218-284. refs
(Contract NCA2-OR-745-104; N00014-82-K-0335)

A Petrov-Galerkin finite element formulation is presented for first-order hyperbolic systems of conservation laws with particular emphasis on the compressible Euler equations. Applications of the methodology are made to one- and two-dimensional steady and unsteady flows with shocks. Results obtained suggest the potential of the type of methods developed. Author

N85-20177# Joint Publications Research Service, Arlington, Va.
MBB USES SUPERPLASTIC FORMING, DIFFUSION BONDING FOR ALLOYS
In its West Europe Rept. Sci. and Technol. (JPRS-WST-85-008) p 5-6 19 Feb. 1985 Transl. into ENGLISH from Franfurter Zeitung/Blick Durch die Wirtsch. (Frankfurt/Main), 3 Dec. 1984 p 7
Avail: NTIS HC A07/MF A01

The need for the greatest economy possible when operating airplanes requires, among other things, a low structural weight and low manufacturing costs. Superplastic forming and diffusion bonding are considered to be an extremely effective technology or lowering production costs drastically. Both procedures are discussed. B.G.

N85-20189# Joint Publications Research Service, Arlington, Va.
CHINA REPORT: SCIENCE AND TECHNOLOGY
18 Sep. 1984 36 p Transl. into ENGLISH from various Chinese articles
(JPRS-CST-84-026) Avail: NTIS HC A03/MF A01

Applications of remote sensing in China, advances in computational fluid dynamics and research in radiation protection are discussed. Heat transfer in hypersonic flow is also examined.

N85-20192# Joint Publications Research Service, Arlington, Va.
A MIXED FINITE DIFFERENCE ANALYSIS OF THE INTERNAL AND EXTERNAL TRANSONIC FLOW FIELDS OF INLETS WITH CENTERBODY Abstract Only
S. LUO, H. SHEN, M. JI, Z. XING, S. DONG, and A. HAN *In its* China Rept.: Sci. and Technol. (JPRS-CST-84-026) p 23 18 Sep. 1984 Transl. into ENGLISH from Kongqidonglixue Xuebao (Mianyang, China), no. 2, 1984 p 25-34
Avail: NTIS HC A03/MF A01

A mixed finite difference method for calculating the external and internal flow field around inlet with centerbody is presented. First, calculation by mixed finite difference method of the velocity potential equation with small disturbance in the transverse direction using Cartesian mesh, irrotational schemes, and exact body surface boundary conditions is carried out to obtain a basic field solution including the shape and location of the shock and the sonic line. Then, the full potential equation is used to improve the accuracy of the computed value of field variables. The use of multi-layer line relaxations along the radial lines is effective for inlet with centerbody, and in this case, more relaxation sweeps are carried out (with smaller relaxation factor) inside the inlet than outside. Computations were made for axisymmetric inlet with different freestream Mach numbers M (infinity) = 1.04 to approximately 1.27. Computation results show that the method is promising. Author

N85-20204# Joint Publications Research Service, Arlington, Va.
NEW AIR SUPPLY-PRIME MOVER FACILITY FOR ENGINE TESTS DETAILED
In its China Rept.: Sci. and Technol. (JPRS-CST-84-032) p 9-15 22 Oct. 1984 Transl. into ENGLISH from Guoji Hankong (Peking), no. 7, Jul. 1984 p 30-32
Avail: NTIS HC A03/MF A01

The development of new engines and the verification of technical specifications of engine parts require conducting experimental research conditions in order to determine their performance and mechanical reliability. Air supply and prime mover facilities are pre-requisites for performing tests on engines and engine parts. Air Supply facility provides the required air flow for the test equipment used in aerodynamic, combustion, blade screen, heat transfer and turbine tests; prime mover facility provides the drive power for testing compressors and transmission systems. The capability of the air supply and prime mover facility will determine the range of parameters and the scope of the tests. The facility imported is primarily used by universities and colleges for research and instruction; therefore, the main requirements of this facility are advanced technical design and versatility. In the following, the main features of the components and the overall system of this imported facility are introduced. Author

N85-20205# Joint Publications Research Service, Arlington, Va.
BIOMECHANICS FINDS PRACTICAL APPLICATIONS IN AEROSPACE RESEARCH
X. YANGHE *In its* China Rept.: Sci. and Technol. (JPRS-CST-84-032) p 16-21 22 Oct. 1984 Transl. into ENGLISH from Hangkong Zhishi (Peking), no. 8, Aug. 1984 p 2-3
Avail: NTIS HC A03/MF A01

Biomechanics is a branch of science which studies the mechanical properties of biological parts using the basic principles of mechanics and engineering. Formulas and quantitative calculations are used to analyze and understand physiological phenomena. Problems caused by weightlessness, coronary heart disease, blood circulation, use of medication, and application of biomechanics in aviation rescue are discussed. B.G.

N85-20206# Joint Publications Research Service, Arlington, Va.
CHINA REPORT: SCIENCE AND TECHNOLOGY
3 Dec. 1984 156 p refs Transl. into ENGLISH from various Chinese articles
(JPRS-CST-84-039) Avail: NTIS HC A08/MF A01

The research and development in science and technology in China is reported. The Star Wars space program is reported in the Chinese press. A thermionic converter for a space reactor is

described as is the development of a super large circuit. A routing algorithm for distributed computer network was developed and research in environment biology is reviewed. The radioactive dose on China's population is assessed and a report on China's first lung cancer research center is studied. Transonic and subsonic flow past an oscillating wing and an flexible wing is discussed under the heading aerodynamic along with other developments.

N85-20226*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
IMPROVED LEGISLATED EMERGENCY LOCATING TRANSMITTERS AND EMERGENCY POSITION INDICATING RADIO BEACONS Patent Application
W. R. WADE, inventor (to NASA) (Proteon Associates, Inc.) 28 Sep. 1984 23 p Sponsored by NASA
(NASA-CASE-GSC-12892-1; NAS 1.71:GSC-12892-1; US-PATENT-APPL-SN-655606) Avail: NTIS HC A02/MF A01 CSCL 17B

An emergency locating transmitting (ELT) system is disclosed which comprises a legislated ELT modified with an interface unit and connected by a multiwire cable to a remote control monitor (RCM), typically located at the pilot position. The RMC can remotely test the ELT by disabling the legislated swept tone and allowing transmission of a single tone, turn the ELT on for legislated ELT transmission, and reset the ELT to an armed condition. The RCM also provides visual and audio indications of transmitter operating condition as well as ELT battery condition. Removing the RCM or shorting or opening the interface input connections are not to affect traditional ELT operation. NASA

N85-20227# Dikewood Corp., Albuquerque, N. Mex.
SHIELDED ENCLOSURES FOR EXPERIMENTAL STUDIES OF SHIELDING TOPOLOGY Final Report, Jun. 1982 - Nov. 1983
F. C. YANG, K. S. H. LEE, S. A. KOKOROWSKI, C. E. BAUM, J. HAMM, W. GRAF, and E. F. VANCE Kirtland AFB, N. Mex. AFWL Nov. 1984 98 p
(Contract F29601-82-C-0027)
(AD-A149292; DC-FR-1026.610-1B; AFWL-TR-84-11) Avail: NTIS HC A05/MF A01 CSCL 20N

The report discusses the effort to provide shielded enclosures for EMP experimental studies of shielding topology. Section 1 discusses the theoretical modeling for which scattering matrices of subshields and their norms are used to relate the internal signals to the electromagnetic source environment. Both the line and aperture penetrations are included in the scattering matrix formulation. Experimental and analytical methods are proposed for estimating parameters of the scattering matrices. It is pointed out in the discussion that these methods can, in turn, be employed to analyze the overall shielding performance and to synthesize the subshield requirements of a system. The discussion in Section 1 includes an illustrative example. Section 2 describes experiments to characterize and quantify the shielding performance of a rectangular metal enclosure containing various line and aperture penetrations. Experimental techniques and procedures are given for obtaining certain parameters involved in the theoretical model for bounding the shielding performance of an enclosure. Techniques for evaluation of the accuracy of the theoretical calculation and its comparison to measured data are also discussed. Section 3 describes specifications that were developed to construct two shielded enclosures, one with a single layer topology and one with a double layer topology. Details are given on the mechanical design of the two enclosures, and on the design of various replaceable panels that can be used to test the accuracy of the theoretical model. Section 4 describes the experimental results of the shielding performance of the two enclosures constructed by SRI International. GRA

N85-20241# National Telecommunications and Information Administration, Annapolis, Md.
SPECTRUM RESOURCE ASSESSMENT OF THE AERONAUTICAL MOBILE SERVICE BETWEEN 400 MHZ AND 17.7 GHZ
F. MATOS Sep. 1984 98 p refs
(PB85-125995; NTIA/REPT-84/162) Avail: NTIS HC A05/MF A01 CSCL 17B

A spectrum resource assessment of the aeronautical mobile service between 400 MHz and 17.7 GHz is presented which addresses the long-range planning of this service. An assessment is given of 15 federal government frequency bands that are allocated to the mobile or aeronautical mobile services. Information is included on allocations, technical standards, frequency assignments, and system characteristics. The future growth possibilities of the aeronautical mobile service in the various bands is presented. The 4400 to 4900 MHz band was analyzed in detail to determine the sharing possibilities between the fixed service (point-to-point microwave and troposcatter communications systems) and aeronautical systems. Evidence suggests that sharing between such systems and aeronautical systems is feasible.
Author (GRA)

N85-20252# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ACTA ELECTRONICA SINICA (SELECTED ARTICLES)
Z. YOUWEI, Z. GUCHUAN, and F. JI-CHANG 7 Nov. 1984 33 p Transl. into ENGLISH from Dianzi Xuebao (China), v. 11, no. 6, Nov. 1983 p 47-55, 57-63
(AD-A148829; FTD-ID(RS)T-1227-84) Avail: NTIS HC A03/MF A01 CSCL 12A

The theory and simulation results of employing a Kalman filter in an airborne fire control radar tracking system was studied. Problems such as target dynamics modeling, linear filtering and simulation, linear filtering approximation, sensitivity simulation, maneuvering target tracking and adaptivity were considered. A modified Kalman filter for tracking a maneuvering target was presented. It detects a target maneuver by judging whether there is a bias in the observation residue. This estimate was used to correct the state prediction and error covariance. It worked as a single Kalman filter with its maneuver acceleration command at zero. A better compromise between the steady state filtering accuracy and fast response to maneuver was reached. Computer simulation results show that the accuracy of the filter is slightly superior to that of a complicated filter bank. G.L.C.

N85-20295* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
MINIATURE ELECTROOPTICAL AIR FLOW SENSOR Patent
D. D. KERSHNER, inventor (to NASA) 4 Dec. 1984 10 p Filed 14 Apr. 1983 Supersedes N83-25539 (21 - 14, p 2320)
(NASA-CASE-LAR-13065-1; NAS 1.71:LAR-13065-1; US-PATENT-4,485,671; US-PATENT-APPL-SN-484745; US-PATENT-CLASS-73-187) Avail: US Patent and Trademark Office CSCL 14B

A sensor for measuring flow direction and airspeed that is suitable, because of its small size, for rapid instrumentation of research airplanes is described. A propeller driven sphere rotating at a speed proportional to airspeed presents a reflective target to an electro-optical system such that the duty cycle of the resulting electrical output is proportional to yaw angle and the frequency is proportional to airspeed. R.J.F.

N85-20353*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
TECHNOLOGY AND TEST
P. SIEMERS *In* NASA. Marshall Space Flight Center Appl. of Tethers in Space, Vol. 1 5 p Mar. 1985
Avail: NTIS HC A13/MF A01 CSCL 13I

The status of tether-related technology is discussed together with the program that should be initiated to develop the technology required by the tethered satellite system. Successful tethering during the Gemini program is mentioned. Technology areas which

appear to have application to tethered systems are identified, including electrodynamics, atmospherics, and aerothermodynamics. R.S.F.

N85-20370*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
REPORT OF THE TECHNOLOGY AND TEST PANEL
P. SIEMERS, S. GRAFF (JPL, California Inst. of Tech., Pasadena), H. COMPTON, R. J. DUCKETT, C. BUONJIOLNO (CNR, Italy), G. WOOD, D. R. TENNEY, D. D. LANG (NASA. Johnson Space Center), K. SUTTON (Analytical Mechanics Associates), P. FLANAGAN et al. *In* NASA. Marshall Space Flight Center Appl. of Tethers in Space, Vol. 2 27 p Mar. 1985
Avail: NTIS HC A14/MF A01 CSCL 13I

The state of technology relative to the Tethered Satellite System (TSS) was reviewed. The technology areas which could benefit from the TSS were defined. To support TSS design studies it is necessary to develop tether dynamic model computer codes for definition of mission and tether requirements. Present major codes are very elaborate, expensive to run, and not very user friendly. An additional technology concern was related to the manufacturing of tethers. The development of complex tethers (nonconducting-taper/double taper long 100 km, conducting-embedded conduction, fiber optics, and superconducting) and their applications to space stations requires the development of manufacturing capabilities for both Earth-based as well as space-based systems. B.G.

N85-20382# Argonne National Lab., Ill. Energy and Environmental Systems Div.
INTRODUCING ENGINE INNOVATIONS: AN EXAMINATION OF FUTURE MARKETS FOR BRAYTON AND STIRLING AUTOMOTIVE ENGINES
D. J. SANTINI Aug. 1984 40 p refs Presented at the 64th Ann. Transportation Res. Board Meeting, Washington, D.C., 21 Jan. 1985
(Contract W-31-109-ENG-38)
(DE84-016319; CONF-850115-1) Avail: NTIS HC A03/MF A01

A general and particular view of the process of engine innovation was examined. It was suggested that careful corporate and national preparation for automotive innovation is necessary. To that end, advanced (year 2000) engine and vehicle characteristics from the Technology Assessment of Productive Conservation in Urban Transport were used to estimate that the Stirling and Brayton engines are likely to have very specific and different markets. Driving cycle behavior of the engines in an urban and suburban setting was examined to show that the Stirling's most likely market will be as a specialized urban vehicle, while the Brayton's best market will be as a specialized surburban and inter-city vehicle. It was argued that neither engine has the properties necessary to become a universal replacement for all purpose vehicles using advanced Otto-cycle and diesel engines, but that proper use of these vehicles could ultimately help efficiently mitigate national problems of urban air pollution (the Stirling) and/or excessive fuel consumption. DOE

N85-20398*# National Academy of Sciences - National Research Council, Washington, D. C. National Materials Advisory Board.
ASSURING STRUCTURAL INTEGRITY IN ARMY SYSTEMS Final Report, 1 Apr. 1983 - 31 Dec. 1984
National Academy Press 28 Feb. 1985 72 p refs Sponsored in part by NASA
(Contract MDA903-82-C-0434)
(NASA-CR-175492; NAS 1.26:175492) Avail: NTIS HC A04/MF A01 CSCL 20K

The object of this study was to recommend possible improvements in the manner in which structural integrity of Army systems is assured. The elements of a structural integrity program are described, and relevant practices used in various industries and government organizations are reviewed. Some case histories of Army weapon systems are examined. The mandatory imposition of a structural integrity program patterned after the Air Force Aircraft Structural Integrity Program is recommended and the benefits of such an action are identified. Author

N85-21404* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MAGENTICALLY ACTUATED COMPRESSOR Patent
J. EVANS and P. A. STUDER, inventors (to NASA) 19 Feb. 1985 9 p Filed 28 Jan. 1983 Supersedes N83-20153 (21 - 10, p 1526)
(NASA-CASE-GSC-12799-1; NAS 1.71:GSC-12799-1; US-PATENT-4,500,265; US-PATENT-APPL-SN-461724; US-PATENT-CLASS-417-417; US-PATENT-CLASS-417-488; US-PATENT-CLASS-310-22; US-PATENT-CLASS-31-35; US-PATENT-CLASS-62-6; US-PATENT-CLASS-92-98R) Avail: US Patent and Trademark Office CSCL 13H

A vibration free fluid compressor particularly adapted for Stirling cycle cryogenic refrigeration apparatus comprises a pair of identical opposing ferromagnetic pistons located in a housing and between a gas spring including a sealed volume of a working fluid such as gas under pressure. The gas compresses and expands in accordance with movement of the pistons to generate a compression wave which can be vented to other apparatus, for example, a displacer unit in a Stirling cycle engine. The pistons are urged outwardly due to the pressure of the gas; however, a fixed electromagnetic coil assembly located in the housing adjacent the pistons, is periodically energized to produce a magnetic field which interlinks the pistons in such a fashion that the pistons are mutually attracted to one another. The mass of the pistons, in conjunction with the compressed gas between them, form a naturally resonant system which, when the pistons are electromagnetically energized, produces an oscillating compression wave in the entrapped fluid medium.
Official Gazette of the U.S. Patent and Trademark Office

N85-21408# Albany International Corp., Dedham, Mass.
FINGER MATERIALS FOR AIR CUSHION VEHICLES. VOLUME 2: BASE FABRICS FOR FINGER MATERIALS Technical Report, Oct. 1977 - Aug. 1982
M. M. SCHOPPEE, J. SKELTON, M. M. TONEY, and W. KLEMENS Dec. 1984 94 p
(Contract N00600-77-C-1291; F61-541)
(AD-A149701; DTNSRDC-85/004) Avail: NTIS HC A05/MF A01 CSCL 11E

