NASA SP-7037(188)
June 1985

Aeronautical Engineering
A Continuing Bibliography with Indexes

National Aeronautics and
Space Administration

SPECIAL NOTICE ENCLOSED
NEW FOREIGN TECHNOLOGY INDEX INCLUDED IN THIS ISSUE

Pages 311-379

June 1985

ACCESSION NUMBER RANGES

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

STAR (N-10000 Series)	N85-17932 – N85-19920
IAA (A-10000 Series)	A85-22567 – A85-26196

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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.

We are testing out this approach by helping readers bring foreign technology into focus. We would like to know whether it is useful, and how it might be improved.

Check below, tear out, fold, staple, and return this sheet.

Foreign Technology Index:

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NASA SP-7037(188)

AERONAUTICAL ENGINEERING

A CONTINUING BIBLIOGRAPHY WITH INDEXES

(Supplement 188)

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 May 1985 in

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

NASA Scientific and Technical Information Branch 1985
National Aeronautics and Space Administration
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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 477 reports, journal articles, and other documents originally announced in May 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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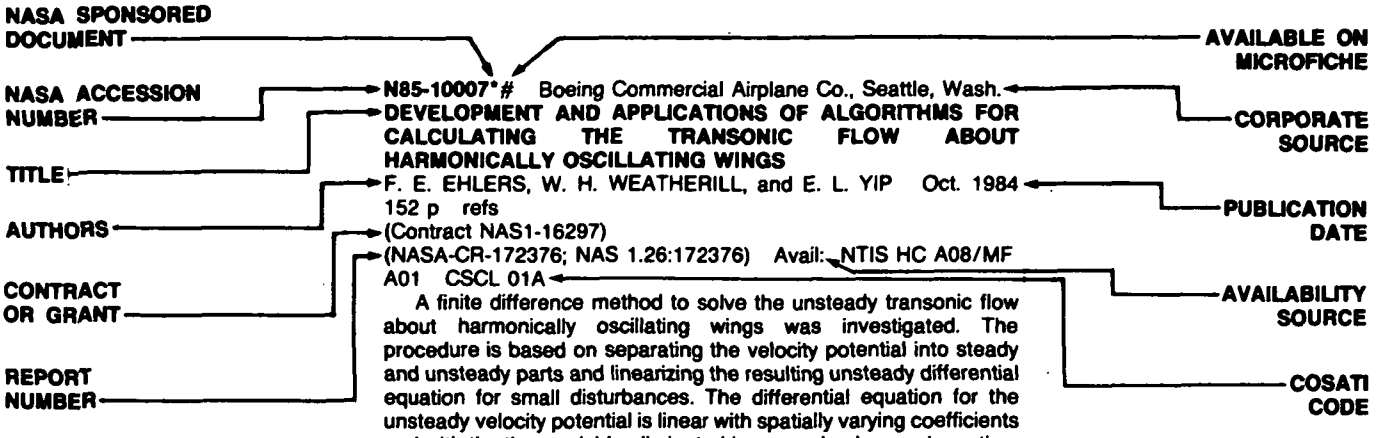

N85-10007*# Boeing Commercial Airplane Co., Seattle, Wash.

DEVELOPMENT AND APPLICATIONS OF ALGORITHMS FOR CALCULATING THE TRANSONIC FLOW ABOUT HARMONICALLY OSCILLATING WINGS

F. E. EHLERS, W. H. WEATHERILL, and E. L. YIP Oct. 1984
152 p refs
(Contract NAS1-16297)
(NASA-CR-172376; NAS 1.26:172376) Avail: NTIS HC A08/MF A01 CSCL 01A

A finite difference method to solve the unsteady transonic flow about harmonically oscillating wings was investigated. The procedure is based on separating the velocity potential into steady and unsteady parts and linearizing the resulting unsteady differential equation for small disturbances. The differential equation for the unsteady velocity potential is linear with spatially varying coefficients and with the time variable eliminated by assuming harmonic motion. An alternating direction implicit procedure was investigated, and a pilot program was developed for both two and three dimensional wings. This program provides a relatively efficient relaxation solution without previously encountered solution instability problems. Pressure distributions for two rectangular wings are calculated. Conjugate gradient techniques were developed for the asymmetric, indefinite problem. The conjugate gradient procedure is evaluated for applications to the unsteady transonic problem. Different equations for the alternating direction procedure are derived using a coordinate transformation for swept and tapered wing planforms. Pressure distributions for swept, untaped wings of vanishing thickness are correlated with linear results for sweep angles up to 45 degrees. E.A.K.

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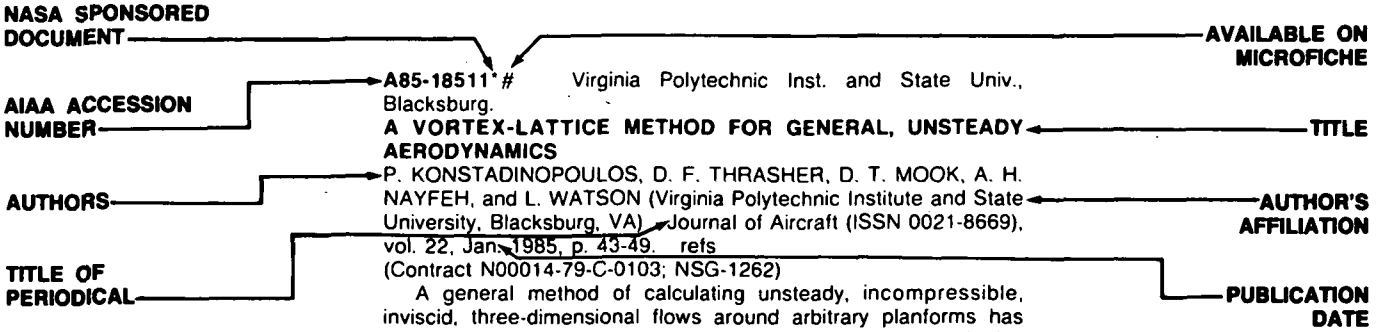

A85-18511*# Virginia Polytechnic Inst. and State Univ., Blacksburg.

A VORTEX-LATTICE METHOD FOR GENERAL, UNSTEADY AERODYNAMICS

P. KONSTADINOPOULOS, D. F. THRASHER, D. T. MOOK, A. H. NAYFEH, and L. WATSON (Virginia Polytechnic Institute and State University, Blacksburg, VA) Journal of Aircraft (ISSN 0021-8669), vol. 22, Jan. 1985, p. 43-49. refs
(Contract N00014-79-C-0103; NSG-1262)

A general method of calculating unsteady, incompressible, inviscid, three-dimensional flows around arbitrary planforms has been developed. The method is an extension of the vortex-lattice technique. It is not limited by aspect ratio, camber, or angle of attack, as long as vortex breakdown does not occur above the surface of the wing and separation occurs only along sharp edges. As the wing performs arbitrary maneuvers, the position of the wake and the distribution of circulation on the wing and in the wake are obtained as functions of time. One desirable feature of the present method is its ability to treat steady lifting flows very efficiently. Several examples of steady and unsteady flows are presented. These include rectangular wings, with and without flaps, delta, and cropped delta wings. Author

AERONAUTICAL ENGINEERING

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AERONAUTICS (GENERAL)

A85-23180#
INNOVATION IN AIRCRAFT STRUCTURES - FIFTY YEARS AGO AND TODAY
N. J. HOFF (Stanford University, Stanford, CA) AIAA Student Journal (ISSN 0001-1460), vol. 22, Winter 1985, p. 2-11, 22-25. refs

The development history of metallic monocoque aircraft structures is traced from its earliest American precursor, the Lockheed Vega, to the commercially highly successful DC-3, and is then contrasted with the more recent development of fiber-reinforced composite structures. It is noted that, although the first successful fiberglass-reinforced plastic sailplane structures were flown in the mid-1950s, the thirty intervening 30 years of technology development have yet to produce an all-composite transport aircraft, while aluminum-based monocoque structures were in airline use within seven years of their introduction. It is suggested that this lag may be due to a major sociocultural change, from the comparatively enthusiastic acceptance of risks in the 1920s to the extreme caution of the present day, as reflected in codes of strict product liability. O.C.

A85-23619
AIRCRAFT REPAIR (2ND REVISED AND ENLARGED EDITION) [REMONT LETATEL'NYKH APPARATOV /2ND REVISED AND ENLARGED EDITION/]
N. L. GOLEGO, ED. Moscow, Izdatel'stvo Transport, 1984, 424 p. In Russian. No individual items are abstracted in this volume.

The organization of aircraft repair service and principal repair techniques and procedures are reviewed. Topics discussed include the main types of malfunctions and their causes, troubleshooting procedures, statistical analysis of defects, and principal processes for rebuilding parts of airframes and engines. The discussion also covers the repair of helicopters, assembly and testing of aircraft, and principles of the design of repair processes. V.L.

A85-24512#
FUTURE HELICOPTER DEVELOPMENTS [ZUKUENFTIGE HUBSCHRAUBERENTWICKLUNGEN]
P. G. HAMEL and B. L. GMELIN (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Institut fuer Flugmechanik, Brunswick, West Germany) Internationales Hubschrauberforum, 15th, Bueckeburg, West Germany, May 23, 24, 1984, Paper. 23 p. In German. refs

The possibilities and limits of the application of new technologies to the improvement of helicopter steering system flying qualities are discussed. The risks inherent in the integration of such technologies are considered, and the significance of experimental studies in that integration is addressed. The role of wind tunnel simulations in the development of new rotor systems and of real time and in-flight simulations in the training of pilots are discussed. C.D.

A85-25100
COMPOSITES FOR ALUMINUM EXTRUSIONS
F. H. REED (U.S. Army, Development and Engineering Directorate, St. Louis, MO) ManTech Journal, vol. 9, no. 4, 1984, p. 3-8. Army-supported research.

A program in which conventional hand layup and autoclave cure techniques are applied to the design, construction, and field evaluation of composite flooring and underfloor structure in the U.S. Army CH-47D Chinook helicopter is discussed. The cargo floor beam design and the design criteria which include frame bending and shear design loads induced by water landing and vehicle wheel loads on the ramp treadways are presented. Fabrication techniques are examined with regard to pultruded beam tee caps and pultruded beam shear web panels. Results of a comparative cost estimate between an all aluminum beam and an all composite pultruded shear web and cap replacement beam assembly are presented. M.D.

A85-25225
AIRMEC 83 - INTERNATIONAL AIRCRAFT MAINTENANCE ENGINEERING EXHIBITION AND CONFERENCE, 3RD, DUESSELDORF, WEST GERMANY, APRIL 12-15, 1983, CONFERENCE REPORTS
Duesseldorf, West Germany, Duesseldorfer Messegesellschaft mbH-NOWEA, 1983, 339 p. No individual items are abstracted in this volume.

The organization and technology of aircraft maintenance are discussed in reviews and reports and illustrated with diagrams, graphs, and photographs. Topics examined include cost-reduction strategies, hangars and hangar equipment, training questions, airframe and engine maintenance, maintenance for general aviation, avionics maintenance, and the impact of future aircraft and maintenance technologies. T.K.

A85-25450
DFVLR, ANNUAL REPORT 1983 [DEUTSCHE FORSCHUNGS- UND VERSUCHSANSTALT FUER LUFT- UND RAUMFAHRT, JAHRESBERICHT 1983]
Cologne, Deutsche Forschungs- und Versuchsanstalt fuer Luftund Raumfahrt, 1984, 98 p. In German. No individual items are abstracted in this volume.

The activities of the DFVLR during 1983 are surveyed and illustrated with specific examples. Topics examined include ATC, aircraft development, turbine motors and fluid-flow engines, nonnuclear energy systems, satellite communications and navigation systems, terrestrial remote sensing, space-flight systems, and sensor-controlled robots. Consideration is given to the organizational structure of the institution; its relations with government, industry, and the universities; personnel developments; and financial status. Graphs, diagrams, photographs, tables, and a balance sheet are provided. T.K.

A85-25977
AN INTRODUCTION TO MSG-3
D. NAKATA (Trans World Airlines, Inc., Kansas City, MO) Society of Automotive Engineers, Aerospace Congress and Exposition, Long Beach, CA, Oct. 15-18, 1984. 6 p. refs
(SAE PAPER 841481)

MSG-3 (Maintenance Steering Group - Third Revision) has the objective to provide an analysis method which may be used to

determine the initial maintenance requirements for a new aircraft and/or engine. MSG-3 is the result of a new type of maintenance philosophy, which is based on the 'on condition' concept. According to this concept, the maintenance requirements are determined by the condition of the aircraft. It is, however, necessary to recognize this condition and react accordingly. Aspects of MSG history are discussed, taking into account the MSG-1 introduced and used in the late 1960's, the MSG-2, and developments leading to the MSG-3. Attention is given to the MSG-3 format, and MSG-3 enhancements. G.R.

A85-25978
INTEGRATION OF MSG-3 INTO AIRLINE OPERATION
L. F. BRETT (Trans World Airlines, Inc., Kansas City, MO) Society of Automotive Engineers, Aerospace Congress and Exposition, Long Beach, CA, Oct. 15-18, 1984. 5 p.
(SAE PAPER 841483)

An airline operator's development of an initial maintenance program has its basis in the FAA's MSG-3 guidelines. The accuracy and clarity of the MSG-3 review process provide a smooth transition for the airline's manpower, parts, tooling, ground equipment, and other established systems, from a given aircraft to a new type. By clearly identifying maintenance tasks, MSG-3 makes manpower resource requirement forecasting easier, allowing determinations to be made of the level of skills that must be used in maintenance tasks. O.C.

A85-25979
MSG-3 - A METHOD FOR MAINTENANCE PROGRAM PLANNING
J. A. PONTECORVO (FAA, Office of Airworthiness, Washington, DC) Society of Automotive Engineers, Aerospace Congress and Exposition, Long Beach, CA, Oct. 15-18, 1984. 6 p.
(SAE PAPER 841485)

An account is given of the development of the Airliner/Manufacturer Maintenance Program Planning document, which, having been formulated by the FAA's Maintenance Steering Group-3 Task Force, is designated 'MSG-3'. Before any new model aircraft enters commercial service, the airline in question must have its maintenance and inspection program approved by the FAA. The airline develops a program for submission to the FAA which is in accord with MSG-3's general organization and decision process for determining the scheduled maintenance requirements projected for the life of both aircraft and powerplant. O.C.

A85-25983
TECHNOLOGY AND THE MARKET PLACE - A CHANGING AIR TRANSPORT EQUATION
J. MORRIS and L. ROMBERG (Douglas Aircraft Co., Long Beach, CA) Society of Automotive Engineers, Aerospace Congress and Exposition, Long Beach, CA, Oct. 15-18, 1984. 14 p.
(SAE PAPER 841-545)

Air transportation is a technology sensitive field. The impressive growth that has taken place is reviewed and the interaction between technology and marketplace is examined. Future developments as suggested by current changes in the operating industry and technological trends are also discussed. It is concluded that technology will continue to support market growth in the foreseeable future, but cost effective applications increasingly present challenges to the manufacturing industry. Author

A85-25989
MSG-3 AS VIEWED BY THE MANUFACTURER (WAS IT EFFECTIVE?)
S. J. BRADBURY (Boeing Commercial Airplane Co., Renton, WA) Society of Automotive Engineers, Aerospace Congress and Exposition, Long Beach, CA, Oct. 15-18, 1984. 14 p. refs
(SAE PAPER 841482)

An evaluation is made of the effectiveness of the FAA's MSG-3 decision process, which was used to develop a scheduled maintenance program for the 757 and 767 aircraft currently being acquired by airline operators. MSG-3 addresses many aspects of the maintenance program development process in very general terms, leaving working groups to consider specific aspects of strutures, systems, avionics, powerplants, and control. Recommendations are presently made toward a future maintenance program formulation process. O.C.

A85-26014
DESIGN METHODS AND TECHNOLOGY OF TRANSPORT AIRCRAFT OF TODAY AND TOMORROW [METHODES DE CONCEPTION ET TECHNOLOGIE DES AVIONS DE TRANSPORT AUJOURD'HUI ET DEMAIN]
C. LENSEIGNE (Aerospatiale, Toulouse, France) L'Aeronautique et l'Astronautique (ISSN 0001-9275), no. 107, 1984, p. 4-12. In French.

The design tools and technology necessary to achieve maximum economy in the aircraft of today and tomorrow are discussed. The objectives of aerodynamic research on transport aircraft are to reduce drag and thus save on fuel, to increase the maximum lifting capacity, and to develop antiturbulence and antiflutter systems. An optimization study of the aircraft structures which is based on the finite element method and an examination of the materials used in the structures is presented. An ergonomic study of aircrew stations reveals the importance of the man-machine interface. Automated active control with applications in reduced longitudinal stability, in airfoil loading control, and in flutter control is considered. The revival of the propellar in short-range aircraft is also discussed. M.D.

A85-26301
APPLIED COMPOSITES - AIRCRAFT STRUCTURAL APPLICATIONS; PROCEEDINGS OF THE AEROSPACE ENGINEERING CONFERENCE AND SHOW, LOS ANGELES, CA, FEBRUARY 12-14, 1985
Conference and Show sponsored by the American Institute of Aeronautics and Astronautics. New York, American Institute of Aeronautics and Astronautics, 1985, 27 p. For individual items see A85-26302 to A85-26304.
(AIAA PAPER 85-0846)

Among the composite material aeronautical applications topics discussed are the performance gains associated with composites in both military and commercial airframes, and the features and performance capabilities of Aramid-Aluminum Laminates. Also considered are design and certification of composite control surfaces for the Gulfstream G-III executive jet, and bismaleimide composite applications for the AV-8B Harrier II fighter. O.C.

A85-26302#
COMPOSITE AIRFRAME PRODUCTION IMPLEMENTATION
R. N. HADCOCK (Grumman Aerospace Corp., Bethpage, NY) IN: Applied composites - Aircraft structural applications; Proceedings of the Aerospace Engineering Conference and Show, Los Angeles, CA, February 12-14, 1985 . New York, American Institute of Aeronautics and Astronautics, 1985, p. 1-9. refs

An evaluation of the performance gains associated with the application of advanced fiber-reinforced polymer materials in such military airframes as the AV-8B and B-1A, and commercial aircraft of the A-320 and 757 class, shows not only weight reductions but improved durability and reliability. Relative to aluminum structures, the part fabrication, assembly, maintenance, and repair operations of composites are less costly; material and tooling costs, which are higher than for aluminum, can be compensated by innovative design and automated manufacturing. O.C.

A85-26304#
DESIGN AND MANUFACTURE OF COMPOSITE CONTROL SURFACES
C. SCHNEIDER (Lockheed-Georgia Co., Marietta, GA) IN: Applied composites - Aircraft structural applications; Proceedings of the Aerospace Engineering Conference and Show, Los Angeles, CA, February 12-14, 1985 . New York, American Institute of Aeronautics and Astronautics, 1985, p. 16-21.

The graphite/epoxy composite rudder that was recently designed, tested and certified for the Gulfstream G-III executive jet aircraft achieves a 50 percent increase in acoustic fatigue life,

together with 22 percent weight savings, over the aluminum structure it replaces. Its design incorporates an innovative rib cap design whose acoustic fatigue resistance is superior to that of conventional designs. Both static and acoustic fatigue subcomponent tests have been conducted, with induced impact damage representative of the initially detectable damage level that could be incurred by the rudder skins. O.C.

N85-17933 British Aerospace Aircraft Group, Kingston-upon-Thames (England).
INNOVATION IN BRITISH INDUSTRY (NOTABLY THE AIRCRAFT INDUSTRY) AND ITS VALUE: COLLECTED PAPERS
C. L. BORE Aug. 1984 10 p refs
(BAE-KRS-N-GEN-286) Avail: Issuing Activity

Aspects of innovation that most need improving in British industry are reviewed. The money values of technical innovations in the aircraft industry are discussed. Author (ESA)

N85-17934*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.
ON THE FRONTIER: FLIGHT RESEARCH AT DRYDEN 1946-1981
R. P. HALLION 1984 394 p refs
(NASA-SP-4303; NAS 1.21:4303; LC-83-14136) Avail: NTIS MF A01; SOD HC $15.00 as SN-033-000-00893-7 CSCL 01B

The history of flight research at the NASA Hugh L. Dryden Flight Research Center is recounted. The period of emerging supersonic flight technology (1944 to 1959) is reviewed along with the era of flight outside the Earth's atmosphere (1959 to 1981). Specific projects such as the X-15, Gemini, Apollo, and the space shuttle are addressed. The flight chronologies of various aircraft and spacecraft are given. R.S.F.

N85-17935*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DESIGN DESCRIPTION OF A MICROPROCESSOR BASED ENGINE MONITORING AND CONTROL UNIT (EMAC) FOR SMALL TURBOSHAFT
A. N. BAEZ Jan. 1985 30 p refs
(NASA-TM-86860; E-2324; NAS 1.15:86860) Avail: NTIS HC A03/MF A01 CSCL 01B

Research programs have demonstrated that digital electronic controls are more suitable for advanced aircraft/rotorcraft turbine engine systems than hydromechanical controls. Commercially available microprocessors are believed to have the speed and computational capability required for implementing advanced digital control algorithms. Thus, it is desirable to demonstrate that off-the-shelf microprocessors are indeed capable of performing real time control of advanced gas turbine engines. The engine monitoring and control (EMAC) unit was designed and fabricated specifically to meet the requirements of an advanced gas turbine engine control system. The EMAC unit is fully operational in the Army/NASA small turboshaft engine digital research program. Author

N85-17936*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A VOICE-ACTUATED WIND TUNNEL MODEL LEAK CHECKING SYSTEM
W. E. LARSON Feb. 1985 8 p refs
(NASA-TM-86359; NAS 1.15:86359) Avail: NTIS HC A02/MF A01 CSCL 01B

A voice-actuated wind tunnel model leak checking system was developed. The system uses a voice recognition and response unit to interact with the technician along with a graphics terminal to provide the technician with visual feedback while checking a model for leaks. Author

N85-17937# Air Force Office of Scientific Research, Bolling AFB, Washington, D.C. Directorate of Aerospace Sciences.
PROCEEDINGS OF THE WORKSHOP ON UNSTEADY SEPARATED FLOW HELD AT THE UNITED STATES AIR FORCE ACADEMY ON AUGUST 10-11, 1983 Interim Report
M. S. FRANCIS and M. W. LUTTGES 1984 197 p
(AD-A148249; AFOSR-84-0911TR) Avail: NTIS HC A09/MF A01 CSCL 20D

This two day program was comprised of 27 presentations on a wide variety of topics ranging from fundamental concepts to potential applications. Flows with time dependent boundary conditions leading to global separated flow structures were highlighted.

N85-17962# Air Force Human Resources Lab., Williams AFB, Ariz.
THE IMAGE 3 CONFERENCE PROCEEDINGS Final Report
E. G. MONROE Sep. 1984 502 p Conf. held at Phoenix, Ariz., 30 May - 1 Jun. 1984
(Contract AF PROJ. 9983)
(AD-A148636; AFHRL-TR-84-36) Avail: NTIS HC A22/MF A01 CSCL 01B

The IMAGE Conference is the only major conference devoted entirely to issues relevant to the development and use of imagery generated and displayed for visual flight simulation. The purpose of the conference is to provide a forum for presenting and discussing topics concerned with the imagery generated for out of the cockpit and sensor visual flight simulation. The Air Force recognizes that the rapid technological advanced and used of real-time visual simulators requires that the interchange of information among the user organizations be expanded in order to promote new developments, applications, and techniques, and to avoid unnecessary duplication of efforts. Papers are solicited in all areas compatible with theme of the conference including engineering research and development, behavioral research, application and techniques, program progress and status, as well as technical problems and potential solutions. Pertinent topics include but are not necessarily limited to: (1) software/hardware developments directly resulting in an enhancement of image capabilities; (2) psychological determination of visual cue requirements; and (3) environmental data base design and structure.

N85-17993# European Space Agency, Paris (France).
THE PRANDTL HERGESELL PROJECT OF A NATIONAL RESEARCH ESTABLISHMENT FOR AERONAUTICS
J. C. ROTTA Jun. 1984 54 p refs Transl. into ENGLISH of "Das Prandtl-Hergeseusche Projekt einer Reichsversuchsanstalt fuer Luftschiffahrt" Rept. DFVLR-Mitt-83-10 Goettingen, West Germany, Aug. 1983 Original language document announced as N84-17123
(ESA-TT-835; DFVLR-MITT-83-10) Avail: NTIS HC A04/MF A01; original German version available from DFVLR, Cologne DM 18.50

A historical account on the project of a national research establishment for aeronautics in Germany is presented. The memorandum by Ludwig Prandtl and Hugo Hergesell on the project of a national research establishment for aeronautics, which was important in the founding of the German Research Establishment for Aeronautics (DUL) in 1912, is described. Developments which took place between submission of the memorandum and the date of foundation of the DUL are recounted. Author (ESA)

N85-18037# Joint Publications Research Service, Arlington, Va.
RESEARCH AT AUTOMATED ATC SCIENTIFIC-EXPERIMENTAL CENTER
T. ANODINA *In its* USSR Rept.: Transportation (JPRS-UTR-85-003) p 26-28 12 Feb. 1985 Transl. into ENGLISH from Grashdanskaya Aviatsiya (USSR), no. 11, Nov. 1984 p 44-45
Avail: NTIS HC A06/MF A01

Air traffic control systems improvements discussed include:

radar; communication equipment; microwave equipment; workloads; navigation aids; and flight simulation B.G.

N85-18041# Joint Publications Research Service, Arlington, Va.
NEW DISCOVERY IN SUPERSONIC FLIGHT RESEARCH
I. NOVODVORSKIY *In its* USSR Rept.: Transportation (JPRS-UTR-85-003) p 40-41 12 Feb. 1985 Transl. into ENGLISH from Izvestiya (USSR), 30 Nov. 1984 p 5
Avail: NTIS HC A06/MF A01

Compressibility and viscosity are important characteristics in supersonic aviation. At high speed the flow-past becomes turbulent and separating flows appear. These separated flows most often produce undesirable effects; especially an increase in drag. Experimental data is used to explain these effects. B.G.

N85-18950*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
DETAILED PRESSURE DISTRIBUTION MEASUREMENTS OBTAINED ON SEVERAL CONFIGURATIONS OF AN ASPECT-RATIO-7 VARIABLE TWIST WING
G. T. HOLBROOK and D. M. DUNHAM Mar. 1985 66 p refs (NASA-TM-86308; L-15859; NAS 1.15:86308) Avail: NTIS HC A04/MF A01 CSCL 01B

Detailed pressure distribution measurements were made for 11 twist configurations of a unique, multisegmented wing model having an aspect ratio of 7 and a taper ratio of 1. These configurations encompassed span loads ranging from that of an untwisted wing to simple flapped wings both with and without upper-surface spoilers attached. For each of the wing twist configurations, electronic scanning pressure transducers were used to obtain 580 surface pressure measurements over the wing in about 0.1 sec. Integrated pressure distribution measurements compared favorably with force-balance measurements of lift on the model when the model centerbody lift was included. Complete plots and tabulations of the pressure distribution data for each wing twist configuration are provided. Author

02

AERODYNAMICS

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

A85-23147
PARAMETERS AFFECTING HELICOPTER INTERACTIONAL AERODYNAMICS IN GROUND EFFECT
E. J. HANKER, JR. (Boeing Vertol Co., Philadelphia, PA) and R. P. SMITH (U.S. Army, Applied Technology Laboratory, Fort Eustis, VA) American Helicopter Society, Journal (ISSN 0002-8711), vol. 30, Jan. 1985, p. 52-61. refs
(Contract DAAK51-80-C-0025; DAAG29-78-C-0021)

In the last decade, Army helicopter operational experience has shown that aerodynamic interaction of the primary flow components significantly affects helicopter handling qualities. An experimental investigation was conducted during August 1981, in the Boeing Vertol 20-ft by 20-ft V/STOL wind tunnel to develop further insights into the parameters that affect helicopter interactional aerodynamics in ground effect. Changes in aircraft forces and moments due to variations in main rotor thrust, tail rotor thrust, wind magnitude and direction are presented for a 1:4.85 scale model of the YUH-61A. Additional studies include the effects of varying fin size and tail rotor blockage ratio on main rotor/tail/rotor/empennage interactions. All tests were conducted at airspeeds representative of Nap-of-the-Earth (NOE) flight, i.e., below 45 knots. Author

A85-23148
UNSTEADY AERODYNAMICS OF OSCILLATING AIRFOILS WITH INPLANE MOTIONS
S. B. R. KOTTAPALLI (United Technologies Corp., Sikorsky Aircraft Div., Stratford, CT) American Helicopter Society, Journal (ISSN 0002-8711), vol. 30, Jan. 1985, p. 62, 63. refs

A derivation of the unsteady potential flow about an airfoil that is pitching, flapping, and performing lead-lag (in-plane) oscillations, which differs from the derivation due to Greenberg (1947), is presented. This derivation, which is more plausible than Greenberg's, is based on an order-of-magnitude approximation to the in-plane perturbational velocity, rather than a limiting value in oscillation frequency. Usable formulas for lift and pitching moment are obtained. O.C.

A85-23193#
INLET FLOW DISTORTIONS IN CENTRIFUGAL FANS
S. MADHAVAN, J. DIRE (Westinghouse Electric Corp., Sturtevant Div., Hyde Park, MA), and T. WRIGHT (Flow Dynamics Laboratory, Inc., West Lafayette, IN) American Society of Mechanical Engineers and Institute of Electrical and Electronics Engineers, Joint Power Generation Conference, Toronto, Canada, Oct. 1-4, 1984. 6 p.
(ASME PAPER 84-JPGC-GT-4)

Recent measurements of the performance of a centrifugal fan subjected to inlet flow distortion are presented. Results of axial and multilobed distortion modes are discussed in the context of a previously published study to provide a more comprehensive evaluation of related fan performance degradation. Distortion parameters presented in the previous study are shown to be insufficient for the complete description of inlet distortion and further indicators are proposed. Author

A85-23388#
THREE-DIMENSIONAL UNSTEADY FLOW IN AN AXIAL FLOW TURBINE
O. P. SHARMA, T. L. BUTLER (United Technologies Corp., Engineering Div., East Hartford, CT), H. D. JOSLYN, and R. P. DRING (United Technologies Research Center, East Hartford, CT) Journal of Propulsion and Power (ISSN 0748-4658), vol. 1, Jan.-Feb. 1985, p. 29-38. Previously cited in issue 16, p. 2294, Accession no. A83-36257. refs

A85-23391#
IMPROVED SUPERSONIC PERFORMANCE FOR THE F-16 INLET MODIFIED FOR THE J79 ENGINE
L. G. HUNTER and J. A. CAWTHON (General Dynamics Corp., Fort Worth, TX) Journal of Propulsion and Power (ISSN 0748-4658), vol. 1, Jan.-Feb. 1985, p. 50-57. Previously cited in issue 17, p. 244, Accession no. A84-37641.

A85-23392*# Lockheed-Georgia Co., Marietta.
APPROXIMATE FACTORIZATION ALGORITHM FOR THREE-DIMENSIONAL TRANSONIC NACELLE/INLET FLOWFIELD COMPUTATIONS
J. VADYAK and E. H. ATTA (Lockheed-Georgia Co., Advanced Flight Sciences Dept., Marietta, GA) Journal of Propulsion and Power (ISSN 0748-4658), vol. 1, Jan.-Feb. 1985, p. 58-64. Research sponsored by the Lockheed Independent Research and Development Program. Previously cited in issue 16, p. 2295, Accession no. A83-36401. refs
(Contract NAS2-11285)

A85-23957
THIN TURBOMACHINERY BLADE DESIGN USING A FINITE-VOLUME METHOD
J. V. SOULIS (Thrace, University, Xanthi, Greece; Cambridge University, Cambridge, England) International Journal for Numerical Methods in Engineering (ISSN 0029-5981), vol. 21, Jan. 1985, p. 19-36. refs

Soulis (1982) has developed a finite-volume method for the calculation of transonic, potential, inviscid flows through three-dimensional turbomachinery blade rows with complex

geometry. This method combines the advantages of finite elements for handling complicated geometries and the use of simple finite difference approximations. It uses a first-order shape function, while it offers an accurate approximation and simple treatment of the solid boundary flow conditions. It is pointed out that this finite-volume approach can form the baseline for the design of turbomachinery blades. The current finite-volume design approach is intended to combine the advantages of the finite-volume analysis (direct problem) with the design procedure of thin turbomachinery blades. An in depth review of the analysis problem is presented, and applications are discussed. G.R.

A85-23982
APPROXIMATE DETERMINATION OF THE BOUNDARIES OF AN IDEAL GAS JET ISSUING UNDER CONDITIONS OF PRESSURE DIFFERENCE FROM A NOZZLE WITH THE FORMATION OF A FREE VORTEX FLOW [PRIBLIZHENNOE OPREDELENIE GRANITS STRUI IDEAL'NOGO GAZA PRI NERASCHETNOM ISTECHENII IZ SOPLA, REALIZNIUSHCHEGO POTOK SVOBODNOGO VIKHRIA]
B. S. VINOGRADOV, V. I. PANCHENKO, and G. V. MALKOV Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 3, 1984, p. 28-32. In Russian. refs

An approximate method is proposed for calculating the deflection of a plane jet of an ideal gas and for determining the jet boundaries for the case where the jet issues from a nozzle, under a pressure differential, forming a free vortex flow. The method proposed here can be used for designing nozzle-free vortex jet-exhaust diffuser systems. V.L.

A85-23998
THE EFFECT OF THE FAN CHARACTERISTIC ON THE DYNAMICS OF A STAND SUPPORTED BY EXCESS PRESSURE [VLIIANIE KHARAKTERISTIKI VENTILIATORA NA DINAMIKU STENDA, PODDERZHIVAEMOGO IZBYTOCHNYM DAVLENIEM]
V. G. DONTSOV and S. V. TRUNOV Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 3, 1984, p. 91-93. In Russian. refs

The effect of the fan characteristic on the dynamics of a stand supported by excess pressure is described by a simple mathematical model which is then solved in quadratures. It is shown that stable operation of the stand is achieved when the gradient dp/dQ (where p is pressure and Q is fan output) is negative at the operating point of the fan characteristic. The steeper the pressure drop with an increase in output, the more stable is the system. V.L.

A85-24028
SHAPED OPTIMIZATION OF THE SUBSONIC PROFILES OF AXIAL-FLOW TURBINE CASCADES [OPTIMIZATSIIA FORMY DOZVUKOVYKH PROFILEI RESHETOK OSEVYKH TURBIN]
A. V. BOIKO, S. N. KOZHEVNIKOV, and V. A. MELTIUKHOV Akademiia Nauk SSSR, Izvestiia, Energetika i Transport (ISSN 0002-3310), Nov.-Dec. 1984, p. 119-124. In Russian. refs

A method is proposed for designing aerodynamically perfect subsonic turbine cascades for fixed blade area and leading edge thickness. The method proposed here is based on solving a nonlinear programming problem with the coefficient of profile losses used as the minimization function and with a constraint in the form of an inequality corresponding to nonseparated flow. Results of a comparative experimental study of nonoptimized and optimized cascades are presented. V.L.

A85-24091#
COMPUTATION OF POTENTIAL FLOW ON S2 STREAM SURFACE FOR A TRANSONIC AXIAL-FLOW COMPRESSOR ROTOR
P. LU and C.-H. WU (Chinese Academy of Sciences, Institute of Engineering Thermophysics, Beijing, People's Republic of China) Journal of Engineering Thermophysics, vol. 5, Aug. 1984, p. 233-238. In Chinese, with abstract in English. refs

A set of conservative full-potential-function equations governing the fluid flow along a given S2 stream surface in a transonic axial compressor rotor was obtained. By the use of artificial density and a potential-function/density iteration, this set of equations can be solved, and the passage shock on the S2 stream surface can be captured. A computer program for this direct problem has been developed and used to compute the flow field along a mean S2 stream surface in the DFVLR transonic axial compressor rotor. A comparison of computed results with DFVLR L2F measurement at 100 percent of design speed shows fairly good agreement. Author

A85-24092#
A MULTIGRID METHOD FOR CALCULATING TRANSONIC FLOWS IN CASCADES
X. ZHOU and F. ZHU (Northwestern Polytechnical University, Xian, Shaanxi, People's Republic of China) Journal of Engineering Thermophysics, vol. 5, Aug. 1984, p. 239-243. In Chinese, with abstract in English. refs

The main disadvantage of time-dependent method for turbomachinery flow calculation is its comparatively high cost in computer time. The computation time can be very largely saved by using the so-called multigrid technique developed in recent years. Based upon the MacCormack explicit two-step difference scheme a simple multigrid method for solving the Euler equations in integral form is proposed in this paper. The paper describes the basic idea of this approach, and deals with the stability condition and a new artificial viscosity form. Several numerical results of transonic flows in turbine cascades are given to illustrate the effectiveness of this method. Author

A85-24093#
NUMERICAL SOLUTIONS FOR TRANSONIC STREAM EQUATIONS OF FLOW ALONG S1 RELATIVE STREAM SURFACE EMPLOYING NON-ORTHOGONAL CURVILINEAR COORDINATES AND CORRESPONDING VELOCITY COMPONENTS
X. ZHAO (Chinese Academy of Sciences, Institute of Engineering Thermophysics, Beijing, People's Republic of China) Journal of Engineering Thermophysics, vol. 5, Aug. 1984, p. 244-249. In Chinese, with abstract in English. refs

A85-24094#
SOLUTION OF TRANSONIC S1 SURFACE FLOW BY SUCCESSIVELY REVERSING THE DIRECTION OF INTEGRATION OF THE STREAM FUNCTION EQUATION
Z. WANG (Chinese Academy of Sciences, Institute of Engineering Thermophysics, Beijing, People's Republic of China) Journal of Engineering Thermophysics, vol. 5, Aug. 1984, p. 250-255. In Chinese, with abstract in English. refs

In the solution of transonic stream function equation the occurrence of two values of the density is avoided by using a method of combining simple iteration with an integration method. In this method, the direction of integration is successively reversed, i.e., the starting line for the integration is varied from iteration to iteration. The governing equations are therefore satisfied as fully as possible during each iteration, and the procedure leads to rapid convergence. The method uses non-orthogonal curvilinear coordinates and artificial compressibility. The technique can be used to calculate transonic S1 surface flows, with either subsonic or supersonic inlet velocities. Author

A85-24095#
TRANSONIC CASCADE FLOW WITH GIVEN SHOCK SHAPES SOLVED BY SEPARATE SUPERSONIC AND SUBSONIC COMPUTATIONS
C.-H. WU, W. WU, Y. HUA, and B. WANG (Chinese Academy of Sciences, Institute of Engineering Thermophysics, Beijing, People's Republic of China) Journal of Engineering Thermophysics, vol. 5, Aug. 1984, p. 256-262. In Chinese, with abstract in English. refs

A method for calculating the flow field in a certain type of transonic cascade is presented. The shapes of the detached bow wave in front of the cascade and the passage shock in the cascade channel are given, and the flow downstream of the passage shock is subsonic. The supersonic region upstream of the passage shock

and the subsonic region downstream of the passage shock are calculated separately. The method of characteristics and the oblique shock relations are used for the supersonic part, and in the subsonic region downstream of the passage shock, the set of linear algebraic equations obtained after discretization of the stream-function equation, expressed with respect to nonorthogonal curvilinear coordinates, is solved by a direct-matrix method. The whole transonic field can be very rapidly determined by this method, and the result agrees well with the experimental measurement and gives useful flow details which are not available experimentally. Author

A85-24096#
THE DISCUSSION OF THE POSITION OF CONICAL SHOCK OF AXISYMMETRIC AIR INTAKE OF SUPERSONIC AIRCRAFT RELATIVE TO THE LEADING EDGE OF THE COWL LIP
Z. HE (Nanjing Aeronautical Institute, Nanjing, People's Republic of China) Journal of Engineering Thermophysics, vol. 5, Aug. 1984, p. 263-265. In Chinese, with abstract in English.

Experimental data on the position of oblique conical shocks on the lee and windward sides of an axisymmetric aircraft air intake in supersonic flow are summarized and illustrated with diagrams and schlieren photographs. The variation of position relative to the leading edge of the cowl lip with the angle of attack is found to follow a pattern exactly opposite to that predicted by Nechaev (1962 and 1977). T.K.

A85-24097#
A PREDICTION RESEARCH OF ROTATING STALL IN AXIAL COMPRESSORS
Y. LU and H. MA (Beijing Institute of Aeronautics and Astronautics, Beijing, People's Republic of China) Journal of Engineering Thermophysics, vol. 5, Aug. 1984, p. 266-268. In Chinese, with abstract in English.

A characteristic parameter-equivalent half-divergent angle (alpha/2) representing the degree of pressure increase through a cascade is presented. It can be used as a criterion to predict onset of rotating stall in axial compressors. A quantitative relation between alpha/2 and the cascade geometric and aerodynamic parameters is derived. An empirical formula correlating the equivalent half divergent angle at onset of rotating stall with the blade setting angle solidity, and the inlet Mach number is obtained from experimental data for 18 rotors. Using this formula and the quantitative relation mentioned above, the flow coefficient Ca at the onset of rotating stall can be predicted. The Ca values at onset of rotating stall of 14 other rotors were calculated to check the accuracy and applicability of present method. The agreement between the calculated results and the experiment data is fairly satisfactory. Author

A85-24202
EXPERIMENTAL INVESTIGATION OF THE PARTIAL IMPINGEMENT OF A JET ON A HALF-PLATE
N. W. M. KO and W. T. CHEUNG (University of Hong Kong, Hong Kong) Aeronautical Journal (ISSN 0001-9240), vol. 88, Dec. 1984, p. 447-455. refs

The flow before and after the partial impingement of a jet on a half plane has been studied. From the extensive mean velocity and turbulence intensity measurements the three basic flow regimes of the main jet flow, the flow over the flat plate and the redirected flow on the flat plate surface have been isolated. The inherited characteristics and axisymmetry of the upstream jet flow and their extent downstream of the flat plate have also been established. The effect of the leading edge on the flow over the flat plate and the effect of friction on the surface on the redirected flow have also been studied. Author

A85-24203
EFFECT OF WING NOSE SHAPE ON THE FLOW IN A WING/BODY JUNCTION
R. D. MEHTA (Stanford University, Stanford, CA; Imperial College of Science and Technology, London, England) Aeronautical Journal (ISSN 0001-9240), vol. 88, Dec. 1984, p. 456-460. refs

The development of a horseshow vortex as the result of lateral shear skewing at a wing-body junction is investigated experimentally, using 42 mm-thick 325-mm long wing models with elliptic, superelliptic, or wedge-elliptic nose profiles in a 762 x 127-mm blower tunnel at nominal flow speed 25 m/sec. Boundary layers are tripped at the contraction exit and 25 mm from the leading edge by wires, and velocity profiles are obtained with X-wire probes located 175 mm downstream. The results are presented graphically, and the bluntness of the wing nose is found to have a significant effect on the size and strength of the horseshoe vortex. It is estimated that a 50-percent reduction in the size of the concentrated-vorticity region and a 40-percent reduction in the horseshoe-vortex circulation can be achieved by changing from a superelliptic to a wedge-elliptic nose shape. T.K.

A85-24448* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SPECTRAL MULTIGRID METHODS WITH APPLICATIONS TO TRANSONIC POTENTIAL FLOW
C. L. STREETT (NASA, Langley Research Center, Hampton, VA), T. A. ZANG (NASA, Langley Research Center, Hampton; College of William and Mary, Williamsburg, VA), and M. Y. HUSSAINI (NASA, Langley Research Center, Institute for Computer Applications in Science and Engineering, Hampton, VA) Journal of Computational Physics (ISSN 0021-9991), vol. 57, Jan. 15, 1985, p. 43-76. Previously announced in STAR as N83-33851. refs
(Contract NAG1-109; NAS1-17130; NAS1-17070)

Spectral multigrid methods are demonstrated to be a competitive technique for solving the transonic potential flow equation. The spectral discretization, the relaxation scheme, and the multigrid techniques are described in detail. Significant departures from current approaches are first illustrated on several linear problems. The principal applications and examples, however, are for compressible potential flow. These examples include the relatively challenging case of supercritical flow over a lifting airfoil. Author

A85-24449
COMPUTER-AIDED ANALYSIS OF THE CONVERGENCE TO STEADY STATE OF DISCRETE APPROXIMATIONS TO THE EULER EQUATIONS
L. E. ERIKSSON and A. RIZZI (Flygtekniska Forsoksanstalten, Bromma, Sweden) Journal of Computational Physics (ISSN 0021-9991), vol. 57, Jan. 15, 1985, p. 90-128. refs

The behavior of a centered finite volume scheme for the isoenergetic Euler equations in two space dimensions is studied by numerical differentiation and approximate eigensystem analysis. The entire semidiscrete approximation including boundary conditions is formulated as a large system of ODEs, which are linearized by numerically approximating the Frechet derivative. An approximate eigensystem procedure that only needs the Frechet derivative is used to extract the least damped eigenmodes. The overall method has been applied to the case of transonic flow past an airfoil and has revealed that the most persistent transient modes are highly structured and are associated with eigenvalues of small modulus. Furthermore, they appear to be centered around the shock region, the stagnation region and the trailing edge/wake region of the airfoil. The beneficial effect of local time-step scaling and artificial dissipation is also demonstrated by the method. Author

A85-24800
TRANSONIC SHOCK WAVE - BOUNDARY LAYER INTERACTION AT A CONVEX WALL
B. KOREN and W. J. BANNINK (Delft, Technische Hogeschool, Delft, Netherlands) Delft Progress Report, vol. 9, Sept. 1984, p. 155-169. refs

A standard finite element procedure has been applied to the problem of transonic shock wave - boundary layer interaction at a convex wall. The method is based on the analytical Bohning-Zierep model (1976), where the boundary layer is perturbed by a weak normal shock wave which shows a singular pressure gradient at the curved edge of the boundary layer. In the present numerical method the application of a power law velocity distribution at the upstream end of the boundary layer has been abandoned and a more realistic distribution is applied. The results are compared to other numerical solutions and to experimental results. The differences are discussed together with the limitations introduced by the method. Author

A85-24804#
EXPERIMENTAL AND THEORETICAL STUDY OF TRANSITION PHENOMENA ON AN INFINITE SWEPT WING
D. ARNAL, E. COUSTOLS, and J. C. JUILLEN (ONERA, Centre d'Etudes et de Recherches de Toulouse, Toulouse, France) La Recherche Aerospatiale (English Edition) (ISSN 0379-380X), no. 4, 1984, p. 39-54. refs

The evolution of three-dimensional transition phenomena on an infinite 40-60-deg-swept wing (a 1.96-m-long 35-cm-constant-chord ONERA D airfoil of AU4G alloy without holes or of composite material with static pressure holes along four spanwise sections) is investigated experimentally in the 35 x 60 x 250-cm test section of an Eiffel wind tunnel at velocities up to 90 m/sec, extending the experiments of Arnal et al. (1984). The results of pitot-tube and hot-wire anemometry and wall visualizations are presented graphically and characterized in detail, focusing on the motion of the transition in response to parameter variations and on the role of stationary waves, and simplified practical computation techniques are developed. The stationary-wave data are found to confirm many of the predictions of laminar instability theory. T.K.

A85-24805#
EXPERIMENTAL STUDY OF THE UNSTEADY FLOW AROUND A BUFFETING WING
B. BENOIT and D. LE BIHAN (ONERA, Chatillon-sous-Bagneux, Hauts-de-Seine, France) La Recherche Aerospatiale (English Edition) (ISSN 0379-380X), no. 4, 1984, p. 55-58. refs

Theoretical and experimental investigations of the unsteady flow around a buffeting wing are discussed, with an emphasis on preliminary three-dimensional studies on an Airbus-type As 200-06 transport-aircraft half-model in the S1 Modane-Avrieux wind tunnel. Some sample data are presented in graphs, and the relationships between the parts of the overall theoretical problem are illustrated with a flow chart. It is pointed out that present theoretical methods are inadequate to predict the buffeting limits for actual flight conditions, and that the transposition of wind-tunnel data (obtained at different Reynolds numbers and with different structural parameters) to the realistic case remains mainly guesswork, indicating the need for more extensive experiments using sophisticated measurement and data-reduction techniques. T.K.

A85-25126#
LEADING-EDGE SEPARATIONS AND CROSS-FLOW SHOCKS ON DELTA WINGS
L. C. SQUIRE (Cambridge University, Cambridge, England) AIAA Journal (ISSN 0001-1452), vol. 23, March 1985, p. 321-325. refs

Recently published numerical solutions of the Euler equations have shown the existence of very strong cross-flow shocks in the attached flow on the lee surface of uncambered delta wings. These shocks occur in flight conditions where previous work has shown that the lee-surface flow would be expected to show a leading-edge separation with a pair of contrarotating vortices inboard. This paper presents the results of an experimental study of the flow over one of the wings (mounted on a small body) for which numerical solutions were obtained. At the test Mach numbers where strong shocks occur in the numerical solutions, the experimental flow shows a complete leading-edge separation with a pressure distribution very different from that calculated. The significance of these results in relation to the change from leading-edge separation to attached flow around the leading edge with increasing Mach number is discussed. Author

A85-25127#
APPLICATION OF A TWO-DIMENSIONAL GRID SOLVER FOR THREE-DIMENSIONAL PROBLEMS
V. SHANKAR (Rockwell International Science Center, Thousand Oaks, CA) and S. RUDY (Rockwell International Corp., Columbus, OH) AIAA Journal (ISSN 0001-1452), vol. 23, March 1985, p. 326, 327. Abridged. Previously cited in issue 02, p. 124, Accession no. A84-11588.

A85-25129#
ANALYSIS OF STEADY, TWO-DIMENSIONAL, CHEMICALLY REACTING, NONEQUILIBRIUM, INVISCID FLOW IN NOZZLES
R. J. STILES (U.S. Air Force Academy, Colorado Springs, CO) and J. D. HOFFMAN (Purdue University, West Lafayette, IN) AIAA Journal (ISSN 0001-1452), vol. 23, March 1985, p. 342-348. Previously cited in issue 19, p. 3254, Accession no. A81-40869. refs
(Contract F33615-79-C-2065)

A85-25134*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
IMPLICIT UPWIND METHODS FOR THE COMPRESSIBLE NAVIER-STOKES EQUATIONS
T. J. COAKLEY (NASA, Ames Research Center, Moffett Field, CA) (Computational Fluid Dynamics Conference, 6th, Danvers, MA, July 13-15, 1983, Collection of Technical Papers, p. 505-514) AIAA Journal (ISSN 0001-1452), vol. 23, March 1985, p. 374-380. Previously cited in issue 18, p. 2682, Accession no. A83-39401. refs

A85-25135*# Ohio State Univ., Columbus.
PREDICTING RIME ICE ACCRETION ON AIRFOILS
M. B. BRAGG (Ohio State University, Columbus, OH) AIAA Journal (ISSN 0001-1452), vol. 23, March 1985, p. 381-387. refs
(Contract NAG3-28)

A method for predicting the droplet impingement and resulting rime ice accretion on airfoils in an incompressible, inviscid flowfield is presented. The governing equations for the water droplet trajectories are described briefly and the appropriate similarity parameters presented. Droplet impingement parameters are described for both monodisperse and arbitrary droplet size distributions. A time-stepping ice accretion process is presented where the flowfield and droplet impingement characteristics are updated periodically to model the time-dependent nature of the process. The method compares well to experimental results of both droplet impingement and rime ice shapes. The time stepping improves the accuracy of the ice shape predictions. Recommendations are given for further research. Author

A85-25136#
BASE PRESSURE OF A PROJECTILE WITHIN THE TRANSONIC FLIGHT REGIME
W. L. CHOW (Illinois, University, Urbana, IL) AIAA Journal (ISSN 0001-1452), vol. 23, March 1985, p. 388-395. Previously cited in issue 06, p. 706, Accession no. A84-17961. refs
(Contract DAAG29-83-K-0043)

A85-25148#
VORTICITY GROWTH AND DECAY IN THE JET IN CROSS FLOW
R. H. NUNN (U.S. Naval Postgraduate School, Monterey, CA; Royal Naval Engineering College, Plymouth, England) AIAA Journal (ISSN 0001-1452), vol. 23, March 1985, p. 473-475. refs

Although analytical models have been developed for the jet-in-cross flow problem on the basis of a representation of the jet as a system of distributed potential flow singularities, few

theories account for the jet vortex system directly. It is presently noted that a simple premise relating the strength of the contrarotating vortex pair to their path can lead to a semiempirical expression for the variation of circulation that furnishes a significant degree of correlation with currently available data. O.C.

A85-25149#
A LOWER BOUND FOR THREE-DIMENSIONAL TURBULENT SEPARATION IN SUPERSONIC FLOW
R. H. KORKEGI (National Research Council, Washington, DC) AIAA Journal (ISSN 0001-1452), vol. 23, March 1985, p. 475, 476. USAF-sponsored research.

Attention is given to the determination of the lower bounds for turbulent boundary layer separation in such three-dimensional configurations as yawed wedges on flat plates. It is suggested that for such cases, flow characteristics in a plane normal to the shock or wedge leading edge bear strong similarity to those for the two-dimensional case. Possible trends based on this conjecture, together with Korkegi's (1975) two-dimensional data, can serve as a qualitative guide to further investigations. O.C.

A85-25150#
THE RESPONSE OF NORMAL SHOCKS IN DIFFUSERS
M. SAJBEN (McDonnell Douglas Research Laboratories, St. Louis, MO) AIAA Journal (ISSN 0001-1452), vol. 23, March 1985, p. 477, 478. Research supported by the McDonnell Douglas Independent Research and Development Program.
(Contract F49620-77-C-0082)

The present discussion of time-dependent pressure distribution near normal shocks, whose response in divergent channels to periodic (low frequency) downstream perturbations Culick and Rodgers (1983) analyzed, extends one of their pressure distribution graphs to infinite frequencies. This representation clearly illustrates frequency effects on the relative amplitude and phase of the pressure and shock displacement fluctuations. O.C.

A85-25213#
AN IMPROVED MODEL OF SHOCK WAVES IN FRONT OF TWO-DIMENSIONAL CASCADES
Z. RUAN (Chinese Academy of Science, Institute of Engineering Thermophysics, Beijing, People's Republic of China) Journal of Engineering Thermophysics, vol. 5, Nov. 1984, p. 338-341. In Chinese, with abstract in English.

This paper presents an approximate method for predicting the shape and location of shock waves in front of two-dimensional cascades. Comparisons of calculated results with experimental results show that the accuracy of this method is good. Author

A85-25214#
INVESTIGATIONS ON TRANSONIC DOUBLE CIRCULAR ARC (DCA)PROFILES OF AXIAL FLOW COMPRESSOR CALCULATIONS OF PROFILE DESIGN
R. YAN and Z. QIAN (Northwestern Polytechnical University, Xian, Shaanxi, People's Republic of China) Journal of Engineering Thermophysics, vol. 5, Nov. 1984, p. 342-344. In Chinese, with abstract in English.

Concepts and methods for designing high Mach number airfoils of axial flow compressors are described. The correlation equations of the main parameters, including the geometries of the airfoils and cascades, stream parameters, and compressor wake characteristic parameters are provided. Several curves and charts are given for obtaining the total pressure loss coefficients of the cascades and for the adoption of a simplified calculating method. Test results and calculated values are compared and found to be in improved agreement. C.D.

A85-25215#
THE SOLUTION OF VARIATIONAL FINITE ELEMENT METHOD FOR THE INVERSE PROBLEM ON S2 RELATIVE STREAM SURFACE IN TURBINES
R. QIN and F. YI (Harbin Institute of Technology, Harbin, People's Republic of China) Journal of Engineering Thermophysics, vol. 5, Nov. 1984, p. 345-347. In Chinese, with abstract in English.

A85-25216#
SOME ANALYTICAL SOLUTIONS APPLICABLE TO VERIFY 3-D NUMERICAL METHODS IN TURBOMACHINES
R. CAI, H. JIANG, and C. SUN (Chinese Academy of Science, Institute of Engineering Thermophysics, Beijing, People's Republic of China) Journal of Engineering Thermophysics, vol. 5, Nov. 1984, p. 348-353. In Chinese, with abstract in English.

Some analytical solutions of 3-D incompressible potential flow similar to blade channel flow in turbomachines are found. The mathematical expressions of their potential function, the velocity vector, and the S1 and S2 stream surfaces are obtained. More attention is focused on two solutions, which are more similar to the blade channel flow in centrifugal and axial turbomachines, respectively. These solutions can be used to check whether a 3-D numerical method is feasible or not. As an example, the computational results from the Mean Stream Surface Method are compared with one of these analytical solutions, and it is shown that they are of great use for verifying the reliability of 3-D numerical methods. Author

A85-25217#
GENERAL CHARACTERISTIC THEORY OF AERODYNAMICS WITH OBLIQUE CURVILINEAR COORDINATE SYSTEM
J. WANG and T. BO (Shanghai Institute of Mechanical Engineering, Shanghai, People's Republic of China) Journal of Engineering Thermophysics, vol. 5, Nov. 1984, p. 354-356. In Chinese, with abstract in English.

A85-25448
EXPERIMENTAL AND THEORETICAL INVESTIGATIONS OF THE SUPERSONIC FLOW FIELD ON A TWO-DIMENSIONAL STEP [EXPERIMENTELLE UND THEORETISCHE UNTERSUCHUNGEN DES STROEMUNGSFELDES AN 2-D-STUFEN IM UEBERSCHALL]
W. WEINERT Darmstadt, Technische Hochschule, Fachbereich Maschinenbau, Dr.-Ing. Dissertation, 1984, 197 p. In German. refs

The two-dimensional turbulent flow field over a step profile in a supersonic flow is investigated experimentally in the 15 x 15-cm working section of a wind tunnel at freestream Mach numbers from 2.5 to 4.0. Measurement techniques applied include analog methods, oil-based-coating visualization, probes, schlieren photography, shadow method, Mach-Zehnder interferometry, LDA, L2F, and LSA; the results are presented in photographs, graphs, diagrams, and tables and characterized. A semiempirical computation procedure using error-function profiles is developed and shown to give accurate predictions in the higher Mach-number range and to permit the analysis of the wake geometry. T.K.

A85-25457
COMPRESSOR CASCADES RESEARCH USING A HELIUM-DRIVEN SHOCK TUBE
R. A. NEEMEH, P. SETIAWAN, J. H. T. WU (Concordia University, Montreal, Canada), and J. A. RAW (Pratt and Whitney Canada, Mississauga, Ontario, Canada) IN: Shock tubes and waves; Proceedings of the Fourteenth International Symposium on Shock Tubes and Shock Waves, Sydney, Australia, August 19-22, 1983 . Sydney, Australia, Sydney Shock Tube Symposium Publishers, 1984, p. 85-91. Sponsorship: National Research Council of Canada. refs
(Contract NRC-P-8102; NRC A-4206)

The performance of a helium-driven shock tube, 154 nm inside diameter and 6 m long, is investigated experimentally for its ability in providing uniform flow for use in testing supersonic flow in compressor cascades. At the downstream end of the shock tube, a rectangular tube, was mounted to allow flow visualization in the test section. In the latter, the uniformity and duration of the flow were examined via spark schlieren photography and pressure measurements. Using a three blade compressor cascade system, placed in a uniform flow at a mach number of 1.52, similarity in the flow was easily achieved provided that two extension plates are present downstream of the first and third blade. The flow conditions and the pressure ratio across the cascades were varied

by means of a damper placed at the end of the two plates. With the damper fully open, supersonic flow is maintained in the cascades. With the damper partially closed, strong shock waves were observed and the flow behind those shocks becomes subsonic. For the above two cases, pressure variations were successfully determined using miniature pressure transducers. Author

A85-25458
SUPPRESSION OF SHOCKS ON TRANSONIC AIRFOILS
G. SAVU, O. TRIFU, and L. Z. DUMITRESCU (Institutul National Pentru Creatie Stiintifica si Tehnica, Bucharest, Rumania) IN: Shock tubes and waves; Proceedings of the Fourteenth International Symposium on Shock Tubes and Shock Waves, Sydney, Australia, August 19-22, 1983 . Sydney, Australia, Sydney Shock Tube Symposium Publishers, 1984, p. 92-101. refs

Shockless supercritical airfoils have a very narrow range of acceptable off-design performance; a new airfoil concept has been developed, with significant, predicted improvements, based on the use of a permeable upper surface, similar to the walls of transonic wind-tunnels. The backflow in the plenum chamber beneath spreads out sharp pressure gradients in the flow, avoiding wave reflections which build up into shocks. A simplified theory, based on the transonic small-disturbance equation, with a Darcy-type boundary conditions on the perforated wall, predicts smooth pressure distributions and a marked increase in drag-rise Mach number. Schlieren visualizations, carried out in the INCREST Ludwieg tube, substantiate the theoretical arguments. A subsonic potential flow analysis reveals also a marked increase in lift. Provided that unaccounted-for adverse boundary-layer effects will not crop up in future tests, it is concluded that the proposed scheme has a broad application potential and is to be further investigated. Author

A85-25465* Massachusetts Inst. of Tech., Cambridge.
ON THE USE OF PARAMETRIC DIFFERENTIATION TO PREDICT WEAK SHOCK WAVES
W. L. HARRIS (MIT, Cambridge, MA) IN: Shock tubes and waves; Proceedings of the Fourteenth International Symposium on Shock Tubes and Shock Waves, Sydney, Australia, August 19-22, 1983 . Sydney, Australia, Sydney Shock Tube Symposium Publishers, 1984, p. 213-220. refs
(Contract NAG1-60; NAG1-329; NSG-1219; N00014-83-K-0311)

The method of parametric differentiation is shown to be an effective means to transform both the time-linearized and the fully nonlinear transonic small disturbance potential flow equations to a linear system of equations. The globally linearized equations are then solved in phase space by finite difference methods and integral equation methods. The predicted birth, growth, and motion of weak shock waves in two-dimensional transonic flows are compared with existing theory and experiment. Author

A85-25467
THE SHOCK WAVE FROM A SUPERSONIC PROJECTILE
D. V. RITZEL (Defence Research Establishment Suffield, Ralston, Alberta, Canada) and J. J. GOTTLIEB (Toronto, University, Downsview, Ontario, Canada) IN: Shock tubes and waves; Proceedings of the Fourteenth International Symposium on Shock Tubes and Shock Waves, Sydney, Australia, August 19-22, 1983 . Sydney, Australia, Sydney Shock Tube Symposium Publishers, 1984, p. 231-238. refs

Whitham's first-order theory for steady flow at a moderate supersonic Mach number around a slender axisymmetric body is reviewed and applied to solve sonic-boom shock-wave signatures from projectile shapes. For simple body shapes an analytic solution is given for the smooth-body F-function. However, it is shown that another formulation for F(y) derived by Lighthill for nonsmooth bodies must be evaluated for most realistic body shapes. A computer program was developed to solve sonic-boom overpressure signatures by either method, given the body's shape and Mach number. Numerical studies were conducted to investigate and illustrate important results in applications to projectiles. Numerically predicted overpressure signatures are compared with extensive, new measured signatures from free-flight projectiles, and good agreement is obtained. Also, some analytic results based on the theory are given for the evolution of mid-field signature waveforms composed of linear segments. Author

A85-25474
VORTICES IN WAKES INDUCED BY SHOCK WAVES
H. OERTEL, JR. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Institut fuer theoretische Stroemungsmechanik, Goettingen, West Germany) IN: Shock tubes and waves; Proceedings of the Fourteenth International Symposium on Shock Tubes and Shock Waves, Sydney, Australia, August 19-22, 1983 . Sydney, Australia, Sydney Shock Tube Symposium Publishers, 1984, p. 293-300. refs

Results of shock-tube experiments are compared to stability diagrams and eigenfunctions of symmetrical and asymmetrical wakes in shock waves, and the role of the channel height and symmetrical time-averaged wake velocity profiles is investigated. The facility consisted of an ISL experimental shock tube of a 10-cm diameter and a driven tube 20-m long. The test duration was approximately 150 microseconds, depending on the test section used. An incompressible two-dimensional linear stability theory is shown to be applicable close to the trailing edge and can be used to define shedding frequencies and the influence of the walls. The theoretical results are suggested to be a good base for more extensive nonlinear three-dimensional calculations. L.T.