Since the short lifetimes of seal/skirt systems on surface effect vehicles (SEV's) severely limit the long-term serviceability on such craft, a systematic study was undertaken to evaluate the effects of fabric structure on the performance of rubber/fabric skirt materials under conditions of high speed, high-curvature flexing. A series of nylon fabrics was designed and manufactured in which the fiber denier, yarn denier, yarn twist, yarn crimp, weave pattern and float length were varied, but in which the tensile strength was kept constant throughout. Each one of the fabrics was rubber-coated using the same natural rubber/polybutadiene blend and the same coating technique. A flex-testing apparatus was designed and built for flexing the rubber/fabric composite materials in air at an average radius of curvature of 0.28 in. at a cycling frequency of 15 Hz. The lifetimes in flex of the experimental series of fabrics, as indicated by the appearance of flex cracks in the rubber layer, ranged from a low of 140,000 cycles to a high of 21.7 million cycles, a range of over two orders of magnitude. Factorial analysis of the test results showed that lower yarn denier, lower yarn crimp, and shorter float length (plain weave) in the fabric substrate offer significant advantages in the ability of the fabric to withstand flexing. Design of three broad fabrics for full-scale skirt trials on the SRN4 craft is described. GRA

N85-21411# Technische Univ., Clausthal-Zellerfeld (West Germany). Inst. fuer Ernergieverfahrenstechnik.
THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF DUST LOADED FLOW FIELDS IN INDUSTRIAL HALLS Final Report, Jun. 1982
R. WAGNER, R. JESCHAR, and R. SCHOLZ Bonn Bundesministerium fuer Forschung und Technologie Nov. 1984 141 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-HA-84-044; ISSN-0171-7618) Avail: NTIS HC A07/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 30

Dust flow field simulations are presented. Dimensionless characteristic factors governing the flow field were derived for the drafting of scaled down models of an industrial hall. It is shown that experiments are only practicable if the free aerodynamic lift over a heat source is substituted by forced convection. A steel foundry flow field and the resulting flow in the model were compared. Good applicability is stated. Experiments give information on location and dimensioning of induction and extraction systems in a steel foundry. Author (ESA)

N85-21444# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.
PROCEEDINGS OF THE SYMPOSIUM ON ELECTROMAGNETIC WINDOWS (17TH) HELD AT GEORGIA INST. OF TECHNOLOGY, ENGINEERING EXPERIMENT STATION, ATLANTA, GEORGIA ON 25-27 JULY 1984. PART 2 Final Report, 9 May 1984 - 8 May 1985
H. L. BASSETT, ed. 1984 262 p
(Contract DAAG29-84-M-0346)
(AD-A149125; ARO-21807.1-MS-CF-PT-2) Avail: NTIS HC A12/MF A01 CSCL 17I

The Seventeenth Electromagnetic Window Symposium marks 29 years of regularly scheduled symposia on electromagnetic windows. The first seven symposia were held at Ohio State University. The Georgia Institute of Technology has hosted the symposium biennially since 1966, with the U.S. Air Force cohosting the symposia of 1966, 1968, and 1972.

N85-21467# Electronic Space Systems Corp., Concord, Mass.
A RADOME FOR AIR TRAFFIC CONTROL SSR RADAR SYSTEMS
In Georgia Inst. of Technology Proc. of the Symp. on Electromagnetic Windows (17th), Part 2 p 219-224 1984
(AD-P004373) Avail: NTIS HC A12/MF A01 CSCL 17I

A new generation of monopulse and discrete interrogation systems has evolved for air traffic control applications that presents significant challenges to total system design and performance. Reliable operation of the antenna system is essential in today's ever increasing air traffic congestion. An important component of the total system is a radome to protect the antenna from the environment and to enable consistent, reliable electromagnetic performance. The various types of radomes that have been employed over the years to protect antennas are discussed and evaluated relative to the air traffic control radar application. The sandwich radome is selected as the best option and a detailed design analysis is presented which considers the vital characteristics of transmissivity, boresight error, and sidelobe perturbations. GRA

N85-21468# Northrop Corp., Hawthorne, Calif. Aircraft Group.
DEVELOPMENT OF THE F-20 NOSE RADOME
E. L. CAIN and P. TULYATHAN in Georgia Inst. of Technology Proc. of the Symp. on Electromagnetic Windows (17th), Part 2 p 225-235 1984
(AD-P004374) Avail: NTIS HC A12/MF A01 CSCL 17I

Northrop's newest fighter aircraft, the F-20 Tigershark, is based on the successful aerodynamic design and size of the F-5 Tiger II aircraft. It has a single engine providing 80 percent more thrust than that of the twin-engine Tiger II, digital avionics, and a newly designed AN/APG-67 (V) X-band radar. This coherent pulse Doppler radar provides both look-up and look-down target detection and tracking. Successful operation of this radar necessitated an antenna/radome system which provides low RMS side-lobe levels to minimize false alarm rate in the look-down mode, and high antenna gain/low radome loss to maximize radar range. These system requirements prompted a redesign of the F-5 Shark Shape nose section which had been aerodynamically configured to improve the post-stall handling qualities of the Tiger II aircraft. The design change included: (1) provisions for a larger radar antenna, (2) a clean radome, i.e., no pitot-static probe, air lines or heater wires, and (3) a blunted radome shape, designed to preserve aerodynamic handling qualities and provide the required electrical characteristics. GRA

N85-21469# Brunswick Corp., Marion, Va. Defense Div.
NOSE AND INLET DUCT RADOMES FOR THE FIREBOLT AERIAL TARGET
L. C. HOOTS in Georgia Inst. of Technology Proc. of the Symp. on Electromagnetic Windows (17th), Part 2 p 237-246 1984
(AD-P004375) Avail: NTIS HC A12/MF A01 CSCL 17I

Radomes of the Firebolt Aerial Target (AQM-81A) facilitate an uncommon set of operational conditions. The target vehicle is first carried captively. Stones may be dislodged from the runway and impact the Nose or Inlet Duct Radomes with considerable force. The drone has various flight profiles after launch, encompassing levels of MACH 1.2 at 35,000 feet to MACH 4 at 100,000 feet. For flights of 10 minutes, attendant aerothermal loads produce temperature peaks of 680 deg F and 980 deg F for the Nose and Inlet Duct units, respectively. Firebolt is normally retrieved, by helicopter after its parachute deploys, for refurbishment and re-use. Occasionally, sea recovery is effected using flotation gear. Electrically, the Nose Radome accommodates an L-band antenna for the electronic scoring system, and a small circulary polarized X-band horn. The Inlet Duct Radome houses an identical broad-beamed horn. Author (GRA)

N85-21579# National Aerospace Lab., Amsterdam (Netherlands).
UNSTEADY TRANSONIC PRESSURE MEASUREMENTS ON A SEMI-SPAN WIND-TUNNEL MODEL OF A TRANSPORT-TYPE SUPERCRITICAL WING (LANN MODEL). PART 2: PRESSURE DISTRIBUTIONS (PLOTTED) AND PLOTS OF THE VIBRATION MODES Final Technical Report, Apr. 1980 - Apr. 1982
J. J. NORSTEN, R. G. DENBOER, and R. J. ZWAAN Wright-Patterson AFB, Ohio Air Force Wright Aeronautical Labs. Mar. 1983 187 p
(Contract AF-AFOSR-0136-80)
(AD-A130488; AFWAL-TR-83-3039-PT-2; NLR-TR-82069-U-PT-2) Avail: NTIS HC A09/MF A01 CSCL 20D

Unsteady transonic pressure measurements were performed on a semi-span wind-tunnel model of a transport-type supercritical wing, oscillating in pitch. For each run, the vibration mode and detailed steady and unsteady pressure distributions have been measured. Sectional as well as wing aerodynamic coefficients have been obtained by integration of the pressure distributions. The tests covered a Mach number range between 0.62 and 0.95. The reduced frequency covered a range between zero and a maximum value varying from 0.3 at M = 0.62 to 0.2 at M = 0.95 (related to half mean aerodynamic chord). Author

N85-21587# Calspan Advanced Technology Center, Buffalo, N.Y. Physical Sciences Dept.
EXPERIMENTAL STUDIES OF QUASI-TWO-DIMENSIONAL AND THREE-DIMENSIONAL VISCOUS INTERACTION REGIONS INDUCED BY SKEWED-SHOCK AND SWEPT-SHOCK BOUNDARY LAYER INTERACTIONS Final Technical Report, 15 Jan. 1982 - 31 Jul. 1984
M. S. HOLDEN Jul. 1984 80 p
(Contract F49620-82-C-0026; AF PROJ. 2307)
(AD-A150080; CALSPAN-7018-A-2; AFOSR-84-1228TR) Avail: NTIS HC A05/MF A01 CSCL 20D

This report describes results from 3 experimental studies designed to examine the aerothermal characteristics of regions of

three-dimensional shock wave/boundary layer interaction in high-speed flow over non-adiabatic surfaces. The objectives were: (1) to explore the basic mechanisms associated with 3D boundary layer separation in high-speed flows with special emphasis on the large heat transfer rates and gradients developed in the separation and reattachment regions of these flows; and (2) to obtain detailed sets of experimental measurements with which to extend the simple semi-empirical prediction methods to the hypersonic/cooled wall regime where no previous data existed. These studies were conducted at Mach 11 for Reynolds number of up to 40 million in Calspan's 96-Inch Shock Tunnel. In the first study we examined the effects of crossflow on the scale and properties of attached and separated region induced over a flat plate at the base of skewed/oblique shocks. Analysis of the detailed heat transfer and pressure measurements together with flow visualization demonstrated that, for sweep angles of up to 45 deg, crossflow had little effect on the size or characteristics of the interaction regions. In the second study the swept-shock was induced normal to the flat plate boundary layer by a shock generator mounted perpendicular to the flat plate. Our corner flow measurements demonstrated that, in highly-cooled hypersonic flows, the pressure rise to induce incipient separation is significantly larger than predicted by the semi-empirical methods. GRA

N85-21605*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EVALUATION RESULTS OF THE 700 DEG C CHINESE STRAIN GAUGES
H. F. HOBART 1985 11 p refs Presented at the High Temperature Measurements for Experimental Mechanics Conf., Knoxville, Tenn., 27-28 Mar. 1985
(NASA-TM-86973; E-2502; NAS 1.15:86973) Avail: NTIS HC A02/MF A01 CSCL 14B

Gauges fabricated from specially developed Fe-Cr-Al-V-Ti-Y alloy wire in the Republic of China were evaluated for use in static strain measurement of hot gas turbine engines. Gauge factor variation with temperature, apparent strain, and drift were included. Results of gauge factor versus temperature tests show gauge factor decreasing with increasing temperature. The average slope is -3-1/2 percent/100 K, with an uncertainty band of + or - 8 percent. Values of room temperature gauge factor for the Chinese and Kanthal A-1 gauges averaged 2.73 and 2.12, respectively. The room temperature gauge factor of the Chinese gauges was specified to be 2.62. The apparent strain data for both the Chinese alloy and Kanthal A-1 showed large cycle to cycle nonrepeatability. All apparent strain curves had a similar S-shape, first going negative and then rising to positive value with increasing temperatures. The mean curve for the Chinese gauges between room temperature and 100 K had a total apparent strain of 1500 microstrain. The equivalent value for Kanthal A-1 was about 9000 microstrain. Drift tests at 950 K for 50 hr show an average drift rate of about -9 microstrain/hr. Short-term (1 hr) rates are higher, averaging about -40 microstrain for the first hour. In the temperature range 700 to 870 K, however, short-term drift rates can be as high as 1700 microstrain for the first hour. Therefore, static strain measurements in this temperature range should be avoided. A.R.H.

N85-21607# National Bureau of Standards, Gaithersburg, Md.
ADVANCED THIN FILM THERMOCOUPLES
K. G. KREIDER, S. SEMANCIK, and C. OLSON Oct. 1984 85 p refs
(Contract NASA ORDER C-54715-D)
(NASA-CR-175541; NAS 1.26:175541; PB85-132322; NBSIR-84-2949) Avail: NTIS HC A05/MF A01 CSCL 14B

The fabrication, materials characterization, and performance of thin film platinum rhodium thermocouples on gas turbine alloys was investigated. The materials chosen for the study were the turbine blade alloy systems MAR M200+Hf with NiCoCrAlY and FeCrAlY coatings, and vane alloy systems MAR M509 with FeCrAlY. Research was focussed on making improvements in the problem areas of coating substrate stability, adhesion, and insulation reliability and durability. Diffusion profiles between the substrate and coating with and without barrier coatings of Al2O3 are reported. The relationships between fabrication parameters of thermal oxidation and sputtering of the insulator and its characterization and performance are described. The best thin film thermocouples were fabricated with the NiCoCrAlY coatings which were thermally oxidized and sputter coated with Al2O3. GRA

N85-21634 Department of the Air Force, Washington, D.C.
LASER CLOCK Patent
R. L. FACKLAM, inventor (to Air Force) 13 Nov. 1984 6 p Supersedes AD-D010362
(AD-D011513; US-PATENT-4,482,259; US-PATENT-APPL-SN-498238; US-PATENT-CLASS-368-118)
Avail: US Patent and Trademark Office CSCL 17G

A laser clock includes a linear laser in one embodiment of the clock and a ring laser gyro in the other embodiment. The linear laser is frequency stabilized and utilizes a single active medium in the form of a low pressure gas, such as He-Ne, with a Doppler broadened gain curve. The ring laser gyro is a four frequency laser with a Faraday rotor. Detector and electronic circuitry associated with the laser of each embodiment detect a beat frequency and coverts it to a clock signal. GRA

N85-21657*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TRIBOLOGICAL SYSTEMS AS APPLIED TO AIRCRAFT ENGINES
D. H. BUCKLEY 26 Apr. 1985 23 p refs To be presented at the 60th AGARD Struct. and Mater. Panel Meeting, San Antonio, 21-26 Apr. 1985
(NASA-TM-86965; E-2478; NAS 1.15:86965) Avail: NTIS HC A02/MF A01 CSCL 13I

Tribological systems as applied to aircraft are reviewed. The importance of understanding the fundamental concepts involved in such systems is discussed. Basic properties of materials which can be related to adhesion, friction and wear are presented and correlated with tribology. Surface processes including deposition and treatment are addressed in relation to their present and future application to aircraft components such as bearings, gears and seals. Lubrication of components with both liquids and solids is discussed. Advances in both new liquid molecular structures and additives for those structures are reviewed and related to the needs of advanced engines. Solids and polymer composites are suggested for increasing use and ceramic coatings containing fluoride compounds are offered for the extreme temperatures encountered in such components as advanced bearings and seals. M.G.

N85-21658*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LUBRICATION AND PERFORMANCE OF HIGH-SPEED ROLLING-ELEMENT BEARINGS
E. V. ZARETSKY, F. T. SCHULLER, and H. H. COE 1985 19 p refs Proposed for presentation at the 1985 Ann. Meeting of the American Society of Lubrications Engineers, Las Vegas, Nev., 6-9 May 1985
(NASA-TM-86958; E-2362; NAS 1.15:86958) Avail: NTIS HC A02/MF A01 CSCL 13I

Trends in aircraft engine operating speeds have dictated the need for rolling-element bearings capable of speeds to 3 million DN. A review of high-speed rolling-element bearing state-of-the-art performance and lubrication is presented. Through the use of under-race lubrication and bearing thermal management bearing operation can be obtained to speeds of 3 million DN. Jet lubricated ball bearings are limited to 2.5 million DN for large bore sizes and to 3 million DN for small bore sizes. Current computer programs are able to predict bearing thermal performance. Author

N85-21676# Aeronautical Research Labs., Melbourne (Australia).
FINITE ELEMENT ANALYSIS OF PROBLEMS ASSOCIATED WITH LIFE ENHANCEMENT TECHNIQUES
M. HELLER, J. PAUL, R. P. CAREY, and R. JONES 1984 20 p refs
(ARL-STRUC-R-404; AR-003-929) Avail: NTIS HC A02/MF A01

Fatigue life enhancement systems such as interference-fit fasteners and cold-expanded holes, are assuming increasing importance for aircraft structures. A penalty finite-element method is formulated for the stress analysis of these common fatigue life enhancement systems. The method is demonstrated by considering two illustrative examples under elastic, plane-stress conditions. The three-dimensional analysis of a uniformly pressurized hole in a plate is also discussed with reference to cold-expanded holes.
Author

N85-21689*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
EXPLORATORY FLUTTER TEST IN A CRYOGENIC WIND TUNNEL
S. R. COLE Feb. 1985 11 p refs Presented at the AIAA/ASME/ASCE/AHS 26th SDM Conf., Orlando, Fla., 15-17 Apr. 1985
(NASA-TM-86380; NAS 1.15:86380) Avail: NTIS HC A02/MF A01 CSCL 20K

A model consisting of a rigid wing with an integral, flexible beam support that was cantilever mounted from the wall in the NASA LaRC 0.3-m transonic cryogenic tunnel was used in a flutter analysis study. The wing had a rectangular planform of aspect ratio 1.5 and a 64A010 airfoil. Various considerations and procedures for conducting flutter tests in a cryogenic wind tunnel were evaluated. Flutter onset conditions were established from extrapolated subcritical response measurements. A flutter boundary was determined at cryogenic temperatures over a Mach number M range from 0.5 to 0.9. Flutter was obtained at two different Reynolds numbers R at M = 0.5 (R = 4.4 and 18.4 x 10 to the 6th power) and at M = 0.8 (R = 5.0 and 10.4 x 10 to the 6th power). Flutter analyses using subsonic lifting surface (kernel function) aerodynamics were made over the range of test conditions. To evaluate the Reynolds number effects at M = 0.5 and 0.8, the experimental results were adjusted using analytical trends to account for differences in the model test temperatures and mass ratios. The adjusted experimental results indicate that increasing Reynolds number from 5.0 to 20.0 x 10 to the 6th power decreased the dynamic pressure by 4.0 to 6.5 percent at M = 0.5 and 0.8. A.R.H.

N85-22218*# Auburn Univ., Ala. Dept. of Computer Science.
SINGULAR ASYMPTOTIC EXPANSIONS IN NONLINEAR ROTORDYNAMICS
W. B. DAY *In* Alabama Univ. Res. Rept.: 1984 NASA/ASEE Summer Faculty Fellowship Program (NASA-CR-171317) 24 p Jan. 1985 refs Previously announced as N85-10100
Avail: NTIS HC A99/MF E03 CSCL 13K

During hot firing ground testing of the Space shuttle's Main Engine, vibrations of the liquid oxygen pump occur at frequencies which cannot be explained by the linear Jeffcott model of the rotor. The model becomes nonlinear after accounting for deadband, side forces, and rubbing. Two phenomena present in the numerical solutions of the differential equations are unexpected periodic orbits of the rotor and tracking of the nonlinear frequency. A multiple scale asymptotic expansion of the differential equations is used to give an analytic explanation of these characteristics.
M.A.C. (IAA)

13

GEOSCIENCES

Includes geosciences (general); earth resources; energy production and conversion; environment pollution; geophysics; meteorology and climatology; and oceanography.

A85-26476
COSMIC INTERPOLATION OF TERRESTRIAL POTENTIAL VALUES
K. ARNOLD and D. SCHOEPS (Deutsche Akademie der Wissenschaften, Zentralinstitut fuer Physik der Erde, Potsdam, East Germany) Gerlands Beitraege zur Geophysik (ISSN 0016-8696), vol. 93, no. 6, 1984, p. 409-422. refs

It is shown that the values of the gravity potential at the surface of the earth can be interpolated between the data of the satellite altimetry by cosmic methods. This requires the observation of a low-low mission of two satellites. The method seems to offer also a way to determine the topography of the oceans. Author

A85-27098#
STREAMTUBE EXPANSION EFFECTS ON THE DARRIEUS WIND TURBINE
I. PARASCHIVOIU (Montreal, Universite, Montreal, Canada), P. FRAUNIE, and C. BEGUIER (Aix-Marseille II, Universite, Marseille, France) Journal of Propulsion and Power (ISSN 0748-4658), vol. 1, Mar.-Apr. 1985, p. 150-155. refs

The purpose of the work described in this paper was to determine the aerodynamic loads and performance of a Darrieus wind turbine by including the expansion effects of the streamtubes through the rotor. The double-multiple streamtube model with variable interference factors was used to estimate the induced velocities with a modified CARDAAV computer code. Comparison with measured data and predictions shows that the stream-tube expansion effects are relatively significant at high tip-speed ratios, allowing a more realistic modeling of the upwind/downwind flowfield asymmetries inherent in the Darrieus rotor. Author

A85-27344
THE EFFECTS OF NON-COHERENCE ON ENERGY EXTRACTION FROM A TURBULENT WIND
J. V. HEALEY (U.S. Naval Postgraduate School, Monterey, CA) Wind Engineering (ISSN 0309-524X), vol. 8, no. 4, 1984, p. 221-230. refs

This study of the energy extractable from the longitudinal turbulence of wind extends a previous work by including the effects of non-coherence of gusts across the swept area of a turbine rotor. Expressions are derived for the mean of the square root of the coherence for a circle and a square and results are presented showing the percent excess kinetic energy, above that in the mean wind, that is extractable from the turbulence. This excess is a function of the site elevation and roughness, machine response time and rotor diameter. The greatest excess occurs on the roughness sites at lowest elevations for the shortest response times and smallest diameter rotors. Author

A85-27346
THE PROPERTIES OF ISOLATED AND COUPLED SAVONIUS ROTORS
G. J. BOWDEN (New South Wales, University, Kensington, Australia) and S. A. MCALEESE (Strathclyde, University, Glasgow, Scotland; New South Wales, University, Kensington, Australia) Wind Engineering (ISSN 0309-524X), vol. 8, no. 4, 1984, p. 271-288. refs

Some measurments on the Queensland optimum S-shaped rotor are presented. In particular it is shown that the efficiency of the turbine is about 18 percent, which is lower than the figure of about 23 percent given by earlier workers. In addition, detailed measurements of the pulsating wind-flow around a Savonius rotor are presented. These results were obtained using (1) tell-tales and a stroboscope, (2) a hot-wire anemometer (0-5 kHz response),

and (3) a turbulence meter. This data can be used to suggest that 'active coupling' between Savonius rotors might be useful in 'redirecting' the wind-flow more efficiently. In particular, it is shown that if two counter-rotating rotors are placed side by side in a wind-tunnel, a natural phase locking occurs. Author

A85-27359* Bolt, Beranek, and Newman, Inc., Canoga Park, Calif.
AIRCRAFT NOISE ANNOYANCE AT THREE JOINT AIR CARRIER AND GENERAL AVIATION AIRPORTS
S. FIDELL, R. HORONJEFF, J. MILLS, E. BALDWIN, S. TEFFETELLER, and K. PEARSONS (Bolt Baranek and Newman, Inc., Canoga Park, CA) Acoustical Society of America, Journal (ISSN 0001-4966), vol. 77, March 1985, p. 1054-1068. NASA-supported research. refs

The results of social surveys conducted near three airports that support both general aviation and scheduled air carrier operations are presented and discussed. Inferences supported by these data include: (1) the nature of noise exposure and community reaction at smaller airports may differ from that at larger airports; (2) survey techniques are capable of identifying changes in annoyance associated with numerically small changes in noise exposure; (3) changes in the prevalence of annoyance are causally produced by changes in noise exposure; and (4) changes in annoyance associated with changes in exposure vary with time. Author

A85-28140#
RADIAL VARIATIONS OF A SATELLITE ORBIT DUE TO GRAVITATIONAL ERRORS - IMPLICATIONS FOR SATELLITE ALTIMETRY
C. A. WAGNER (NOAA, Charting and Geodetic Services, Rockville, MD) Journal of Geophysical Research (ISSN 0148-0227), vol. 90, March 10, 1985, p. 3027-3036. refs

The linear perturbations of the radius of a satellite orbit due to the geopotential are derived. From these, estimates are made of the radial orbit error due just to geopotential errors from current models employing only conventional satellite-tracking data. The estimates show that about an order of magnitude improvement in the satellite geopotential will be necessary to utilize the full accuracy of independent satellite altimeter measurements. The linear perturbations are used to show that: (1) a substantial improvement in the low-degree geopotential is possible from the indirect use of Seasat altimetry at track crossovers, and (2) a separation of 'permanent' sea topography and geoid may be possible from direct use of the heights along the track. Author

A85-28770
COMPARISONS OF LIDAR AND RADAR WIND MEASUREMENTS MADE DURING THE JAWS EXPERIMENT
R. M. HARDESTY, M. E. JACKSON (NOAA, Wave Propagation Laboratory, Boulder, CO), and K. ELMORE (NOAA, Wave Propagation Laboratory; National Center for Atmospheric Research, Boulder, CO) IN: Conference on Radar Meteorology, 21st, Edmonton, Alberta, Canada, September 19-23, 1983, Preprints . Boston, MA, American Meteorological Society, 1983, p. 584-589. refs

Physical differences between radar and lidar for remote sensing of atmospheric phenomena are discussed, based on microburst observations by a 5.45 x 10 to the -2 m wavelength radar and a 10.6 x 10 to the -6th m lidar in the course of the Joint Airport Weather Study experiment. The analysis of the two data sets indicates that while radar is best used for examining velocities, reflectivities, and other intrinsic parameters of a storm, lidar is useful for studying the dynamic processes outside the storm clouds. It is pointed out that such complimentary characteristics could be further improved; modifications to the lidar transmitter could increase average power by a factor of 100, which may widen the maximum range to 25 km. L.T.

A85-28771* National Center for Atmospheric Research, Boulder, Colo.
JAWS DATA COLLECTION, ANALYSIS HIGHLIGHTS, AND MICROBURST STATISTICS
J. MCCARTHY, R. ROBERTS, and W. SCHREIBER (National Center for Atmospheric Research, Boulder, CO) IN: Conference on Radar Meteorology, 21st, Edmonton, Alberta, Canada, September 19-23, 1983, Preprints . Boston, MA, American Meteorological Society, 1983, p. 596-601. NSF-NOAA-supported research; U.S. Department of Transportation. refs
(Contract FA01-82-Y-10513; NASA ORDER H-59314-B)

Organization, equipment, and the current status of the Joint Airport Weather Studies project initiated in relation to the microburst phenomenon are summarized. Some data collection techniques and preliminary statistics on microburst events recorded by Doppler radar are discussed as well. Radar studies show that microbursts occur much more often than expected, with majority of the events being potentially dangerous to landing or departing aircraft. Seventy events were registered, with the differential velocities ranging from 10 to 48 m/s; headwind/tailwind velocity differentials over 20 m/s are considered seriously hazardous. It is noted that a correlation is yet to be established between the velocity differential and incoherent radar reflectivity. L.T.

A85-28772* National Center for Atmospheric Research, Boulder, Colo.
THE STRUCTURE OF A MICROBURST - AS OBSERVED BY GROUND-BASED AND AIRBORNE DOPPLER RADAR
C. K. MUELLER and P. H. HILDEBRAND (National Center for Atmospheric Research, Boulder, CO) IN: Conference on Radar Meteorology, 21st, Edmonton, Alberta, Canada, September 19-23, 1983, Preprints . Boston, MA, American Meteorological Society, 1983, p. 602-608. NSF-NOAA-supported research; U.S. Department of Transportation. refs
(Contract DOT-FA01-82-Y-10513; NASA ORDER H-59314-B)

Attention is given to the microburst observed near Denver, CO, on June 29, 1982, in the course of the Joint Airport Weather Study (JAWS). The JAWS ground radar network was specifically established to furnish high spatial and temporal resolution multiple Doppler data for microburst observations. The data, which were collected from directly above the microburst, permitted direct measurements of vertical velocities to be made. P-3 surveillance aircraft Doppler data was also available for this microburst, whose considerable complexity is noted. O.C.

A85-28774* National Center for Atmospheric Research, Boulder, Colo.
EVALUATION OF DOPPLER RADAR FOR AIRPORT WIND SHEAR DETECTION
J. WILSON and R. ROBERTS (National Center for Atmospheric Research, Boulder, CO) IN: Conference on Radar Meteorology, 21st, Edmonton, Alberta, Canada, September 19-23, 1983, Preprints . Boston, MA, American Meteorological Society, 1983, p. 616-623. NSF-NOAA-supported research; U.S. Department of Transportation. refs
(Contract DOT-FA01-82-4-10513; NASA ORDER H-59314-B)

The utility of Doppler radar measurement techniques for detecting low-level wind shear at airports is examined. The Doppler radar data of the Joint Airport Weather Studies (JAWS) for windshear microburst features are analyzed, in order to determine the optimal resolution, sensitivity, and scanning strategy for a standard system. The performance of three separate systems for measuring wind shear at heights of less than 200 meters is compared. The three systems included a dual-Doppler system, a single off-airport Doppler system, and a single on-airport Doppler system. On the basis of the comparison the following recommendations are offered concerning the optimal performance of a Doppler radar system in the airport environment: (1) the system should be able to measure radial velocities over a range of reflectivity of -10-80 dBZ; (2) ground clutter should be reduced; and techniques for identifying and disseminating wind shear information should be automated. I.H.

A85-28775
AIRCRAFT AND DOPPLER AIR MOTION COMPARISONS IN A JAWS MICROBURST
A. R. RODI, W. P. MAHONEY (Wyoming, University, Laramie, WY), and K. L. ELMORE (National Center for Atmospheric Research, Boulder, CO) IN: Conference on Radar Meteorology, 21st, Edmonton, Alberta, Canada, September 19-23, 1983, Preprints . Boston, MA, American Meteorological Society, 1983, p. 624-629. (Contract NSF ATM-82-05776)

Mechanisms affecting the formation and development of the strong downdrafts which induce aircraft-damaging 'microburst' winds near ground level have been studied by the Joint Airport Weather Studies (JAWS) project. Attention is given to a dry microburst on the basis of data from two Doppler radars and one instrumented aircraft comprising the JAWS network. It is found that the microburst's preponderance of strong downdrafts (of horizontal extension smaller than 4 km) is associated with high cloud bases having dry air beneath them. Rain evaporation is seen as the dominant forcing mechanism in a dry microburst. O.C.

A85-28776* FWG Associates, Inc., Tullahoma, Tenn.
AIRCRAFT PERFORMANCE IN A JAWS MICROBURST
W. FROST (FWG Associates, Inc.; Tennessee, University, Space Institute, Tullahoma, TN), H.-P. CHANG (Tennessee, University, Space Institute, Tullahoma, TN), J. MCCARTHY, and K. ELMORE (National Center for Atmosperic Research, Boulder, CO) IN: Conference on Radar Meteorology, 21st, Edmonton, Alberta, Canada, September 19-23, 1983, Preprints . Boston, MA, American Meteorological Society, 1983, p. 630-637. NSF-NOAA-supported research; U.S. Department of Transportation. refs
(Contract DOT-FA01-82-Y-10513; NASA ORDER H-59314-B)

Attention is given to the detailed features of a servere microburst event, the flight behavior of a 727 airliner in such an event as predicted by a numerical simulation, and several low level wind shear detection and warning concepts. The Joint Airport Weather Studies project data sets are the basis of the numerical simulation. The calculation of meaningful flight paths under varying wind conditions for microburst avoidance is demonstrated. O.C.

A85-28777* Chicago Univ., Ill.
MICROBURSTS IN JAWS DEPICTED BY DOPPLER RADARS, PAM, AND AERIAL PHOTOGRAPHS
T. T. FUJITA (Chicago, University, Chicago, IL) and R. M. WAKIMOTO (California, University, Los Angeles, CA) IN: Conference on Radar Meteorology, 21st, Edmonton, Alberta, Canada, September 19-23, 1983, Preprints . Boston, MA, American Meteorological Society, 1983, p. 638-645. refs
(Contract NSF ATM-81-09828; NGR-14-001-008; NOAA-NA-80AAD00001)

Preliminary results obtained from the JAWS (Joint Airport Weather Studies) Project near Denver, Colorado in the spring and summer of 1982 using Doppler radar, PAM, and aerial photography are presented. The definitions of the microburst phenomenon are discussed, and statistics comparing NIMROD (Northern Illinois Meteorological Research On Downbursts) for the Midwest region are compared with JAWS for the High Plains region. Possible parent clouds of the microburst are considered, and an analysis of a macroburst/microburst event on July 14, 1982 is presented. C.D.

A85-28779
CHARACTERISTICS OF GUST FRONT AND DOWNDRAFTS FROM SINGLE DOPPLER RADAR DATA
D. S. ZRNIC, R. J. DOVIAK, J. T. LEE (NOAA, National Severe Storms Laboratory, Norman, OK), and R. S. GE (Chinese Academy of Meteorological Sciences, Beijing, People's Republic of China; NOAA, National Severe Storms Laboratory, Norman, OK) IN: Conference on Radar Meteorology, 21st, Edmonton, Alberta, Canada, September 19-23, 1983, Preprints . Boston, MA, American Meteorological Society, 1983, p. 650-654. Sponsorship: U.S Department of Transportation. refs
(Contract DOT-FA01-80-Y-10524; FA01-81-Y-10521)

A85-28956
OPTIMIZATION OF AVERAGING INTERVALS OF WIND VELOCITY FOR METEOROLOGICAL SERVICES TO AVIATION [OPTIMIZATSIIA INTERVALOV OSREDNENIIA SKOROSTI VETRA PRI METEOROLOGICHESKOM OBESPECHENII AVIATSII]
V. E. BOKHANOV (Glavnaia Geofizicheskaia Observatoriia, Leningrad, USSR) Meteorologiia i Gidrologiia (ISSN 0130-2906), Feb. 1985, p. 40-44. In Russian. refs

Errors in the extrapolation of meteorological measurements associated with the variability of the measured values are minimized in order to determine an optimum averaging interval. An analysis is made of the different values recommended, depending on the type of aircraft, stability of the onboard equipment, human factors, and takeoff or landing maneuverability of the aircraft. A quasi-optimum interval of 2 min is proposed for 1-10-min prediction and a 10-min interval for 10-min to 3-hr predictions. For predictions in the entire period from 1 min to 3 hr the quasi-optimum interval is 6 min. L.T.