A85-25478* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
HEAT-TRANSFER DISTRIBUTIONS FOR BICONICS AT INCIDENCE IN HYPERSONIC-HYPERVELOCITY REAL-GAS FLOWS
C. G. MILLER, P. A. GNOFFO, and J. R. MICOL (NASA, Langley Research Center, Hampton, VA) IN: Shock tubes and waves; Proceedings of the Fourteenth International Symposium on Shock Tubes and Shock Waves, Sydney, Australia, August 19-22, 1983 . Sydney, Australia, Sydney Shock Tube Symposium Publishers, 1984, p. 333-341. refs

Laminar heat-transfer distributions were measured on spherically blunted, 13/7 deg straight and bent biconics at freestream velocities from 4.5 to 6.9 km/s and Mach numbers from 6 to 9. The flows were generated in the NASA's Langley Expansion Tube using helium, nitrogen, air, and carbon dioxide; angle of attack, referenced to the axis of the aft cone, was varied from zero to 20 deg. The penalty in windward heating to the fore cone due to the 7-deg nose bend diminished rapidly with increasing angle of attack and was only 10 to 20 percent at the design trim angle of attack of 20 deg. Leeward heating initially decreased, then increased, with increasing angle of attack. Windward heating rates predicted with a computer code that solves the parabolized Navier-Stokes equations were in good agreement with measurements for helium and air. The study used a 1.9-percent scale model of the proposed generic planetary vehicle and is directly applicable to the orbital transfer vehicle, which incorporates a spherically blunted biconic. L.T.

A85-25479
FINITE DIFFERENCE COMPUTATIONS OF FLOW ABOUT SUPERSONIC LIFTING BODIES
J. M. R. GRAHAM and R. HILLIER (Imperial College of Science and Technology, London, England) IN: Shock tubes and waves; Proceedings of the Fourteenth International Symposium on Shock Tubes and Shock Waves, Sydney, Australia, August 19-22, 1983 . Sydney, Australia, Sydney Shock Tube Symposium Publishers, 1984, p. 342-349. Research supported by the Ministry of Defence (Procurement Executive). refs

This paper presents numerical solutions for steady supersonic flow past a series of conical lifting bodies, using the Fluid-in-Cell (FLIC) method. Two basic approaches have been followed. The first uses an unsteady piston-type analogy, neglecting the chordwise velocity perturbation and solving the unsteady pseudo two-dimensional flow in a reference cross plane. The second

method specifically formulates the equations in a form such that they can be 'time-marched' to a conical steady state. Author

A85-25480
FLOW FIELD STUDIES ON A BICONIC MODEL IN HIGH ENTHALPY NON-EQUILIBRIUM FLOW
S. L. GAI, R. J. SANDEMAN, P. LYONS, D. KILPIN (Australian National University, Canberra, Australia), and J. P. BAIRD (New South Wales, University, Duntroon; Australian National University, Canberra, Australia) IN: Shock tubes and waves; Proceedings of the Fourteenth International Symposium on Shock Tubes and Shock Waves, Sydney, Australia, August 19-22, 1983 . Sydney, Australia, Sydney Shock Tube Symposium Publishers, 1984, p. 350-357. refs

A flow field study on a spherically-blunted biconic type model is presented. The experiments were conducted in a shock tunnel with a dissociated nitrogen free stream at speeds ranging from 5 km/s to 8 km/s and a Mach number of about 6. The corresponding reservoir enthalpies ranged from 15 MJ/kg to 50 MJ/kg. The results showed appreciable nonequilibrium effects in the nose region of the body, particularly on the shock wave which tends to move closer to the body with increasing enthalpy and shows an inflection point. Author

A85-25481
AERODYNAMIC FORCE MEASUREMENTS IN THE IISC HYPERSONIC SHOCK TUNNEL
N. M. REDDY (Indian Institute of Science, Bangalore, India) IN: Shock tubes and waves; Proceedings of the Fourteenth International Symposium on Shock Tubes and Shock Waves, Sydney, Australia, August 19-22, 1983 . Sydney, Australia, Sydney Shock Tube Symposium Publishers, 1984, p. 358-362. Research supported by the Aeronautics Research and Development Board.

By using fast response accelerometers, a three-component balance system has been developed and successfully used in a shock tunnel to measure aerodynamic forces. It has been shown theoretically that this balance system essentially behaves as a free body during the very short testing time (order of a few milliseconds) available in the shock tunnel. Hence, by measuring the accelerations, the aerodynamic forces are deduced by using Newton's second law. The lift, drag, and pitching-moment coefficients for a sharp cone-cylinder model have been measured at Mach number 4 in the IISc shock tunnel. The measured values compare very well with the modified Newtonian theory in an angle of attack range between 0 and 16 deg. Author

A85-25483
MEASUREMENTS OF DENSITY AND VELOCITY PROFILES IN NON-EQUILIBRIUM LAMINAR HYPERSONIC BOUNDARY LAYERS IN AIR
J. P. BAIRD, S. L. GAI (New South Wales, University, Duntroon, Australia), and P. LYONS (Australian National University, Canberra, Australia) IN: Shock tubes and waves; Proceedings of the Fourteenth International Symposium on Shock Tubes and Shock Waves, Sydney, Australia, August 19-22, 1983 . Sydney, Australia, Sydney Shock Tube Symposium Publishers, 1984, p. 374-380. refs

Wind-tunnel measurements of the Pitot pressure and density in a laminar boundary layer on a flat plate at zero incidence are presented. The measurements correspond to free-stream velocities of 5.74 and 4.4 km/s with stagnation pressures of 270 and 250 bar, respectively. Nitrogen laser and 8-beam He-Ne laser interferometry was used for fringe position and density gradient determination. It was found that the velocity profile at 880 microseconds after the shock does not differ significantly from the 680-microsecond profile, though helium contaminations for the two conditions are different (50 and 10 percent, respectively). It is concluded that while the Blasius profile lies within the error bars of each of the profiles for much of the boundary layer, all of the profiles exhibit the same characteristic shape, not predicted by previous detailed calculations. L.T.

A85-25484
NON-EQUILIBRIUM HIGH ENTHALPY AIRFLOWS IN A FREE PISTON SHOCK TUNNEL
D. J. KEWLEY (Southampton, University, Southampton, England; Department of Defence, Weapons Systems Research Laboratory, Salisbury, Australia) and N. H. PRATT (Southampton, University, Southampton, England) IN: Shock tubes and waves; Proceedings of the Fourteenth International Symposium on Shock Tubes and Shock Waves, Sydney, Australia, August 19-22, 1983 . Sydney, Australia, Sydney Shock Tube Symposium Publishers, 1984, p. 381-388. Research supported by the Australian Research Grants Committee, Science and Engineering Research Council of England, Australian National University, and University of Southampton. refs

Nonequilibrium flows of air and air-like mixtures over cylinders and wedges at incidence have been studied in the Australian National University's free piston shock tunnel T3 at stagnation enthalpies greater than 2.0 x 10 to the 7th J/kg. Contamination of the test gas by helium driver gas becomes important at these conditions. It is shown that experimental results can be quantitatively modeled, for enthalpies at least up to about 3.4 x 10 to the 7th J/kg, if modest levels of contamination are incorporated consistent with composition measurements obtained in other experiments in T3. Other features reported include the influence of contamination on bow shock stand-off distance as a function of flow time and a lack of run-to-run repeatability for a range of test gas compositions. It is concluded that in future work at high enthalpies the test flow should be characterized using measured, rather than inferred, free stream properties. Author

A85-25926*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AIRFOIL LARGE-EDDY BREAKUP DEVICES FOR TURBULENT DRAG REDUCTION
J. B. ANDERS and R. D. WATSON (NASA, Langley Research Center, High-Speed Aerodynamics Div., Hampton, VA) American Institute of Aeronautics and Astronautics, Shear Flow Control Conference, Boulder, CO, Mar. 12-14, 1985. 12 p. refs
(AIAA PAPER 85-0520)

Large-eddy breakup devices were tested in a turbulent boundary layer at a momentum thickness Reynolds number of 7400. The drag reducing characteristics of thin, tapered plates, NACA 0009, and NACA 4409 airfoil shapes were determined and compared with lower Reynolds number data obtained with thin elements. The results indicate that at the higher Reynolds numbers of the present tests the thin, tapered plates in a tandem arrangement produced large downstream skin-friction reductions (maximum 0/40 percent/), and gave net drag reductions at least as large as for lower Reynolds numbers. Tandem NACA 0009 airfoils, which were approximately 10 times thicker than the thin plates, gave similar results with a maximum downstream skin-friction reduction of 0(30 percent) and a net drag reduction of 7 percent. The device drag for this shape was determined to be near laminar skin friction. The NACA 4409 airfoils suffered large regions of separated flow and produced no net drag reduction. Author

A85-25927#
MORE DETAILED MEASUREMENTS BEHIND TURBULENCE MANIPULATORS INCLUDING TANDEM DEVICES USING SERVO-CONTROLLED BALANCES
V. D. NGUYEN, J. DICKINSON (Universite Laval, Quebec, Canada), J. LEMAY, D. PROVENCAL, and R. GOURDEAU American Institute of Aeronautics and Astronautics, Shear Flow Control Conference, Boulder, CO, Mar. 12-14, 1985. 13 p. Research supported by the National Research Council of Canada. refs
(AIAA PAPER 85-0521)

Further experimental data is presented of skin friction and velocity profile measurements behind a large variety of flat plate turbulence manipulators, consisting of single, double-stacked and tandem blades placed parallel to the surface at differing heights inside an incompressible boundary layer. Skin friction measurements were made using both a servo-controlled, floating element balance and a Preston tube, together with mean velocity

profiles registered at twelve different stations with a pitot probe. The data, extending some 160 boundary layer thicknesses downstream of the manipulators, illustrates relaxation characteristics as the boundary layer returns to its equilibrium state, for a range of Reynolds numbers (R-Theta) based on momentum thickness varying from 2400 to 6200. Author

A85-25928*# Tennessee Univ. Space Inst., Tullahoma.
FLOW CONTROL IN A DIFFUSING S-DUCT
A. D. VAKILI, J. M. WU, P. LIVER, and M. K. BHAT (Tennessee, University, Space Institute, Tullahoma, TN) American Institute of Aeronautics and Astronautics, Shear Flow Control Conference, Boulder, CO, Mar. 12-14, 1985. 8 p. refs
(Contract NAG3-364)
(AIAA PAPER 85-0524)

Accurate measurements have been made of secondary flow in a 1.51 area ratio diffusing 30 deg - 30 deg S-Duct with circulair cross section. Turbulent flow was entering the duct at Mach number of 0.6, the boundary layer thickness at the duct entrance was ten percent of the duct inlet diameter. Through measurements made, local flow velocity vector as well as static and total pressures mapping of the flow at several stations were obtained. Strong secondary flow was measured in the first bend which continued into the second bend with new vorticity produced in there in the opposite direction. Surface oil flow visualization and wall pressures indicated a region of separated flow starting at theta approximately equal to 22 deg on the inside of the first bend up to theta approximately equal to 44 deg on the outside of the second bend. The flow separated in 'cyclone' form and never reattached in the duct. As a result of the secondary flow and the flow separation, significant total pressure distortion was observed at the exit of the duct. Using flow control devices the separation was eliminated while the exit distortion was improved. Author

A85-25930#
EFFECT OF A LONGITUDINAL VORTEX ON A SEPARATED TURBULENT BOUNDARY LAYER
R. D. MEHTA (Stanford University, Stanford, CA) American Institute of Aeronautics and Astronautics, Shear Flow Control Conference, Boulder, CO, Mar. 12-14, 1985. 12 p. refs
(AIAA PAPER 85-0530)

A subsonic experimental study on the effect of a single longitudinal vortex on a separated turbulent boundary layer has been completed. The vortex was generated by a half-delta wing mounted at the front end of an axisymmetric 'bump' model. The adverse pressure gradient over the back of the bump was severe enough to produce a small region of boundary layer separation. A detailed flow visualization study was conducted using vapor screen and surface oil-flow techniques. In addition to surface pressures, detailed mean flow and turbulence measurements in the UV - plane were obtained using a two-component laser velocimeter. As expected, the overall effect of the vortex was to reduce the region of boundary layer separation. In particular, the vortex delayed or eliminated boundary layer separation on the downgoing side and enhanced it on the upgoing side. The boundary layer turbulence was found to reorganize accordingly, although in a very complex manner. The asymmetric separation produced by the generated vortex resulted in a secondary vortex with its origin at a focus on the surface. The results obtained in this investigation will be useful in improving basic understanding of such complex interactions where a longitudinal vortex is used to control boundary layer separation. Author

A85-25931#
CONTROL OF UNSTEADY SEPARATED FLOW STRUCTURES ON AIRFOILS
M. W. LUTTGES, M. C. ROBINSON, and D. A. KENNEDY (Colorado, University, Boulder, CO) American Institute of Aeronautics and Astronautics, Shear Flow Control Conference, Boulder, CO, Mar. 12-14, 1985. 13 p. refs
(Contract AF-AFOSR-81-0037)
(AIAA PAPER 85-0531)

Experimental techniques were devised to generate, simulate and control the appearance of turbulent structures over a pitched NACA 0015 airfoil. The structures were generated by oscillation of the airfoil within the flow and similar formations were produced by a vortex generator and an air pulse injection device. The flow distortions were visualized using stroboscopic illumination and photography. Injection of an air pulse into the flow over the airfoil and over a thin plate in the same situation significantly reduced the frequency of the separated flow features when the pulses were generated at specific moments in the pitching cycle. Further tests are required to fully characterize what appears to be an effective means of controlling the formation of the separated flow structures. M.S.K.

A85-25943*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
THE EFFECT OF OPPOSING UNSTEADY VORTICITY ON TURBULENT WALL FLOW
W. L. GOODMAN (NASA, Langley Research Center, High-Speed Aerodynamics Div., Hampton, VA) American Institute of Aeronautics and Astronautics, Shear Flow Control Conference, Boulder, CO, Mar. 12-14, 1985. 10 p. refs
(AIAA PAPER 85-0550)

A cylinder and a thin plate were placed close together in a flow adjacent to a wall to study the effects on the turbulent boundary layer. Different spacings of the cylinder and plate within the shear flow were investigated to assess the possibility of lowering the production of fluctuating vorticity in the boundary layer by generating a fluctuating vorticity of opposite sign. Streakline photographs visualized changes in the flow induced by alterations in the cylinder/plate separation distance, the flow velocity and the angle of attack of the thin plate. Drag data were also acquired with varying thicknesses of the thin plate and diameters of the cylinder. Downstream skin friction reductions were obtained with the production of unsteady control vortices with a low turbulence boundary layer. Up to 4 percent drag reduction was also observed when the cylinder was sufficiently far from the wall. M.S.K.

A85-25946#
MODIFICATION OF VORTEX INTERACTIONS IN A REATTACHING SEPARATED FLOW
S. BHATTACHARJEE, B. SCHEELKE, and T. R. TROUTT (Washington State University, Pullman, WA) American Institute of Aeronautics and Astronautics, Shear Flow Control Conference, Boulder, CO, Mar. 12-14, 1985. 9 p. refs
(AIAA PAPER 85-0555)

Recent experimental observations have shown that large-scale organized vortices are produced in reattaching separated flows. Interactions between these vortices are important in the downstream development of these flows. The presented experimental results for an air flow produced by a downstream facing step demonstrate that substantial changes in a reattaching separated flow can be achieved by controlled forcing techniques. The forcing apparently works by affecting the vortex merging process in a fashion similar to that observed in forced mixing layer experiments. The separated mean flow spreading rate could be increased most effectively by forcing at a nondimensional frequency (based on step height and free stream velocity) between 0.2 - 0.4. This result was found to be largely independent of step Reynolds number over the range (26,000 - 76,000) studied. Decreases in reattachment lengths of approximately 10 percent were observed in the experiments. Considerable changes in the turbulence energy and the Reynolds stress levels accompanied the increased mean flow spreading. Author

A85-25952#
LOCK-ON AND INSTABILITY IN A FLAT PLATE WAKE
M. MASSELIN and C.-M. HO (Southern California, University, Los Angeles, CA) American Institute of Aeronautics and Astronautics, Shear Flow Control Conference, Boulder, CO, Mar. 12-14, 1985. 7 p. Navy-supported research. refs
(AIAA PAPER 85-0571)

The lock-on phenomenon of a flat plate wake was studied in relation to wake stability characteristics. The onset of the lock-on was found to be determined by the ratio of the perturbing frequency and the most amplified frequency of the wake. Author

A85-26016
FLOW FIELDS NEAR BODIES PLACED IN RAREFIED SUBSONIC AND SUPERSONIC JETS [CHAMPS D'ECOULEMENTS, AU VOISINAGE DE CORPS PLACES DANS DES JETS SUBSONIQUES ET SUPERSONIQUES RAREFIES]
J. ALLEGRE, M. RAFFIN (Societe d'Etudes de Constructions et de Services pour Souffleries et Installations Aerothermodynamiques, Paris, France), and J.-C. LENGRAND (CNRS, Paris, France) L'Aeronautique et l'Astronautique (ISSN 0001-9275), no. 107, 1984, p. 22-28. In French. Research supported by the Direction des Recherches, Etudes et Techniques.

In order to validate the application of theoretical models based on the solution of Navier-Stokes equations or on the Monte Carlo simulation, comparisons between experimental and calculated flow fields are given. The rarefaction conditions result in dense shock waves and in the development of boundary layers near the profiles. Density profiles are visualized using electron beams. Results for flow fields around a sphere and around an NACA 0012 profile are presented for subsonic and supersonic flows at Mach numbers of 0.8 and 2. The Reynolds number based on the radius of the sphere and on the chord of the profile varies from 73 to 106. In the case of an experimental flow field around a sphere, the agreement between the theoretical and experimental values is satisfactory. Experimental and theoretical results are found to diverge to some extent for the NACA 0012 profile in supersonic flow. M.D.

A85-26025
UNSTEADY TRANSONIC PHENOMENA AROUND HIGHLY SWEPT WINGS [PHENOMENES TRANSSONIQUES INSTATIONNAIRES AUTOUR D'AILES A FORTE FLECHE]
A. LAURENT (Avions Marcel Dassault-Breguet Aviation, Saint-Cloud, Hauts-de-Seine, France) (NATO, AGARD, Meeting on Transonic Aerodynamics and Its Aeroelastic Applications, Toulouse, France, Sept. 2-7, 1984) L'Aeronautique et l'Astronautique (ISSN 0001-9275), no. 109, 1984, p. 52-60. In French. Research supported by the Service Technique des Programmes Aeronautiques.

The Deltatrans transonic code is used to model the flow around all points of a wing. It is assumed that only small disturbances are present in the flow and that the unsteady solutions are periodic. Boundary conditions are defined near the wall, the Kutta-Joukowski condition is assumed valid for the wake, and the Sommerfeld condition is assumed at infinity. A variational form is defined for the flow disturbance equations and account is taken of the shock and memory effects in the flow. The model predictions are compared with experimental data from wind tunnel data on the Mirage F1 tail fin, which has a 50 deg sweep. Deltatrans is shown capable of accurately describing situations with a superposition of aerodynamic effects which produce flow nonlinearities. M.S.K.

A85-26310
FIVE YEARS EXPERIENCE WITH MINIMUM INDUCED LOSS PROPELLERS. I - THEORY
E. E. LARRABEE (MIT, Cambridge, MA) Society of Automotive Engineers, International Congress and Exposition, Detroit, MI, Feb. 27-Mar. 2, 1984. 12 p. refs
(SAE PAPER 840026)

An actuator disk is approximated by minimum induced loss propeller rotors, which are the rotational analogs of elliptically loaded wings with minimum kinetic energy loss for specific disk loading, number of blades, and flight speed. Such propellers are uniquely suited for man-powered flight vehicle applications. Attention is presently given to design and performance algorithms for such propellers, which may be implemented on pocket calculators. O.C.

A85-26311
FIVE YEARS EXPERIENCE WITH MINIMUM INDUCED LOSS PROPELLERS. II - APPLICATIONS
E. E. LARRABEE (MIT, Cambridge, MA) Society of Automotive Engineers, International Congress and Exposition, Detroit, MI, Feb. 27-Mar. 2, 1984. 8 p.
(SAE PAPER 840027)

An evaluation is made of the effect of minimum induced loss propellers' incorporation by low speed and man-powered aircraft designs, as well as horizontal axis wind turbines. Propellers of this large diameter, high twist/high taper design have been essential to the achievement of high performance by the Gossamer Albatros, CHRYSALIS, and MONARCH man-powered aircraft, as well as the photovoltaic-powered Solar Challenger. O.C.

A85-26321#
WING-IN-GROUND EFFECT AERODYNAMIC PREDICTIONS USING PANAIR
A. R. GOETZ (USAF, Foreign Technology Div., Wright-Patterson AFB, OH), R. F. OSBORN (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH), and M. S. SMITH (USAF, Institute of Technology, Wright-Patterson AFB, OH) AIAA, AHS, and ASEE, Aircraft Design, Systems, and Operations Meeting, San Diego, CA, Oct. 31-Nov. 2, 1984. 10 p. refs
(AIAA PAPER 84-2429)

The Panel Aerodynamics (PANAIR) higher-order panel method computer code was used to predict the lift and drag characteristics of an aspect ratio two rectangular wing operating in-ground effect with and without end plates. Results of the theoretical calculations obtained using the image technique to simulate ground effect were compared with subsonic wind tunnel experimental data. Excellent agreement between theory and experiment was achieved for the wing without end plates down to heights of ten percent of the wing chord above the ground. For the wing with end plate geometries, PANAIR predicted lift and drag within five percent of the experimentally measured level at wing heights above the ground greater than twenty percent of the wing chord. PANAIR results underpredicted experimental data by over twenty percent for wing positions near the ground because the numerical model used did not properly simulate spanwise flow between the bottom of the end plate and the ground. Author

A85-26382#
AERODYNAMIC EFFECTS OF PROBE-INDUCED FLOW SEPARATION OF BLUFF BODIES AT TRANSONIC MACH NUMBERS
B. F. HAUPT, R. S. BUFF (USAF, Armament Laboratory, Eglin AFB, FL), and K. KOENIG (Mississippi State University, Mississippi State, MS) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 23rd, Reno, NV, Jan. 14-17, 1985. 12 p. refs
(AIAA PAPER 85-0103)

An experimental investigation using probe-induced flow separation devices to reduce transonic blunt body drag has been conducted. Particularly examined were blunt axisymmetric mainbodies with axially aligned cylindrical probes extended ahead. The experiments were performed in a ballistics facility, and the data obtained includes drag coefficients and shadowgraphs of the flow field. Drag reductions of twenty-five percent were observed over the Mach number range from 0.85 to 1.25. Flow visualization reveals a distinct difference in the manner in which the flow reattaches onto the mainbody for low and high drag geometries. The flow field also exhibits modes resembling open and closed cavity flows, depending primarily on the probe length. Large scale flow oscillations are observed for both low and high drag cases. This work clearly demonstrates the possibility for transonic drag reductions using cylindrical probes and provides useful information

on more fundamental questions concerning transonic flow separation and reattachment. Author

A85-26383#
NUMERICAL SIMULATION OF UNSTEADY FLOW IN A COMPRESSOR ROTOR CASCADE
J. N. SCOTT (Dayton, University, Dayton, OH) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 23rd, Reno, NV, Jan. 14-17, 1985. 12 p. refs
(Contract F33615-83-K-2318)
(AIAA PAPER 85-0133)

Numerical simulation of unsteady flow in a two-dimensional supersonic compressor rotor cascade is accomplished by solving the time-dependent compressible Navier-Stokes equations. The flow is computed between two adjacent rotor blades for a stream surfce located near the blade tip. For this stream surface, flow enters the blade passage at a relative Mach number of 1.33 and an absolute Mach number of about 0.66. The primary emphasis of this study is focused on the flow entering the blade passage where a new method has been developed for predicting the unsteady inflow due to the presence of the upstream stator and inlet guide vane. This new procedure accounts for the unsteady behavior in the form of an entropy wave which is expressed in terms of a stagnation pressure profile. The computations are performed first for a steady inflow using two different formulations of boundary conditions. One of these formulations which is based on characteristic variables is then modified for the unsteady inflow. The computed results generally show qualitative agreement with experimental data. Author

A85-26386*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EFFECT OF VARIABLE SURFACE CATALYSIS ON HEATING NEAR THE STAGNATION POINT OF A BLUNT BODY
D. A. STEWART, D. B. LEISER (NASA, Ames Research Center, Moffett Field, CA), and P. KOLODZIEJ (Informatics, Inc., Palo Alto, CA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 23rd, Reno, NV, Jan. 14-17, 1985. 14 p. refs
(AIAA PAPER 85-0248)

This paper describes arc-jet data obtained on the performance of glass coated thermal protection systems in a convectively heated environment. These data confirm earlier flight and arc-jet data that show an increased surface catalysis with salt contamination and a decreased surface catalysis near the softening point temperature of the glass. In addition, surface temperature distributions along sphere-cones with abruptly changing surface catalysis were measured near the stagnation point and compared well with computations using a reacting boundary layer code. Author

A85-26389*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ANALYTICAL MODELING OF CIRCUIT AERODYNAMICS IN THE NEW NASA LEWIS ALTITUDE WIND TUNNEL
C. E. TOWNE, L. A. POVINELLI, W. G. KUNIK, K. K. MURAMOTI, C. E. HUGHES (NASA, Lewis Research Center, Cleveland, OH), and R. LEVY (Scientific Research Associates, Inc., Glastonbury, CT) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 23rd, Reno, NV, Jan. 14-17, 1985. 21 p. Previously announced in STAR as N85-15688. refs
(AIAA PAPER 85-0380)

Rehabilitation and extention of the capability of the altitude wind tunnel (AWT) was analyzed. The analytical modelling program involves the use of advanced axisymmetric and three dimensional viscous analyses to compute the flow through the various AWT components. Results for the analytical modelling of the high speed leg aerodynamics are presented; these include: an evaluation of the flow quality at the entrance to the test section, an investigation of the effects of test section bleed for different model blockages, and an examination of three dimensional effects in the diffuser due to reentry flow and due to the change in cross sectional shape of the exhaust scoop. E.A.K.

N85-17939# Lockheed Missiles and Space Co., Sunnyvale, Calif.
WING ROCK FLOW PHENOMENA
L. E. ERICSSON *In* AFOSR Proc. of the Workshop on Unsteady Separated Flow p 10-20 1984
(AD-P004154) Avail: NTIS HC A09/MF A01 CSCL 20D

Flow mechanisms that can generate wing-rock type oscillations are described. It is shown that the slender wing rock phenomenon, the limit cycle oscillation in roll observed for very slender delta wings, is caused by asymmetric leading edge vortices and that vortex breakdown can never be the cause of it as it has a damping effect. For that reason slender wing rock is only realized for delta wings with more than 74 deg leading edge sweep for which asymmetric vortex shedding occurs before vortex breakdown. For straight or moderately swept wings the flow mechanics causing wing rock is two-dimensional in nature, closely related to the dynamic stall phenomenon. Pointed forebodies provide a third flow mechanism, asymmetric vortex shedding sensitive to body motion, which can generate a rocking motion of a slender vehicle unless it is completely axisymmetric. Author (GRA)

N85-17941# United Technologies Research Center, East Hartford, Conn.
UNSTEADY STALL PENETRATION OF AN OSCILLATING SWEPT WING
F. O. CARTA *In* AFOSR Proc. of the Workshop on Unsteady Separated Flow p 28-37 1984
(AD-P004156) Avail: NTIS HC A09/MF A01 CSCL 20D

Results include: (1) Mean angle of attack has little or no effect on wave speed which in all cases increases uniformly with reduced frequency. Motion amplitude also has little or no effect on wave speed. Mach number has a small but consistent effect on wave speed, with higher Mach numbers yielding slightly smaller wave speeds; (2) Sweep angle has a dominant effect on wave speed. The overall wave speed for the unswept wing is consistently greater than that for the swept wing by a factor of 1.5 to 2.0. This represents a major failure above stall for the cosine law normalization which has been shown to be consistently valid below stall; (3) Mach number has a dominant effect on vortex inception angle and static stall angle, with a decrease in both angles as the chordwise Mach number increases; (4) Vortex inception is substantially independent of amplitude of motion and mean angle of attack; and (5) Local wave speed differences associated with sweep are confined to the region of the blade aft of the 15% chord. Wave speeds are substantially the same for both sweep angles forward of this chord location. GRA

N85-17942# Southwest Research Inst., San Antonio, Tex.
SIMULTANEOUS FLOW VISUALIZATION AND UNSTEADY LIFT MEASUREMENT ON AN OSCILLATING LIFTING SURFACE
R. L. BASS, J. E. JOHNSON, and J. F. UNRUH *In* AFOSR Proc. of the Workshop on Unsteady Separated Flow p 38-44 1984
(AD-P004157) Avail: NTIS HC A09/MF A01 CSCL 20D

Boundary layer and trailing edge flow activities were recorded using hydrogen bubble flow visualization techniques on an oscillating lifting surface in a two-dimensional water tunnel. Simultaneous with flow documentation, unsteady lift was measured over a range of reduced frequencies from 0.5 to 10. Unsteady loads using classical, inviscid theories were predicted for the experimental conditions investigated. Reduced frequency bands exhibiting poor agreement between experiment and theory were identified and a correlation to observed flow phenomena was accomplished. The results support the use of a separate viscous model near the trailing edge coupled with an inviscid flow field model to predict unsteady loads. The results further show that for certain reduced frequency bands, classical inviscid solutions may be applicable and adequate. GRA

N85-17943# Flow Research, Inc., Kent, Wash.
A VISUAL STUDY OF A DELTA WING IN STEADY AND UNSTEADY MOTION
M. GAD-EL-HAK, C. M. HO, and R. F. BLACKWELDER *In* AFOSR Proc. of the Workshop on Unsteady Separated Flow p 45-51 1984
(Contract F49620-82-C-0020)
(AD-P004158) Avail: NTIS HC A09/MF A01 CSCL 20D

Two delta wings with a leading edge sweep of 45 deg and 60 deg were studied in a towing tank at chord Reynolds number up to 350,000. The wings were pitched about the quarter chord point through typical angles of attack of 15 deg + or - 15 deg, with a reduced frequency in the range of 0 to 3. In the steady state flow, dye visualizations revealed the existence of a shear layer near the leading edge that rolls up and forms 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. GRA

N85-17947# Colorado Univ., Boulder.
UNSTEADY AERODYNAMIC LOADING OF AN AIRFOIL DUE TO VORTICES RELEASED INTERMITTENTLY FROM ITS UPPER SURFACE
C. Y. CHOW and C. S. CHIU *In* AFOSR Proc. of the Workshop on Unsteady Separated Flow p 76-81 1984
(Contract F49620-83-K-0009)
(AD-P004162) Avail: NTIS HC A09/MF A01 CSCL 20D

An unsteady flow analysis is made of the flow past a symmetric airfoil with identical vortices released intermittently from its upper surface. The vortex train is used to simulate the flow observed in the laboratory which was perturbed by an oscillating spoiler or a rotating cam embedded in the airfoil surface. Based on numerical computations, the airfoil lift has a general behavior that it increases oscillatorily with time, and seems to approach an asymptotic value as time increases indefinitely. The asymptotic lift is enhanced with increasing frequency as which vortices are generated, and is only slightly influenced by changing the vortex releasing position along the chord. The behavior of the drag is similar to that of the lift, but its magnitude is two orders smaller. Our study also indicates that it is more efficient to implement the vortex augmented unsteady lift at higher angles of attack of airfoil. Author (GRA)

N85-17948*# Scientific Research Associates, Inc., Glastonbury, Conn.
A NAVIER-STOKES CALCULATION OF THE AIRFOIL DYNAMIC STALL PROCESS
S. J. SHAMROTH *In* AFOSR Proc. of the Workshop on Unsteady Separated Flow p 82-89 1984
(Contract NAS1-15214)
(AD-P004163) Avail: NTIS HC A09/MF A01 CSCL 20D

A time dependent Navier-Stokes calculation procedure has been applied to the problem of an NACA 0012 airfoil oscillating in pitch in a low Mach number, high Reynolds number environment. The calculated results show many of the known physical features, including sudden suction surface separation, vortices shed at the leading and trailing edges and the return to attached flow at low incidences. Both the lift and moment coefficient curves show the expected features and the calculated wall pressure coefficients show strong correspondence to measured data. Author (GRA)

N85-17950# McDonnell-Douglas Corp., Long Beach, Calif. Aircraft Div.
CAN THE SINGULARITY BE REMOVED IN TIME-DEPENDENT FLOWS?
T. CEBECI, A. A. KHATTAB, and S. M. SCHIMKE *In* AFOSR Proc. of the Workshop on Unsteady Separated Flow p 97-105 1984
(Contract F49620-82-C-0055)
(AD-P004165) Avail: NTIS HC A09/MF A01 CSCL 20D

The evolution of unsteady boundary layers on oscillating airfoils is studied. The computational difficulties associated with the movement of the stagnation point as a function of space and time are solved by using a novel numerical scheme. Calculations are performed for pressure distributions typical of those found near the leading edge of airfoils. Results are presented for two cases. In the first, solutions are obtained for a flow with separation and with prescribed pressure distribution; they infer that a singularity develops and is of the same type as that observed on a circular cylinder started impulsively from rest. In the second, results are obtained for the same flow and the viscous flow solutions are interacted with the external flow by using an inverse boundary layer method. The interaction seems to remove the singularity, however, these results are preliminary and need to be checked and improved upon. Author (GRA)

N85-17952# Colorado Univ., Boulder. Dept. of Aerospace Engineering Sciences.
UNSTEADY SEPARATED FLOW: FORCED AND COMMON VORTICITY ABOUT OSCILLATING AIRFOILS
M. C. ROBINSON and M. W. LUTTGES *In* AFOSR Proc. of the Workshop on Unsteady Separated Flow p 117-126 1984
(Contract AF-AFOSR-0037-81)
(AD-P004167) Avail: NTIS HC A09/MF A01 CSCL 20D

Flow perturbations induced through dynamic sinusoidal oscillations of an NACA 0015, NACA 0012, and flat plate were examined across a wide range of test conditions. Phase locked multiple exposure flow visualization in conjunction with corroborative hotwire anemometry documented the development of temporally and spatially synchronous leading and trailing edge vortices induced through unsteady flow separation. Airfoil oscillation dynamics directly influenced vortex initiation, development and traversing velocities. The results suggest the existence of optimal combinations of variables for maximizing both vortex strength and residence time over the airfoil. Author (GRA)

N85-17953# Colorado Univ., Boulder. Dept. of Aerospace Engineering Sciences.
UNSTEADY SEPARATED FLOWS: GENERATION AND USE BY INSECTS
M. W. LUTTGES, C. SOMPS, M. KLISS, and M. ROBINSON *In* AFOSR Proc. of the Workshop on Unsteady Separated Flow p 127-136 1984
(AD-P004168) Avail: NTIS HC A09/MF A01 CSCL 20D

The novel lift generation mechanism postulated by Weis-Fogh and evaluated by Lighthill in regard to hovering insects provided graphic evidence for the possible utility of unsteady flows. The present report summarizes flight mechanisms in dragonflies that appear to exploit unsteady flows to achieve rather remarkable aerodynamics. Overall, these experiments indicate that unsteady flows may be used to support quite sophisticated insect flight maneuvers. No significant change in wing geometry is needed to achieve such flight and only modest alterations in dynamic wing stroke variables are required. The observations made here indicate that dragonflies use mechanisms quite different from those used by the Chalcid wasp, as described by Weis-Fogh. Other means of exploiting unsteady separated flows may exist also within the insect world. GRA

N85-17954# Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.
THEORETICAL STUDY OF NON-LINEAR UNSTEADY AERODYNAMICS OF A NON-RIGID LIFTING BODY
J. C. WU, N. L. SANKAR, and H. H. CHEN *In* AFOSR Proc. of the Workshop on Unsteady Separated Flow p 137-147 1984
(Contract AF-AFOSR-0108-82)
(AD-P004169) Avail: NTIS HC A09/MF A01 CSCL 20D

A recently developed general theory of aerodynamics is used in an investigation of nonlinear unsteady flow problems involving a nonrigid lifting body. It is shown that this theory, developed on the basis of viscous flow equations, permits the important interactive fluid dynamic elements dominating the aerodynamics of nonlinear unsteady flows to be identified and their contributions evaluated individually. Closed form expressions for the lift, the drag, and the power expenditure of the Weis-Fogh problem, considered as a special case of flexible lifting bodies, are presented and discussed. GRA

N85-17955# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
THEORETICAL INVESTIGATION OF DYNAMIC STALL USING A MOMENTUM INTEGRAL METHOD
E. J. JUMPER and J. E. HITCHCOCK *In* AFOSR Proc. of the Workshop on Unsteady Separated Flow p 148-151 1984
(AD-P004170) Avail: NTIS HC A09/MF A01 CSCL 20D

An analytical study into the gust response of an airfoil is presented. The momentum integral equation for steady flow is extended into the airfoil that experiences a constant-rate-of-change of angle-of-attack gust. The von Karman-Pohlhausen method of integration is successfully modified to incorporate the additional transient flow terms; the equation of closure necessary to do this is also presented. Finally, computation of the flow about a Joukowski airfoil using the new equations is performed and the results are presented and discussed. It is shown that these results are in agreement with existing experimental data. GRA

N85-17956# Texas Technological Univ., Lubbock.
PRELIMINARY RESULTS FROM THE UNSTEADY AIRFOIL MODEL USTAR2
J. H. STRICKLAND, J. W. OLER, and B. J. IM *In* AFOSR Proc. of the Workshop on Unsteady Separated Flow p 152-157 1984
(Contract AF-AFOSR-1218-74; AF-AFOSR-3727-52)
(AD-P004171) Avail: NTIS HC A09/MF A01 CSCL 20D

Preliminary results from an UnSTeady AiRfoil analysis in two dimensions have been obtained from a computer code (USTAR2) developed by the present authors. This computer code is based upon an analysis which uses a doublet panel method to model the airfoil surface, an integral unsteady boundary layer scheme to model the viscous attached flow, and discrete vortices to model the detached boundary layers which form the airfoil wake region. This model has been used successfully to predict steady lift and drag coefficients as well as pressure distributions for several airfoils with both attached and detached boundary layers. In addition, calculations have been made for a limited number of cases for both attached and detached unsteady flow situations. These calculations are compared in a cursory way with experimental data to point out some of the strengths and weaknesses of the present formulation. GRA

N85-17959# Massachusetts Inst. of Tech., Cambridge. Dept. of Aeronautics and Astronautics.
FLOW SEPARATION INDUCED BY PERIODIC AERODYNAMIC INTERFERENCE
E. E. COVERT, P. F. LORBER, and C. M. VACZY *In* AFOSR Proc. of the Workshop on Unsteady Separated Flow p 169-176 1984
(Contract AF-AFOSR-0282-80)
(AD-P004174) Avail: NTIS HC A09/MF A01 CSCL 20D

Analysis of experimental surface pressure distributions on an NACA 0012 airfoil has revealed four flow states: attached, separated, borderline, and dynamically separated. The important parameters that determine the flow state are Reynolds number, reduced frequency, airfoil angle of attack, and surface condition at the leading edge. Testing was done at Re=700,000, .5 = k =6.4, and 0=alpha=18 degrees. For this flow the dynamically separated state takes the form of an alternation between attached and separated flow. It has a period that ranges from 1 to 30 times that of the unsteady perturbation. In the separated state a convected surface pressure disturbance was identified, and found to propagate downstream from a location near the leading edge at a phase speed of 1/3 to 1/2 that of the freestream velocity. GRA

N85-17960# Vehicle Research Corp., Pasadena, Calif.
LEADING EDGE SEPARATION CRITERION FOR AN OSCILLATING AIRFOIL
E. C. JAMES *In* AFOSR Proc. of the Workshop on Unsteady Separated Flow p 177-183 1984
(Contract F49620-82-C-0038)
(AD-P004175) Avail: NTIS HC A09/MF A01 CSCL 20D

Unsteady flow about the well-rounded nose of a subsonic airfoil is investigated from the viewpoint of leading edge separation. For an airfoil undergoing forced pitching and heaving motions in a uniform flow, fluid accelerations about the leading edge can be enormous according to inviscid flow theory. Such accelerations are limited by viscous flow and separation realities. The method of matched asymptotic expansions is used to develop a uniformly valid first order approximation to the inviscid flow about the airfoil's leading edge which is driven by a history dependent term related to the airfoil's transverse motions. Applying this flow to the laminar boundary layer flow at the airfoil nose produces possibilities for a laminar boundary layer to separate. A method is proposed for predicting leading edge dynamic stall based upon relating properties of the envelope of the unsteady part of the boundary layer speed and shear stress to the steady part of the boundary layer flow. GRA

N85-17994 Georgia State Univ., Atlanta.
ANALYSIS OF PRESSURE GRADIENT-VELOCITY CORRELATION IN TURBULENT, PREMIXED FLAMES Ph.D. Thesis
S. B. S. CHANDRAN 1984 167 p
Avail: Univ. Microfilms Order No. DA8424818

The correlation of pressure and velocity, as it occurs in turbulent stress equations is often neglected in the analysis of turbulent, reacting flows. The heat release and the ensuing dilation in reacting flows, make the measurement and modelling of these correlations difficult. An analytical study of planar, premixed flames using models for the pressure correlations and an experimental determination of these correlations in a premixed flame are done here. The models are developed by expressing pressure in terms of the velocity field. For this, a variable which depends on the pressure is defined and an equation for this variable is obtained from the momentum equation. Using the solution of this equation the pressure-velocity correlations are represented in terms of velocity correlations. The analysis of a one-dimensional, premixed, turbulent flame shows that the pressure gradient-velocity correlation term in such a flow could be of the order of the dilatation term and causes the turbulent kinetic energy to increase across the flame. Dissert. Abstr.

N85-17995 Cincinnati Univ., Ohio.
A NUMERICAL STUDY OF SEVERAL SUPERSONIC FLOWS Ph.D. Thesis
A. D. DILLEY 1984 234 p
Avail: Univ. Microfilms Order No. DA8425377

Two separate supersonic flows were studied: (1) oscillations associated with shock capturing supersonic, and (2) conical flows. Two dimensional supersonic inviscid flow past compression surfaces involves a shock. If shock capturing is used, oscillations usually develop and persist. A numerical scheme is developed, using two arbitrary weight factors and contains artificial dissipation. Supersonic flow past sharp cones was examined extensively and this body geometry is used for analyzing computational methods.

A new numerical scheme is developed using the Navier-Stokes equations subject to the locally conical approximation. The continuity equation and two momentum equations are solved in a coupled manner using a coupled strongly implicit (CSIP) algorithm. The normal momentum and energy equations are uncoupled, and a strongly implicit (SIP) algorithm is used to solve the energy equation for the total enthalpy. The boundary conditions are coupled implicity into the solution algorithms. The shock is fitted. Inviscid and viscous solutions for past a circular cone at small angles of attack were obtained using this scheme.

Dissert. Abstr.

N85-17996 British Aerospace Aircraft Group, Kingston-upon-Thames (England).

AIR INTAKE EFFICIENCY AT ZERO SPEED AND LIP SUCTION

C. L. BORE Oct. 1984 8 p refs

(BAE-KRS-N-GEN-303) Avail: Issuing Activity

The connection between lip suction and the pressure recovery factor (efficiency) for air intakes at zero speed is examined to show the relationship between the realized lip suction force and the total pressure losses. Measurement of the lip suction force could be used as an alternative method for finding the pressure recovery factor by experiment. A rule for provision of adequate bell-mouth area for high intake efficiency is derived.

Author (ESA)

N85-17997*# Old Dominion Univ., Norfolk, Va.

CORRECTIONS FOR ATTACHED SIDEWALL BOUNDARY-LAYER EFFECTS IN 2-DIMENSIONAL AIRFOIL TESTING

A. V. MURTHY Washington NASA Feb. 1985 37 p refs (Contract NAG1-334)

(NASA-CR-3873; NAS 1.26:3873) Avail: NTIS HC A03/MF A01 CSCL 01A

The problems of sidewall boundary-layer effects in airfoil testing is treated by considering the changes in the flow area due to boundary-layer thinning under the influence of the airfoil flowfield. Using von Karman's momentum integral equation, it is shown that the sidewall boundary-layer thickness in the region of the airfoil can reduce to about half the undisturbed value under the conditions prevailing in testing of supercritical airfoils. A Mach number correction due to this increased width of the flow passage is proposed. Using the small disturbance approximation, the effect of the sidewall boundary-layers is shown to be equivalent to a change in the test Mach number and also in the airfoil thickness. Comparison of the results of this approach with other similarity rules and correlation of the experimental data demonstrate the applicability of the analysis presented from low speeds to transonic speeds. Author

N85-17998# National Aerospace Lab., Tokyo (Japan).

CALCULATIONS FOR AERODYNAMIC CHARACTERISTICS ON A 3-D LIFTING BODY IN A SUBSONIC FLOW USING BOUNDARY ELEMENT METHOD

M. YANAGIZAWA Sep. 1984 29 p refs In JAPANESE; ENGLISH summary

(NAL-TR-835; ISSN-0389-4010) Avail: NTIS HC A03/MF A01

A boundary element method for the evaluations of steady aerodynamic loads around complex configurations in subsonic flow was developed using Green's function. Morino described the form of the integral equation, which is transformed into a set of linear algebraic equations. The velocity on the arbitrary point of the body surface is given by the derivative of the velocity potential on the point along the surface stream line. A new paneling and derivative technique is presented which can be applied to any complex configuration. To evaluate the derivative of velocity potential on the surface, the surface element is replaced with the circular arc, which is determined by three collocation points in adjoining panels. Aerodynamic quantities, such as pressure distributions, lift, pitching moment, and drag of the actual airplane in compressible flow, are calculated as an example. Comparisons between numerical and experimental results show good agreement. Author

N85-17999*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

EFFECT OF JET EXIT VANES ON FLOW PULSATIONS IN AN OPEN-JET WIND TUNNEL

W. L. SELLERS, III, Z. T. APPLIN, and J. K. MOLLOY Mar. 1984 217 p refs

(NASA-TM-86299; L-15810; NAS 1.15:86299) Avail: NTIS HC A10/MF A01 CSCL 01A

An investigation was conducted of various jet exit vane configurations in the open test section of the Langley 4- by 7-Meter Tunnel to determine their effectiveness in reducing flow pulsations. The data consist of the instantaneous velocity fluctuations measured with hot-wire anemometers located at the tunnel centerline, 39.5 ft (12.0) downstream of the jet exit. The data are presented in the form of measured root-mean-square turbulence levels in the test section and a time series analysis for the baseline jet exit configuration (without vanes) and forthe most effective vane configuration, which consisted of triangular vanes alternating into and out of the flow around the jet exit. Author

N85-18000*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

FLOW INSTABILITIES IN TRANSONIC SMALL DISTURBANCE THEORY

M. H. WILLIAMS (Purdue Univ., Lafayette, Indiana), S. R. BLAND, and J. W. EDWARDS Jan. 1985 27 p refs

(NASA-TM-86251; NAS 1.15:86251) Avail: NTIS HC A02/MF A01 CSCL 01A

The dynamics of unsteady transonic small disturbance flows about two-dimensional airfoils is examined, with emphasis on the behavior in the region where the steady state flow is nonunique. It is shown that nonuniqueness results from an extremely long time scale instability which occurs in a finite Mach number and angle of attack range. The similarity scaling rules for the instability are presented and the possibility of similar behavior in the Euler equations is discussed. Author

N85-18001*# McDonnell Aircraft Co., St. Louis, Mo.

NUMERICAL APPROACH FOR THE AERODYNAMIC ANALYSIS IF AIRFOILS WITH LAMINAR SEPARATION Final Report, Oct. 1983 - Oct. 1984

D. W. HALT and D. R. BRISTOW Feb. 1985 33 p refs

(NASA-CR-172496; NAS 1.26:172496) Avail: NTIS HC A03/MF A01 CSCL 01A

A numerical method for simultaneously and efficiently coupling an external subsonic potential flow and an interior viscous flow such that the two flows match at an interfacing boundary is discussed. Both a panel method and a simple point compressible vortex model are used for the outer potential field. The interior flow solvers which were used are the Navier-Stokes and Euler codes of T. J. Coakley and the Euler code of A. Verhoff. In order to test compatibility, the panel method is coupled to the less expensive Euler codes since the coupling procedure is identical with the Navier-Stokes code. The results show significant efficiency improvements can be obtained over the uncoupled approach. Results also indicate the outer potential flow is best represented by the simple point compressible vortex model. The panel method couples smoothly to Coakley's implicit code but is numerically incompatible as coupled with the explicit Euler code. An improved Navier-Stokes code is under initial development which extends the Euler code to include the necessary viscous terms. Results are shown for all infinite length channel with one wavy periodic wall with and without laminar separation. M.G.

N85-18002*# Boston Univ., Mass. Dept. of Mathematics.
A FIRST-ORDER GREEN'S FUNCTION APPROACH TO SUPERSONIC OSCILLATORY FLOW: A MIXED ANALYTIC AND NUMERIC TREATMENT
M. I. FREEDMAN, S. SIPCIC, and K. TSENG Feb. 1985 38 p refs
(Contract NAG1-276)
(NASA-CR-172207; NAS 1.26:172207) Avail: NTIS HC A03/MF A01 CSCL 01A

A frequency domain Green's Function Method for unsteady supersonic potential flow around complex aircraft configurations is presented. The focus is on the supersonic range wherein the linear potential flow assumption is valid. In this range the effects of the nonlinear terms in the unsteady supersonic compressible velocity potential equation are negligible and therefore these terms will be omitted. The Green's function method is employed in order to convert the potential flow differential equation into an integral one. This integral equation is then discretized, through standard finite element technique, to yield a linear algebraic system of equations relating the unknown potential to its prescribed co-normalwash (boundary condition) on the surface of the aircraft. The arbitrary complex aircraft configuration (e.g., finite-thickness wing, wing-body-tail) is discretized into hyperboloidal (twisted quadrilateral) panels. The potential and co-normalwash are assumed to vary linearly within each panel. The long range goal is to develop a comprehensive theory for unsteady supersonic potential aerodynamic which is capable of yielding accurate results even in the low supersonic (i.e., high transonic) range. Author

N85-18003*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
TRANSONIC STEADY- AND UNSTEADY-PRESSURE MEASUREMENTS ON A HIGH-ASPECT-RATIO SUPERCRITICAL-WING MODEL WITH OSCILLATING CONTROL SURFACES
M. C. SANDFORD, R. H. RICKETTS, and F. W. CAZIER, JR. Dec. 1980 261 p refs
(NASA-TM-81888; L-13964; NAS 1.15:81888) Avail: NTIS HC A12/MF A01 CSCL 01A

A supercritical wing with an aspect ratio of 10.76 and with two trailing-edge oscillating control surfaces is described. The semispan wing is instrumented with 252 static orifices and 164 in situ dynamic-pressure gages for studying the effects of control-surface position and motion on steady- and unsteady-pressures at transonic speeds. Results from initial tests conducted in the Langley Transonic Dynamics Tunnel at two Reynolds numbers are presented in tabular form. Author

N85-18004*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SUBSONIC AND TRANSONIC PRESSURE MEASUREMENTS ON A HIGH-ASPECT-RATIO SUPERCRITICAL-WING MODEL WITH OSCILLATING CONTROL SURFACES
M. C. SANDFORD, R. H. RICKETTS, and J. J. WATSON Nov. 1981 225 p refs
(NASA-TM-83201; L-14831; NAS 1.15:83201) Avail: NTIS HC A10/MF A01 CSCL 01A

A high aspect ratio supercritical wing with oscillating control surfaces is described. The semispan wing model was instrumented with 252 static orifices and 164 in situ dynamic pressure gases for studying the effects of control surface position and sinusoidal motion on steady and unsteady pressures. Data from the present test (this is the second in a series of tests on this model) were obtained in the Langley Transonic Dynamics Tunnel at Mach numbers of 0.60 and 0.78 and are presented in tabular form. Author

N85-18005*# United Technologies Research Center, East Hartford, Conn.
SYNTHESIZED AIRFOIL DATA METHOD FOR PREDICTION OF DYNAMIC STALL AND UNSTEADY AIRLOADS
S. T. GANGWANI Washington NASA Feb. 1983 136 p refs
(Contract NAS1-168032; DA PROJ. 1L1-61103-AH-45)
(NASA-CR-3672; NAS 1.26:3672) Avail: NTIS HC A07/MF A01 CSCL 01A

A detailed analysis of dynamic stall experiments has led to a set of relatively compact analytical expressions, called synthesized unsteady airfoil data, which accurately describe in the time-domain the unsteady aerodynamic characteristics of stalled airfoils. An analytical research program was conducted to expand and improve this synthesized unsteady airfoil data method using additional available sets of unsteady airfoil data. The primary objectives were to reduce these data to synthesized form for use in rotor airload prediction analyses and to generalize the results. Unsteady drag data were synthesized which provided the basis for successful expansion of the formulation to include computation of the unsteady pressure drag of airfoils and rotor blades. Also, an improved prediction model for airfoil flow reattachment was incorporated in the method. Application of this improved unsteady aerodynamics model has resulted in an improved correlation between analytic predictions and measured full scale helicopter blade loads and stress data. Author

N85-18006# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
GENERATION OF 3-DIMENSIONAL BODY FITTED COORDINATES USING HYPERBOLIC PARTIAL DIFFERENTIAL EQUATIONS Final Report
J. L. STEGER Mar. 1984 80 p
(Contract AF-AFOSR-0254-82)
(AD-A148059; AFOSR-84-1022TR) Avail: NTIS HC A05/MF A01 CSCL 20D

The purpose of this research has been to further develop a simple efficient grid generation procedure for external aerodynamics applications. The grid generation scheme is based on solving hyperbolic partial differential equation constraints of grid angularity and mesh incremental volumes. The grid generation scheme has been previously used in two dimensional applications to generate grids about smooth body shapes. The main thrust of this AFOSR supported research has been to extend the hyperbolic partial differential equation procedure to three dimensional applications and to study ways of applying the procedure to body shapes that have discontinuous derivatives. The main part of this report, Part 1, is devoted to describing the three dimensional hyperbolic grid generator. This Section first reviews the hyperbolic grid generation procedure in two dimensions and then describes the extension to three dimensions. Part 2 of this report is both brief and sketchy in its presentation. In this section we describe some of our successes in treating bodies with sharp edges and bodies that are exceptionally concave. The last part of this report describes a flow field algorithm development. During the course of this research we had some considerable interaction with AFWAL, and at one point became side-tracked into a successful approach of improving the efficiency of our general implicit Euler and Navier-Stokes code. GRA

N85-18007# European Space Agency, Paris (France).
A FINITE DIFFERENCE METHOD FOR INVERSE MODE CALCULATIONS OF A THREE-DIMENSIONAL BOUNDARY LAYER
M. FORMERY Sep. 1984 158 p refs Transl. into ENGLISH of "Methode aux Differences Finies pour le Calcul en Modes Inverses de la Couche Limite Turbulente Tridimensionnelle" Rept. ONERA-NT-1982-6 ONERA, Paris, 1982 Original language document announced as N84-25956
(ESA-TT-863; ONERA-NT-1982-6) Avail: NTIS HC A08/MF A01

A numerical method to solve the turbulent 3-D boundary layer equations by inverse approaches where either the longitudinal and transverse displacement thicknesses or the wall shear stress

components are prescribed is proposed. The method was programmed for a boundary layer developing on a flat wall, for incompressible and compressible flows. Simple turbulence models were used. The equations are solved by a strongly implicit finite difference method. Applications in subsonic and transonic flows show that a separation is crossed without numerical difficulty, and that it is possible to extend the calculation of the boundary layer in the separated zone and beyond the reattachment line. Results agree with experimental data; the flow structure in the vicinity of the separation line is faithfully represented. Author (ESA)

N85-18008# Rolls-Royce Ltd., Derby (England).
LAMINAR SEPARATION BUBBLE WITH TRANSITION: PREDICTION TEST WITH LOCAL INTERACTION
C. GLEYZES (ONERA, Toulouse), J. COUSTEIX (ONERA, Toulouse), and J. L. BONNET (ONERA, Toulouse) 8 Nov. 1984 30 p refs
(PNR-90231; TRANS-16569/TLT-00917) Avail: NTIS HC A03/MF A01

A leading edge separation bubble on a peaky airfoil was studied. Boundary layer measurements, mean volocity and longitudinal turbulence intensity were recorded at Reynolds numbers between 100,000 and 1 million. The transition process in a long bubble was also studied. Calculation methods applicable to short bubbles based on a local viscid-inviscid interaction scheme are proposed. The development of the boundary layer downstream of the laminar separation bubble with transition is defined although the size of the profile prevented detailed results for the actual short bubble. Author (ESA)

N85-18951*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
STATIC INTERNAL PERFORMANCE OF A TWO-DIMENSIONAL CONVERGENT NOZZLE WITH THRUST-VECTORING CAPABILITY UP TO 60 DEG
L. D. LEAVITT Feb. 1985 70 p refs
(NASA-TP-2391; L-15837; NAS 1.60:2391) Avail: NTIS HC A04/MF A01 CSCL 01A

An investigation was conducted at wind-off conditions in the static-test facility of the Langley 16-Foot Transonic Tunnel to determine the internal performance characteristics of a two-dimensional convergent nozzle with a thrust-vectoring capability up to 60 deg. Vectoring was accomplished by a downward rotation of a hinged upper convergent flap and a corresponding rotation of a center-pivoted lower convergent flap. The effects of geometric thrust-vector angle and upper-rotating-flap geometry on internal nozzle performance characteristics were investigated. Nozzle pressure ratio was varied from 1.0 (jet off) to approximatealy 5.0. Author

N85-18952*# National Aeronautics and Space Administration, Washington, D. C.
ON THE FLOW PROCESSES IN SHARPLY INCLINED AND STALLED AIRFOILS IN PARALLEL MOVEMENT AND ROTATION
M. KOHLER Sep. 1984 44 p refs Transl. into ENGLISH from Luftfahrtforsch. (West Germany), v. 16, no. 4, 1939 p 158-177 Transl. by Kanner (Leo) Associates, Redwood City, Calif.
(Contract NASW-3541)
(NASA-TM-77509; NAS 1.15:77509) Avail: NTIS HC A03/MF A01 CSCL 01A

The purpose of this study is to obtain a deeper insight into the complicated flow processes on airfoils in the region of the buoyancy maxima. To this end calculated and experimental investigations are carried out on a straight stationary, a twisted stationary and a straight rotating rectangular wing. According to the available results the method gives results which can be applied sufficiently for flow applied firmly on all sides for all rotation values. The reliability of the method may be questioned for a flow undergoing transition from the attached to the separated state or for totally separated flow and higher rotation values. Author

N85-18953*# National Aeronautics and Space Administration, Washington, D. C.
PROFILE DESIGN FOR WINGS AND PROPELLERS
A. QUAST and K. H. HORSTMANN Dec. 1984 33 p refs Transl. into ENGLISH of "Profilauslegung fuer Tragfluegel und Propeller" Deutsche Gesellschaft fuer Luft- und Raumfahrt, 1983 p 107-138 Presented at the Probl. and Develop. Trends in Gen. Aviation Symp., Friedrichshafen, West Germany, 24-25 Mar. 1983 Original language document was announced in IAA as A84-15411 Transl. by Kanner (Leo) Associates, Redwood City, Calif.
(Contract NASW-4005)
(NASA-TM-77785; NAS 1.15:77785) Avail: NTIS HC A03/MF A01 CSCL 01A

It has now become customary to develop profiles for wings and propellers for a given employment of the aircraft. This is possible because methods and computers are available to study an entire series of variants in comparatively short time. The basic viewpoints for profile design are presented. It is shown that laminarization has its advantages in almost all cases, including the design of a turbine blade and the design of the profile of an airliner. The requirements which profiles have to satisfy are discussed along with the possibilities for increasing lift on profiles. G.R. (IAA)

N85-18954*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SOME FIGHTER AIRCRAFT TRENDS
L. SPEARMAN Jan. 1985 38 p refs Presented at AIAA Aircraft Design, Systems, and Operations Meeting, San Diego, Calif., 31 Oct. - 2 Nov., 1984
(NASA-TM-86352; NAS 1.15:86352) Avail: NTIS HC A03/MF A01 CSCL 01A

Some basic trends in fighters are traced from the post World II era. Beginning with the first operational jet fighter, the P-80, the characteristics of subsequent fighter aircraft are examined for performance, mission capability, effectiveness, and cost. Characteristics presented include: power loading, wing loading, maximum speed, rate of climb, turn rate, weight and weight distribution, cost and cost distribution. The characteristics of some USSR aircraft are included for comparison. The trends indicate some of the rationale for certain fighter designs and some likely characteristics to be sought in future fighter aircraft designs. E.A.K.