A85-29716* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
REGIONAL MEAN SEA SURFACES BASED ON GEOS-3 AND SEASAT ALTIMETER DATA
J. G. MARSH (NASA, Goddard Space Flight Center, Geodynamics Branch, Greenbelt, MD), R. E. CHENEY (NOAA, National Geodetic Survey, Rockville, MD), J. J. MCCARTHY, and T. V. MARTIN (EG & G Washington, Analytical Services Center, Inc., Riverdale, MD) Marine Geodesy (ISSN 0149-0419), vol. 8, no. 1-4, 1984, p. 385-402. refs

Altimetric sea surfaces provide a basis for detailed analyses of the earth's gravity, crustal structure, and the oceanic surface circulation. Long-term mean surfaces have been computed for the Bering Sea, Northwest Atlantic Ocean, and Gulf of Mexico based on a combination of the entire SEASAT (three-month) and GEOS-3 (3.5-year) altimeter data sets. The number of available passes ranged from 558 in the gulf to 1396 in the Atlantic. The large amount of data in these areas, coupled with the incresed constraint provided by the combination of data from two orbital inclinations, has permited the accurate removal of the effects of radial ephemeris error through crossing arc adjustments. The precision of these regional mean sea surfaces is approximately 15 cm, with horizontal resolutions approaching 25 km. Author

N85-19965# University of Northern Illinois, De Kalb. Dept. of Biological Sciences.
SUCCESSFUL CONTROL OF GULLS AND OTHER BIRDS AT A SANITARY LANDFILL
W. E. SOUTHERN and L. K. SOUTHERN *In* PEER Consultants, Inc. Wildlife Hazards to Aircraft Conf. and Training Workshop p 231-240 May 1984
(AD-P004198) Avail: NTIS HC A16/MF A01 CSCL 13B

Data were collected on the presence of Ring-billed Gulls, Herring Gulls, Turkey Vultures, American Crows and European Starlings at a Maryland landfill. Control procedures involving pyrotechnics were implemented. The effectiveness of control procedures on the various species is discussed. It is demonstrated that gulls and other species can be prevented from concentrating at a landfill. E.A.K.

N85-19966# LGL Ltd., Toronto (Ontario).
EFFECTIVENESS OF AN OVERHEAD WIRE BARRIER IN DETERRING GULLS FROM FEEDING AT A SANITARY LANDFILL
M. A. MCLAREN, R. E. HARRIS, and W. J. RICHARDSON *In* PEER Consultants, Inc. Wildlife Hazards to Aircraft Conf. and Training Workshop p 241-252 May 1984 refs
(AD-P004199) Avail: NTIS HC A16/MF A01 CSCL 13A

The effectiveness of fine parallel overhead wires in deterring herring and ring-billed gulls from landing at an active sanitary landfill was assessed. The study design consisted of alternating periods with and without wires over the active portion of the test landfill, and control observations at two other landfills. Overhead wires at

12 m spacing deterred most herring gulls from feeding. Ring-billed gulls were largely deterred by wire at 12 m spacing when limited garbage was present, but penetrated wires at 12 m spacing when attracted by large amounts of garbage. Wires at 6 m spacing deterred most ring-billed gulls in late spring even with large amounts of garbage present. In summer, when peak numbers of gulls visit landfill sites in the area, numbers of feeding ring-billed gulls were substantially reduced by wires 6 m apart. E.A.K.

N85-19967# Citadel Coll., Charleston, S.C. Dept. of Biology.
EFFECTIVENESS OF AN OVERHEAD WIRE BARRIER SYSTEM IN REDUCING GULL USE AT THE BFI JEDBURG SANITARY LANDFILL, BERKELEY AND DORCHESTER COUNTIES, SOUTH CAROLINA
D. M. FORSYTHE and T. W. AUSTIN *In* PEER Consultants, Inc. Wildlife Hazards to Aircraft Conf. and Training Workshop p 253-264 May 1984 refs
(AD-P004200) Avail: NTIS HC A16/MF A01 CSCL 13B

Sanitary landfills were studied to determine the bird species that actively fed at the landfill and to measure the effected and overhead wire barrier system on bird populations and behavior. The main species were Ring-billed Gulls, Fish Crows and Common Crows. The wire system reduced the mean number of gulls and crow by as much as two-thirds, but did not effect the hour to hour variation in gull and crow numbers. The wire system also reduced the number of gulls and crows soaring over the BFI landfill when compared with the Dorchester Country-SCA landfill. It is shown that a wire barrier system effectively reduced the numbers of gulls and especially crows feeding and loafing at Jedburg. E.A.K.

N85-19968# Canadian Wildlife Service, Ottawa (Ontario).
EVALUATION OF EFFECTIVENESS OF BIRD SCARING OPERATIONS AT A SANITARY LANDFILL SITE NEAR CFB TRENTON, ONTARIO, CANADA
C. RISLEY and H. BLOKPOEL *In* PEER Consultants, Inc. Wildlife Hazards to Aircraft Conf. and Training Workshop p 265-274 May 1984 refs
(AD-P004201) Avail: NTIS HC A16/MF A01 CSCL 13B

Birds are a world-wide hazard at airports due to the potential for strikes with aircraft or their ingestion into engines. Bird hazards can be particularly troublesome at airports located near sanitary landfill sites (SLSs) or other areas where birds may congregate. Daily bird-scaring operations were undertaken at Quinte sanitary landfill site to help reduce gull numbers at nearby CFB Trenton. Independent bird observations were made each week during that same period both at Quinte SLS and at two control SLSs where no bird-scaring operations took place. The effectiveness of individual visits to Quinte SLS by the bird-scaring personnel was usually of short duration. The long-term, cumulative effect of the persistent harassment of the gulls was a large drop in gull numbers, despite the fact that individual bird-scaring visits had only limited success. R.S.F.

N85-20375*# Naples Univ. (Italy).
TRANSPORT PROCESSES IN THE UPPER ATMOSPHERE
G. M. CARLOMAGNO *In* NASA. Marshall Space Flight Center Appl. of Tethers in Space, Vol. 2 10 p Mar. 1985
Avail: NTIS HC A14/MF A01 CSCL 04A

A proposed study to measure aerodynamic and heat transfer coefficients within the thermo-fluid-dynamic range experienced by a tethered satellite and to compare the coefficients with previous correlations is discussed. Tests are proposed on a satellite of existing design, on a satellite design consisting of models carried aboard, and on a newly designed satellite devoted to energy, mass, and momentum transfer studies on particular geometries. R.J.F.

N85-21769* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SOLAR POWERED ACTUATOR WITH CONTINUOUSLY VARIABLE AUXILIARY POWER CONTROL Patent
F. J. NOLA, inventor (to NASA) 18 Dec. 1984 6 p Filed 6 May 1982 Supersedes N82-26780 (20 - 17, p 2426)
(NASA-CASE-MFS-25637-1; NAS 1.71:MFS-25637-1; US-PATENT-4,489,243; US-PATENT-APPL-SN-375684; US-PATENT-CLASS-307-64; US-PATENT-CLASS-307-66; US-PATENT-CLASS-318-46; US-PATENT-CLASS-318-729; US-PATENT-CLASS-290-1R; US-PATENT-CLASS-290-4R) Avail: US Patent and Trademark Office CSCL 10A

A solar powered system is disclosed in which a load such as a compressor is driven by a main induction motor powered by a solar array. An auxiliary motor shares the load with the solar powered motor in proportion to the amount of sunlight available, is provided with a power factor controller for controlling voltage applied to the auxiliary motor in accordance with the loading on that motor. In one embodiment, when sufficient power is available from the solar cell, the auxiliary motor is driven as a generator by excess power from the main motor so as to return electrical energy to the power company utility lines.
Official Gazette of the U.S. Patent and Trademark Office

N85-21872*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SIMULTANEOUS CABIN AND AMBIENT OZONE MEASUREMENTS ON TWO BOEING 747 AIRPLANES. VOLUME 3: OCTOBER 1978 - JULY 1979
J. D. HOLDEMAN and W. H. JASPERSON (Control Data Corp., Minneapolis) Feb. 1985 579 p refs
(Contract DOT-FA78WAI-893)
(NASA-TM-86883; E-2344; NAS 1.15:86883) Avail: NTIS HC A25/MF A01 CSCL 04B

Measurements of ozone concentrations at cruise altitudes both outside and in the cabin of a Boeing 747SP and Boeing 747-100 airliners in routine commercial service are presented. Plotted and tabulated data are identified by route and are arranged chronologically for each airplane. These data were taken at 5- or 10-min intervals by automated instruments used in the NASA Global Atmospheric Sampling Program (GASP). All GASP cabin ozone data obtained from October 1978 to early July 1979 are presented. R.J.F.

N85-21877*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
DIRECT-STRIKE LIGHTNING PHOTOGRAPHS, SWEPT-FLASH ATTACHMENT PATTERNS, AND FLIGHT CONDITIONS FOR STORM HAZARDS 1982
K. P. ZAEPFEL, B. D. FISHER, and M. S. OTT Feb. 1985 249 p refs Prepared in cooperation with Lightning Technologies, Inc.
(Contract NAS1-15884)
(NASA-TM-86347; NAS 1.15:86347) Avail: NTIS HC A11/MF A01 CSCL 04B

As part of the NASA Langley Research Center Storm Hazards Program, 241 thunderstorm penetrations were made in 1982 with an F-106B airplane in order to record direct-strike lightning data and the associated flight conditions. During these penetrations, the airplane received 156 direct lightning strikes; in addition, lightning transient data were recorded from 26 nearby lightning flashes. The tests were conducted within 150 nautical miles of Hampton, Virginia, assisted by ground-based weather-radar guidance from the NASA Wallops Flight Facility. The photographs of the lightning attachments taken from two onboard 16-mm color movie cameras and the associated strike attachment patterns are presented. A table of the flight conditions recorded at the time of each lightning event, and a table in which the data are cross-referenced with the previously published lightning electromagnetic waveform data are included. Author

N85-21879# Committee on Science and Technology (U. S. House).
WIND SHEAR DETECTION TECHNOLOGY
Washington GPO 1984 145 p refs Hearing before the Subcomm. on Transportation, Aviation and Mater. of the Comm. on Sci. and Technol., 98th Congr., 2nd Sess., No. 112, 25 Jul. 1984
(GPO-38-920) Avail: Subcommittee on Transportation, Aviation and Materials

Our understanding of wind shear, although limited, has progressed in recent years. In spite of this progress, however, low altitude wind shear continues to be a significant hazard to aviation. Thus, our objective to examine our current technical capability to detect wind shear, the status of the FAA's low level wind shear alert system implementation program, as well as the operational aspects of assuring that pilots have timely and accurate weather information en route, and especially on takeoff and landing. G.L.C.

N85-21881# Systems Control Technology, Inc., West Palm Beach, Fla. Technology Industries Div.
EVALUATING WIND FLOW AROUND BUILDINGS ON HELIPORT PLACEMENT Final Report, Sep. 1983 - Aug. 1984
J. B. MCKINLEY Washington, D.C. FAA Oct. 1984 45 p refs
(Contract DEFA01-80-C-10080)
(FAA-PM-84-25) Avail: NTIS HC A03/MF A01

A heliport wind assessment methodology for evaluating and potentially minimizing the influences of building-induced wind on heliport operations is presented. Descriptions and illustrations of wind flow patterns and characteristics for both isolated and multiple building configurations are provided to assist heliport planners, operators, and helicopter pilots in understanding the problems associated with building-induced winds. Based on geometric flow patterns, general guidelines for ground level and rooftop heliport placement are provided. Additional guidelines for determining the area of wind influence about isolated and multiple building configurations are detailed. Rules for calculating the distance from the sides of buildings for heliport siting is provided, as well as, rules for calculating the area of influence of buildings with respect to the prevailing climatic wind conditions. Recommendations are delineated for further data gathering and evaluation to validate and enhance the heliport wind assessment methodology. Author

N85-21908# National Weather Service, Garden City, N.Y.
FTASUM: AVIATION FORECAST SUMMARIES
M. R. PEROUTKA Aug. 1985 24 p refs
(PB85-112977; NOAA-NWS-ERCP-25) Avail: NTIS HC A02/MF A01 CSCL 04B

Aviation terminal forecasts are generally logged by hand onto Weather Service Form D-7 along with their associated surface observations. In past years, the purpose of this log was to help the forecaster keep up with the weather. Maintaining this sort of log is time-consuming and cumbersome, and the log does not reflect the entire aviation picture. This paper describes a program which uses the AFOS database to produce a complete log sheet. All forecasts and observations which occur during a given time window are printed in chronologic order. Each site can specify three time windows and the time of day during which each window is used. GRA

15

MATHEMATICAL AND COMPUTER SCIENCES

Includes mathematical and computer sciences (general); computer operations and hardware; computer programming and software; computer systems; cybernetics; numerical analysis; statistics and probability; systems analysis; and theoretical mathematics.

A85-26427#
NONCONSERVATIVE EVALUATION OF UNIFORM STABILITY MARGINS OF MULTIVARIABLE FEEDBACK SYSTEMS
H.-H. YEH (Kentucky, University, Lexington, KY; USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, OH), D. B. RIDGELY, and S. S. BANDA (USAF Flight Dynamics Laboratory, Wright-Patterson AFB, OH) (Guidance and Control Conference, Seattle, WA, August 20-22, 1984, Technical Papers, p. 581-591) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 8, Mar.-Apr. 1985, p. 167-174. Previously cited in issue 21, p. 3105, Accession no. A84-43466. refs

A85-26608
INFORMATION APPROACH TO FIXED-GAIN DESIGN
Y. BARAM (Technion - Israel Institute of Technology, Haifa, Israel) and D. EIDELMAN (Israel Ministry of Defence, Tel Aviv, Israel) IEEE Transactions on Aerospace and Electronic Systems (ISSN 0018-9251), vol. AES-21, Jan. 1985, p. 47-55. refs
(Contract AF-AFOSR-80-0178)

A method for designing fixed-gain controllers and filters for systems with large parameter variation is presented. The approach is based on finding the minimax point of the Kullback information measure between the fixed-gain system and the optimal system at a given operating point. The effectiveness of the proposed approach is illustrated by designing a fixed-gain system for the short-period control of a high-performance aircraft and evaluating its performance over the flight envelope. Author

A85-26776
AUTOTESTCON '83; PROCEEDINGS OF THE CONFERENCE, FORT WORTH, TX, NOVEMBER 1-3, 1983
Conference sponsored by the Institute of Electrical and Electronics Engineers. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 498 p. For individual items see A85-26777 to A85-26842.

Selected topics pertaining to Automatic Test Equipment (ATE) are discussed. Topics examined include control and support software, integrated logistics support, test program sets development, and ATE cost elements. Consideration is also given to modeling-tester, shop, and reliability; optical testing ATPG (Automatic Test Program Generator) techniques, ATLAS programming techniques, and military testing. M.D.

A85-26783
INTEGRATION STATUS ACCOUNTING PROGRAM (ISAP) - A DATA COLLECTION AND ANALYSIS PROGRAM FOR ATE AND TPS DEVELOPMENT
D. C. BOLSEN (McDonnell Aircraft Co., St. Louis, MO) and T. NELSON (McDonnell Douglas Automation Co., St. Louis, MO) IN: AUTOTESTCON '83; Proceedings of the Conference, Fort Worth, TX, November 1-3, 1983 . New York, Institute of Electrical and Electronics Engineers, Inc., 1983, p. 51-54. refs

The Integration Status Accounting Program (ISAP) which provides efficient, reliable, and current means of collection and maintenance of statistics, and generation of both individual and combined periodic summary reports is discussed. The Test Program Set Data Base (TPSDB) and the Automatic Test Equipment Data Base (ATEDB) which are linked together, comprise ISAP. A description of each data base and its applications are given. The TPSDB contains compilation and integration statistics and the ATEDB contains a configuration log of the respective ATE statistics. ISAP gives the user extensive on-line data-base management capabilities such as computation, sorting, cross referencing,

information retrieval, report generation, program control, and data security. M.D.

A85-26790
SYSTEM CONCEPTS/REAL-TIME PARAMETERS FOR A MIL-STD-1553B INTERMEDIATE LEVEL TESTER
M. P. VARA (Bendix Corp., Test Systems Div., Teterboro, NJ) IN: AUTOTESTCON '83; Proceedings of the Conference, Fort Worth, TX, November 1-3, 1983 . New York, Institute of Electrical and Electronics Engineers, Inc., 1983, p. 101-104.

Present avionic systems increasingly use the Military Standard 1553B serial, multiplexed, Manchester coded, communication bus. To properly support these new avionic systems, a next generation, general purpose MIL-STD-1553B Manchester II modular test capability is required for Automatic Test Equipment at all maintenance levels. This paper discusses the basic conceptual system decisions that the hardware/software design engineer must face before implementing this tester capability. It emphasizes the selection of real-time test parameters and tester modes of operation - both normal and abnormal. Author

A85-26807
DATA BASE MANAGEMENT FOR ATE RELIABILITY ENHANCEMENT
W. R. HORNEY (General Dynamics Corp., Electronics Div., San Diego, CA) IN: AUTOTESTCON '83; Proceedings of the Conference, Fort Worth, TX, November 1-3, 1983 . New York, Institute of Electrical and Electronics Engineers Inc, 1983, p. 240-245.

This paper describes a program at the General Dynamics Electronics Division whereby multiple data sources were integraed into a useable management information system. This system is designed to track F-16 intermediate-level ATE field performance from the base to component level, identify and prioritize areas where product improvement efforts would pay the highest dividends, and then track the effectiveness of product improvement initiatives. Author

A85-26817
AUTOMATIC ATLAS PROGRAM GENERATOR (AAPG) FOR THE ADVANCED ELECTRONIC WARFARE TEST SET
O. B. CROSS and J. S. GERG (ITT, ITT Avionics Div., Nutley, NJ) IN: AUTOTESTCON '83; Proceedings of the Conference, Fort Worth, TX, November 1-3, 1983 . New York, Institute of Electrical and Electronics Engineers, Inc., 1983, p. 286-291.

The automatic ATLAS program generator (AAPG), developed as a utility program to facilitate the development of efficient test programs for the advanced electronic warfare test set is described. Its prime purpose is to develop efficient syntactically correct logical and uniformly structured ATLAS (abbreviated test-language for all systems). The AAPG is a menu-driven interactive system which has the features of an ATLAS source generator and a text editor. Its software system consists of a main driver program, a series of menu-driven task routines, and a tree-structured file which is composed of a series of ATLAS template or fill-in-the-blanks files. The edit commands and modes, their functions and the system directory are discussed. The AAPG provides significant cost savings by reducing coding, processing, and integration time. M.D.

A85-26821#
INTELLIGENT TEST GENERATOR
J. L. KUNERT (U.S. Naval Air Engineering Center, Lakehurst, NJ) IN: AUTOTESTCON '83; Proceedings of the Conference, Fort Worth, TX, November 1-3, 1983 . New York, Institute of Electrical and Electronics Engineers, Inc, 312-317.

Automatic test equipment (ATE) is playing a major role in the Navy's maintenance program for operational readiness of its aircraft. A typical ATE system is comprised of a test operator, an automatic test station (ATS), a test program set (TPS), and the unit-under-test. Certain problems arise in connection with conventional TPS, and a new approach is needed to reduce software (TPS) costs and development time, and to improve performance. A utilization of Artificial Intelligence (AI), a new generation of computer science, is, therefore, considered. Knowledge-Based Systems (KBS) is a subfield of AI directed towards specific problem domains such as maintenance through the logical application of rules developed by experienced personnel and stored in a special data-base. In order to provide a clearer picture of KBS, a description is provided of the MYCIN system. Acknowledging the successful production rule format of MYCIN, the Naval Air Engineering Center will develop a similar format for the Intelligent Test Generator (ITG). G.R.

A85-26831
USING FLOWCHARTS TO MAP ATLAS ROUTE
R. E. PERSSON, W. E. MORLOCK, and D. A. GOEHRING (Honeywell, Inc., Military Avionics Div., Minneapolis, MN) IN: AUTOTESTCON '83; Proceedings of the Conference, Fort Worth, TX, November 1-3, 1983 . New York, Institute of Electrical and Electronics Engineers, Inc., 1983, p. 384-388.

Honeywell-generated flowcharts are being used by Air Force test station operators and technicians to trouble-shoot both the unit under test (UUT) and the test station itself. The flowcharts graphically depict how the ATLAS software program chronologically executes the test set-ups and procedures. The flowcharts are also an aid for those who do not have an extensive programming background or familiarity with the ATLAS language but need to understand how the software runs their test station. Author

A85-26832
ATLAS AVIONICS AUTOMATIC RESOURCE ALLOCATION - A STATEMENT AND SOLUTION OF THE PROBLEM
P. MEEHAN (AMG Associates, Inc., Arlington, VA) IN: AUTOTESTCON '83; Proceedings of the Conference, Fort Worth, TX, November 1-3, 1983 . New York, Institute of Electrical and Electronics Engineers, Inc., 1983, p. 389-394.

A85-26836
AUTOMATING THE DECISION SUPPORT FOR ATE OPERATIONS MANAGEMENT
A. SHENOLIKAR (Harris Corp., Government Support Systems Div., Syosset, NY) IN: AUTOTESTCON '83; Proceedings of the Conference, Fort Worth, TX, November 1-3, 1983 . New York, Institute of Electrical and Electronics Engineers, Inc., 1983, p. 420-425.

The specific areas that require decision support in a high-volume maintenance operation such as a land-based Naval air station are identified. The three levels of the maintenance concept (organizational, intermediate, and depot) as well as ATE (automatic test equipment) and nonATE related activities contributing to mission readiness are considered. Some issues requiring management decisions include: pre-deployment planning, post-deployment production scheduling, inventory control, and modes of operation. A generic decision support system (GDSS) which integrates the data management capabilities of a maintenance management information system and a modeling system is described. The impact of new and evolving technologies, such as artificial intelligence, mass storage, speech interpretation, and data communications, on a system like the GDSS, is examined. M.D.

A85-26838
A MODEL FOR THE OPTIMAL SYNTHESIS AND ANALYSIS OF MAINTENANCE FACILITIES
K. R. PATTIPATI, J. J. SHAW, D. P. BERTSEKAS, J. C. DECKERT, M. P. KASTNER, L. K. BEEAN, and R. F. GENDRON (Alphatech, Inc., Burlington, MA) IN: AUTOTESTCON '83; Proceedings of the Conference, Fort Worth, TX, November 1-3, 1983 . New York, Institute of Electrical and Electronics Engineers, Inc., 1983, p. 449-456. Research supported by Sperry Corp. refs

This paper introduces an optimization-based ATE design program. This program combines efficient algorithms from pattern recognition, mathematical programming, and network queueing theory to solve problems that had heretofore defied optimization. Computationally efficient, this program allows design sensitivity analysis from several points of view, and has applications in other

facets of ATE design. The program is currently in use in the design and analysis of an intermediate maintenance facility (IMF) for several hundred types of avionics equipment. Author

A85-27506
A FORTRAN SUBROUTINE FOR THE SOLUTION OF PERIODIC BLOCK-TRIDIAGONAL SYSTEMS
M. NAPOLITANO (Bari, Universita, Bari, Italy) Communications in Applied Numerical Methods (ISSN 0748-8025), vol. 1, Jan. 1985, p. 11-15. refs

In a number of problems, periodic boundary conditions arise. The numerical simulation of the flow past an arbitrary airfoil (if a numerical grid generation technique is employed) or a turbomachinery cascade, by means of block-Alternating Direction Implicit (ADI) methods, requires the numerical solution of large numbers of cyclic block-tridiagonal systems. It is very important to solve such systems as efficiently as possible. Ahlberg et al. (1967) have provided a method for the extension of the so-called Thomas algorithm to a cyclic tridiagonal system. The present investigation is concerned with the implementation of the approach reported by Ahlberg et al. (1967), taking into account a generalization to the case of a block-tridiagonal system of arbitrary block size. A brief outline of the algorithm is presented and a FORTRAN subroutine implementation is provided. The correctness of the enclosed FORTRAN subroutine for two cases is verified with the aid of a model problem. G.R.

A85-27514* Rensselaer Polytechnic Inst., Troy, N. Y.
A METHOD FOR HIGH ORDER LINEAR SYSTEM REDUCTION AND NONLINEAR SYSTEM SIMPLIFICATION
A. A. DESROCHERS and R. Y. AL-JAAR (Rensselaer Polytechnic Institute, Troy, NY) Automatica (ISSN 0005-1098), vol. 21, Jan. 1985, p. 93-100. refs
(Contract NAG1-171)

Least-squares-type algorithms for reducing the order of linear systems in the frequency domain and simplifying nonlinear systems in time domain are developed and demonstrated. The possible model structures are represented as nodes in a tree, and costs along the branches are assigned using the repeated-Gram-Schmidt orthogonalization procedure of Desrochers and Saridis (1980), permitting identification of the optimal n-term model by searching the tree to depth n, with no need for parameter identification. The efficiency and flexibility of the algorithms is shown in applications to the eighth-order linear system studied by Hsia (1972), a three-state eight-nonlinear-term aircraft-dynamics problem, and the related linear-controller problem (Garrard and Jordan, 1977). T.K.

A85-27989
VALIDATION OF FLIGHT-BODY SYSTEM SIMULATIONS [VALIDIERUNG VON FK-SYSTEMSIMULATIONEN]
W. BUB (Messerschmitt-Boelkow-Blohm GmbH, Ottobrunn, West Germany) Symposium ueber Simulationstechnik, 2nd, Vienna, Austria, Sept. 25-27, 1984, Paper. 11 p. In German.
(MBB-UA-837-84-OE)

Procedures for establishing the validity of computer simulations of flight-body systems and for convincing prospective users (who have not participated in the development of the simulation) of its validity are discussed, and the recommendations of Working Group 12 of the AGARD 1982 Flight Mechanics Panel (1984) are summarized. The distinction between verification (comparing model output and data bases used in constructing the model) and validation (comparing model output with new data bases) is stressed, and consideration is given to the confirmation of the mathematical and physical basis of the model, the scientific and engineering evaluation of the behavior of the model, confidence-building measures, validation of subsystems, hardware-in-loop validations, and flight tests. It is pointed out that the large amounts of numerical data and documentation required to validate a model may not be acceptable to the industrial users for whom they are intended. T.K.

A85-28601
SUMMER COMPUTER SIMULATION CONFERENCE, 15TH, VANCOUVER, CANADA, JULY 11-13, 1983, PROCEEDINGS. VOLUMES 1 & 2
Conference sponsored by the Society for Computer Simulation. La Jolla, CA, Society for Computer Simulation, 1983. Vol. 1, 941 p.; vol. 2, 256 p. For individual items see A85-28602 to A85-28631.

Simulation methods are discussed, taking into account operational evaluation modeling, continuous system simulation methodologies, numerical methods for simulation, simulation languages, general simulation methodologies, and applied simulation techniques. Other topics considered are related to computer systems, simulation credibility and validation, physical and engineering processes, management and social sciences, chemical sciences, training and research simulators, state-of-the-art topics, and energy, resources, and environment. Attention is given to distributed systems and networks, graphics, digital systems, missile life-cycle support through simulation, controls and optimization, vibration and mechanics, missile flight, engineering physics, parallel processing for jet engine simulation, simulation of communication of radar systems, electric power system simulation studies, nuclear power plant simulation, financial analysis, management planning, business models, and supercomputers. G.R.

A85-28612* College of William and Mary, Williamsburg, Va.
THE USE OF ADA IN DISTRIBUTED SIMULATIONS
W. R. COLLINS and S. FEYOCK (College of William and Mary, Williamsburg, VA) IN: Summer Computer Simulation Conference, 15th, Vancouver, Canada, July 11-13, 1983, Proceedings. Volume 1 . La Jolla, CA, Society for Computer Simulation, 1983, p. 364-370. refs
(Contract NAG3-232)

The increasing need for detailed information about systems of continually growing complexity enhances steadily the demands regarding the employed models. The present investigation is concerned with work related to the development of high-performance computer hardware intended for the support of the real-time simulation of jet engines. The hardware is structured in the form of a network of communicating microprocessors running in parallel. The need for a higher-order language capability for programming such a network has led to the research considered in this study. Attention is given to the hardware which is being developed, an abstract model, programming language considerations, research considerations, research objectives, Ada tasks, Ada packages, the Ada model, the mapping of the model to the hardware, a precompiler example, and the advantages of Ada. G.R.

A85-28613* Arizona State Univ., Tempe.
MULTIBUS-BASED PARALLEL PROCESSOR FOR SIMULATION
E. P. OGRADY and C.-H. WANG (Arizona State University, Tempe, AZ) IN: Summer Computer Simulation Conference, 15th, Vancouver, Canada, July 11-13, 1983, Proceedings. Volume 1 . La Jolla, CA, Society for Computer Simulation, 1983, p. 371-375. refs
(Contract NAG3-112)

A Multibus-based parallel processor simulation system is described. The system is intended to serve as a vehicle for gaining hands-on experience, testing system and application software, and evaluating parallel processor performance during development of a larger system based on the horizontal/vertical-bus interprocessor communication mechanism. The prototype system consists of up to seven Intel iSBC 86/12A single-board computers which serve as processing elements, a multiple transmission controller (MTC) designed to support system operation, and an Intel Model 225 Microcomputer Development System which serves as the user interface and input/output processor. All components are interconnected by a Multibus/IEEE 796 bus. An important characteristic of the system is that it provides a mechanism for a processing element to broadcast data to other selected processing

elements. This parallel transfer capability is provided through the design of the MTC and a minor modification to the iSBC 86/12A board. The operation of the MTC, the basic hardware-level operation of the system, and pertinent details about the iSBC 86/12A and the Multibus are described. Author

A85-28614* California Univ., Los Angeles.
DATA FLOW METHODS FOR DYNAMIC SYSTEM SIMULATION - A CSSL-IV MICROCOMPUTER NETWORK INTERFACE
A. MAKOUI and W. J. KARPLUS (California, University, Los Angeles, CA) IN: Summer Computer Simulation Conference, 15th, Vancouver, Canada, July 11-13, 1983, Proceedings. Volume 1 . La Jolla, CA, Society for Computer Simulation, 1983, p. 376-382. refs
(Contract NAG3-132)

A major problem in employing networks of microcomputers for the real-time simulation of complex systems is to allocate computational tasks to the various microcomputers in such a way that idle time and time lost in interprocess communication is minimized. The research reported in this paper is directed to the development of a software interface between a higher-level simulation language and a network of microcomputers. A CSSL-IV source program is translated to a data flow graph. This graph is then analyzed automatically so as to allocate computing tasks to the various processors. Author

A85-28615* California Univ., Los Angeles.
A FUNCTIONAL LANGUAGE APPROACH IN HIGH-SPEED DIGITAL SIMULATION
M. D. ERCEGOVAC and S.-L. LU (California, University, Los Angeles, CA) IN: Summer Computer Simulation Conference, 15th, Vancouver, Canada, July 11-13, 1983, Proceedings. Volume 1 . La Jolla, CA, Society for Computer Simulation, 1983, p. 383-387. refs
(Contract NAG3-132)

A functional programming approach for a multi-microprocessor architecture is presented. The language, based on Backus FP, its intermediate form and the translation process are discussed and illustrated with an example. The approach allows performance analysis to be performed at a high level as an aid in program partitioning. Author

A85-28649
THE MICROCOMPUTER IN FLIGHT TEST DATA REDUCTION
S. A. WALTERS (Aerospatiale Helicopter Corp., Grand Prairie, TX) IN: Flight testing today: Innovative management and technology; Proceedings of the Fourteenth Annual Symposium, Newport Beach, CA, August 15-19, 1983 . Lancaster, CA, Society of Flight Test Engineers, 1983, p. 5.2-1 to 5.2-9.

Features and applications of the computer-based electronic flight test data recording and analysis system being implemented in flight tests of the Coast Guard HH 65A helicopter are delineated. PCM techniques are employed in storing the telemetered analog data on magnetic tape in digitized form. The system receives data from 54 flight parameter sensors at a 100 samples/sec rate. Menu-driven CRT data displays permit operator scans of the stored/analyzed data in various formats, some on a quick-look, near-real-time basis. The system can generate time history plots and print-outs, perform search routines, and be used in vibration, weight and balance analyses. M.S.K.

A85-28810
DESIGN OF COMPENSATION SCHEMES FOR A NONMINIMUM-PHASE MULTIVARIABLE PLANT
P. T. KIDD, N. MUNRO, and D. E. WINTERBONE (University of Manchester Institute of Science and Technology, Manchester, England) IEE Proceedings, Part D - Control Theory and Applications (ISSN 0143-7054), vol. 132, pt. D, no. 2, March 1985, p. 75-85. Research supported by the Ministry of Defence (Procurement Executive).

The design of analogue and digital controllers for a gas-turbine-powered, controllable pitch propeller marine propulsion plant, which displays nonminimum phase characteristics, is considered. Rosenbrock's multivariable system theory is used to guide the development of control schemes that do not aggravate the nonminiumum phase problems of the system. Author

A85-29081*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
NEWTON-LIKE MINIMAL RESIDUAL METHODS APPLIED TO TRANSONIC FLOW CALCULATIONS
Y. S. WONG (NASA, Langley Research Center, Institute for Computer Applications in Science and Engineering, Hampton, VA; McGill University, Montreal; Alberta, University, Edmonton, Canada) AIAA Journal (ISSN 0001-1452), vol. 23, April 1985, p. 515-521. Previously announced in STAR as N84-20275. refs
(Contract NAS1-1581; NAS1-16394)

A computational technique for the solution of the full potential equation is presented. The method consists of outer and inner iterations. The outer iterate is based on a Newton like algorithm, and a preconditioned Minimal Residual method is used to seek an approximate solution of the system of linear equations arising at each inner iterate. The present iterative scheme is formulated so that the uncertainties and difficulties associated with many iterative techniques, namely the requirements of acceleration parameters and the treatment of additional boundary conditions for the intermediate variables, are eliminated. Numerical experiments based on the new method for transonic potential flows around the NACA 0012 airfoil at different Mach numbers and different angles of attack are presented, and these results are compared with those obtained by the Approximate Factorization technique. Extention to three dimensional flow calculations and application in finite element methods for fluid dynamics problems by the present method are also discussed. The Inexact Newton like method produces a smoother reduction in the residual norm, and the number of supersonic points and circulations are rapidly established as the number of iterations is increased. Author

A85-29370
A ROBUST AND EFFICIENT TECHNIQUE FOR DEALING WITH TIME-VARYING INSTRUMENTAL BIAS IN LINEAR FILTERING
M. H. VERHAEGEN, J. VANDEWALLE (Leuven, Katholieke Universiteit, Heverlee, Belgium), and P. VAN DOOREN (Philips Research Laboratory, Brussels, Belgium) Control and Computers (ISSN 0315-8934), vol. 12, no. 3, 1984, p. 96-99. Research supported by the Instituut tot Aanmoediging van het Wetenschappelijk Onderzoek in Nijverheid en Landbouw. refs

A unifying approach is formulated for estimating zero bias errors on input signals of linear discrete dynamic systems in real time applications. The problem of extending the state description to include the zero bias errors on the input signals is formulated, and special features of the mathematical model used in a simulation to reconstruct an aircraft's flight path are discussed. A method for making the corresponding modes of the zero bias terms controllable is given along with its effect on the Ricatti Recursion. An efficient implementation of the results in a more reliable Square Root Covariance Filter are given, and the good performance of the derived algorithm is demonstrated for the case of simulated constant and linear time-varying bias errors. C.D.