N85-18955# National Aerospace Lab., Tokyo (Japan).
ANALYSIS OF INVISCID TRANSONIC FLOW AROUND AN AIRFOIL BY DIAGONAL FORM OF IAF SCHEME
N. KAWAI Aug. 1984 15 p refs In JAPANESE; ENGLISH summary
(NAL-TR-831; ISSN-0389-4010) Avail: NTIS HC A02/MF A01

In order to analyze inviscid transonic flow around an airfoil, the program has been developed for solving two-dimensional Euler equations by the diagonal form of implicit approximate factorization scheme. Numerical results show two patterns of shock. The other, a flow from supersonic to supersonic, exhibits oblique shock. Numerical solutions of Euler equations are compared with those of potential flow, showing the differences in shock position, and pressure rise after shock. Author

N85-18957*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
EFFECTS OF AIRFOIL SHAPE, THICKNESS, CAMBER, AND ANGLE OF ATTACK ON CALCULATED TRANSONIC UNSTEADY AIRLOADS
J. T. BATINA Mar. 1985 56 p refs
(NASA-TM-86320; L-15786; NAS 1.15:86320) Avail: NTIS HC A04/MF A01 CSCL 01A

The effects of airfoil shape, thickness, camber, and mean angle of attack on transonic unsteady airloads were investigated as calculated by the transonic small-disturbance computer code XTRAN2L. Shape effects were investigated by examining the pressure distributions, shock locations, and unsteady airloads for three 10 percent thick airfoils. NACA 0010, NACA 64A010, and

parabolic arc. Thickness effects were determined by studying a single airfoil shape with three different thicknesses: NACA 0008, NACA 0010, and NACA 0012. Angle of attack and camber effects were studied by including mean angle of attack or by adding a simple parabolic camber distribution to the originally symmetric airfoils. Comparisons of unsteady airloads for different airfoil configurations show similar results caused by variations in airfoil shape, thickness, camber, or mean angle of attack. Computer costs can be reduced by limiting the number of transonic unsteady aerodynamic calculations for small changes in airfoil geometry or angle of attack. Author

N85-18958*# Analytical Methods, Inc., Redmond, Wash.
INVISCID ANALYSIS OF UNSTEADY BLADE TIP FLOW CORRELATION STUDIES Final Report
B. M. RAO and B. MASKEW Feb. 1985 67 p refs
(Contract NAS1-15472)
(NASA-CR-172506; NAS 1.26:172506; AMI-8409) Avail: NTIS HC A04/MF A01 CSCL 01A

Two computer programs, VSAERO-TS and VSAERO-H, were used for computing the unsteady subsonic aerodynamic characteristics of arbitrarily shaped wings oscillating in pitch. Program VSAERO-TS is a time-stepping analysis capable of treating large amplitude motions while program VSAERO-H uses harmonic wake and small amplitude assumptions. A comparison between the computed (VSAERO-TS and VSAERO-H) and DFVLR test results for chordwise pressure distributions for rectangular, swept, taper and ogee blade tips is presented in this report. A wide range of angles of attack (mean) from 0 to 12 deg and reduced frequencies of 0.1, 0.2 and 0.3 are covered in this report. Also, the comparison includes several spanwise stations. B.W.

N85-18959*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
EFFICIENT SELF-CONSISTENT VISCOUS-INVISCID SOLUTIONS FOR UNSTEADY TRANSONIC FLOW
J. T. HOWLETT Jan. 1985 12 p refs Presented at the 23rd AIAA Aerospace Sci. Meeting, Reno, Nev., 14-17 Jan. 1985
(NASA-TM-86335; NAS 1.15:86335) Avail: NTIS HC A02/MF A01 CSCL 01A

An improved method is presented for coupling a boundary layer code with an unsteady inviscid transonic computer code in a quasi-steady fashion. At each fixed time step, the boundary layer and inviscid equations are successively solved until the process converges. An explicit coupling of the equations is described which greatly accelerates the convergence process. Computer times for converged viscous-inviscid solutions are about 1.8 times the comparable inviscid values. Comparison of the results obtained with experimental data on three airfoils are presented. These comparisons demonstrate that the explicitly coupled viscous-inviscid solutions can provide efficient predictions of pressure distributions and lift for unsteady two-dimensional transonic flow. Author

N85-18960*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
UNSTEADY TRANSONIC FLOW CALCULATIONS FOR TWO-DIMENSIONAL CANARD-WING CONFIGURATIONS WITH AEROELASTIC APPLICATIONS
J. T. BATINA Feb. 1985 11 p refs Proposed for presentation at the AIAA/ASME/ASCE/AHS 26th Struct., Struct. Dyn. and Mater. Conf., Orlando, Fla., 15-17 Apr. 1985
(NASA-TM-86375; NAS 1.15:86375; AIAA-85-0585) Avail: NTIS HC A02/MF A01 CSCL 01A

Unsteady transonic flow calculations for aerodynamically interfering airfoil configurations are performed as a first step toward solving the three dimensional canard wing interaction problem. These calculations are performed by extending the XTRAN2L two dimensional unsteady transonic small disturbance code to include an additional airfoil. Unsteady transonic forces due to plunge and pitch motions of a two dimensional canard and wing are presented. Results for a variety of canard wing separation distances reveal the effects of aerodynamic interference on unsteady transonic airloads. Aeroelastic analyses employing these unsteady airloads demonstrate the effects of aerodynamic interference on aeroelastic stability and flutter. For the configurations studied, increases in wing flutter speed result with the inclusion of the aerodynamically interfering canard. Author

N85-18961*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
VISCOUS EFFECTS ON TRANSONIC AIRFOIL STABILITY AND RESPONSE
H. M. BERRY, J. T. BATINA, and T. Y. YANG Feb. 1985 15 p refs Proposed for presentation at the AIAA/ASME/ASCE/AHS 26th Struct., Struct. Dyn. and Mater. Conf., Orlando, Fla., 15-17 Apr. 1985
(NASA-TM-86374; NAS 1.15:86374; AIAA-85-0586) Avail: NTIS HC A02/MF A01 CSCL 01A

Viscous effects on transonic airfoil stability and response are investigated using an integral boundary layer model coupled to the inviscid XTRAN2L transonic small disturbance code. Unsteady transonic airloads required for stability analyses are computed using a pulse transfer function analysis including viscous effects. The pulse analysis provides unsteady aerodynamic forces for a wide range of reduced frequency in a single flow field computation. Nonlinear time marching aeroelastic solutions are presented which show the effects of viscosity on airfoil response behavior and flutter. Effects of amplitude on time marching responses are demonstrated. A state space aeroelastic model employing Pade approximants to describe the unsteady airloads is used to study the effects of viscosity on transonic airfoil stability. State space dynamic pressure root loci are in good overall agreement with time marching damping and frequency estimates. Parallel sets of results with and without viscous effects reveal the effects of viscosity on transonic unsteady airloads and aeroelastic characteristics of airfoils. Author

N85-18962*# George Washington Univ., Washington, D.C.
DETERMINATION OF CORRECTIONS TO FLOW DIRECTION MEASUREMENTS OBTAINED WITH A WING-TIP MOUNTED SENSOR M.S. Thesis
T. M. MOUL Aug. 1983 91 p refs Sponsored in part by NASA
(NASA-CR-174412; NAS 1.26:174412) Avail: NTIS HC A05/MF A01 CSCL 01A

The nature of corrections for flow direction measurements obtained with a wing-tip mounted sensor was investigated. Corrections for the angle of attack and sideslip, measured by sensors mounted in front of each wing tip of a general aviation airplane, were determined. These flow corrections were obtained from both wind-tunnel and flight tests over a large angle-of-attack range. Both the angle-of-attack and angle-of-sideslip flow corrections were found to be substantial. The corrections were a function of the angle of attack and angle of sideslip. The effects of wing configuration changes, small changes in Reynolds number, and spinning rotation on the angle-of-attack flow correction were found to be small. The angle-of-attack flow correction determined from the static wind-tunnel tests agreed reasonably well with the correction determined from flight tests. Author

N85-18963# Ballistic Research Labs., Aberdeen Proving Ground, Md.
HYPOTHETICAL ZERO YAW DRAG TRAJECTORY OF SPINNING PROJECTILES BETWEEN M = 5 AND M = 10 Final Report
W. F. DONOVAN Nov. 1984 32 p
(Contract DA PROJ. 1L1-62618-AH-80)
(AD-A148899; AD-F300525; BRL-MR-3404) Avail: NTIS HC A03/MF A01 CSCL 19A

From a review of existing techniques and extrapolation of lower velocity data, the drag characteristics of a typical spin stabilized projectile are proposed for application in the range $5<M<10$. GRA

N85-18964# Tennessee Univ. Space Inst., Tullahoma. Gasdynamics Div.
AERODYNAMIC IMPROVEMENTS BY DISCRETE WING TIP JETS Final Report, Sep. 1981 - Nov. 1983
J. M. WU and A. D. VAKILI Wright-Patterson AFB, Ohio AFWAL Mar. 1984 102 p
(Contract F33615-81-K-3034)
(AD-A148981; AFWAL-TR-84-3009) Avail: NTIS HC A06/MF A01 CSCL 20D

The effects of applying discrete wing tip jets on a rectangular wing and the generated flow field have been studied. Analysis included low speed wing tunnel testing, water tunnel testing and analytical modeling. Wing tip jet parameters investigated included number of jets, jet direction, shape of jets, and blowing coefficients. Tailoring of jet parameters to optimize planform circulation and flow separation were included. Flow interactions of the discrete tip jets with wing vorticies were successfully visualized with water tunnel techniques. Author (GRA)

N85-18965# National Aerospace Lab., Amsterdam (Netherlands).
UNSTEADY TRANSONIC PRESSURE MEASUREMENTS ON A SEMISPAN 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. HORSTEN, R. G. DENBOER, and R. J. ZWAAN Wright-Patterson AFB, Ohio AFWAL Mar. 1983 189 p
(Contract AF-AFOSR-0136-80)
(AD-A130488; AFWAL-TR-83-3039-PT-2; NRL-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 distribution were measured. Sectional as well as wing aerodynamic coefficients were obtained by integration of the pressure distribution. The tests covered a Mach number range between 0.62 and 09.5. 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). B.W.

03

AIR TRANSPORTATION AND SAFETY

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

A85-22751
SAFE ASSOCIATION, ANNUAL SYMPOSIUM, 21ST, SAN ANTONIO, TX, NOVEMBER 5-8, 1983, PROCEEDINGS
Van Nuys, CA, SAFE Association, 1984, 257 p. For individual items see A85-22752 to A85-22777.

The present conference discusses factors affecting human tolerance to sustained acceleration, the technology base of the High Acceleration Cockpit, a selectable thrust rocket motor for crew escape systems, crew training in a simulated toxic chemical/biological environment, helicopter crash survivability and emergency escape, Kevlar and fiberglass reinforcements for helmet shells, the development of a ram air-inflated flexible wing, advanced oxygen life support systems, and the development history of immersion suits. Also covered is an analysis of the reported incidence of ejectee tumble, flail, and windblast, factors influencing ejection-associated neck injuries, the laboratory assessment of the Advanced Chemical Defense Aircrew Respirator, side-by-side unsequenced ejection from A-6 aircraft, and nuclear/biological/chemical protection for combat aircraft crews. O.C.

A85-22754
FRIENDLY EJECTION SEAT TRAJECTORY COMPUTER PROGRAM
R. B. CALKINS (USAF, Aeronautical Systems Div., Wright-Patterson AFB, OH) IN: SAFE Association, Annual Symposium, 21st, San Antonio, TX, November 5-8, 1983, Proceedings . Van Nuys, CA, SAFE Association, 1984, p. 29-32.

A novel, simplified ejection seat trajectory and miss distance calculation program has been developed which yields accurate results for such ejection seats as those currently deployed in F-15, F-16, A-10 and B-1 aircraft. Unlike previous programs, the present one only requires the user's entry of aircraft type, air speed, altitude, and roll and pitch angle parameters. Questions typically addressed concern changes in system timing, subsystem malfunctions, recovery heights for given ejection conditions, and proximity of trajectories in paired-seat ejections. O.C.

A85-22757
ACES II R&D UPGRADE PROGRAM
M. G. UCCHINO (USAF, Aeronautical Systems Div., Wright Patterson AFB, OH) IN: SAFE Association, Annual Symposium, 21st, San Antonio, TX, November 5-8, 1983, Proceedings . Van Nuys, CA, SAFE Association, 1984, p. 53-55.

The U.S. Air Force's Advanced Concept Ejection Seat II (ACES II) program, begun in 1964, led upon completion in 1974 to the deployment of an aircrew ejection seat that has saved 66 lives in 71 separate emergency escape attempts. Attention is presently given to an upgrading program for ACES II which encompasses an Advanced Ejection Sequencer, an Automatic Inflation Modulation parachute, and an Active Limb Restraint System, as well as an entirely novel proposal for a Sea Water Activated Release System. O.C.

A85-22760
A BRIEF REVIEW OF THE PERFORMANCE OF THE CANADIAN AIRCREW LIFE PRESERVERS OVER THE LAST TWENTY YEARS
C. J. BROOKS and J. A. FIRTH (Defence and Civil Institute of Environmental Medicine, Downsview,Ontario, Canada) IN: SAFE Association, Annual Symposium, 21st, San Antonio, TX, November 5-8, 1983, Proceedings . Van Nuys, CA, SAFE Association, 1984, p. 89-91.

An assessment is made of the Canadian armed forces' 20 years of use of two different air crew life preserver designs. Attention is given to the performance of the either manually or automatically inflated life preservers, as shown by a detailed analysis of both those accidents where they functioned correctly and those in which activation of the inflation mechanism caused difficulties. O.C.

A85-22762
NEW PERFORMANCE REQUIREMENTS FOR MIL-T-25959 TIEDOWN ADJUSTERS
M. PORTER (USAF, San Antonio Air Logistics Center, Kelly AFB, TX) IN: SAFE Association, Annual Symposium, 21st, San Antonio, TX, November 5-8, 1983, Proceedings . Van Nuys, CA, SAFE Association, 1984, p. 95-97.

Engineers at San Antonio Air Logistics Center are going to include new performance requirements, and related acceptance tests, in specifications for cargo restraint devices. The new requirements are for side loading and accelerated handling. Additionally, a questionnaire is being prepared to survey the users as to their likes, dislikes, and suggestions in the field of cargo restraint. If user suggestions are practical, they will be incorporated into future specifications. Author

A85-22764
INVESTIGATION OF THE USE OF RADAR DATA FOR THE MEASUREMENT OF PARACHUTE RATE OF DESCENT AND GLIDE RATIO
T. BOZACK (U.S. Naval Weapons Center, China Lake, CA) IN: SAFE Association, Annual Symposium, 21st, San Antonio, TX, November 5-8, 1983, Proceedings . Van Nuys, CA, SAFE Association, 1984, p. 101-107.

The 'circular trajectory averaging' technique is noted to be useful in the measurement of gliding parachute glide ratios; the approach to such averaging presented is one of many possible implementations of the method, and is appropriate for a super minicomputer employing virtual memory. The circular trajectory averaging method determines wind by measuring the horizontal displacement in the time the parachute takes to complete an exact 360-deg turn; this displacement, divided by time, is the average magnitude of the wind velocity over that time period, and a line drawn from the position at the start of the 360-deg turn to that at the end gives average wind direction. O.C.

A85-22765
A LOOK AT 'CHAIR-CHUTES' - PARACHUTE INDUSTRY'S ANSWER TO AIRLINE SAFETY IN THE 1940S
D. GOLD (U.S. Naval Weapons Center, China Lake, CA) IN: SAFE Association, Annual Symposium, 21st, San Antonio, TX, November 5-8, 1983, Proceedings . Van Nuys, CA, SAFE Association, 1984, p. 119-128.

An assessment is made of the 'chair-chute' parachute systems which were developed in the 1940s for use by commercial passenger airliners. The chair-chute integrated a parachute into the structure and upholstery of an airline passenger seat. Weight and cost factors, however, together with psychological factors, discouraged the acceptance of chair-chute systems by airlines. The possible impact that such systems may have had on airliner safety if they had been widely accepted is speculated on. O.C.

A85-22766
PROBLEMS IN THE QUANTIFICATION OF AIRCREW AUTOMATED ESCAPE SYSTEMS (AAES) IN-SERVICE RELIABILITY
F. C. GUILL (U.S. Naval Air Systems Command, Crew Systems Div., Washington, DC) IN: SAFE Association, Annual Symposium, 21st, San Antonio, TX, November 5-8, 1983, Proceedings . Van Nuys, CA, SAFE Association, 1984, p. 129-133.

The available data base on MIL STD-2067 reliability tests for U.S. Navy crew ejection systems are discussed from a reliability engineering point of view and concluded to be inadequate. Attempts to assess the reliability have thus far been based on the number of survivors vs. the ejection instances and on expert examination of the retrievable system components. There have been no other techniques for testing equipment otherwise tested only through use. It is noted that no account has been taken of the equipment age, the uneven depths of post-accident investigations, actions initiated after a failure, and exploring opportunities for providing aircrew with redundant or back-up systems. It is recommended that the reliability of the escape equipment be jugged by the results of series of tests of the equipment rather than solely on the bases of post-use statistics. M.S.K.

A85-22767
U.S. NAVY AIRCREW AUTOMATED ESCAPE SYSTEMS (AAES) AND AIRCREW LIFE SUPPORT SYSTEMS (ALSS) IN-SERVICE USAGE DATA ANALYSIS PROGRAM - A PROGRESS REPORT AND REPORT OF LONGER TERM PLANS
F. C. GUILL (U.S. Naval Air System Command, Crew Systems Div., Washington, DC) IN: SAFE Association, Annual Symposium, 21st, San Antonio, TX, November 5-8, 1983, Proceedings . Van Nuys, CA, SAFE Association, 1984, p. 134-139. refs

This report discusses the progress made during FY 1983, the insights obtained from those efforts, and the current long range plans resulting from those insights, for establishing a more useful AAES/ALSS in-service usage data analysis system to satisfy the AAES/ALSS resources managerial decision needs of the Crew Systems Division, Naval Air Systems Command. Author

A85-22768
U.S. NAVY EXPERIENCE WITH SIDE-BY-SIDE UNSEQUENCED ESCAPE IN A-6 SERIES AIRCRAFT LESSONS TO BE LEARNED (1 JANUARY 1969 THROUGH 31 DECEMBER 1979)
F. C. GUILL (U.S. Naval Air Systems Command, Crew Systems Div., Washington, DC) IN: SAFE Association, Annual Symposium, 21st, San Antonio, TX, November 5-8, 1983, Proceedings . Van Nuys, CA, SAFE Association, 1984, p. 140-142.

U.S. Navy A-6 series two-plane aircraft are unique among current Navy escape system equipped aircraft in that crew escape is initiated independently by each crewmember and not automatically sequenced upon the initiation of escape by one of the crew. The reasons for this difference are discussed and the consequences examined. Author

A85-22769
ESCAPE SYSTEM OPERATION THROUGH ADAPTIVE CONTROL
R. J. DOBBEK (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, OH) IN: SAFE Association, Annual Symposium, 21st, San Antonio, TX, November 5-8, 1983, Proceedings . Van Nuys, CA, SAFE Association, 1984, p. 148-152. refs

Low altitude maneuvering flight by military aircraft that are also capable of flight at extremely high dynamic pressures is discussed in terms of the emergency crew escape requirements that these flight regimes create. The conceptual idea of adaptive control of escape system operation is introduced and discussed as it might be used in the crew escape application. Examples of improvements in emergency escape capabilities that can be achieved through adaptive proportional control of the escape subsystems' operation are presented. Advantages are discussed and system design approaches involving the types of componentry that appear appropriate are included. Suggested goals are also set for the future in the ejection seat escape system technology area specifically oriented to the development of the adaptive control escape system. Author

A85-22774
ANALYSIS OF THE REPORTED INCIDENCE OF TUMBLE, FLAIL AND WINDBLAST BY EJECTEES
G. R. HERD IN: SAFE Association, Annual Symposium, 21st, San Antonio, TX, November 5-8, 1983, Proceedings . Van Nuys, CA, SAFE Association, 1984, p. 194-200.

On occasions during the ejection process an ejectee will experience flail, tumble, and/or windblast problems. Ejection seat designs have often included features to reduce the incidence and severity of these problems. In an attempt to assess the effectiveness of such design efforts an analysis of the in-service experience data has been undertaken. Employing the response data developed from the medical officers' reports and knowledge of the speed at ejection, the threshold speeds for experiencing each of these phenomena for each group of seat was established. The differences observed among seat design groups were shown to be consistent with the presence or absence of those design features that were incorporated to reduce the impact of windblast, flail, or tumble. Author

A85-22777
SIGNIFICANCE AND LIMITATIONS OF FAMILY TIES AMONG EJECTION SEAT TYPE AIRCREW AUTOMATED ESCAPE SYSTEMS (AAES)
F. C. GUILL (U.S. Naval Air Systems Command, Crew Systems Div., Washington, DC) IN: SAFE Association, Annual Symposium, 21st, San Antonio, TX, November 5-8, 1983, Proceedings . Van Nuys, CA, SAFE Association, 1984, p. 231-238.

A common practice within the escape systems community is to group seats into families and to then discuss them as though they were single seats not multiple seats with often significant differences. This practice is examined and the benefits derivable

from and the hazards associated with it are discussed and illustrated. Author

A85-25793* Georgia Inst. of Tech., Atlanta.
AN INTELLIGENT FLIGHT-MANAGEMENT AID FOR PROCEDURE EXECUTION
J. M. HAMMER (Georgia Institute of Technology, Atlanta, GA) IEEE Transactions on Systems, Man, and Cybernetics (ISSN 0018-9472), vol. SMC-14, Nov.-Dec. 1984, p. 885-888. refs
(Contract NAG2-123)

A computer program is described that contains a model of the procedures used in the operation of a twin engine aircraft. This program, by comparing the model to the aircraft state, can determine when a procedure (or checklist) should be or is invoked and when each step (detectable by a change in the aircraft state) is completed. Thus, the program tracks the flight crew's procedure execution through changes in the aircraft state. Data were used for evaluation from an earlier experiment on a Link GAT-II simulator. The program had been able to identify practically all of the errors identified by human judges as well as locate some missed by them. It is felt that this model could significantly aid flight crews. Author

A85-26308*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
DEVELOPMENT OF AN ENERGY ABSORBING PASSENGER SEAT FOR THE B-720 TEST AIRCRAFT
C. P. EICHELBERGER (NASA, Langley Research Center, Hampton, VA) IN: Aircraft engineering design - Design engineer's problems are now; Proceedings of the Aerospace Engineering Conference and Show, Los Angeles, CA, February 12-14, 1985 . New York, American Institute of Aeronautics and Astronautics, 1985, 7 p.

An evaluation is made of the experimental results obtained in the 720B airliner flight crash testing of an energy-absorbing passenger seat design, which has been derived through modification of a standard three-passenger commercial aviation seat. The highly instrumented 720B aircraft was crashed at the end of a remotely controlled flight on a specially prepared, gravel-covered ground site. In order to limit acceleration upon impact, the seat tested had been designed and fabricated to collapse under a controlled load. The aircraft impact's shock pulse is absorbed by tubes which crush under load as axial columns. O.C.

A85-26313
ANALYSIS OF KC-10 LOADING ALTERNATIVES
P. D. TUCK (USAF, Office of the Assistant Chief of Staff, Washington, DC) Society of Automotive Engineers, International Forum for Air Cargo, 12th, Singapore, May 21-24, 1984. 18 p. refs
(SAE PAPER 840701)

The options available to on/offload the KC-10 currently being procured by the Air Force are considered. The typical Air Force-owned 463L-System aircraft cargo loaders will not reach high enough to service the main-cargo deck of the KC-10 (or B-747). Advances in development of transport (and tanker) aircraft have historically paced development and acquisition of complementary grounds systems. The analysis focuses on the use of various Materials-Handling Equipment alternatives, including the 463L-System. These are: KC-10 On-Board Loaders (OBLs); Austere Elevator Loaders; 15 K Forklifts; Leased Loaders; and 25 K Transporter Loaders with Adapter. Key observations are: OBLs tend to be expensive; Elevator Loaders are relatively inexpensive and versatile; existing 15 K forklifts can be used safely; industry did not express interest in leasing loaders; and 25 K Transporter Loaders with Adapters have serious stability problems. Author

A85-26315
ADVANCED BAGGAGE/CARGO HANDLING
N. D. FOLLING (Boeing Commercial Airplane Co., Seattle, WA) Society of Automotive Engineers, International Forum for Air Cargo, 12th, Singapore, May 21-24, 1984. 7 p.
(SAE PAPER 840711)

It is noted that significant cost and time savings are obtained when airline cargo and baggage are consolidated into unit loads that fit efficiently inside their vehicles and are handled at airports by modern techniques. Attention is presently given to a proprietary effort to develop such consolidated cargo/baggage systems in light of existing aircraft and the handling methods applicable to current or modified ground equipment. Belt and conveyor-based handling facilities are considered. O.C.

A85-26387#
THERMAL ANALYSIS TECHNIQUES FOR DESIGN OF VSTOL AIRCRAFT ROTOR ICE PROTECTION
A. A. PETERSON (Boeing Vertol Co., Philadelphia, PA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 23rd, Reno, NV, Jan. 14-17, 1985. 12 p. refs
(AIAA PAPER 85-0340)

Examples of helicopter and tilt rotor ice protection approaches are presented, and thermal analytical tools and test techniques are discussed. Thermal modeling is essential for the design of VSTOL aircraft rotor ice protection since it permits the prediction of internal and external temperatures under the extreme ice protection operating conditions prior to final design and fabrication of the system. The access to measured external and internal surface temperatures is the key to an acceptable thermal modeling program. The DeWitt/Baliga one-dimensional thermal program has proven to be very useful in the thermal correlation with measured temperature data. V.L.

N85-18009*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
FLIGHT TRAINING TECHNOLOGY FOR REGIONAL/COMMUTER AIRLINE OPERATIONS: REGIONAL AIRLINE ASSOCIATION/NASA WORKSHOP PROCEEDINGS
A. T. LEE, ed. and J. K. LAUBER, ed. Dec. 1984 253 p refs Workshop held at Moffett Field, Calif., 28-30 Sep. 1983
(NASA-CP-2348; A-9863; NAS 1.55:2348) Avail: NTIS HC A12/MF A01 CSCL 05I

Programs which have been developed for training commercial airline pilots and flight crews are discussed. The concept of cockpit resource management and the concomitant issues of management techniques, interpersonal communication, psychological factors, and flight stress are addressed. Training devices and simulation techniques are reported.

N85-18020*# Flight Safety Foundation, Inc., Arlington, Va.
SAFETY AWARENESS, PILOT EDUCATION, AND INCIDENT REPORTING PROGRAMS
J. ENDERS *In* NASA. Ames Research Center Flight Training Technol. for Regional/Commuter Airline Operations p 159-170 Dec. 1984
Avail: NTIS HC A12/MF A01 CSCL 01C

Education in safety awareness, pilot training, and accident reporting is discussed. Safety awareness and risk management are examined. Both quantitative and qualitive risk management are explored. Information dissemination on safety is considered. E.A.K.

N85-18021*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THE AVIATION SAFETY REPORTING SYSTEM
W. D. REYNARD *In its* Flight Training Technol. for Regional/Commuter Airline Operations p 171-180 Dec. 1984
Avail: NTIS HC A12/MF A01 CSCL 01C

The aviation safety reporting system, an accident reporting system, is presented. The system identifies deficiencies and discrepancies and the data it provides are used for long term identification of problems. Data for planning and policy making

are provided. The system offers training in safety education to pilots. Data and information are drawn from the available data bases. E.A.K.

N85-18022*# Harvard Univ., Cambridge, Mass.
COCKPIT RESOURCES MANAGEMENT AND THE THEORY OF THE SITUATION
L. BOLMAN *In* NASA. Ames Research Center Flight Training Technol. for Regional/Commuter Airline Operations p 181-197 Dec. 1984
Avail: NTIS HC A12/MF A01 CSCL 01C

The cockpit resource management (CRM) and hypothetical cockpit situations are discussed. Four different conditions which influence pilot action are outlined: (1) wrong assumptions about a situation; (2) stress and workload; (3) frustration and delays to cause risk taking; and (4) ambigious incomplete or contradicting information. Human factors and behavior, and pilot communication and management in the simulator are outlined. E.A.K.

N85-18023*# Pennsylvania Airlines, Middletown.
COCKPIT RESOURCE MANAGEMENT TRAINING
M. YOCUM and C. FOUSHEE *In* NASA. Ames Research Center Flight Training Technol. for Regional/Commuter Airline Operations p 201-210 Dec. 1984
Avail: NTIS HC A12/MF A01 CSCL 01C

Cockpit resource management which is a multifaceted concept is outlined. The system involves the effective coordination of many resources: aircraft systems, company, air traffic control, equipment, navigational aids, documents, and manuals. The main concept, however, is group interaction. Problems which arise from lack of coordination, decision making, and lack of communication are pointed out. Implementation by the regional airline industry of cockpit resource management, designed to deal with human interactions problems in the most cost effective manner, is discussed. E.A.K.

N85-18026*# Air Midwest, Inc., Wichita, Kans.
PILOT EDUCATION AND SAFETY AWARENESS PROGRAMS
M. SHEARER and W. D. REYNARD *In* NASA. Ames Research Center Flight Training Technol. for Regional/Commuter Airline Operations p 229-239 Dec. 1984
Avail: NTIS HC A12/MF A01 CSCL 01C

Guidelines necessary for the implementation of safety awareness programs for commuter airlines are discussed. A safety office can be viewed as fulfilling either an education and training function or a quality assurance function. Issues such as management structure, motivation, and cost limitations are discussed. B.W.

N85-18027*# Air Wisconsin, Inc., Appleton.
INITIATIVE USES OF AIRCRAFT FOR FLIGHT TRAINING
M. SELE and M. BAETGE *In* NASA. Ames Research Center Flight Training Technol. for Regional/Commuter Airline Operations p 241-247 Dec. 1984
Avail: NTIS HC A12/MF A01 CSCL 01C

The use of the aircraft rather than a flight simulator as a training device is investigated. Particular attention is paid to the application of LOFT concepts to the aircraft in its home environment. B.W.