A85-29408* Michigan Univ., Ann Arbor.
A UNIFIED METHOD FOR EVALUATING REAL-TIME COMPUTER CONTROLLERS AND ITS APPLICATION
K. G. SHIN (Michigan, University, Ann Arbor, MI), C. M. KRISHNA (Massachusetts, University, Amherst, MA), and Y.-H. LEE (IBM Hawthorne Research Laboratory, Yorktown Heights, NY) IEEE Transactions on Automatic Control (ISSN 0018-9286), vol. AC-30, April 1985, p. 357-366. Previously announced in STAR as N85-13478. refs
(Contract NAG1-296)

A real time control system consists of a synergistic pair, that is, a controlled process and a controller computer. Performance measures for real time controller computers are defined on the basis of the nature of this synergistic pair. A case study of a typical critical controlled process is presented in the context of new performance measures that express the performance of both

controlled processes and real time controllers (taken as a unit) on the basis of a single variable: controller response time. Controller response time is a function of current system state, system failure rate, electrical and/or magnetic interference, etc., and is therefore a random variable. Control overhead is expressed as a monotonically nondecreasing function of the response time and the system suffers catastrophic failure, or dynamic failure, if the response time for a control task exceeds the corresponding system hard deadline, if any. A rigorous probabilistic approach is used to estimate the performance measures. The controlled process chosen for study is an aircraft in the final stages of descent, just prior to landing. First, the performance measures for the controller are presented. Secondly, control algorithms for solving the landing problem are discussed and finally the impact of the performance measures on the problem is analyzed. M.G.

A85-29669#
ADA - WILL DOD'S NEW COMPUTER LANGUAGE CUT SOFTWARE COST?
E. J. LERNER Aerospace America (ISSN 0740-722X), vol. 23, April 1985, p. 58-60.

The key feature of the U.S. Department of Defense standard computer language, Ada, is its ability to structure a program out of smaller parts that can be put together in different ways. Each part, or package, consists of subprograms, data, data types, and other information required for a certain procedure. A second important feature is its unique approach to parallel or concurrent processing, using the special feature called 'rendezvous' for intertask communications to ensure that tasks remain well synchronized. An important new application of Ada is in the digital flight control system for the F-15 fighter. Attention is given to the experience of this aircraft's manufacturer with Ada software. O.C.

A85-30122
CHECK OF AN ELECTRONIC MODEL OF CONTROLLED SYSTEMS [KONTROL' ELEKTRONNOI MODELI UPRAVLIAEMYKH SISTEM]
A. M. MIKHAILICHENKO (Nauchno-Issledovatel'skii Institut Avtomatizatsii Upravleniia i Proizvodstva, Kharkov, Ukrainian SSR) Elektronnoe Modelirovanie (ISSN 0204-3572), vol. 7, Mar.-Apr. 1985, p. 61-64. In Russian.

One of the final stages in the design of a controlled system (the object of control and the controller) is the modeling of system behavior in real time. This paper examines a method for checking the electronic model of a controlled system: checking is based on the computation of the roots of the characteristic equation of the electronic model and the comparison of these roots with the design roots. Coincidence of the roots indicates that the electronic model is equivalent to its mathematical analog. B.J.

N85-20763# Air Force Space Div., Los Angeles, Calif.
POTENTIAL IMPACT OF NAVSTAR GPS ON NATO TACTICAL OPERATIONS
E. M. PRICE and B. SPROSEN *In* AGARD Space System Applications to Tactical Operations 5 p Oct. 1984
Avail: NTIS HC A09/MF A01

The Navstar Global Positioning System was created when the United States Deputy Secretary of Defense directed that separate efforts by the U.S. Navy and the U.S. Air Force to develop a satellite-based navigation system be combined into a single program and placed under the executive control of the USAF. In 1978, at the invitation of the United States, nine NATO nations joined the project by establishing a NATO team at the Navstar Joint Program Office. NATO involvement in the program is discussed and some of the unique, operationally significant features of the system are presented. A few representative operational scenarios where the benefits of Navstar would be particularly useful are presented. B.W.

N85-22024# Naval Research Lab., Washington, D. C.
INTERFACE SPECIFICATIONS FOR SCR (SOFTWARE COST REDUCTION) (A-7E) EXTENDED COMPUTER MODULE, REVISED
D. L. PARNAS, D. M. WEISS, P. C. CLEMENTS, and K. H. BRITTON 31 Dec. 1984 128 p Supersedes NRL-MR-4843 (Contract F21-243)
(AD-A149948; NRL-MR-5502-REV; NRL-MR-4843) Avail: NTIS HC A07/MF A01 CSCL 09B

This document describes the programmer interface to a computing machine partially implemented in software. The Extended Computer is part of NRL's Software Cost Reduction (SCR) project, to demonstrate the feasibility of applying advanced software engineering techniques to complex real-time systems in order to simplify maintenance. The Extended Computer allows code portability among avionics computers by providing extensible addressing, uniform i/o and data access, representation-independent data types, uniform event signalling, a standard subprogram invocation mechanism, and parallel process capability. The purpose of the Extended Computer is to allow the remainder of the software to remain unchanged when the host computer is changed or replaced. This report describes the modular structure of the Extended Computer, and contains the abstract interface specifications for all the facilities provided to users. It serves as development and maintenance documentation for the SCR software design, and is also intended as a model for other people interested in applying the abstract interface approach on other software projects. Additional keywords included: real time, systems engineering. GRA

N85-22025# Naval Postgraduate School, Monterey, Calif.
AN INTERACTIVE ENVIRONMENT FOR THE DEVELOPMENT OF AN EXPERT SYSTEM IN ZOG M.S. Thesis
D. BUTLER, III Jun. 1984 63 p
(AD-A149954) Avail: NTIS HC A04/MF A01 CSCL 09B

ZOG is a rapid-response, large-network, menu-selection human-computer interface implemented on the PERQ microcomputer. This thesis develops a framework for and discusses issues relative to implementing the OPS7 expert system language as an interactive programming environment in ZOG. It begins by tracing the history of ZOG's frame structure are explained. A discussion of the expert system language used in ZOG, OPS7, is presented to acquaint the reader with its character. The subnet schemes required to run an OPS7 style interpreter agent are developed and the user's perspective of the agent is presented. Finally, recommendations for future work in this area are made. Additional keywords included: Management information systems, Shipboard aircraft carriers, AIRPLAN rule based expert system, Programming languages. Author (GRA)

16

PHYSICS

Includes physics (general); acoustics; atomic and molecular physics; nuclear and high-energy physics; optics; plasma physics; solid-state physics; and thermodynamics and statistical physics.

A85-26443#
LEAST ACCELERATION MOTION FOR GIVEN TERMINAL CONDITIONS
V. RAAE Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 8, Mar.-Apr. 1985, p. 275.

The motion of a particle from an initial to a final position with given terminal velocities and transfer time is presently treated in such a way as to define an inertial two-dimensional coordinate system within which the optimal particle motion takes place. This effectively reduces the problem from three-dimensional to two-dimensional complexity. Use of a 'chain' analogy shows that

a nonconstant acceleration magnitude may be excluded as the optimal possibility. O.C.

A85-26742
THEORETICAL PRINCIPLES OF TURBULENCE AND A SIMPLE EXAMPLE OF TURBULENT FLOW [TEORETICHESKIE OSNOVY TURBULENTNOSTI I PROSTEISHII PRIMER TURBULENTNOGO TECHENIIA]
V. V. STRUMINSKII (Akademiia Nauk SSSR, Sektor Mekhaniki Neodnorodnykh Sred, Moscow, USSR) Akademiia Nauk SSSR, Doklady (ISSN 0002-3264), vol. 280, no. 4, 1985, p. 820-826. In Russian. refs

The theoretical principles of turbulence are developed on the basis of the kinetic theory of gases. The system of kinetic equations obtained in an earlier study (Struminskii, 1985) is solved here using a new method which significantly differs from the Chapman-Enskog method. By using the new method the problem is reduced to that of solving a generalized aerohydrodynamic system of equations for flow parameters characterizing the motion of individual groups of molecules. A simple example is presented which supports the validity of the approach proposed here. V.L.

A85-27880#
THE OPTICS OF AIRCRAFT SHEAR FLOWS
J. E. CRAIG (Spectron Development Laboratories, Inc., Costa Mesa, CA) and W. C. ROSE (Rose Engineering and Research, Inc., Incline Village, NV) American Institute of Aeronautics and Astronautics, Shear Flow Control Conference, Boulder, CO, Mar. 12-14, 1985. 11 p. USAF-supported research.
(AIAA PAPER 85-0557)

The aero-optics of laser propagation through aircraft turbulent boundary layers and porous fence generated shear layers are examined. Using optical instrumentation with fast time resolution (about 30 microsec) through a finite aperture (15 cm diameter), the optical performance was determined and compared with the infinite aperture aerodynamically derived performance. A custom Q-switched Nd:YAG doubled pulsed laser and a holographic camera recorded the random flow field in a double pass, double pulse mode. Aerodynamic parameters were measured using hot film anemometer probes and a five-hole pressure probe. The effects of finite aperture and spatial and temporal frequencies of the random flow are considered. The results presented represent five flights flown at altitudes from 1.8-10.7 km and at Mach numbers from 0.32-0.79. Single pass phase deviations for the boundary layer were from 0.06-0.17 waves (at a 0.53 micron wavelength) with piston and tilt components removed. Measured phase deviations for the fence generated shear flows varied from 0.10-0.279 waves (at a 0.53 micron wavelength) with piston and tilt components removed. However, when low order aberrations through coma were removed, the remaining deviations were only 0.09-0.18 waves. This resulted in 33-250 percent increase in the Strehl ratio at 14 cm optical aperture. Author

A85-29005
AN EXPERIMENTAL STUDY OF PRESSURE FLUCTUATIONS IN FLOW AROUND A SPHERE [EKSPERIMENTAL'NOE ISSLEDOVANIE PUL'SATSII DAVLENIIA PRI OBTEKANII SHARA]
N. I. MIKHAILOVA and A. I. SHVETS (Moskovskii Gosudarstvennyi Universitet, Moscow, USSR) IN: Selected problems in contemporary mechanics. Part II . Moscow, Izdatel'stvo Moskovskogo Universiteta, 1982, p. 87-95. In Russian. refs

Results of blowdown wind tunnel tests are presented for a 70-mm-diameter sphere for Mach 0.3-1.2 and 3. The Reynolds numbers, determined from the incoming flow parameters and sphere diameter, are (0.6-1.5) x 10 to the 6th. The relative pressure fluctuations, measured for different points on the surface of the sphere, are presented as a function of the Mach number of the incoming flow. The factors responsible for the observed pressure fluctuations are examined. V.L.

A85-29079#
NEAR-FIELD FREQUENCY-DOMAIN THEORY FOR PROPELLER NOISE
D. B. HANSON (United Technologies Corp., Hamilton Standard Div., Windsor Locks, CT) AIAA Journal (ISSN 0001-1452), vol. 23, April 1985, p. 499-504. Previously cited in issue 11, p. 1651, Accession no. A83-28007. refs

A85-29097#
A MAPPED, FACTORED-IMPLICIT SCHEME FOR THE COMPUTATION OF DUCT AND FAR-FIELD ACOUSTICS
J. W. WHITE and P. E. RAAD (Tennessee, University, Knoxville, TN) AIAA Journal (ISSN 0001-1452), vol. 23, April 1985, p. 629-631. Previously cited in issue 06, p. 837, Accession no. A84-18134. refs

A85-29258*# Columbia Univ., New York.
NOISE TRANSMISSION THROUGH AIRCRAFT PANELS
R. VAICAITIS (Columbia University, New York, NY), F. W. GROSVELD (Bionetics Corp., Hampton, VA), and J. S. MIXSON (NASA, Langley Research Center, Hampton, VA) (Structures, Structural Dynamics and Materials Conference, 25th, Palm Springs, CA, May 14-16, 1984, Technical Papers. Part 1, p. 211-221) Journal of Aircraft (ISSN 0021-8669), vol. 22, April 1985, p. 303-310. Previously cited in issue 13, p. 1962, Accession no. A84-31648. refs
(Contract NSG-1450)

A85-30017
PERIODIC MOTIONS OF GENERALIZED CONSERVATIVE MECHANICAL SYSTEMS WHOSE EQUATIONS OF MOTION CONTAIN A LARGE PARAMETER [PERIODICHESKIE DVIZHENIIA OBOBSHCHENNO-KONSERVATIVNYKH MEKHANICHESKIKH SISTEM, URAVNENIIA DVIZHENIIA KOTORYKH SODERZHAT BOL'SHOI PARAMETR]
V. V. SAZONOV Moscow, Institut Prikladnoi Matematiki AN SSSR, 28 p. In Russian. refs

An analysis is made of a generalized conservative mechanical system whose equations of motion contain a large parameter characterizing local forces acting along certain generalized coordinates. It is shown that the equations have periodic solutions which are close to periodic solutions to the corresponding degenerate equations. As an example, the periodic motions of a satellite with respect to its center of mass due to gravitational and restoring aerodynamic moments are examined for the case where the aerodynamic moment is much larger than the gravitational moment. Such motions can be treated as nominal unperturbed motions of a satellite under conditions of single-axis aerodynamic attitude control. V.L.

N85-22108*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FURTHER COMPARISON OF WIND TUNNEL AND AIRPLANE ACOUSTIC DATA FOR ADVANCED DESIGN HIGH SPEED PROPELLER MODELS
J. H. DITTMAR 1985 23 p refs To be presented at the 109th Meeting of the Acoust. Soc. of Am., Austin, Tex., 8-12 Apr. 1985
(NASA-TM-86935; E-2448; NAS 1.15:86935) Avail: NTIS HC A02/MF A01 CSCL 20A

Comparisons were made bewtween the SR-2 and SR-3 model propeller noise data taken in the NASA 8-by-6 wind tunnel, in the United Technologies Research Center (UTRC) anechoic tunnel, and with boom and fuselage microphones on the NASA Jetstar airplane. Plots of peak blade passage tone noise versus helical tip Mach number generally showed good agreement. The levels of the airplane fuselage data were somewhat lower than the boom data by an approximately uniform value. The curve shapes were similar except for the UTRC data which was flatter than the other sets. This was attributed to the UTRC data being taken at constant power while the other data were taken at constant advance ratio. General curves of the peak blade passage tone versus helical tip Mach number fit through all the data are also presented. Directivity

shape comparisons at the cruise condition were similar for the airplane and 8-by-6 tunnel data. The UTRC data peaked farther forward but, when an angle correction was made for the different axial Mach number used in the UTRC tests, the shape was similar to the others. The general agreement of the data from the four configurations enables the formation of a good consensus of the noise from these propellers. Author

N85-22109*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NOISE TRANSMISSION LOSS OF A RECTANGULAR PLATE IN AN INFINITE BAFFLE
L. A. ROUSSOS Mar. 1985 36 p refs Presented at the 107th Meeting of the Acoustical Society of America, Norfolk, Va., 7-10 May 1984
(NASA-TP-2398; L-15861; NAS 1.60:2398) Avail: NTIS HC A03/MMF A01 CSCL 20A

An improved analytical procedure was developed that allows for the efficient calculation of the noise transmission characteristics of a finite rectangular plate. Both isotropic and symmetrically laminated composite plates are considered. The plate is modeled with classic thin-plate theory and is assumed to be simply supported on all four sides. The incident acoustic pressure is assumed to be a plane wave impinging on the plate at an arbitrary angle. The reradiated pressure is assumed to be negligible compared with the blocked pressure, and the plate vibrations are calculated by a normal-mode approach. A Green's function integral equation is used to link the plate vibrations to be transmitted far-field sound waves, and transmission loss is calculated from the ratio of incident to transmitted acoustic powers. The result is a versatile research and engineering analysis tool that predicts noise transmission loss and enables the determination of the modal behavior of the plate. E.A.K.