N85-18029# Ecole Nationale Superieure des Telecommunications, Paris (France). Dept. Informatique.
ANALYTICAL MODELING OF A POLLING PROTOCOL [MODELISATION ANALYTIQUE D'UN PROTOCOLE DE POLLING]
F. OUGIER 27 Jun. 1984 60 p refs In FRENCH
(ENST-84H001; ISSN-0751-1361) Avail: NTIS HC A04/MF A01

Polling protocols for an airline operations information network were analyzed. A waiting time formula was derived from an analytical model of a polling protocol. An algorithm for obtaining the distribution of waiting time from a computer was developed. Test results show that a fast modem performs more poorly than a slow one. Author (ESA)

N85-18030# Transportation Research Board, Washington, D.C.
ISSUES IN AIR TRANSPORT
J. C. OCALLAHAN, D. J. BENNETT, G. R. MORRISSEY, D. S. MCLEOD, R. D. SANDLER, E. T. DENHAM, J. BLAIR, M. L. FORD, R. SHIRACK, and M. M. ETSCHMAIER 1984 59 p refs
(PB85-121374/GAR; TRB/TRR-958; ISBN-0-309-03704-2; LC-84-22804) Avail: NTIS HC A04/MF A01 CSCL 01B

Some probable effects of deregulation on airline industry economics; discount fare market research, 1981 to 1983; airline cost trends as viewed by an airframe manufacturer; economic impact of general aviation in Florida: suggested method of analysis; estimating aircraft activity at nontowered airports: results of the aircraft activity counter demonstration projects; mission-oriented maintenance for military aircraft and implications for public transportation fleet maintenance; a model for determining the width of airport pedestrain corridors; and, aviation legislation and infrastructure: policy implications for the 1980s are discussed. GRA

N85-18031# Factory Mutual Research Corp., Norwood, Mass.
MODELING OF AIRCRAFT CABIN FIRES
M. A. DELICHATSIOS Sep. 1984 116 p refs Sponsored in part by FAA
(Contract NB82-NADA-3041)
(PB85-137685/GAR; FMRC-J-I-OHOJ2-BU1; NBS/GCR-84/473)
Avail: NTIS HC A06/MF A01 CSCL 13L

Simple fire dynamic models for various components of an aircraft cabin fire are developed. These simple integral models can be incorporated in global zone models for aircraft cabin fires occurring in flight or caused by an impact-survivable crash. The major accomplishment was the development of simple expressions for the burning of vertical walls, simulating, for example, the burning of wall panels in the fuselage. Flame heights of vertical wall fires are predicted and correlated by a simple expression. In addition, critical conditions for extinction of rapid flame spread were investigated for fires in vertical walls consisting of charring materials, allowing for the prediction of flame spread rates. Author (GRA)

N85-18032# Joint Publications Research Service, Arlington, Va.
USSR REPORT: TRANSPORTATION
12 Feb. 1985 118 p Transl. into ENGLISH from various Russian articles
(JPRS-UTR-85-003) Avail: NTIS HC A06/MF A01

Transportation in the USSR is discussed, with particular emphasis on civil aviation, motor vehicles and highways, and rail systems. In addition, maritime and river fleets, ports and transshipment centers, and intersector network development are considered.

N85-18033# Joint Publications Research Service, Arlington, Va.
FIRST DEPUTY MINISTER ON 1984 CIVIL AVIATION PERFORMANCE
In its USSR Rept.: Transportation (JPRS-UTR-85-003) p 1-2 12 Feb. 1985 Transl. into ENGLISH from Vozdushnyy Transport (USSR), 27 Dec. 1984 p 2
Avail: NTIS HC A06/MF A01

The activities of Aeroflot in 1984 are summarized. Air service between the Soviet Union and other countries is discussed together with air service within the USSR. In addition to passenger transportation, the role of civil aviation in working out the food program of the USSR is mentioned. R.S.F.

N85-18035# Joint Publications Research Service, Arlington, Va.
FINNAIR, LOT, SAS REPS IN USSR ON PRESENT OPERATIONS, PLANS
In its USSR Rept.: Transportation (JPRS-UTR-85-003) p 15-18 12 Feb. 1985 Transl. into ENGLISH from Vozdushnyy Transport (USSR), 29 Dec. 1984 p 4
Avail: NTIS HC A06/MF A01

The operations and plans of Finnair (Finland), LOT (Poland), and SAS (Denmark/Norway/Sweden) airlines are discussed. R.S.F.

N85-18966# Aeronautical Systems Div., Wright-Patterson AFB, Ohio.
EVALUATION OF THE BIRDSTRIKE THREAT TO THE F-15 PRESENT FLEET, RAPID DEPLOYMENT FORCE, AND DUAL ROLE FIGHTER TRANSPARENCIES
P. KOLODZIEJCZYK Sep. 1984 57 p
(AD-A148954; ASD-TR-84-5026) Avail: NTIS HC A04/MF A01 CSCL 01C

The information contained in this report is developed from analytical and empirical techniques used to establish statistical models for evaluating the birdstrike threat to the F-15 aircraft transparencies. Consideration is given to two areas: (1) the operational impact rate for specific aircraft usage profiles, and (2) the probability of a random birdstrike which could result in penetration of the aircraft cockpit. GRA

N85-18967# Federal Aviation Administration, Washington, D.C. Office of Civil Aviation Security.
SEMIANNUAL REPORT TO CONGRESS ON THE EFFECTIVENESS OF THE CIVIL AVIATION SECURITY PROGRAM Recurring Report, 1 Jan. - 30 Jun. 1984
11 Oct. 1984 19 p
(AD-A149522; DOT/FAA/ACS-84-1(20)) Avail: NTIS HC A02/MF A01 CSCL 01B

This report provides details on the effectiveness of security screening of passengers and all property intended to be carried out in the aircraft cabin in the air transportation or intrastate air transportation. It also provides a statistical summary of aircraft hijackings and alleged violations of Federal Aviation regulations pertaining to security screening. GRA

N85-18968# Department of the Navy, Washington, D. C.
DEPLOYMENT SEQUENCE MODE SELECTION SYSTEM FOR AIRCRAFT EJECTION SEAT Patent Application
P. AYOUB and A. CANTOR, inventors (to Navy) 8 Sep. 1983 19 p
(AD-D011464; US-PATENT-APPL-SN-531097) Avail: NTIS HC A02/MF A01 CSCL 01C

An electronic system is described for selecting the proper mode sequence for deploying a recovery parachute from an aircraft ejection seat. The system senses altitude, airspeed, and sink rate; and compares these to predetermined reference signals. The system also incorporates logic circuits and time delay circuits. The logic circuits are arranged to select one of four time delays depending on the status of the various parameters relative to the reference signals. GRA

N85-19658# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
PERSONNEL PROTECTION CONCEPTS FOR ADVANCE ESCAPE SYSTEM DESIGN
J. W. BRINKLEY *In* AGARD Human Factors Considerations in High Performance Aircraft 12 p Nov. 1984 refs
Avail: NTIS HC A09/MF A01

The severe emergency escape conditions associated with low-altitude and high-speed environments are often beyond the performance capabilities of contemporary ejection seats. A new escape system design approach is needed to extend the performance envelope without increasing the stresses imposed on the ejecting crewmembers. A new approach was developed and specific ejection-seat subsystem design technologies are being explored by the United States Air Force. The central concept of the approach is the automatic selection of the performance characteristics of the escape system based on the conditions that exist at the time of ejection, and the adaptive control of the escape-system performance throughout the escape episode. Ejection-seat subsystem design concepts being developed to implement this approach are summarized. Several crew-protection concepts are reviewed, including a method to control the risk of injury to be proportional to the life threat of specific escape conditions and a windblast protection device called the flow-stagnation fence. A means to provide real-time assessment and control of the accelerations imposed on an ejection seat's occupant is vital to the new escape system design approach. A six-degree-of-freedom acceleration exposure-limit method currently being developed to meet this requirement is presented. Author

04

AIRCRAFT COMMUNICATIONS AND NAVIGATION

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

A85-22649
LASER IMAGING RADAR SENSOR (LIRS)
R. W. FREY, R. C. HARNEY, and C. R. LAYNE (Martin Marietta Aerospace, Orlando, FL) IN: Coherent infrared radar systems and applications II; Proceedings of the Meeting, Arlington, VA, April 7, 8, 1983 . Bellingham, WA, SPIE - The International Society for Optical Engineering, 1983, p. 2-12.

The Laser Imaging Radar Sensor (LIRS) is a propriatory test facility which supports development efforts in the field of IR radar sensors and their application in military fire control and avionics systems. The LIRS configuration was chosen to yield a versatile brassboard sensor that both addresses several identified technology development problems and provides a baseline design for tactical military aircraft sensor design. Attention is presently given to the methodology employed in choosing LIRS multifunction sensor parameters, especially the radar modulation format for a particular mission. Unique signal processing methods have been used to obtain range, pulse width, and velocity imagery. O.C.

A85-22650
APPLICATIONS OF FM-CW CO2 WAVEGUIDE LASER RADAR
E. R. WASHWELL, C. M. BJORKLUND, R. S. LOE, J. T. OZAWA, D. G. PETERSON, and G. R. ROSSI (Lockheed Research Laboratories, Palo Alto, CA) IN: Coherent infrared radar systems and applications II; Proceedings of the Meeting, Arlington, VA, April 7, 8, 1983 . Bellingham, WA, SPIE - The International Society for Optical Engineering, 1983, p. 13-20. Research supported by the Lockheed Independent Research Fund. refs

FM-CW CO2 laser radar can provide high resolution information useful in a number of applications. Velocity and range data can be obtained from a properly configured system. These data are useful in such diverse applications as wind velocity measurements, navigation, battlefield obscurant mapping and range imaging. Range images obtained from laser radar have a number of tactical applications. Techniques for terminal homing and target recognition based on range information are outlined. The general features of an FM-CW range imaging sensor using a commercial waveguide CO2 laser are described. The basic principles of FM-CW radar are reviewed, and the results of laboratory measurements of the frequency stability and range resolution obtained with diffuse targets presented. Intensity and range images of laboratory objects at short range with the system are also presented. Author

A85-22651
FIELD TESTS AND SIGNATURE ANALYSIS OF AN IMAGING CO2 LASER RADAR
J. Y. WANG, B. J. BARTHOLOMEW, M. L. STREIFF, E. F. STARR, and P. A. PRUITT (General Dynamics Corp., Convair Div., San Diego, CA) IN: Coherent infrared radar systems and applications II; Proceedings of the Meeting, Arlington, VA, April 7, 8, 1983 . Bellingham, WA, SPIE - The International Society for Optical Engineering, 1983, p. 21-28.

A coherent, imaging CO2 laser radar has been built and tested in the field. This laser radar uses a single-waveguide CO2 laser and heterodyne detection. Two acoustooptic frequency shifters generate the IF frequency. An acoustooptic standing wave device provides the 15 MHz intensity modulation used for ranging. The sensor includes a two-axis, dual-aperture galvonometer scanner with selectable field of view and depression angles. The optical

system fits on an easily transportable, 3 ft-by-4 ft optical bench. Both reflectance and range images are produced. The range imagery analysis shows a range resolution of approximately 1 ft. Statistical analysis of the reflectance data from a military truck, the dirt ground, and an asphalt road shows that they are Rayleigh distributed. The reflectivities of these objects are determined to be around 2 percent through comparison with laboratory reflectometer measurements. Author

A85-23812
NAVSTAR
F. X. KANE (Rockwell International Corp., El Segundo, CA) IN: Space safety and rescue 1982-1983, including worldwide disaster response, rescue and safety employing space-borne systems; Proceedings of the Fifteenth and Sixteenth International Symposia, Paris, France, September 27-October 2, 1982 and Budapest, Hungary, October 10-15, 1983 . San Diego, CA, Univelt, Inc., 1984, p. 331-341. refs
(IAF PAPER 83-265)

The Navstar/GPS satellite navigation and time-transfer system is characterized with an emphasis on its use by civilian customers, and the results of FAA tests of aircraft applications (Esposito, 1981) are summarized. The space, control, and user-equipment segments of the system are briefly described and illustrated; the current 6-satellite and eventual 18-satellite configurations are compared; the user fees and probable equipment costs are indicated; and the use of the system to facilitate computer-aided air navigation and to improve safety and extend the range of operating conditions at smaller airports is discussed. The FAA tests show that Navstar/GPS will meet the accuracy requirements for nonprecision approaches. T.K.

A85-24832
AIRBORNE DOPPLER RADAR ANTENNAS
F. GAUTIER (Thomson-CSF, Malakoff, Hauts-de-Seine, France) IN: International Radar Symposium, Bangalore, India, October 9-12, 1983, Proceedings . Bangalore, India, Institution of Electronics and Telecommunication Engineers, 1983, p. 31-35.

Three main types of mechanical antennas may be used in airborne Doppler radars: flat plate antenna (FPA), twist-polarizer antenna (TPA) and scanned twist-polarizer antenna (STPA). Theoretical and experimental work on these antennas has resulted in an efficient optimization algorithm for FPA; as for TPA and STPA, the use of electrical models for wire grids, multilayer anisotropic structures and monopulse feed are involved in optimization. The choice criteria analysed are: gain, bandwith, sidelobe levels, inertia, and multibeam capability. They allow the preferable use of each antenna type to be emphasized. Author

A85-24845
POWER TRAVELING-WAVE TUBES FOR MODERN AIRBORNE RADARS
R. METIVIER (Thomson-CSF, Division Tubes Electroniques, Boulogne-Billancourt, Hauts-de-Seine, France) IN: International Radar Symposium, Bangalore, India, October 9-12, 1983, Proceedings . Bangalore, India, Institution of Electronics and Telecommunication Engineers, 1983, p. 108-114.

Described is a remarkable new TWT for airborne Doppler radars, part of a family of coupled-cavity tubes. This TWT is capable of over 120 kW peak output power in X-band. The electron gun has a non-intercepting modulating grid and an osmium-coated impregnated cathode. Beam confinement is ppm type and cooling by liquid circulation. Featuring high efficiency, this tube also has excellent gain and noise characteristics and a large instantaneous bandwidth. Author

A85-24887
A MULTIPURPOSE SYNTHETIC APERTURE RADAR
P. ANTHOUARD (Thomson-CSF, Malakoff, Hauts-de-Seine, France) IN: International Radar Symposium, Bangalore, India, October 9-12, 1983, Proceedings . Bangalore, India, Institution of Electronics and Telecommunication Engineers, 1983, p. 389-392. Research supported by the Service Technique des Telecommunications et des Equipements Aeronautiques.

In this paper is presented a multipurpose synthetic aperture radar (SAR) which is the combination of a pulse compression surveillance airborne radar (VARAN) with a synthetic aperture processing unit (ANACONDA). In addition to classical functions such as real beam antenna mapping, sea targets detection, the VARAN-ANACONDA radar provides Doppler beam sharpening mapping with rotating antenna or side looking antenna. These two modes deliver high resolution radar images whose exploitation can be made either in real time on board the aircraft through a TV set or after film or digital tape recording. The ANACONDA unit uses a flexible digital processor to generate in real time SAR images. This unit also contains circuitry able to make the VARAN transceiver coherent and a digital image memory which delivers a standard TV video signal. One highlight of the VARAN-ANACONDA radar is its ability to gather functions which usually need two different radars. So, this solution is very interesting for aircraft installation in terms of weight, volume, and power supply. Author

A85-24911
RANGE AMBIGUITY RESOLUTION IN AN AIRBORNE MEDIUM PRF PULSE DOPPLER RADAR
R. P. RAMALINGAM, M. N. BHASKAR NAIDU, and N. P. R. RAO (Electronics and Radar Development Establishment, Bangalore, India) IN: International Radar Symposium, Bangalore, India, October 9-12, 1983, Proceedings . Bangalore, India, Institution of Electronics and Telecommunication Engineers, 1983, p. 561-565. refs

The detection of airborne targets against the background clutter in the look-down mode of operation is an important requirement in an airborne radar. In order to meet the detection performance requirements in nose as well as tail hemisphere search, medium PRF (pulse repetition frequency) is commonly used for airborne radar transmitters. Medium PRF operation results in range ambiguity of radar returns. This paper describes a novel and simple hardware scheme to resolve the range ambiguity in a medium PRF radar without using any mathematical operations such as multiplication, division, substraction or addition. Also the method proposed claims the advantage that the multiple PRFs chosen for the radar need not be mutually prime, and the time taken for range ambiguity resolution is independent of the number of targets to be handled in a dwell time. The scheme proposed in this paper can also be used to resolve the velocity ambiguity. Author

A85-24912
ANOMALOUS CLUTTER INTERFERENCE IN RADAR RANGING
A. K. SEN, S. K. TREHAN, N. SENGUPTA, M. K. DAS GUPTA (Calcutta, University, Calcutta, India), D. PAL, M. K. PAL (Department of Civil Aviation, Calcutta, India), S. C. MAJUMDAR, and S. K. SEN (K.N. College, Berhampore, India) IN: International Radar Symposium, Bangalore, India, October 9-12, 1983, Proceedings . Bangalore, India, Institution of Electronics and Telecommunication Engineers, 1983, p. 567-570. refs

The range of an operational microwave radar for civil aviation (Dum Dum Airport) is often reduced seriously in winter particularly during night and early morning hours. At such times, ground clutter appear from unusually long ranges. At the same time the echo from the target is weakened. A review of the anomalous TV signal records obtained in the same region reveals that the anomalous clutter radar interference and the anomalous TV signals may have a common origin in elevated inversion layers. Author

A85-24916
THE PRINCIPLES AND PRACTICE OF MODERN AEW RADAR
J. CLARKE (Royal Signals and Radar Establishment, Malvern, Worcs., England) IN: International Radar Symposium, Bangalore, India, October 9-12, 1983, Proceedings . Bangalore, India, Institution of Electronics and Telecommunication Engineers, 1983, p. 613-624. refs

Airborne Early Warning (AEW) Radar meets the operational requirement of detection and tracking of low flying aircraft. The important and fundamental radar parameters of RF, PRF, Pulse length and power are discussed together with a number of factors relating to the antenna. An overview of the modern fixed-wing AEW systems now in service is given - E-3A AWACS, NIMROD AEW, and E-2C HAWKEYE. Author

A85-24936
MILLIMETER WAVE GUIDANCE APPLICATIONS - AN OVERVIEW
C. R. SEASHORE (Honeywell Millimeter Wave Technology Center, Bloomington, MN) IN: Millimeter wave technology II; Proceedings of the Meeting, San Diego, CA, August 23, 24, 1983 . Bellingham, WA, SPIE - The International Society for Optical Engineering, 1983, p. 66-73. refs

The considerations and tradeoffs for applying millimeter wave sensors to tactical missile guidance requirements are discussed. These sensors can operate in the active (radar) and passive (radiometric) modes for achieving a high degree of countermeasure immunity. The missile with its millimeter wave seeker is typically required to operate in an autonomous, lock-on-after-launch mode. This implies precise acquisition and track capabilities in the RF head as well as the signal processor such that competing clutter can be rejected and likely target candidates detected and classified. Author

A85-24938
SIGNAL PROCESSING CONSIDERATION FOR A MILLIMETER WAVE SEEKER
A. B. MAHMOODI (3M Graphic Research Laboratory, St. Paul, MN) and M. KAVEH (Minnesota, University, Minneapolis, MN) IN: Millimeter wave technology II; Proceedings of the Meeting, San Diego, CA, August 23, 24, 1983 . Bellingham, WA, SPIE - The International Society for Optical Engineering, 1983, p. 87-99. refs

It is recommended that the radar system designer concerned with a system operating in the millimeter wavelength range should take into consideration the differences between reflectivity characteristics at millimeter wavelengths and the corresponding relations at longer wavelengths. The present investigation is concerned with the introduction of a statistical signal processing approach which can be incorporated in the design of a constant false alarm rate processor of an airborne millimeter wave seeker. The employed algorithm maximizes the signal to interference ratio (clutter and noise) in a variable clutter environment (Log-normal and Weibull). G.R.

A85-25102
EXPERIMENTAL ANALYSIS OF AN INNOVATIONS-BASED DETECTION ALGORITHM FOR SURVEILLANCE RADAR
P. A. S. METFORD (Motorola Information Systems, Ltd., Brampton, Ontario, Canada) and S. HAYKIN (McMaster University, Hamilton, Ontario, Canada) IEE Proceedings, Part F - Communications, Radar and Signal Processing (ISSN 0143-7070), vol. 132, pt. F, no. 1, Feb. 1985, p. 18-26. Research supported by the Natural Sciences and Engineering Research Council of Canada. refs

A very rapidly convergent solution (in the form of a likelihood ratio test) for the problem of detecting a discrete-time stochastic process in additive white Gaussian noise has been derived. This likelihood ratio test is applied to the problem of moving-target detection as encountered in an airport-surveillance radar system. Using real radar data, the receiver operating characteristics are obtained for two different implementations of this adaptive detection algorithm, and for the three generations of the classical moving-target-detection algorithm presently in use in modern radar systems. The best of the two implementations of the adaptive detection algorithm employs Kalman prediction tapped delay-line filters and attains a minimum of 3 dB average performance improvement relative to the classical moving-target-detection algorithms. Author

A85-25105
ADAPTIVITY AND DESIGN CRITERIA OF A LATEST-GENERATION MTD PROCESSOR
E. DADDIO (Selenia S.p.A., Rome, Italy) and G. GALATI (Selenia S.p.A., Rome; Calabria, Universita, Cosenza, Italy) IEE Proceedings, Part F - Communications, Radar and Signal Processing (ISSN 0143-7070), vol. 132, pt. F, no. 1, Feb. 1985, p. 58-65. refs

A moving-target-detector (MTD) digital radar processor utilizes a bank of finite impulse response (FIR) Doppler filters for clutter rejection and coherent integration of pulses. The design of the first MTD processor had been based on an 8-point fast Fourier transform (FFT) cascaded with a conventional double canceller. It is pointed out that the generalized FIR permits much greater flexibility than an FFT in the design of filters. The employment of generalized FIR filters has now been made possible by the availability of LSI circuits. The flexibility of filtering provided by the use of FIR filters has been utilized in the adaptive moving target detector (A-MTD). Attention is given to the main features of adaptive MTD, the design method and tradeoffs, the implementation and performance of the bank of filters, and the effect of amplitude and phase unbalance. G.R.

A85-25194
A COMPARISON OF MULTICHANNEL, SEQUENTIAL AND MULTIPLEX GPS RECEIVERS FOR AIR NAVIGATION
R. A. MAHER (Texas Instruments, Inc., Lewisville, TX) Navigation (ISSN 0028-1522), vol. 31, Summer 1984, p. 96-111.

As the NAVSTAR Global Positioning System (GPS) begins moving beyond the initial development stage, potential air navigation users are going to have a considerable range of choices for set designs. This paper describes three of the main receiver architecture approaches: multichannel, sequential, and multiplex (MUX). These major options are compared according to functional capabilities, effects of dynamics on navigation accuracy, and relative cost. Oscillator g-loading effects are addressed. The most appropriate choice for a given military or civil air navigation application likely involves a judicious combination of the various basic set architectures. A general familiarity with NAVSTAR/GPS is assumed. Author

A85-25195
OPERATIONAL BENEFITS AND DESIGN APPROACHES FOR COMBINING JTIDS AND GPS NAVIGATION
W. R. FRIED (Hughes Aircraft Co., Fullerton, CA) Navigation (ISSN 0028-1522), vol. 31, Summer 1984, p. 112-128. refs

This paper describes the Joint Tactical Information Distribution System (JTIDS) Navigation Function and the Global Positioning System (GPS), emphasizing their technical similarities and differences. Based on these, the paper discusses the operational benefits, performance, and design approaches for combining the navigational and time data from these two systems. Both JTIDS and GPS are time synchronous, spread spectrum systems which provide high accuracy navigation data through the use of time-of-arrival measurements and pseudo-ranging techniques. Both are subject to Geometric Dilution of Precision (GDOP) effects, though under different conditions; and both are highly resistant to interference, though to different degrees. JTIDS is more a tactical or local system, while GPS is global in nature. Exchanging data between the two systems, under certain constraints, therefore has the potential of great performance and operational benefits with respect to system availability, under a variety of operational scenarios and interference conditions. These benefits and proposed methods for combining the data from the two systems are described in the paper. Author

A85-25196
PHASE III GPS INTEGRATION OPTIONS FOR AIRCRAFT PLATFORMS
L. F. WIEDERHOLT and D. KLEIN (Intermetrics, Inc., Cambridge, MA) Navigation (ISSN 0028-1522), vol. 31, Summer 1984, p. 129-151.

The GPS User Equipment is being designed for use on various platform types (aircraft, surface ships, submarines, land vehicles and manpack) with the integrated components of the user equipment (UE) being developed as separate modules. GPS UE can be integrated on board a platform to varying levels. The system enhancements available to the individual platform are dependent on the complement of GPS UE selected and the degree to which it is being integrated onto the platform. This paper describes the GPS UE capability options available to aircraft platforms. The capability options are described as generic options (i.e., not specific to any aircraft). For each option, three topics are addressed: the benefits, possible equipment configuration and implementation issues. These topics are addressed independent of particular aircraft. Author

A85-25516
NAVIGATION, THE SAGNAC EFFECTS, AND THE MICHELSON EXPERIMENT [NAVIGATION, SAGNAC-EFFEKT UND MICHELSON-EXPERIMENT]
M. BOEHM (Standard Elektrik Lorenz AG, Stuttgart, West Germany) (Technischer Ueberwachungs-Verein Rheinland, Institut fuer Unfallforschung, and Deutsche Gesellschaft fuer Ortung und Navigation, Kolloquium 'Leitwarten', Cologne, West Germany, Oct. 16, 17, 1984) Ortung und Navigation (ISSN 0474-7550), vol. 25, no. 3, 1984, p. 698-715. In German. refs

The significance of the Sagnac effect and the Michelson experiment for navigation science is reviewed. The experiment is explained in terms of the effect, and the principle of absolute velocity measurement is addressed. Inertial navigation without the measurements of acceleration is examined, experiments to measure the velocity of light are discussed, and contemporary views on time dilatation and the speed of light are summarized. C.D.

A85-25817
WHAT CAN CIVIL TRANSPORT AIRCRAFT DO WITH NAVSTAR? [QU'EST-CE QUE L'AVIATION CIVILE DE TRANSPORT PEUT BIEN FAIRE DE NAVSTAR?]
O. CAREL Navigation (Paris) (ISSN 0028-1530), vol. 33, Jan. 1985, p. 31-35. In French.

Predictions are made of the technical and socioeconomic problems expected to arise with the implementation of the GPS with its 100 m accuracy, for civil applications. Navstar offers orders of magnitude improvement for transoceanic flights, but not so for landing approaches, where the 100 m error is too large. Standard ground-based radio beacons such as the MLS and VOR will probably continue in service. A rapid notification system is thought necessary to alert pilots when accuracy deterioration is occurring in the functions of the GPS components. The complete system will consist of 18 satellites, each with a 5 yr predicted life. Redundant measurements from multiple satellites are necessary to maintain margins of safety when using the GPS for navigation, particularly in approach conditions. Caution is, however, expected for non-U.S. users of Navstar equipment, who would then be dependent on U.S. military decisions for air navigation. Finally, it is recommended that some European GEO satellites be equipped with Navstar capabilities. M.S.K.

A85-25818
GPS/NAVSTAR - SOME EXPERIMENTAL RESULTS [G.P.S./NAVSTAR - QUELQUES RESULTATS EXPERIMENTAUX]
J.-L. DORNSTETTER (Laboratoire Central de Telecommunications, Velizy-Villacoublay, Yvelines, France) and A. SALOMON (Laboratoire de Recherches Balistiques et Aerodynamiques, Vernon, Eure, France) Navigation (Paris) (ISSN 0028-1530), vol. 33, Jan. 1985, p. 41-57. In French. Research supported by the Service Technique des Constructions et Armes Navales.

A series of tests were run with a Navstar signal receiver/analyzer mounted in a moving land vehicle. The trials interfaced with the current GPS configuration to provide a data base for predicting performance levels when the system becomes operational in 1986. The methods employed for three-dimensional position-fixing using the signals are reviewed, noting that signals from four satellites are received and need corrections for ionospheric effects. The signals are automatically analyzed for Doppler shifts to obtain distance data, with position biases proportional to the position dilution of precision. A dozen measurements in one day yielded horizontal resolutions close to or within 75 m accuracy. M.S.K.

A85-25819
AN EXAMPLE OF A FRENCH NAVSTAR/GPS RECEIVER [EXEMPLE DE REALISATION FRANCAISE D'UN RECEPTEUR NAVSTAR/G.P.S.]
G. BONIN (Societe Sercel, France) Navigation (Paris) (ISSN 0028-1530), vol. 33, Jan. 1985, p. 58-73. In French.

Design features, block diagrams and performance characteristics of a French-built GPS receiver/analyzer are presented. Civil uses of the system potentially offer 100 m horizontal position accuracy. The first step in the development of the receiver was to make it capable of handling the transmitted P code, storing the satellites' ephemerides, and calculating the ionospheric and tropospheric corrections. Real-time calculations, the capability of receiving signals simultaneously from five satellites, and the ability to calculate pseudo-distants and Doppler shifts were added. Details of the receiver and signal processor electronics are provided, along with techniques for real-time and stored signal data analysis. It is noted that the P code, reserved for the U.S. DoD applications, will not be freely accessible when the GPS becomes operational. M.S.K.

A85-25820
EQUIPMENT FOR A MARITIME USER OF THE GLOBAL POSITIONING SYSTEM (GPS) [EQUIPEMENT D'UTILISATEUR MARITIME DU SYSTEME DE POSITIONNEMENT GLOBAL /G.P.S./]
A. STANSELL, JR. (Magnavox Advanced Products and Systems Co., Torrance, CA) (Royal Institute of Navigation, Colloquium NAV 84 - Global Civil Satellite Systems, London, England, May 1984) Navigation (Paris) (ISSN 0028-1530), vol. 33, Jan. 1985, p. 74-92. In French. refs

By the end of 1987 a sufficient number of Navstar satellites will be operational and serve as a real-time two-dimensional navigation system. The constellation will be completed by 1988 and will permit 100 m accuracy in three-dimensional positioning. Portable ocean vehicle receivers/analyzers are now undergoing tests in concert with a pre-operational set of satellites. The military will have sole access to the P code, and thereby the second L-band signal of the GPS, during the operational phase. Some allowance for one-time civil use with a military attendant and operator on-board has been considered for special circumstances or when national defense warrants it. Congress has defined a $370 (U.S.) annual fee for users of the system, although the charge may never be collected. The present system permits tuning of cheaper, quartz clocks to the 10 nsec accuracy of the GPS cesium clocks. Finally, universal use of the GPS system is predicted once the system becomes operational and may be done with receivers that can also access the Soviet Glonass system. M.S.K.

A85-25851#
AVIONICS SYSTEMS FOR HELICOPTERS OF THE NEXT GENERATION
D. BATZLEN, H. SEELMANN, and H. WOITSCHELLA Dornier-Post (English Edition) (ISSN 0012-5563), no. 4, 1984, p. 11-13.

By means of highly integrated helicopter avionics systems, such high performance functions as adverse weather and night nap-of-the-earth flight can be safely accomplished. Attention is presently given to the use of distributed processing bus transfer techniques in advanced helicopter avionics systems, which integrate flight controls with navigation sensors, as well as to integrated communication/navigation/identification avionics and integrated threat analysis and management systems. O.C.

A85-25852#
DORNIER HELICOPTER AVIONICS EXPERIMENTS
H. E. HAUCK and P. WOLFF Dornier-Post (English Edition) (ISSN 0012-5563), no. 4, 1984, p. 14-17.

Night flight, adverse weather flight, and night attack condition performance requirements have compelled the extensive use of flight testing for advanced helicopter avionics, such as the West German Night Vision Cockpit (designated 'NSC'), aboard the UH-1D helicopter Advanced Helicopter Equipment Test Bed. NSC incorporates night vision aids, computerized display symbol generation, Doppler navigation, automated map reading, and an avionics data multiplexing system. O.C.

A85-26020
AERONAUTICAL TECHNOLOGY IN AIRBORNE SYSTEMS [TECHNOLOGIE AERONAUTIQUE DANS LES SYSTEMES AEROPORTES]
B. ESTANG (Thomson - CSF, Bureau d'Etudes Aeroportes et Missiles, Montrouge, Hauts-de-Seine, France) L'Aeronautique et l'Astronautique (ISSN 0001-9275), no. 107, 1984, p. 70-73. In French.

The development of airborne radar systems at Thomson-Montrouge is discussed, with consideration given to the current status of radar technology. Design tools including modal analysis which permits the visualization of vibration modes in tested materials and the CAD/CAM system which assures gains in time and reliability are described. Developments for the next 10 years include the systematization of modal analysis and of static dynamic calculations, and the use of structures made of composite materials, carbon, and magnesium alloys. CAD/CAM methods include three areas of application: printed circuits, hybrid and microwave circuits, and mechanical circuits. M.D.

A85-26322#
CONSIDERATIONS IN LEVEL OF FIDELITY IN REAL-TIME AVIONIC SYSTEM SIMULATIONS
R. D. TEICHGRAEBER (General Dynamics Flight Simulation Laboratory, Fort Worth, TX) AIAA, AHS, and ASEE, Aircraft Design, Systems, and Operations Meeting, San Diego, CA, Oct. 31-Nov. 2, 1984. 7 p.
(AIAA PAPER 84-2437)

Many real-time digital simulations have mixed levels of fidelity within them, particularly within the avionic system models. In most cases, there are reasons why the varying levels of modeling detail are acceptable in the simulation. In particular, as the simulation continues to be used, a change involving new avionic systems and requirements may require an upgrade in the level of model detail in order to support the requirement. Considerations affecting the level of fidelity for these simulations are discussed. Examples are presented to illustrate the difficulties with lack of fidelity in the area of interest. Author

N85-18042# Naval Postgraduate School, Monterey, Calif. Dept. of Operations Research.
THREE POSITION ESTIMATION PROCEDURES
R. N. FORREST Jun. 1984 25 p
(AD-A148748; NPS55-84-13) Avail: NTIS HC A02/MF A01 CSCL 17C

This report describes three position estimation procedures. The first is for estimates based on bearings taken on or from stations with uncertain locations. The second is for use with two or more lines of position. The third is combining estimates from different sources. GRA

N85-18043# Sandia Labs., Albuquerque, N. Mex.
AUTOMATIC LAND VEHICLE NAVIGATION USING ROAD MAP DATA
R. SCHINDWOLF Jun. 1984 21 p refs
(Contract DE-AC04-76DP-00789)
(DE84-017178; SAND-84-0838) Avail: NTIS HC A02/MF A01

A land navigation system has been developed that provides accurate navigation data while it is traveling on mapped roads. The system is autonomous and consists of a simple dead-reckoning navigator that is updated with stored road map data. Simulation and preliminary test results indicate that accuracies on the order of 50 feet can be achieved. Accuracy is independent of time. DOE

N85-18044# Ecole Nationale Superieure des Telecommunications, Paris (France).
DESIGN AND REALIZATION OF A MULTIRADAR TRACKING SYSTEM FOR AIR TRAFFIC CONTROL Ph.D. Thesis [CONCEPTION ET REALISATION D'UN SYSTEME DE POURSUITE MULTI-RADAR POUR LE CONTROLE DU TRAFIC AERIEN]
G. TSAKNAKIS 22 Jun. 1984 212 p refs In FRENCH
(ENST-84E010; ISSN-0751-1358) Avail: NTIS HC A10/MF A01

The variable update method was implemented in a minicomputer controlled multiradar tracking system for air traffic control. Algorithms for plot-path correlation, maneuver detection, path initialization, and plot dating were developed. An isotropic Kalman X-Y filter with an algorithm for following evolutions was derived. Comparison with classic multiradar tracking methods shows that the variable update method gives improved results with standard hardware. Author (ESA)

N85-18045# National Oceanic and Atmospheric Administration, Boulder, Colo. Program for Regional Observing and Forecasting Services.
DENVER ARTCC (AIR ROUTE TRAFFIC CONTROL CENTER) EVALUATION OF PROFS (PROGRAM FOR REGIONAL OBSERVING AND FORECASTING SERVICES) MESOSCALE WEATHER PRODUCTS
F. FOSS and J. W. HINKELMAN, JR. Jan. 1984 84 p refs Prepared in cooperation with Denver Air Route Traffic Control Center, Longmont, Colo. Sponsored in part by FAA
(PB85-120301/GAR) Avail: NTIS HC A05/MF A01 CSCL 17G

This project was initiated in April 1982 at the request of the Denver Air Route Traffic Control Center to help alleviate the serious impact on the entire air traffic control (ATC) system of adverse weather situations at centrally located Denver Stapleton International Airport. There are four major weather problems at Stapleton: severe thunderstorms, wind shear resulting from convection, upslope clouds and precipitation with deteriorating ceiling and visibility conditions, and wind shifts. To help forecasters detect, analyze and forecast these, the Program for Regional Observing and Forecasting Services (PROFS) provided real time high resolution data sets: conventional Weather Service radar (WSR) data, automated mesoscale surface observations, and 20 minute winds aloft vertical profiles. Author (GRA)

N85-18969# Defence Research Establishment, Ottawa. (Ontario).
AN ALIGNMENT FIXTURE FOR A 2-DEGREE-OF-FREEDOM (TDF) GYROSCOPE
R. G. APPS Jun. 1984 19 p
(AD-A148885; AD-E850737; DREO-TN-84-5) Avail: NTIS HC A02/MF A01 CSCL 17G

A description of the Honeywell GG1111 Single-Degree-Of Freedom (SDF) strapdown gyroscope alignment fixture and it's shortcomings are presented. The requirements for a new all aluminum alignment fixture for the Litton CSG-2 Two-Degree-Of-Freedom (TDF) strapdown gyroscope are discussed. A description of the new alignment fixture package is presented. GRA

N85-18970# Department of the Air Force, Washington, D.C.
TRANSDIGITIZER FOR RELAYING SIGNALS FROM GLOBAL POSITIONING SYSTEM (GPS) SATELLITES Patent Application
E. E. WESTERFIELD, inventor (to Air Force) 31 Oct. 1984 25 p
(AD-D011442; US-PATENT-APPL-SN-666784) Avail: NTIS HC A02/MF A01 CSCL 17G

The reception, downconversion and retransmission of the 1575.42 MH2 Global Positioning System (GPS) satellite signal is accomplished by the following. First, an RF stage comprising of an antenna, filter and preamplifier receiver, filters and amplifies the 1575.42 MHz signals. Following the RF stage, a converter stage, consisting of a bandpass filter, converts the GPS signal to a lower frequency. Then, an Intermediate Frequency (IF), comprising an IF amplifier, multiplier, bandpass filter and limiter further amplifies and filters the signals to remove the effects of the signals. A final downconverter converts the signal to a base band frequency and in a zero crossing detector the signal to a base band frequency and in a zero crossing detector the signal is amplified and 1 bit quantized. Finally, a local oscillator controls a frequency synthesizer to latch the signal from the zero crossing detector in a flip flop, which in turn is used to control a quadraphase monitor, whose signals are amplified and transmitted out the transmit antenna. Author (GRA)

N85-18971# Environmental Research Inst. of Michigan, Ann Arbor. Radar Div.
THE USE OF SYNTHETIC APERTURE RADAR IMAGERY TO DETECT HAZARDS TO NAVIGATION
E. S. KASISCHKE, G. A. MEADOWS, and P. L. JACKSON Nov. 1984 253 p Original contains color illustrations
(Contract N00014-83-C-2223)
(AD-A149324; ERIM-169200-2-F) Avail: NTIS HC A12/MF A01 CSCL 17I

The purpose of this manual is to familiarize the hydrographer with the methods and techniques to interpret synthetic aperture radar (SAR) imagery for hazards to navigation. Numerous examples of SAR imagery are presented to familiarize the hydrographer with how a SAR detects bottom-related surface patterns and also surface patterns caused by other oceanic and meteorologic phenomena, such as winds, storms, rain, internal waves, gravity waves, deep and shallow water currents, water mass boundaries and ice. The principles of imaging radars, specifically SARs, are discussed. SAR systems, whose imagery are available to the hydrographer, are described and the sources of the imagery identified. The fundamental concepts on how a SAR detects ocean surface patterns, particularly bottom-related patterns, are presented, along with the hydrodynamic causes of these patterns. Test cases are discussed which illustrate the different types of surface patterns on SAR imagery which are bottom-related. Multi-temporal analysis of SAR imagery is described. Sources of false alarms are identified. Techniques to combine SAR data with other remotely-sensed imagery (a multi-sensor analysis) are discussed. Methods to digitally process SAR data, including geometric and radiometric rectification, are presented. GRA

N85-18972# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Electrical and Computer Engineering.
OPTICAL DATA PROCESSING FOR MISSILE GUIDANCE Final Report, Sep. 1983 - Sep. 1984
D. CASASENT 21 Nov. 1984 136 p
(Contract AF-AFOSR-0091-79)
(AD-A149346; AFOSR-84-1162TR) Avail: NTIS HC A07/MF A01 CSCL 17G

Research on optical data processing for missile guidance and robotics is described. Components addressed include acousto-optic cells. Pattern recognition work includes feature extraction (Fourier coefficients and moments) and correlation (using synthetic discriminant functions). All pattern recognition work concerns multi-class distortion-invariant pattern recognition. Optical linear algebra processors are addressed with attention to: algorithms, architectures, applications, Kalman filtering, system fabrication, accuracy and performance, plus error source modeling and simulation. GRA

N85-18973# Federal Aviation Administration, Washington, D.C.
NATIONAL AIRSPACE SYSTEM: OPERATIONAL REQUIREMENTS
Oct. 1984 210 p
(AD-A149349; AD-E751073) Avail: NTIS HC A10/MF A01 CSCL 17G

The National Airspace System (NAS) Plan for Facilities, Equipment and Associated Development has set a framework for the modernization of the NAS for the next decade. It was developed with specific overall goals in a mind. These include the replacement and modernization of an aging air traffic control and navigation system, the development of a total system related to the specific needs of the user community, and the design of that system to serve as a basis for further enhancement of safety, improved efficiency, and reduced operation costs. The primary objective of this document is to provide a comprehensive and accurate representation of the requirements of the entire aviation community, while accommodating modifications or new requirements in response to changing operational needs during the NAS evolution. It is not a stand alone document, but one that is supported by a myriad of other documents and specifications. GRA

N85-18974# Coast Guard Research and Development Center, Groton, Conn.
AN EVALUATION OF FLASHTUBE SIGNAL CHARACTERISTICS Final Report
J. R. THACKER Aug. 1984 32 p
(AD-A149569; CGR/DC-13/84; USCG-D-26-84) Avail: NTIS HC A03/MF A01 CSCL 17G

The United States Coast Guard has long been interested in using flashtubes as an aid-to-navigation. They are highly conspicuous and are energy efficient. In the single flick operation mode, mariners report difficulty in fixing the time (less than 10 milliseconds). This factorial experiment investigated the effect on observer performance as each of three factors was varied; (1) Flash Repetition Rate; (2) Flick Frequency; and (3) Number of Flicks comprising the multiflick flash. An analysis of variance revealed all three main factors to be significant as well as some interactions. From the model provided, observer performance can be predicted by specifying the three factors. A simplifying parameter is introduced which reduces the performance model to two factors. Recommendations are made for each of these factors.
Author (GRA)

05

AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

A85-22753
DEVELOPMENT AND TESTING OF THE MARTIN-BAKER CRASHWORTHY SEAT
J. E. ILES (Martin-Baker Aircraft Co., Ltd., Higher Denham, Middx., England) IN: SAFE Association, Annual Symposium, 21st, San Antonio, TX, November 5-8, 1983, Proceedings . Van Nuys, CA, SAFE Association, 1984, p. 24-28.

The development history and performance test results of an armored seat bucket-equipped, crashworthy helicopter crew seat designed to meet the MIL-S-58095(AV) specifications are presented. The seat assembly should be able to withstand a minimum impact of 25 G in the yaw axis without structural failure, and incorporates an Impact Attenuation System which attaches to the aircraft bulkhead. The armored seat bucket is a Kevlar/boron carbide laminate composite capable of withstanding three 7.62-mm rounds fired from 100 m, or one 12.7-mm armor piercing/incendiary round fired from 800 m. O.C.

A85-22758
SELECTABLE THRUST ROCKET MOTOR FOR CREW ESCAPE SYSTEMS
M. C. WHITNEY (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, OH) IN: SAFE Association, Annual Symposium, 21st, San Antonio, TX, November 5-8, 1983, Proceedings . Van Nuys, CA, SAFE Association, 1984, p. 56-59.

The rocket motors currently used in ejection seat systems possess a single thrust profile, which may not be adequate for safe ejection in adverse flight conditions. In order to expand the ejection seat performance envelope, the Flight Dynamics Laboratory of the U.S. Air Force has begun to develop a selectable-thrust rocket motor which can furnish several thrust profiles and will permit the selection of one that is optimum for the prevailing conditions. Attention is given to the results yielded to date by two competing contractors' initial design development efforts. O.C.

A85-23923
ISRAEL - NEW DETAILS ON THE FUTURE 'LAVI' [ISRAEL - NOUVEAUX DETAILS SUR LE FUTUR 'LAVI']
J.-M. MITHOIS Air et Cosmos (ISSN 0044-6971), vol. 22, Jan. 19, 1985, p. 11, 12. In French.

Design and performance features of the Israeli Lavi fighter, scheduled for flight tests in 1986, are presented. The aircraft was developed as a means to reach parity with other modern, hostile forces, lessen the balance of trade burdens of importing weapons, and avoid the problems of embargoes imposed by arms suppliers being manipulated by countries hostile to Israel. The wings and vertical empannage will be carbon fiber composites. The avionics will include active and passive ECM equipment, automatic target tracking, pulse Doppler radar, and automated terrain following capability. The PW 1120 engine will furnish up to 18,760 lb thrust with reheat. The Lavi will be 14.39 m long, have 5.29 m maximum height, weigh a maximum of 34,000 lb, and will have a Mach 1.85 speed at 36,000 ft. It will have a 13 deg/sec continuous turn rate at Mach 0.8 and will withstand 9 g loading. The $20 million aircraft is scheduled for production in 1989. M.S.K.

A85-24201
A SIMPLIFIED MODEL FOR EXTERNAL LOADING ON AN ENGINE NACELLE ENCLOSING AN ENGINE. I - FOR THE NACELLE AT A STEADY INCIDENCE
M. J. SHEU and G. J. HANCOCK (Queen Mary College, London, England) Aeronautical Journal (ISSN 0001-9240), vol. 88, Dec. 1984, p. 431-446.

The steady and unsteady loads on a thin cylindrical-shell nacelle enclosing an engine (represented by an actuator disk) and submerged in a uniform low-velocity flow are investigated numerically using a vortex-lattice model, considering the effects of changes in engine mass flow at steady incidence or with a simple harmonic oscillation of the nacelle. The results are presented graphically and discussed, and the nacelle nose, unlike the nose of an engineless nacelle, is found to contribute significantly to the overall pitching motion, although the overall loading arises mostly over the front portion of the nacelle. The problems introduced when density changes are taken into account (at higher engine-flow speeds) are discussed. T.K.

A85-24230
FLIGHT TEST TECHNIQUES FOR THE ADVANCED FIGHTER TECHNOLOGY INTEGRATION (AFTI) F-16
H. H. HEIMPLE and D. R. MCMONAGLE (USAF, Edwards AFB, CA) Cockpit (ISSN 0742-1508), vol. 19, Oct.-Dec. 1984, p. 4-19.

The flight-test and data-reduction techniques used in the first phase of the US Air Force/Navy/NASA AFTI program, involving a digital flight-control system (DFCS) for a modified F-16 aircraft, are surveyed, and some sample data are presented graphically. The objectives of the DFCS phase are listed; the aicraft, the DFCS, and the instrumentation are characterized; and ground and airborne simulations of test-flight maneuvers, data-analysis methods, high-angle-of-attack performance, DFCS failue modes, structural loads, and pilot-vehicle interfaces (head-up displays, helmet-mounted sights, voice command, and throttle twist-grip controller) are discussed. The overall evaluation categories include bombing, strafing, air-to-air, and formation-flight performance. The need for careful simultaneous flight testing and development of DFCS, six-degree-of-freedom control laws, and avionics is stressed. T.K.

A85-24250#
APPLICATION OF COMPUTER GRAPHICS TO THE PRELIMINARY DESIGN OF AIRCRAFT [UNA APPLICAZIONE DI GRAFICA COMPUTERIZZATA NELL'AVANPROGETTO DI VELIVOLI]
S. CHIESA and G. VILLERO (Torino, Politecnico, Turin, Italy) Ingegneria (ISSN 0035-6263), Nov.-Dec. 1984, p. 301-307. In Italian. refs

DESIGN, a computer-graphics program developed by Piccolo (1982/1983) for use with the conceptual-design program for conventional transport aircraft of Chiesa and Guerra (1983) is characterized and demonstrated. DESIGN not only visualizes the results of the aircraft-optimization algorithms but also facilitates the definition of dimensional quantities (such as the longitudinal position of the wing, the track and longitudinal position of the main undercarriages, and the position of the wing engines) not defined by the program. A flow chart, graphs, and sample graphics illustrating the flexibility of the program are provided. T.K.

A85-24725
MODIFIED F-15 WILL INVESTIGATE ADVANCED CONTROL CONCEPTS
R. R. ROPELEWSKI Aviation Week and Space Technology (ISSN 0005-2175), vol. 122, Feb. 11, 1985, p. 51-53.

Combat performance and runway flexibility improvements of a magnitude normally associated with the development of an entirely new aircraft are anticipated for the F-15 fighter through the incorporation of canards, two-dimensional thrust vectoring nozzles, and integrated flight and propulsion controls. A short takeoff and landing (STOL)/maneuver technology demonstration aircraft with the aforementioned features has been budgeted by the U.S. Air Force, and this vehicle will also feature rough/soft field STOL

landing gear and an advanced pilot/vehicle cockpit interface. The two-dimensional nozzles will be able to vector engine thrust upward or downward 20 deg from the aircraft longitudinal axis, as well as to reverse thrust up to 135 deg for in-flight deceleration or rapid deceleration after landing. O.C.

A85-24818
USE OF HIGH PERFORMANCE COMPOSITE MATERIALS IN MODERN AIRCRAFT STRUCTURES
C. PICARD (Avions Marcel Dassault-Breguet Aviation, Direction Generale Technique, Saint-Cloud, Hauts-de-Seine, France) IN: High performance composite materials: New applications and industrial production; Proceedings of the Fourth International Conference and Exhibition, Bordeaux, France, October 17-20, 1983 . Chatou, Yvelines, France, Society for the Advancement of Materials and Process Engineering, 1983, p. 209-219.

A development history is presented of the application of high strength/high modulus carbon and boron fiber-reinforced composites to secondary and primary structural elements in high performance combat aircraft such as the Mirage F1, Mirage III, and Mirage 2000 and 4000 fighters. The mechanical properties of both isotropic and unidirectional composite materials are compared with those of conventional aluminum alloys. Resin matrices employed to date are of polyester, epoxy, and polyimide polymers. O.C.

A85-24819
CARBON AND KEVLAR IN THE DORNIER 228 UTILITY-COMMUTER AIRCRAFT
M. KAITATZIDIS and R. RENZ (Dornier GmbH, Friedrichshafen, West Germany) IN: High performance composite materials: New applications and industrial production; Proceedings of the Fourth International Conference and Exhibition, Bordeaux, France, October 17-20, 1983 . Chatou, Yvelines, France, Society for the Advancement of Materials and Process Engineering, 1983, p. 221-228.

Attention is given to the design, tooling, fabrication, and comparative performance of several Do-228 commuter aircraft structural components that have been realized in composite, rather than metallic, materials. The relative advantages and disadvantages of glass, carbon, and aramid fiber-reinforced composites are noted, and the aileron structure of the Do-228 is taken as an exemplary case of metallic structure substitution which has yielded both weight savings and cost reductions by comparison with conventional methods. O.C.

A85-25510
COCKPIT TECHNOLOGY IN A MODERN COMMERCIAL AIRCRAFT [DIE TECHNIK IM COCKPIT EINES MODERNEN VERKEHRSFLUGZEUGES]
J.-P. HACH (Deutsche Lufthansa AG, Cologne, West Germany) (Technischer Ueberwachungs-Verein Rheinland, Institut fuer Unfallforschung, and Deutsche Gesellschaft fuer Ortung und Navigation, Kolloquium 'Leitwarten', Cologne, West Germany, Oct. 16, 17, 1984) Ortung und Navigation (ISSN 0474-7550), vol. 25, no. 3, 1984, p. 456-466. In German.

The ground rules for the design for an up-to-date commercial aircraft cockpit are described and their application to the cockpit of the A310 aircraft is shown. These rules are: the technology must be suited to the pilot, and not vice-versa; redundancy of flight crew and system elements; no direct intervention by the crew necessary after the first failure; and transparency of the technical systems. The configuration of instruments in the A310 cockpit, the Primary Flight Display and Navigation Display, and the system control are discussed as embodiments of these rules. The influence of the rules on future cockpit developments is discussed. C.D.

A85-25921
AQUILA, THE NEXT-GENERATION RPV - ADVANCED CAPABILITY, AT A PRICE
B. WANSTALL Interavia (ISSN 0020-5168), vol. 40, Feb. 1985, p. 145-147.

Military standards imposed on the second-generation RPV (Remote Piloted Vehicle), to come into operation by the late 1980s, and the technology currently available for the Forward Looking Infrared sensor and for operational controls are summarized.The Aquila RPV is a swept-wing tailless 2.1-m long monoplane with a single pusher propeller, powered by a twin-cylinder 26-HP engine. The sensor packages include a 3-axis stabilized day TV system and a YAG-laser designator/rangefinder. The control of the Aquila is planned to be conducted by ground control stations at the frontline in conjunction with those positioned some 15 km back, for operation several kilometers back from the frontline. Presently, 35 test flights have been completed with full-scale models. L.T.

A85-26015
THE ROLE OF COMPUTERS IN AERODYNAMIC AND STRUCTURAL RESEARCH AND DEVELOPMENT AT AVIONS MARCEL DASSAULT-BREGUET AVIATION [LE ROLE DE L'INFORMATIQUE DANS LES RECHERCHES ET DEVELOPPEMENTS AERODYNAMIQUES ET STRUCTURAUX AUX AVIONS MARCEL DASSAULT-BREGUET AVIATION]
B. REVELLIN-FALCOZ (Avions Marcel Dassault-Breguet Aviation, Saint-Cloud, Hauts-de-Seine, France) L'Aeronautique et l'Astronautique (ISSN 0001-9275), no. 107, 1984, p. 13-21. In French.

The fundamental role of digital computers in two areas of aeronautical research and development is discussed. The areas which have been the object of constant research over the last two decades at AMD/BA include: computational fluid dynamics and experimental aerodynamics, and structural analysis, synthesis, and optimization. The advances achieved in these areas are due to the capabilities of digital computers, to the parallel development of efficient numerical methods, and the corresponding software. An analysis of the principles of both disciplines, followed by some typical examples, is given. Theoretical aerodynamics is a powerful and relatively economical tool for the study of configurations and their optimization in the absence of intense shocks, separations, and significant vortex sheets. The soft-ware package ELFINI, created to analyze, synthesize, and optimize aircraft structures is considered. M.D.

A85-26305
AIRCRAFT ENGINEERING DESIGN - DESIGN ENGINEER'S PROBLEMS ARE NOW; PROCEEDINGS OF THE AEROSPACE ENGINEERING CONFERENCE AND SHOW, LOS ANGELES, CA, FEBRUARY 12-14, 1985
Conference and Show sponsored by the American Institute of Aeronautics and Astronautics. New York, American Institute of Aeronautics and Astronautics, 1985, 24 p. For individual items see A85-26306 to A85-26309.
(AIAA PAPER 85-0847)

Among the topics discussed are a commercial aircraft window redesign prompted by environmental crazing of acrylic panels, the design features distinguishing the 737-300 airliner from its prodecessor, the solution of galling effect-related problems in spherical joint mechanisms, and the development of an energy-absorbing passenger seat for the B-720 test aircraft. Also covered are the compromises and tradeoffs made in the course of designing an environmental control system. O.C.

A85-26306#
REDESIGN OF AIRPLANE WINDOWS DUE TO ENVIRONMENTAL CRAZING OF ACRYLIC
IN: Aircraft engineering design - Design engineer's problems are now; Proceedings of the Aerospace Engineering Conference and Show, Los Angeles, CA, February 12-14, 1985 . New York, American Institute of Aeronautics and Astronautics, 1985, 3 p.

In late 1982, it was reported that airliner cockpit and passenger acrylic windows which had previously lasted 15,000 hours before

crazing to an objectionable degree had been significantly crazed after less than 1500 hours. Extensive laboratory tests, in collaboration with NOAA and NASA, eventually led to the identification of the cause of crazing as sulfuric acid droplets generated in the stratosphere by the eruption of El Chichon in Mexico. The acrylic window panels may be replaced by hardcoated and glass-laminated ones, or perhaps by either improved acrylic panels or all-glass one. O.C.

A85-26309#
ENVIRONMENTAL CONTROL SYSTEMS (ECS) - COMPROMISE AND TRADE-OFF
R. MONTUSL IN: Aircraft engineering design - Design engineer's problems are now; Proceedings of the Aerospace Engineering Conference and Show, Los Angeles, CA, February 12-14, 1985 . New York, American Institute of Aeronautics and Astronautics, 1985, 6 p.

The complexity of current aircraft cabin environmental control (EC) systems is a function of heating and cooling requirements, expanded flight envelopes, and stringent military specifications. Attention is presently given to an optimization design study which encompasses such system features as air-bearing turbines, onboard oxygen-generating systems, and digital controllers. O.C.

A85-26312
'PHOENIX' - A POLYESTER-FILM INFLATABLE MAN-POWERED AIRCRAFT
F. E. TO (Air Plane Co., Ltd., London, England) Society of Automotive Engineers, International Congress and Exposition, Detroit, MI, Feb. 27-Mar. 2, 1984. 10 p.
(SAE PAPER-840028)

This paper describes some of the design solutions adopted in solving two major problems besetting man-powered aircraft in use: that of breakage and storage. It describes work leading up to the building and testing of 'Phoenix', a man-powered aircraft with a polyester-film inflatable wing. The paper deals mainly with aspects relating to the wing design and construction. Author

A85-26314
HELICOPTER CARGO - NEW OPPORTUNITIES THROUGH TECHNOLOGY TRANSFER
D. S. LAWRENCE (United Technologies Corp., Sikorsky Aircraft, Stratford, CT) Society of Automotive Engineers, International Forum for Air Cargo, 12th, Singapore, May 21-24, 1984. 8 p.
(SAE PAPER 840703)

The S-70C helicopter, derived from the U.S. Army's UH-60A utility transport helicopter, is a low cost, reliable vehicle which has recently been certificated by the FAA for cargo missions. An evaluation is presently made of the cost effectiveness of the use of the S-70C to augment fixed wing aircraft priority express service between major U.S. cities. Such service is found to offer substantial time savings, with commensurate improvements in a forwarder's market share, at a modest increase in total cost. O.C.

A85-26324#
NEW TECHNOLOGY IN THE A320
D. H. JAGGER (Airbus Industrie, Blagnac, Haute-Garonne, France) AIAA, AHS, and ASEE, Aircraft Design, Systems, and Operation Meeting, San Diego, CA, Oct. 31-Nov. 2, 1984. 7 p.
(AIAA PAPER 84-2444)

Some applications and benefits of new technology in the A320 aircraft, which is a narrower-bodied, single-aisle addition to the Airbus family designed to carry 150 passengers over ranges up to 3000 nm are discussed. Summaries are given in the areas of aerodynamics, propulsion, and materials. The design features of the A320 aircraft, which include an advanced wing design for optimum fuel efficiency, a choice of CFM56-5 or V2500 engines, both of which offer high bypass ratio and excellent noise control, and a reduction in weight in the airframe and in the cabin interiors through the use of advanced composites, are considered. Special attention is given to the systems area, in particular the introduction, benefits, and design philosophy by Fly-by-Wire (FbW) and its interactions with the flight deck layout. The FbW primary control is designed for high reliability and low maintenance costs. M.D.