N85-22143# Wisconsin Univ., Madison. Marine Studies Center.
AN AIRBORNE INFRARED THERMAL SCANNING SYSTEM FOR EASY USE ON NAVY P-3 AIRCRAFT Final Report
T. GREEN, III, M. J. GREEN, and F. L. SCARPACE 1 Sep. 1984 66 p
(Contract N00014-79-C-0066)
(AD-A149690) Avail: NTIS HC A04/MF A01 CSCL 17E

This report describes an infrared scanning system which allows almost any Navy P-3 aircraft to be used to obtain maps of sea-surface temperature (SST), and can thus be readily used to provide SST data for many oceanographic experiments. Although a few minor changes need to be made (e.g., adjusting the low-pass filter of the video, and completing the realtime data display software), the device is essentially ready to be put into use. This scanning system will probably be most helpful when operated as part of a larger program, and in areas demanding either frequent coverage, or long flight times. The scale of the phenomena under investigation should probably be at most 50-100 km, and SST should, of course, be indicative of the dynamics of the processes. Such a system would seem to be almost essential to a research program when the SST gradients are sharp, and changing rapidly in time. The sensing device is mounted in a wing pod, and the data are sent optically to recording equipment located in the cabin. The system can be installed on a P-3 in a few hours, and involves no airframe modifications. It has been tested in flight only minor changes are needed to make it fully operational. GRA

N85-22182# Massachusetts Inst. of Tech., Cambridge. Dept. of Materials Science and Engineering.
INVESTIGATION OF DEVICE AND ELECTRONIC INTERACTIONS IN GAAS DEVICE PROCESSING Annual Technical Report, 15 Aug. 1983 - 14 Aug. 1984
H. C. GATOS and J. LAGOWSKI 14 Aug. 1984 11 p
(Contract F49620-83-C-0139)
(AD-A149747; AFOSR-84-1178TR) Avail: NTIS HC A02/MF A01 CSCL 20L

Our Investigation of Defects and Electronic Interactions Associated with GaAs Device Processing has been designed as a three year program with first year tasks focussing on the effects of thermal annealing. During this one year period (August 15, 1983 - August 14, 1984) we have modified the design of the annealing ampule in order to achieve stoichiometry controlled annealing conditions and we have completed the construction of the ultra-high purity annealing apparatus (cosponsored by a grant from (Microgravity Research Associates). Our study of as-grown and annealed GaAs crystals has led to the identification of new defect related midgap levels. We have also discovered that defect interactions in a critical temperature range 800 C to 900 C are controlled by stoichiometry and by the Fermi Energy. We have initiated a collaborative study with Avionics Laboratory of the Wright Patterson Base on ion implantation and defect characterization by the photoluminescence technique. The results of our activity are contained in this report. GRA

17

SOCIAL SCIENCES

Includes social sciences (general); administration and management; documentation and information science; economics and cost analysis; law and political science; and urban technology and transportation.

A85-26785
SUPPORT PROGRAM PLANNING - MANAGING TO GET IT SUPPORTED
R. A. NAVARRO (McDonnell Aircraft Co., St. Louis, MO) IN: AUTOTESTCON '83; Proceedings of the Conference, Fort Worth, TX, November 1-3, 1983 . New York, Institute of Electrical and Electronics Engineers, Inc., 1983, p. 61-64.

Major avionics development programs impose significant management and schedule burdens on the Automatic Test Euipment (ATE) community. The success of an avionic system is directly proportional to the success of its ATE support. Successful, on-time ATE support requires that the contractor create and employ a management process which is usable and responsive to the manager's needs, which provides visibility into the development process, and which assists the manager in the selection of alternate courses of action. McDonnell Aircraft Company (MCAIR) has developed such a Management System for use in MCAIR's management of ATE development efforts associated with the F-15 Multistaged Improvement Program (MSIP). Author

A85-27394
PUNITIVE DAMAGES IN AVIATION PRODUCTS LIABILITY CASES
I. AWFORD (Barlow Lyde and Gilbert, Solicitors, London, England) Air Law (ISSN 0165-2079), vol. 10, Feb. 1985, p. 2-9.

Historical U.S. court decisions regarding punitive damages for air accidents are reviewed noting their potential impact on British air carriers and aircraft manufacturers. Punitive damages for various causes are permitted by law in 46 states. Juries can consider, e.g., the feasibility of safer design, manufacturer knowledge of defects, actual and potential injuries, intentionality with regards profits vs. costs vs. safety, and the wealth of the defendant corporation. Manufacturers may be held liable even if the actions were performed by employees acting outside of company policy. It is recommended that British companies carry full insurance - with British companies - to cover possible punitive awards to plaintiffs. Awards may be reduced in general if criminal charges, rather than liability assessments, are levied against companies and managers. M.S.K.

A85-27395
CARGO CLAIMS - FROM THE CARRIER'S POINT OF VIEW
S. GATES (Beaumont and Son, London, England) Air Law (ISSN 0165-2079), vol. 10, Feb. 1985, p. 10-14.

Techniques for avoiding litigation in British air freight claims are discussed, along with procedures most probably followed if

litigation begins. Courteous and prompt handling of claims by airlines claims officers is recommended, although the chain of events may be upset by apathetic or hostile interim freight carriers. Full freight insurance is necessary in all cases. If litigation arises the petitioner needs to seek as many defendants as possible in order to exceed the limits of liability. The carrier then attempts to assign liability to the handling agent. A current trend is to accept that fault and responsibility are inseparable, and can extend to the Airport Authority, the aircraft manufacturer and the manufacturer of equipment which causes the damage. M.S.K.

A85-27396
REGISTRATION AND NATIONALITY OF AIRCRAFT OPERATED BY INTERNATIONAL AGENCIES IN LAW AND PRACTICE
K. EL-HUSSAINY (Egyptian Civil Aviation Authority, Air Transport, Cairo, Egypt) Air Law (ISSN 0165-2079), vol. 10, Feb. 1985, p. 15-27. refs

The implications of the ICAO Regulation of 1967, which permits the registration of aircraft on other than a national basis, are discussed, particularly for the Arab Air Cargo (AAC) company. The Regulation applies only to States who are parties to the Chicago Convention of 1944 and treats the operating parties as a multinational entity. The entity must operate as if it were a State for the purposes of the Convention, and thereby is exempt from seizure on patient claims in States which are signatories. One of the entity States must be designated as the site of representations of the entire company. The Resolution is vague, however, in terms of assigning the responsibility for air accidents. The Jordan-Iraq AAC petitioned for ICAO certification in 1982 and planned to use aircraft registered exclusively to one of the two partners. It was recommended that all the aircraft used by the AAC be regarded as the responsibility of Jordan, the designated responsible State. M.S.K.

A85-27397
THE LIABILITY OF AIRCRAFT MANUFACTURERS AND CERTIFICATION AUTHORITIES IN THE UNITED KINGDOM
T. SCORER (Barlow Lyde and Gilbert, Solicitors, London, England) Air Law (ISSN 0165-2079), vol. 10, Feb. 1985, p. 28-43. refs

Fine points of an aircraft manufacturer's liability for the product are explored, noting differences which exist between contract and tort issues and procedures in the United Kingdom. Most claims against manufacturers are filed in the U.S., where most of the world's aircraft are manufactured. Claims can be laid at any point in the chain of production and distribution once an article fails and causes damage to health, property or economic well-being. British law requires that all goods are understood as warrantied when used for purposes for which they were sold, even if contractual terms 'unfairly' limit the liability. The existence of unfairness of negligence is left somewhat to the discretionary decision of British judges, and this is done on the bases of 'common sense'. Also, the British Civil Aviation Authority, responsible for certifying aircraft and personnel, may be held negligent if in the case of an accident the Authority is discovered not to have fully discharged their duties of inspection or certification investigation for flightworthiness. M.S.K.

A85-28476
INTERNATIONAL CONFERENCE ON AIR CUSHION TECHNOLOGY, VANCOUVER, CANADA, SEPTEMBER 25-27, 1984, PREPRINTS
Conference sponsored by the Canadian Aeronautics and Space Institute. Ottawa, Canadian Aeronautics and Space Institute, 1984, 114 p. No individual items are abstracted in this volume.

An evaluation is made of the development status of air cushion vehicle (ACV) technology in Canada, including innovative concepts and the theory of ACV operation. Among the topics discussed are an Air Cushion Ice Breaking (ACIB) vehicle design, the heave stability of the Canadian Coast Guard's ACIB, the test program results obtained to date for the Jeff(A) amphibious assault landing craft, a lift system proportional control experiment, and hovercraft lift system evaluation methods. Also considered are the effects of fabric structure on the flex fatigue of ACV skirt materials, problems encountered in the development of air bearing technology, the development of a tangential ACV blower system, the application of Canadian ACV safety standards, experimental ACV development for Antarctic environments, and the feasibility of man-powered ACVs. O.C.

A85-29555
THE CONGRESSIONAL AUTHORIZATION PROCESS AS IT APPLIES TO AERONAUTICAL RESEARCH AND TECHNOLOGY
P. J. LEGENDRE IN: International Instrumentation Symposium, 29th, Albuquerque, NM, May 2-6, 1983, Proceedings . Research Triangle Park, NC, Instrument Society of America, 1983, p. 101-111. refs

The present paper provides a descriptioon of the political process as it affects the National Aeronautics and Space Administration (NASA) budget dealing with the fiscal year 1983 aeronautics technology programs funding. In connection with the budget process, the various congressional committees and joint committees must submit reports on the proposed budget within their jurisdictions to the Budget Committees on both Houses. Attention is given to NASA authorization hearings, an aeronautics hearing on April 1, 1982, a statement for the record, letters to Congress, House action, Senate action, a joint conference, and the NASA appropriations bill. G.R.

A85-30167
SELECTED AMERICAN DECISIONS ON THE WARSAW CONVENTION AND RELATED MATTERS - FEBRUARY 1981 TO JUNE 1984. I
R. MANKIEWICZ Zeitschrift fuer Luft- und Weltraumrecht (ISSN 0340-8329), vol. 34, March 1985, p. 24-43.

N85-22210*# Alabama Univ., Tuscaloosa.
RESEARCH REPORTS: 1984 NASA/ASEE SUMMER FACULTY FELLOWSHIP PROGRAM
L. M. FREEMAN, ed., T. L. OSBORN, ed. (NASA. Marshall Space Flight Center), J. B. DOZIER, ed. (NASA. Marshall Space Flight Center), and G. R. KARR, ed. (Alabama Univ., Huntsville) Jan. 1985 776 p refs Program held 29 May - 3 Aug. 1984
(Contract NGT-01-002-099)
(NASA-CR-171317; NAS 1.26:171317) Avail: NTIS HC A99/MF E03 CSCL 05I

A NASA/ASEE Summer Faulty Fellowship Program was conducted at the Marshall Space Flight Center (MSFC). The basic objectives of the programs are: (1) to further the professional knowledge of qualified engineering and science faculty members; (2) to stimulate an exchange of ideas between participants and NASA; (3) to enrich and refresh the research and teaching activities of the participants' institutions; and (4) to contribute to the research objectives of the NASA Centers. The Faculty Fellows spent ten weeks at MSFC engaged in a research project compatible with their interests and background and worked in collaboration with a NASA/MSFC colleague. This document is a compilation of Fellows' reports on their research during the summer of 1984. Topics covered include: (1) data base management; (2) computational fluid dynamics; (3) space debris; (4) X-ray gratings; (5) atomic oxygen exposure; (6) protective coatings for SSME; (7) cryogenics; (8) thermal analysis measurements; (9) solar wind modelling; and (10) binary systems.

N85-22255*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
BIBLIOGRAPHY OF LEWIS RESEARCH CENTER TECHNICAL PUBLICATIONS ANNOUNCED IN 1983
Jun. 1984 345 p
(NASA-TM-83693; E-2151; NAS 1.15:83693) Avail: NTIS HC A16/MF A01 CSCL 05B

This compilation of abstracts describes and indexes over 800 technical publications that resulted from the scientific and engineering work performed and managed by the Lewis Research Center in 1983. Announced in the 1983 issues of STAR (Scientific

and Technical Aerospace Reports) and/or IAA (International Aerospace Abstracts), the documents cited include research reports, journal articles, conference presentations, patents and patent applications, and theses. A.R.H.

N85-22257# Royal Aircraft Establishment, Farnborough (England).
LIST OF RAE (ROYAL AIRCRAFT ESTABLISHMENT) TRANSLATIONS ISSUED DURING THE PERIOD 1 MARCH 1983 - 31 MARCH 1984
P. O. FLINT Mar. 1984 8 p
(AD-A149787; RAE-LIBRARY BIB-383; DRIC-BR-92835) Avail: NTIS HC A02/MF A01 CSCL 05B

This list covers all Royal Aircraft Establishment translations published from 1 March 1983 to 31 March 1984 and follows Library Bibliography 381. Previous lists have been issued in Library Bibliographies 243, 249, 254, 261, 283, 313, 319, 324, 330, 353, 360, 366, 369, 373, 380 and 381. GRA

18

SPACE SCIENCES

Includes space sciences (general); astronomy; astrophysics; lunar and planetary exploration; solar physics; and space radiation.

A85-28043
THERMOLUMINESCENCE STUDIES ON JILIN METEORITE
G. A. WAGNER (Max-Planck-Institut fuer Kernphysik, Heidelberg, West Germany) Earth and Planetary Science Letters (ISSN 0012-821X), vol. 72, no. 2-3, Feb. 1985, p. 304-306. refs

The thermoluminescence (TL) of Jilin meteorite was measured as a function of depth (up to 21.7 mm) below the fusion crust using the 50-100 micron size fraction. Up to 6 mm depth, the natural TL increases steeply due to thermal draining during atmospheric passage resulting in a temperature gradient of 45 C/mm. Below 7 mm depth, a constant natural TL signal is observed corresponding to an equivalent dose of 3300 Gy. This quantity represents a lower limit for the total natural dose received by the meteorite. Assuming a dose rate of 0.1 Gy/a a minimum age of 33,000 years is calculated for the last thermal event (less than 320 deg, few seconds) affecting the Jilin meteorite (i.e. greater than 7 cm below the fusion crust). Author

19

GENERAL

A85-29374
PIONEERING COMMERCIAL ROCKETRY IN THE UNITED STATES OF AMERICA - REACTION MOTORS, INC. 1941-1958. II - PROJECTS
F. H. WINTER (National Air and Space Museum, Washington, DC) and F. I. ORDWAY, III (Alabama Space and Rocket Center, Huntsville, AL) British Interplanetary Society, Journal (ISSN 0007-084X), vol. 38, April 1985, p. 155-168. refs

The development of Jet-Assisted-Take-Off (JATO) propulsion systems for aircraft is discussed, as part of a general review of commercial rocketry in the U.S. from 1941 to 1958. Attention is given to the structural designs, propellant chemistry, and materials developed by one firm for JATO aircraft between 1941 and 1958. Among the specific systems discussed are: the 3000-A-1 rocket engine, the 6000-C4 engine, the design for the supersonic X-1 rocket plane, and the Viking XLR 10-RM-2 engine. The integration of JATO engine technology into the ICBM program and the early space program is also considered. I.H.

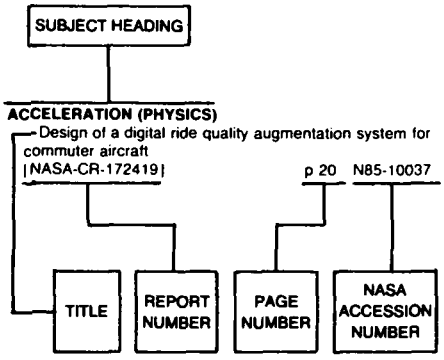
A85-29949
SOVIET DOCTRINE AND AVIATION TECHNOLOGY STUDY SEMINAR, WASHINGTON, DC, APRIL 12, 13, 1985, PROCEEDINGS
Seminar sponsored by the American Institute of Aeronautics and Astronautics. New York, American Institute of Aeronautics and Astronautics, 1985, 232 p. No individual items are abstracted in this volume.

Examinations are conducted of the research, design, and construction organizations and practices that have been developed by the Soviet Union's civil and military aviation authorities, with attention to the nature and consequences of the pervasive centralization and doctrinal direction which characterize their approach. The present discussions also focus on the incremental system by means of which families of aircraft are developed on the basis of already-proven technologies, and the design pressures exerted by the Soviet Union's severe problems of terrain, high latitudes, and inclement weather. Fighters, bombers, cargo, passenger, and rotary wing aircraft are considered, with a view to their developmental sequences and the character of the response they represent to perceived Western development trends. O.C.

A85-29950#
EVOLUTION OF SOVIET AIR POWER
K. R. WHITING American Institute of Aeronautics and Astronautics, Soviet Doctrine and Aviation Technology Study Seminar, Washington, DC, Apr. 12, 13, 1985, Paper. 88 p. refs

A history of military aviation in the USSR is presented. Attention is given to the evolution of combat aircraft design, the political aspects of air power, and the role of Soviet air forces in repelling the German invasion in 1941-1943. The development of military aircraft since World War II is also discussed, and brief descriptions of current defense interceptor and bomber air forces are presented. Among the most recent aircraft designs described are: the Hind assault transport aircraft, the Yak/36 Freehand V/STOL twin turbojet assault aircraft, and the Backfire and Badger bombers. I.H.

Typical Subject Index Listing



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A

ABLATION
Angular motion influence on re-entry vehicle ablation or erosion asymmetry formation p 431 A85-26446
ACCELERATED LIFE TESTS
Forced corrosion tests of construction components of passenger aircraft fuselages p 436 N85-20062
ACCELEROMETERS
The enigma of false bias detection in a strapdown system during transfer alignment p 406 A85-26428
ACCIDENT PREVENTION
The use of falconry as mean to persuade the birds to stay out of the airport vicinity p 404 N85-19956
ACOUSTIC DUCTS
A mapped, factored-implicit scheme for the computation of duct and far-field acoustics p 460 A85-29097
ACOUSTIC EMISSION
Effects of moisture on high performance laminates p 435 A85-29929
Development of acoustic emission techniques for quantitative use on aerospace C.F.R.P. structures p 445 A85-29938
ACOUSTIC EXCITATION
A review of complete weapon vibration testing techniques p 426 A85-26555
Preliminary analysis of tone-excited two-stream jet velocity decay
[NASA-TM-86951] p 397 N85-21114
ACOUSTIC FATIGUE
The effect of acoustic/thermal environments on advanced composite fuselage panels p 445 A85-29251
ACOUSTIC PROPAGATION
A mapped, factored-implicit scheme for the computation of duct and far-field acoustics p 460 A85-29097
ACTUATION
Magentically actuated compressor
[NASA-CASE-GSC-12799-1] p 448 N85-21404
ACTUATORS
Streamtube expansion effects on the Darrieus wind turbine p 451 A85-27098
Solar powered actuator with continuously variable auxiliary power control
[NASA-CASE-MFS-25637-1] p 454 N85-21769
ADA (PROGRAMMING LANGUAGE)
The use of Ada in distributed simulations p 457 A85-28612
Ada - Will DOD's new computer language cut software cost? p 459 A85-29669
ADAPTIVE CONTROL
Dual control guidance for simultaneous identification and interception p 407 A85-27510
Digital simulation of adaptive guidance and control system of a homing missile p 409 A85-28604
Development of a velocity control algorithm for controlling a 6-DOF captive trajectory model support p 427 A85-29567
ADHESIVE BONDING
Use of structural adhesives in aircraft turbine engine nacelles p 382 A85-27600
Surface characterization of anodic oxides on aluminum alloys by means of surface potential difference, surface impedance and surface morphology p 442 A85-27908
Design of an adhesive lap joint p 444 A85-29142
Aeronautical applications of adhesive bonding p 384 A85-29854
ADHESIVES
Ageing of structural film adhesives - Changes in chemical and physical properties and the effect on joint strength p 434 A85-27913
Elastomer toughened polyimide adhesives --- bonding metal and composite material structures for aircraft and spacecraft
[NASA-CASE-LAR-12775-2] p 437 N85-21349
ADSORPTION
Kinetics of a gas adsorption compressor p 438 A85-26504
AERIAL PHOTOGRAPHY
Evaluation of aircraft MSS analytical block adjustment p 439 A85-26641
Microbursts in JAWS depicted by Doppler radars, PAM, and aerial photographs p 453 A85-28777
AERIAL RECONNAISSANCE
Multifunction rotating electronically scanned radar (RESR) for air surveillance p 408 A85-27837
AERIAL RUDDERS
Translating rudder pedal system
[AD-D011510] p 425 N85-21172
AEROACOUSTICS
Aircraft noise annoyance at three joint air carrier and general aviation airports p 452 A85-27359
A mapped, factored-implicit scheme for the computation of duct and far-field acoustics p 460 A85-29097
AERODYNAMIC BALANCE
Design refinements in multi-component strain gage balances p 445 A85-29561
AERODYNAMIC CHARACTERISTICS
X-marching methods to solve the Navier-Stokes equations in two- and three-dimensional flows
[ONERA, TP NO. 1985-6] p 387 A85-27886
The effect of quality of gas jet mixing in the mixing chamber of a subsonic jet pump on the diffuser performance p 442 A85-28374
Aerodynamic characteristics and flow patterns for a number of bluff bodies in subsonic gas flow p 389 A85-28389
Aerodynamic characteristics of delta planes p 389 A85-28396
Quantifying AFTI/F-16 gust alleviation characteristics using frequency response analysis p 424 A85-28641
Dynamics of forebody flow separation and associated vortices p 392 A85-29262
Joined wing - Child of the computer p 393 A85-29672
Calculation of aerodynamic characteristics of winglets and experimental verification p 393 A85-29692
Equation associated with the theory of local interaction in a rarefied gas p 394 A85-30110
Icing flight research - Aerodynamic effects of ice and ice shape documentation with stereo photography
[AIAA PAPER 85-0468] p 402 A85-30192
Noise constraints effecting optimal propeller designs
[NASA-TM-86967] p 394 N85-19923
Wind-tunnel investigation of a full-scale canard-configured general aviation airplane
[NASA-TP-2382] p 395 N85-19925
Measured unsteady transonic aerodynamic characteristics of an elastic supercritical wing with an oscillating control surface
[NASA-TM-86376] p 398 N85-21116
A calculation of slender delta wing with leading-edge separation by quasi-vortex-lattice method p 400 N85-21423
AERODYNAMIC COEFFICIENTS
A method for flight-test determination of propulsive efficiency and drag p 411 A85-26757
Transport processes in the upper atmosphere p 454 N85-20375
Unsteady aerodynamic characterization of a military aircraft in vertical gusts
[NASA-TM-77810] p 396 N85-21110
Flight-measured laminar boundary-layer transition phenomena including stability theory analysis
[NASA-TP-2417] p 398 N85-21118
AERODYNAMIC CONFIGURATIONS
Numerical calculation of rotor performances in real flight configurations
[ONERA, TP NO. 1985-13] p 388 A85-27892
Optimal aerodynamic configurations in a twisted hypersonic gas flow p 389 A85-28390
Parametric study of a canard-configured transport using conceptual design optimization
[NASA-TP-2400] p 415 N85-19979
Semianalytic modeling of aerodynamic shapes
[NASA-TP-2413] p 398 N85-21120
AERODYNAMIC DRAG
A method for flight-test determination of propulsive efficiency and drag p 411 A85-26757
Vector optimization of aircraft deceleration in air p 423 A85-27795
Variational problems of gas dynamics - Formulations, methods of solution, and the relationship between exact and approximate approaches p 388 A85-28382
Investigation of drag and heat transfer for nonuniform supersonic flow past a body in the cases of laminar and turbulent regimes p 388 A85-28387
An analysis of the resistance of two disks in turbulent flow of an incompressible fluid p 390 A85-28466
Techniques to analyze vehicle coastdown data
[DE85-005159] p 399 N85-21127
Determination of the drag of free flying particles in supersonic flow with a pulsed laser p 400 N85-21129
Technical evaluation report on the FDP Symposium on Flight Test Techniques
[AGARD-AR-208] p 417 N85-21157
AERODYNAMIC HEATING
Thermoluminescence studies on Jilin meteorite p 463 A85-28043
AERODYNAMIC INTERFERENCE
A slotted test section numerical model for interference assessment p 426 A85-26759
An asymptotic analysis of transonic wind-tunnel interference based on the full potential theory p 394 A85-30171
AERODYNAMIC LOADS
Streamtube expansion effects on the Darrieus wind turbine p 451 A85-27098
Measured and calculated airloads on a transport wing model p 392 A85-29263
Design and experimental investigation of a high-loaded transonic axial model turbine p 421 A85-29695
Airbus fatigue tests p 416 N85-20186
A study for calculating rotor loads using free vortex concept p 395 N85-20194
Parachute inflation dynamics p 396 N85-20792
Calculation of the flow around thick wings with separation vortices p 400 N85-21424
AERODYNAMIC NOISE
Near-field frequency-domain theory for propeller noise p 460 A85-29079

B

C

D

E

F

G

H

I

J

K

L

M

N

O

P

Q

R

S

T

U

V

W

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Z

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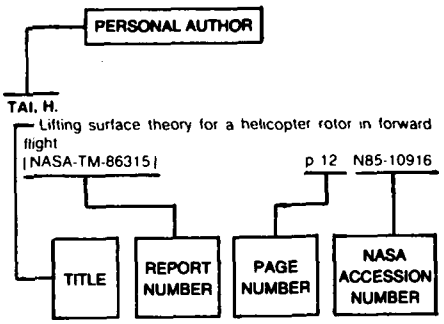

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A

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C

D

E

F

G

H

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J

K

L

M

N

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P

Q

R

S

T

X

Y

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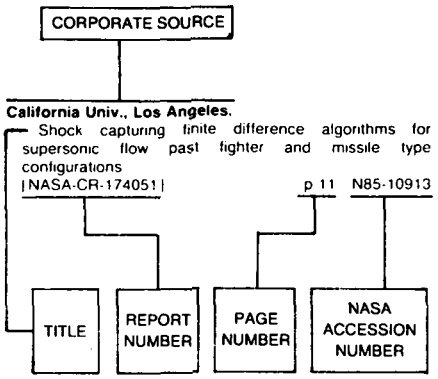

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SOURCE

D

E

F

G

H

I

J

K

L

M

N

O

P

R

S

T

U

V

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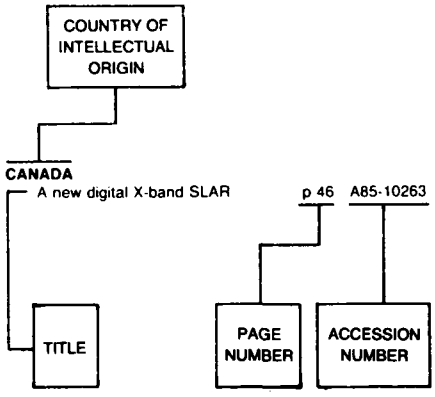

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A

AUSTRALIA
The properties of isolated and coupled Savonius rotors p 451 A85-27346
An energy approach to linearizing squeeze-film damper forces p 440 A85-27479
An explanation for the asymmetry of the modulation sidebands about the tooth meshing frequency in epicyclic gear vibration p 441 A85-27480
Ageing of structural film adhesives - Changes in chemical and physical properties and the effect on joint strength p 434 A85-27913
Modelling turbulent recirculating flows in complex geometries p 445 A85-29967
Vibration analysis of a rotating blade using dynamic discretization p 446 A85-29968
Description of a technique to measure spray distribution in an air stream [AD-A149780] p 398 N85-21122
On the application of compatibility checking techniques to dynamic flight test data [ARL-AERO-R-161] p 416 N85-21151
Fatigue crack propagation in mirage 1110 wing main spar specimens and the effects of spectrum truncation on life [ARL-STRUC-R-405] p 417 N85-21152
Deflection model of a CT4-A undercarriage [AD-A149778] p 417 N85-21156
Interactions between F-111 fuselage fuel tank sealants. Part 2: Variation in performance properties of polysulfides after contact with polyester degradation products [AD-A149777] p 438 N85-21368
Finite element analysis of problems associated with life enhancement techniques [ARL-STRUC-R-404] p 451 N85-21676

B

BELGIUM
A robust and efficient technique for dealing with time-varying instrumental bias in linear filtering p 458 A85-29370

C

CANADA
Streamtube expansion effects on the Darrieus wind turbine p 451 A85-27098
International Conference on Air Cushion Technology, Vancouver, Canada, September 25-27, 1984, Preprints p 462 A85-28476
Design of an adhesive lap joint p 444 A85-29142
Selected American decisions on the Warsaw Convention and related matters - February 1981 to June 1984. I p 462 A85-30167
An asymptotic analysis of transonic wind-tunnel interference based on the full potential theory p 394 A85-30171
Birds and aviation [AD-P004177] p 402 N85-19939
Birds and aircraft engine strike rates [AD-P004184] p 403 N85-19946
Control of mammals at airports [AD-P004192] p 404 N85-19957
Reducing gull use of some attractions near airports [AD-P004195] p 428 N85-19962
Effectiveness of an overhead wire barrier in deterring gulls from feeding at a sanitary landfill [AD-P004199] p 453 N85-19966
Evaluation of effectiveness of bird scaring operations at a sanitary landfill site near CFB Trenton, Ontario, Canada [AD-P004201] p 454 N85-19968
A study of transonic flutter of a two-dimensional airfoil using the U-g and p-k methods [LR-615] p 398 N85-21121
Skin friction measurements for 2 relatively thick airfoil sections at high Reynolds number [AD-A150021] p 399 N85-21125
A history of full-scale testing of aircraft structures at the National Aeronautical Establishment [NAE-AN-24] p 417 N85-21153
CHILE
Biomechanics finds practical applications in aerospace research p 446 N85-20205
CHINA, PEOPLE'S REPUBLIC OF
A fast cool-down J-T minicryocooler p 438 A85-26510
A special boundary element technique in transonic flow p 385 A85-26690
A full Navier-Stokes solution of viscous gas flow through profile cascade on S1 stream surface of revolution employing nonorthogonal curvilinear coordinate system p 385 A85-26699
Natural mode analysis of N blades disc coupled system - Modal synthesis of symmetric structure with Cnv group p 445 A85-29147
Calculation of aerodynamic characteristics of winglets and experimental verification p 393 A85-29692
A type-dependent splitting scheme with variable parameters for the longitudinal large-disturbance potential equation p 393 A85-29693
Design and experimental investigation of a high-loaded transonic axial model turbine p 421 A85-29695
An investigation of association region in maneuvering multi-target tracking p 410 A85-29697
Turbulent vortices and bionics in turbojet p 393 A85-29700
Acta Aeronautica et Astronautic Sinica (selected articles) [AD-A148830] p 384 N85-19922
China report: Science and technology [JPRS-CST-84-026] p 446 N85-20189
A fast algorithm of the finite difference method for computation of the transonic flow past an arbitrary airfoil with the conservative full-potential equation p 395 N85-20191
A mixed finite difference analysis of the internal and external transonic flow fields of inlets with centerbody p 446 N85-20192
A study for calculating rotor loads using free vortex concept p 395 N85-20194
Experimental investigation of heat transfer to bluff cylinders and cones in hypersonic rarefied gas flow p 396 N85-20195
New air supply-prime mover facility for engine tests detailed p 446 N85-20204
China report: Science and technology [JPRS-CST-84-039] p 446 N85-20206
A locally linearized panel method for tran-/subsonic flow past an oscillating wing p 396 N85-20212
Transonic pressure distribution computations of a flexible wing p 396 N85-20213
On relaxation of transonic flows around zero-lift airfoils and convergence of self-correcting wing tunnels p 396 N85-20214
Finite difference computation of the flow around airfoils in two-dimensional transonic slotted wall wind tunnel p 396 N85-20216
Acta Electronica Sinica (selected articles) [AD-A148829] p 447 N85-20252
A calculation of slender delta wing with leading-edge separation by quasi-vortex-lattice method p 400 N85-21423
Calculation of the flow around thick wings with separation vortices p 400 N85-21424
An experimental investigation of flap turbulent heat transfer and pressure characteristics in hypersonic flow p 400 N85-21426
CZECHOSLOVAKIA
Simulation of aircraft control systems on flight simulators p 415 A85-29861
Television systems for flight simulators p 427 A85-29862
Simulators for training aircraft maintenance personnel p 427 A85-29863
Problems in the simulation of the automatic flight control systems of aircraft p 424 A85-29864
Current trends in the development of flight simulators p 427 A85-29866
Prospects for the development of flight simulation equipment p 427 A85-29867

D

DENMARK
The bird strike situation and its ecological background in the Copenhagen Airport, Kastrup [AD-P004203] p 404 N85-19970
Bird Strike Committee Europe [AD-P004207] p 405 N85-19974

F

FRANCE
A new era in commercial aircraft flight management p 382 A85-27448
A viscous-inviscid interaction method for computing unsteady transonic separation [ONERA, TP NO. 1985-5] p 387 A85-27885
X-marching methods to solve the Navier-Stokes equations in two- and three-dimensional flows [ONERA, TP NO. 1985-6] p 387 A85-27886
Transition calculations in three-dimensional flows [ONERA, TP NO. 1985-7] p 387 A85-27887
Quantitative exploitation of tracer visualization obtained in the hydrodynamic tunnels of ONERA [ONERA, TP NO. 1985-10] p 442 A85-27889
Applications of a photomultiplier to visualization of aerodynamic flows by laser tomography [ONERA, TP NO. 1985-11] p 442 A85-27890
Rotor wake measurements for a rotor in forward flight [ONERA, TP NO. 1985-12] p 387 A85-27891
Numerical calculation of rotor performances in real flight configurations [ONERA, TP NO. 1985-13] p 388 A85-27892
Overview of icing research at ONERA [AIAA PAPER 85-0335] p 401 A85-28028

G

I

J

N

P

R

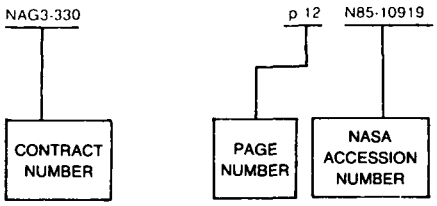
S

U

UNITED ARAB REPUBLIC

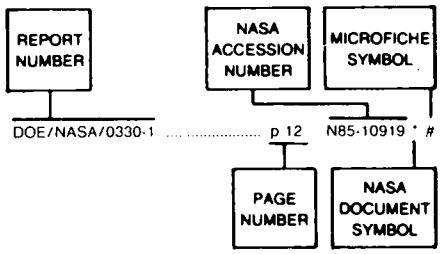
UNITED KINGDOM

Typical Contract Number Index Listing



Listings in this index are arranged alphanumerically by contract number. Under each contract number, the accession numbers denoting documents that have been produced as a result of research done under that contract are arranged in ascending order with the AIAA accession numbers appearing first. The accession number denotes the number by which the citation is identified in the abstract section. Preceding the accession number is the page number on which the citation may be found.

Typical Report Number Index Listing



Listings in this index are arranged alphanumerically by report number. The page number indicates the page on which the citation is located. The accession number denotes the number by which the citation is identified. An asterisk (*) indicates that the item is a NASA report. A pound sign (#) indicates that the item is available on microfiche.

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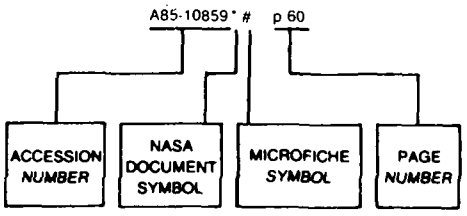

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