A85-26394#
LIMITED FLIGHT INVESTIGATION OF STRAKES MOUNTED ON A HELICOPTER TAIL BOOM
R. P. SMITH, W. A. LEONARD (U.S. Army, Applied Technology Laboratory, Fort Eustis, VA), and H. L. KELLEY (U.S. Army, Structures Laboratory, Hampton, VA) U.S. Army and American Helicopter Society, International Conference on Rotorcraft Basic Research, Research Triangle Park, NC, Feb. 19-21, 1985, Paper. 13 p. refs

A limited flight investigation utilizing an OH-58 A helicopter was conducted to determine the effect of several tail-boom strake configurations on yaw control during sideward flight. The purpose was to determine if the strakes could alter the boom side force in a direction to increase the directional control margin in right sideward flight and to reduce the unsteady effects on the aircraft caused when the tail rotor is operated in the vortex-ring state during left sideward flight. Earlier wind-tunnel results have indicated that flow over a tail boom, induced primarily by the main rotor wake and sideward flight, result in high side forces on the boom and that a strake placed on the boom can reduce and, in some cases, reverse the direction of these loads. Flight-test results confirmed that the boom strakes alter the aerodynamic loading on the boom with an improved pedal control margin and reduce tail rotor thrust required in right and left sideward flight. Strakes aggravated the unsteadiness of the basis aircraft in left sideward flight. Author

N85-17938# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).
SUPERMANEUVERABILITY
W. B. HERBST *In* AFOSR Proc. of the Workshop on Unsteady Separated Flow p 1-9 1984
(AD-P004153) Avail: NTIS HC A09/MF A01 CSCL 01B

Supermaneuverability is defined as the capability of a fighter aircraft to execute tactical maneuvers with controlled side slipping and at angles of attack beyond maximum lift. This paper deals particularly with post stall maneuverability at zero side slipping since this element of supermaneuverability is relatively unknown. The analysis is based on optimum control calculation of simplified maneuver elements and on extensive manned and computerized close air combat simulation. This analysis explains the tactical advantage observed during combat simulations and leads to the definition of a typical maneuver duty cycle which is consistant with conventional air combat maneuvers with all aspect weapons. Reference is made to earlier studies about maneuvers with thrust vectoring and thrust reversal. Finally, requirements are given for the necessary level of thrust-to-weight ratios and control power including indications of technical solutions. Author (GRA)

N85-17945# Analytical Methods, Inc., Redmond, Wash.
PREDICTION OF DYNAMIC STALL CHARACTERISTICS USING ADVANCED NONLINEAR PANEL METHODS
B. MASKEW and F. A. DVORAK *In* AFOSR Proc. of the Workshop on Unsteady Separated Flow p 58-72 1984
(Contract F49620-82-C-0019)
(AD-P004160) Avail: NTIS HC A09/MF A01 CSCL 20D

This paper presents preliminary results of work in which a surface singularity panel method is being extended for modelling the dynamic interaction between a separated wake and a surface undergoing an unsteady motion. The method combines the capabilities of an unsteady time-stepping code and a technique for modelling extensive separation using free vortex sheets. Routines are developed for treating the dynamic interaction between the separated wake and the solid boundary in an environment where the separation point is moving with time. The behavior of these routines is examined in a parallel effort using a two-dimensional pilot version of the three-dimensional code. This allows refinements in the procedures to be quickly developed and tested prior to installation into the main code. The extended code is coupled with an unsteady integral boundary layer method to

examine the prediction of dynamic stall characteristics. The boundary layer code is accessed during the timestep cycle and provides the separation of locations as well as the boundary layer displacement effect the latter is modelled in the potential flow code using the source transpiration technique. GRA

N85-18034# Joint Publications Research Service, Arlington, Va.
COLLEGIUM ON AVIATION FUEL CONSERVATION EFFORTS
In its USSR Rept.: Transportation (JPRS-UTR-85-003) p 3-4 12 Feb. 1985 Transl. into ENGLISH from Vozdushnyy Transport (USSR), 1 Dec. 1984 p 2
Avail: NTIS HC A06/MF A01

Reduction in the consumption levels of fuel by Soviet civil aviation is addressed. Methods proposed to economize aircraft fuel include: the introduction of towing to the runup area, keeping aircraft surfaces in good condition by washing, ensuring the stability of engine operating characteristics by flushing out gas and air lines, using ground-based conditioners and equipment of ramps with ground-based sources of electricity to reduce the operation of auxiliary power plants, replacement of heat engines for clearing runways of snow and ice by the introduction of snowplows with blowers, introduction of machinery with infrared lighting, and broader application of chemical reagents. R.S.F.

N85-18036# Joint Publications Research Service, Arlington, Va.
ACTIVITIES AT MIL EXPERIMENTAL DESIGN BUREAU
A. GOROKHOV *In its* USSR Rept.: Transportation (JPRS-UTR-85-003) p 21-25 12 Feb. 1985 Transl. into ENGLISH from Pravda (USSR), 22 Nov. 1984 p 6
Avail: NTIS HC A06/MF A01

Activities at the OKB design facility and flight test complex are reported. R.S.F.

N85-18046 Kansas Univ., Lawrence.
A FEASIBILITY STUDY OF FREE-TIP ROTOR APPLICATION AS A PASSIVE CYCLIC CONTROL DEVICE Ph.D. Thesis
H. KUMAGAI 1984 225 p
Avail: Univ. Microfilms Order No. DA8424287

A feasibility study of a passive device which provides a cyclic longitudinal control moment for a helicopter rotor was performed utilizing a rotor blade tip which is structurally decoupled from the blade inboard section. This rotor configuration is generally called Free Tip Rotor. A two dimensional numerical model was used to review the constant lift tip rotor, a predecessor of the current configurations, and then the same model was applied to the passive cyclic control device. Both configurations showed a high potential to improve the helicopter performance. A rotor performance analysis was performed by a three dimensional numerical model, originally developed by Boeing Vertol Company. It indicated that the vortices shed from the junction between the tip and the inboard section has a strong influence on the tip, and it may severely limit the tip performance. Dissert. Abstr.

N85-18047 Kansas Univ., Lawrence.
MODELING OF AIRCRAFT PERFORMANCE FROM FLIGHT TEST RESULTS USING QUASI STEADY-STATE TEST TECHNIQUES Ph.D. Thesis
T. R. YECHOUT 1984 436 p
Avail: Univ. Microfilms Order No. DA8424288

The development, implementation and flight test evaluation of a performance modeling technique which required a limited amount of quasi steady-state flight test data to predict the overall one g performance characteristics of an aircraft are described. The concept definition phase of the program included development of: (1) the relationships for defining aerodynamic characteristics from quasi steady-state maneuvers; (2) a simplified in-flight thrust and airflow prediction technique; (3) a flight test maneuvering sequence which efficiently provided definition of baseline aerodynamic and engine characteristics including power effects on life and drag; and (4) the algorithms necessary for cruise and flight trajectory predictions. Implementation of the concept included design of the overall flight test data flow, definition of instrumentation system and ground test requirements, development and verifications of all applicable software and consolidation of the overall requirements in a flight test plan. Performance modeling technology was developed to the point that it is ready for use in a wide range of flight test programs. Dissert. Abstr.

N85-18048 British Aerospace Aircraft Group, Kingston-upon-Thames (England).
WHY VERTICAL LANDING
J. F. FARLEY 16 Feb. 1984 13 p
(BAE-KRS-N-GEN-301) Avail: Issuing Activity

It is argued that vertical landing is better than short landing because it is easier for the pilot, is inherently safer for pilot and aircraft, and gives the greatest possible operational flexibility in choosing a landing site, including the use of ships. It allows safe peacetime training of the realistic operational case. It has better allowable limits of cloud base, visibility, crosswind and turbulence. It allows a safe landing in the presence of aircraft defects that prevent controlled short landings. If combat damage is suspected the serviceability of all necessary aircraft systems can be fully checked before the landing. Author (ESA)

N85-18049*# 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, and P. J. PERKINS, JR. (Sverdrup Technology, Inc., Middleburg Heights, Ohio) 1985 32 p refs Presented at the 23rd Aerospace Sci. Meeting, Reno, Nevada, 14-17 Jan. 1985; sponsored by AIAA
(NASA-TM-86906; E-2395; NAS 1.15:86906; AIAA-85-0468)
Avail: NTIS HC A03/MF A01 CSCL 01C

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 was 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 darg coefficient (c sub d) increased by 75 percent over the uniced baseline at an aircraft lift coefficient (C sub d) of 0.5. Author

N85-18050# Cranfield Inst. of Tech., Bedford (England). Coll. of Aeronautics.
THE DEVELOPMENT OF A DYNAMIC MODEL OF A GENERALISED COMBAT AIRCRAFT WITH FORWARD WINGS FOR THE IDENTIFICATION OF STABILITY AND CONTROL CHARACTERISTICS
F. HEYDARI and M. V. COOK Oct. 1984 144 p refs Sponsored by RAE
(CAR-8433) Avail: NTIS HC A07/MFA01

A forward swept wing aircraft was designed theoretically and then dynamically scaled down to suit the Weybridge wind tunnel facility. The model is then made to fly in four degrees of freedom, namely, pitch, yaw, roll and vertically up and down. Transient response of this model to dipole deflection of the canard, ailerons or rudder are recorded in the computer memory after digitization through an interface. Later, these data are read from the memory into the extended Kalman filter program together with the estimates of relevant aerodynamic derivatives serving as initial values. The output, provided the filter does not diverge, would be the identified

aerodynamic derivative parameters. The confidence level can then be checked by inserting these values into a simulation program written in ACSL. The transient response of this simulated model is then checked against the experimental one. If the two traces coincide, it can be said that the values of identified parameter are close to the actual values. Author

N85-18051*# Boeing Vertol Co., Philadelphia, Pa.
INTEGRATED TECHNOLOGY ROTOR/FLIGHT RESEARCH ROTOR HUB CONCEPT DEFINITION
P. G. C. DIXON Mar. 1983 219 p refs
(Contract DAAK51-81-C-0027)
(NASA-CR-166447; NAS 1.26:166447; USAAVRADCOM-TR-83-A-3; D210-11964-1) Avail: NTIS HC A10/MF A01 CSCL 01C

Two variations of the helicopter bearingless main rotor hub concept are proposed as bases for further development in the preliminary design phase of the Integrated Technology Rotor/Flight Research Rotor (ITR/FRR) program. This selection was the result of an evaluation of three bearingless hub concepts and two articulated hub concepts with elastomeric bearings. The characteristics of each concept were evaluated by means of simplified methodology. These characteristics included the assessment of stability, vulnerability, weight, drag, cost, stiffness, fatigue life, maintainability, and reliability. B.G.

N85-18052# Aeronautical Research Labs., Melbourne (Australia).
A COMPARISON OF FATIGUE LIVES UNDER A COMPLEX AND A MUCH SIMPLIFIED FLIGHT-BY-FLIGHT TESTING SEQUENCE
J. Y. MANN and G. W. REVILL Aug. 1984 35 p refs
(ARL/STRUC-TM-388; AR-003-954) Avail: NTIS HC A03/MFA01

Flight-by-flight fatigue tests were carried out on specimens representing part of the front flange of the main spar of the Mirage 3 wing. Two loading spectra/loading sequences were used, the first being a 200-flight sequence incorporating 24 different types of flight developed by the Eidgenossisches Flugzeugwerk in Switzerland and the second a much simplified 100-flight sequence incorporating only 4 different types of flight developed by Avions Marcel Dassault in France. The fatigue tests show no significant differences in the lives to failure between specimens tested under the two sequences. It was concluded that the use of the simplified stress spectrum/sequence would not have invalidated the findings of a previous investigation to develop life-enhancement procedures for the Mirage wing main spar. Author

N85-18053# Air Force Packaging Evaluation Agency, Wright-Patterson AFB, Ohio. Design Branch.
BI-PAC F-15 EXTERNAL FUEL TANK CONTAINER MODIFICATION
E. J. KOWALSKI Sep. 1984 25 p
(AD-A148836; PTPD-84-R-02) Avail: NTIS HC A02/MF A01 CSCL 13D

A request was made to test and evaluate BI-PAC Fiberglass Containers, NSN 1560-01-017-0858FX, used for shipment/storage of F-15, 600-gallon external fuel tanks. Reports from WR-ALC/DSTD indicated that damage was occurring to the fuel tanks while in transit. Inspection and evaluation by AFPEA revealed a need for container modifications. Tie-down rings, stacking posts, restraint bars, and stowage positions of these items were modified. Results of the in-house testing indicate that the F-15, 600-gallon external fuel tanks can be shipped safely in the modified BI-PAC containers. GRA

N85-18054# Aeronautical Research Inst. of Sweden, Stockholm. Structures Dept.
A LITERATURE SURVEY OF GROUND LOAD STATISTICS FOR LANDING GEAR FATIGUE DESIGN PURPOSES
A. I. GUSTAVSSON Aug. 1984 36 p refs
(Contract STU-81-4626B)
(FFA-TN-1984-39) Avail: NTIS HC A03/MF A01

Statistics of ground and landing gear loads, including measurements of accelerations at the center of gravity and measurements with strain gages applied to the landing gear are surveyed. The landing impact is the most thoroughly studied, especially with the normal acceleration recorded. The least information available is for single events such as braking, towing and pivoting. Author (ESA)

N85-18223# Joint Publications Research Service, Arlington, Va.
ON SOLVING NONLINEAR PROBLEMS OF AIRCRAFT STRUCTURAL MECHANICAL DESIGN Abstract Only
S. K. CHERNIKOV *In its* USSR Rept.: Eng. and Equipment (JPRS-UEQ-85-001) p 33-34 10 Jan. 1985 Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved.: Aviats. Tekhn. (USSR), no. 3, Jul. - Sep. 1983 p 105-107 Original language document was announced in IAA as A84-25584
Avail: NTIS HC A03

In nonlinear problems concerning the stress-strain state of structures, an operator control equation is usually reduced to a system of nonlinear algebraic equations using finite-difference, finite-sum, or some other well known techniques. The problem is then reduced to that of finding the roots of the nonlinear system. An approach to the solution of the nonlinear system of equations is proposed here which is based on the parameter continuation algorithm. Two versions of the approach are examined and shown to be superior to other methods. V.L. (I.A.A.)

N85-18975*# National Aeronautics and Space Administration, Washington, D. C.
THE DESIGN OF SPORT AND TOURING AIRCRAFT
R. EPPLER and W. GUENTHER Dec. 1984 29 p refs Transl. into ENGLISH of "Die Auslegung von Sport- und Reiseflugzeugen" rept. DGLR-83-01 Deutsche Gesellschaft fuer Luft- und Raumfahrt, Bonn, 1983 p 13-39 Presented at the Probl. and Develop. Trends in Gen. Aviation Symp., Friedrichshafen, West Germany, 24-25 Mar. 1983 Original language document was announced in IAA as A84-15407 Transl. by The Corporate Word, Inc., Pittsburgh, Pa.
(Contract NASW-4006)
(NASA-TM-77783; NAS 1.15:77783; DGLR-83-01) Avail: NTIS HC A03/MF A01 CSCL 01C

General considerations concerning the design of a new aircraft are discussed, taking into account the objective to develop an aircraft can satisfy economically a certain spectrum of tasks. Requirements related to the design of sport and touring aircraft included in the past mainly a high cruising speed and short take-off and landing runs. Additional requirements for new aircraft are now low fuel consumption and optimal efficiency. A computer program for the computation of flight performance makes it possible to vary automatically a number of parameters, such as flight altitude, wing area, and wing span. The appropriate design characteristics are to a large extent determined by the selection of the flight altitude. Three different wing profiles are compared. Potential improvements with respect to the performance of the aircraft and its efficiency are related to the use of fiber composites, the employment of better propeller profiles, more efficient engines, and the utilization of suitable instrumentation for optimal flight conduction. G.R. (IAA)

N85-18976# National Aerospace Lab., Tokyo (Japan).
LOW-SPEED WIND TUNNEL TESTS OF THE NAL FAN-JET STOL RESEARCH AIRCRAFT MODEL WITH GROUND SIMULATION BY TANGENTIAL BLOWING
Aug. 1984 109 p refs In JAPANESE; ENGLISH summary
(NAL-TR-828; ISSN-0389-4010) Avail: NTIS HC A06/MF A01

To investigate the basic aerodynamic characteristics of the turbofan powered lift STOL aircraft near the ground, wind tunnel tests were made on the 8% NAL Quiet STOL Research Aircraft complete with an upper surface blowing flap system in the NAL 6.5 m x 5.5 m low speed wind tunnel. The wind tunnel tests were conducted using a fixed ground plane with tangential blowing boundary layer control instead of a moving belt ground plane. The tests covered the effects on longitudinal and lateral static stability produced by variations of flap angle and engine thrust, and by ground proximity. Some of the more significant effects of ground proximity include appreciable changes in six component force and moment once jet impingement occurred. These data obtained in the wind tunnel tests were offered for analysis of flying qualities of the NAL Quiet STOL Research Aircraft. Author

N85-18977*# Kentron International, Inc., Hampton, Va. Aerospace Technologies Div.
PRELIMINARY PERFORMANCE OF A VERTICAL-ATTITUDE TAKEOFF AND LANDING, SUPERSONIC CRUISE AIRCRAFT CONCEPT HAVING THRUST VECTORING INTEGRATED INTO THE FLIGHT CONTROL SYSTEM
A. W. ROBINS, F. L. BEISSNER, JR., C. S. DOMACK, and E. E. SWANSON Feb. 1985 40 p refs
(NASA-CR-172530; NAS 1.26:172530) Avail: NTIS HC A03/MF A01 CSCL 01C

A performance study was made of a vertical attitude takeoff and landing (VATOL), supersonic cruise aircraft concept having thrust vectoring integrated into the flight control system. Those characteristics considered were aerodynamics, weight, balance, and performance. Preliminary results indicate that high levels of supersonic aerodynamic performance can be achieved. Further, with the assumption of an advanced (1985 technology readiness) low bypass ratio turbofan engine and advanced structures, excellent mission performance capability is indicated. G.L.C.

N85-18978*# Textron Bell Helicopter, Fort Worth, Tex.
INTEGRATED TECHNOLOGY ROTOR/FLIGHT RESEARCH ROTOR (ITR/FRR) CONCEPT DEFINITION
J. H. HARSE Moffett Field, Calif. Army Research and Technology Labs. Mar. 1983 85 p Sponsored in part by NASA Ames Research Center
(Contract DAAK51-81-C-0026)
(NASA-CR-166443; NAS 1.26:166443;
USAAVRADCOM-TR-84-A-4) Avail: NTIS HC A05/MF A01 CSCL 01C

A program was performed to identify and evaluate a variety of candidate rotor hub configurations for the ITR/FRR. Design criteria were established for the development of the hub concepts. Eight initial hub configurations were examined and two were selected for further refinement and evaluation. The selected concepts were bearingless designs with and without lead-lag dampers. The selected concepts were refined to the point that their physical properties relative to the Government's technical goals and manufacturing aspects could be assessed. In addition, variations that could be incorporated for the FRR were identified and compatibility for installation on the RSRA was addressed. Author

N85-18979*# Kaman Aerospace Corp., Bloomfield, Conn.
INTEGRATED TECHNOLOGY ROTOR/FLIGHT RESEARCH ROTOR (ITR/FRR) CONCEPT DEFINITION Contractor Report, Aug. 1981 - Mar. 1982
H. E. HOWES and C. A. TOMASHOFSKI Moffett Field, Calif. Army Research and Technology Labs. Mar. 1983 140 p refs Sponsored in part by NASA Ames Research Center
(Contract DAAK51-81-C-0029)
(NASA-CR-166445; NAS 1.26:166445;
USAAVRADCOM-TR-83-A-5) Avail: NTIS HC A07/MF A01 CSCL 01C

A program was performed to identify and evaluate a variety of candidate rotor hub configurations for the ITR/FRR. Design criteria were established for the development of the hub concepts. Five initial hub configurations were examined and two were selected for further refinement and evaluation. The selected configurations were bearingless designs. The Classic Elastic Pitch Beam (CEPB) and the Plain Elastic Pitch Beam (PEPB), both exhibit superior qualities for the criteria in the final evalution. The CEPB is favored over the PEPB primarily because it offers better capability for built in damping for stability and is judged to have a lower risk in development. Author

N85-18980*# Sikorsky Aircraft, Stratford, Conn.
INTEGRATED TECHNOLOGY ROTOR/FLIGHT RESEARCH ROTOR CONCEPT DEFINITION STUDY Contractor Report, Sep. 1981 - Feb. 1982
R. G. CARLSON, E. A. BENO, and H. D. ULISNIK Moffett Field, Calif. Army Research and Technology Labs. Mar. 1983 92 p refs Sponsored in part by NASA
(Contract DAAK51-81-C-0030)
(NASA-CR-166446; NAS 1.26:166446;
USAAVRADCOM-TR-83-A-6; SER-510084) Avail: NTIS HC A05/MF A01 CSCL 01C

As part of the Integrated Technology Rotor/Flight Research Rotor (ITR/FRR) Program a number of advanced rotor system designs were conceived and investigated. From these, several were chosen that best meet the started ITR goals with emphasis on stability, reduced weight and hub drag, simplicity, low head moment stiffness, and adequate strength and fatigue life. It was concluded that obtaining low hub moment stiffness was difficult when only the blade flexibility of bearingless rotor blades is considered, unacceptably low fatigue life being the primary problem. Achieving a moderate hub moment stiffness somewhat higher than state of the art articulated rotors in production today is possible within the fatigue life constraint. Alternatively, low stiffness is possible when additional rotor elements, besides the blades themselves, provide part of the rotor flexibility. Two primary designs evolved as best meeting the general ITR requirements that presently exist. An I shaped flexbeam with an external torque tube can satisfy the general goals but would have either higher stiffness or reduced fatigue life. The elastic gimbal rotor can achieve a better combination of low stiffness and high fatigue life but would be a somewhat heavier design and possibly exhibit a higher risk of aeromechanical instability. M.G.

N85-18981*# Hughes Helicopters, Culver City, Calif.
INTEGRATED TECHNOLOGY ROTOR/FLIGHT RESEARCH ROTOR (ITR/FRR) CONCEPT DEFINITION STUDY Contractor Report, Sep. - Mar. 1982
C. W. HUGHES Moffett Field, Calif. Army Research and Technology Labs. Mar. 1983 146 p refs Sponsored in part by NASA
(Contract DAAK51-81-C-0028)
(NASA-CR-166444; NAS 1.26:166444;
USAAVRADCOM-TR-83-A-2; HHI-82-144) Avail: NTIS HC A07/MF A01 CSCL 01C

Studies were conducted by Hughes Helicopters, Inc. (HHI) for the Applied Technology Laboratory and Aeromechanics Laboratory, U.S. Army Research and Technology Laboratories (AVRADCOM) and the Ames Research Center, National Aeronautics and Space Administration (NASA). Results of predesign studies of advanced main rotor hubs, including bearingless designs, are presented in

this report. In addition, the Government's rotor design goals and specifications were reviewed and evaluated. Hub concepts were designed and qualitatively evaluated in order to select the two most promising concepts for further development. Various flexure designs, control systems, and pitchcase designs were investigated during the initial phases of this study. The two designs selected for additional development were designated the V-strap and flat-strap cruciform hubs. These hubs were designed for a four bladed rotor and were sized for 18,400 pounds gross weight with the same diameter (62 feet) and solidity (23 inch chord) as the existing rotor on the Rotor Systems Research Aircraft (RSRA). B.W.

N85-18982# Joint Publications Research Service, Arlington, Va.
CHINA REPORT: SCIENCE AND TECHNOLOGY
8 Nov. 1984 49 p Transl. into ENGLISH from various Chinese articles
(JPRS-CST-84-037) Avail: NTIS HC A03/MF A01

National developments in China relating to research institutes, the life sciences, and applied sciences are discussed.

N85-18983# Joint Publications Research Service, Arlington, Va.
DETAILS OF EXPORT A-5 CLOSE-SUPPORT AIRCRAFT GIVEN
In its China Rept.: Sci. and Technol. (JPRS-CST-84-037) p 31-34 8 Nov. 1985 Transl. into ENGLISH from Hangkong Zhishi (Beijing), no. 9, Sep. 1984 p 12-13
Avail: NTIS HC A03/MF A01

The technical specifications of the A-5, China's supersonic attack aircraft, are enumerated. The following parameters are among those considered: maximum takeoff weight, takeoff speed, range, engine afterburning power, fuel capacity and consumption, and weapons capability. R.S.F.

N85-18984# Army Military Personnel Center, Alexandria, Va.
A METHODOLOGY FOR THE DETERMINATION OF ROTARY WING AIRCRAFT VULNERABILITIES IN AIR-TO-AIR COMBAT SIMULATION Final Report
K. L. TRAVIS 23 Nov. 1984 87 p
(AD-A148984; AD-E301513) Avail: NTIS HC A05/MF A01 CSCL 01C

This research effort proposes a methodology to calculate an aircraft's vulnerability in an air-to-air engagement. The primal processes of such an engagement--detection, acquisition, missile launch, missile intercept and probability of kill--are modeled using an electro-optical device as the source of target detection. The resultant probability of kill is depicted as a function range or a given aspect angle. This constitutes an enhancement over the traditional kill/no kill representation in that the entire distribution may be obtained for the selected engagement angle. Since little historical or actual test data is available for comparison, evaluation requirements for such a conceptual methodology is discussed. A recalibration process is recommended which will allow the refinement of the model as tests are conducted and observed data becomes available. Applications of the methodology results are recommended for the areas of research and development and pilot tactical training. A pilot decision logic based upon the results of executing the methodology is proposed. GRA

N85-18985# Aeronautical Research Labs., Melbourne (Australia). Structures Div.
LONG TERM DURABILITY OF UREA FORMALDEHYDE GLUED JOINTS REMOVED FROM VAMPIRE AIRCRAFT
T. VANBLARICUM and C. A. PATCHING Jun. 1984 27 p
(AD-A149053; ARL-STRUC-TM-381) Avail: NTIS HC A03/MF A01 CSCL 13E

Two Vampire fuselages originally manufactured in 1950 were used for the Australian Aeronautical Research Lab.'s Vampire Wing Fatigue Tests carried out between 1960 and 1965. The Vampire fuselage is of laminated wooden monocoque construction using spruce, improved wood and aircraft plywood, bonded with Urea Formaldehyde glue. After completion of the wing fatigue tests a number of wooden specimens were removed from these fuselages and stored under ambient laboratory conditions until Sept. 1983. At the time of specimen removal, the fuselages had been subjected to a total of 67,238 and 42,279 hours actual flying and simulated life. Careful inspection of the fuselages before removal of the specimens revealed on indication of any defect indicating that design strength requirements were not being met. This report describes the condition of the wooden joints from these specimens, broken open in Sept., 1983. At this time the glue bonds had reached a life of 33 years. This report concludes that long term exposure (18 years) of these wooden specimens to an ambient laboratory environment had not led to any significant deterioration of the Urea Formaldehyde bonded joints, and that after 33 years since manufacture the joints were still satisfactory. GRA

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AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

A85-22593
CONTEMPORARY PROBLEMS IN AIRBORNE DISPLAYS
J. D. GROSSMAN (U.S. Navy, Naval Weapons Center, China Lake, CA) IN: Advances in display technology III; Proceedings of the Meeting, Los Angeles, CA, January 18, 19, 1983 . Bellingham, WA, SPIE - The International Society for Optical Engineering, 1983, p. 29-31. refs

Certain problems arise in connection with current airborne displays. These problems are basically related to four primary factors. One factor is the rapid increase in the capability to collect and process large amounts of data, while a second factor is the need for increasingly precise information. Cockpit space restrictions represent another factor, and a diminishing gap between workload requirements and crew task load capabilities is a fourth factor. The problems encountered are discussed along with approaches for solving them. Attention is given to the employment of multifunction displays and controls, difficulties caused by a hierarchical rather than simultaneous display, a critical evaluation of voice interactive systems, advantages provided by integrated displays, the possibility that the integration of disparate functions may increase the operator's mental workload, developments related to precision and timeliness, sensor displays, and problems concerning the appropriate use of new technologies. G.R.

A85-24252
MBB - RECONNAISSANCE PROGRAMS
W. FRANKE (Messerschmitt-Boelkow-Blohm GmbH, Munich, West Germany) IN: Airborne reconnaissance VII; Proceedings of the Meeting, San Diego, CA, August 23, 24, 1983 . Bellingham, WA, SPIE - The International Society for Optical Engineering, 1983, p. 8-13.

This presentation briefly traces the history of MBB. Reconnaissance developments are detailed starting with early approaches leading via the F-104 G and RF-4E to the Tornado Reconnaissance System. Emphasis is given particularly to reconnaissance pod developments at MBB in support of the Tornado and other weapon systems. The presentation includes a careful analysis of the present state-of-the-art in recce programs, along with attention to the challenging task of providing reconnaissance for future scenarios. Author

A85-24253
RF-5E PRODUCTION DEVELOPMENT AND FLIGHT TEST
R. M. GIBB (Northrop Corp., Hawthorne, CA) IN: Airborne reconnaissance VII; Proceedings of the Meeting, San Diego, CA, August 23, 24, 1983 . Bellingham, WA, SPIE - The International Society for Optical Engineering , 1983, p. 14-24.

Production design, fabrication, and flight testing have recently been completed on the RF-5E aircraft. The design of this single-cockpit tactical reconnaissance aircraft includes multiple

sensor pallets, a photographic-sensor control system computer with automatic sensor operation, and a television viewfinder system, all of which are contained within a new structure designed to provide quick access to sensor equipment. Flight test results from sensor resolution flights at Edwards AFB and Eglin AFB verify the high inflight film resolution achievable with the stable RF-5E platform. System performance guarantees were satisfactorily met, and the first two aircraft have been delivered on schedule to the first customer. The RF-5E aircraft weapon system was completely developed and paid for with company funds. Author

A85-24254
THE RS-700 SERIES OF INFRARED LINE SCANNERS
M. L. BOWEN and R. R. HUBENTHAL (Texas Instruments, Inc., Dallas, TX) IN: Airborne reconnaissance VII; Proceedings of the Meeting, San Diego, CA, August 23, 24, 1983 . Bellingham, WA, SPIE - The International Society for Optical Engineering, 1983, p. 25-38.

This paper describes the RS-700 series of infrared line scanner (IRLS) systems in terms of their performance parameters. IRLS capabilities and limitations are discussed in terms of the mission, weather, slant range, and scanner design. Influences of system performance in regard to the reconnaissance mission are described, and examples of RS-700 IRLS imagery are presented to show the unique features of infrared imagery. Author

A85-24261
SENSOR CONTROL AND DATA ANNOTATION GETS ON THE BUS
W. G. FISHELL (Fairchild Communications and Electronics, Co., Germantown, MD) IN: Airborne reconnaissance VII; Proceedings of the Meeting, San Diego, CA, August 23, 24, 1983 . Bellingham, WA, SPIE - The International Society for Optical Engineering, 1983, p. 92-99.

Military aircraft being considered to fill the future Airborne Tactical Reconnaissance mission are equipped with the MIL-STD-1553 Digital Multiplex Bus. How is this bus different from previous interfaces? Does the bus enhance or complicate the interface of sensors to aircraft via the Sensor Control/Data Display Set (SC/DDS)? Dedicated reconnaissance aircraft like the RF-4, are fewer and far between; most new, single seat aircraft in dual role missions use reconnaissance pallets or pods while retaining major fighter capabilities. Can the added function of sensor control and monitoring for a single pilot/controller be implemented over the bus? Which functions should be performed in the Mission Computer and which should be contained in the Remote Terminal known as the SC/DDS? Discussed herein are answers to these questions, together with options and capabilities for future airborne reconnaissance design. Author

A85-24263
RECENT ADVANCES IN AIRBORNE VIDEO/DATA RECORDING
L. KLEMENTOWSKI and M. SEKINE (SEKAI Electronics of America, La Mirada, CA) IN: Airborne reconnaissance VII; Proceedings of the Meeting, San Diego, CA, August 23, 24, 1983 . Bellingham, WA, SPIE - The International Society for Optical Engineering, 1983, p. 104-108.

A development history and development status assessment is presented for the U.S. Armed Services' airborne videocassette tape recorders (AVTRs). For reconnaissance, the U.S. Navy has adapted a commercially designed AVTR for use in the F-14's Tactical Airborne Reconnaissance Pod System. This allows aircrews to tape training missions and review the tape immediately upon return to base. Two novel AVTRs of commercial design have been introduced in recent years; one of these is a 4.5-MHz cassette recorder with full remote control capability, while the other is a family of compact recorders employing 1/4-in tape cassettes. A highly compact design measuring only 4.2 x 5.5 x 6.0 in has also been acquired for future use by both Air Force and Navy aircraft. O.C.

A85-24267
A REAL TIME (ON LINE) ADAPTIVE TARGET DETECTION TECHNIQUE FOR AN AIRBORNE MILLIMETER WAVE SEEKER DESIGN
A. B. MAHMOODI (3M Graphic Research Laboratory, St. Paul, MN) and M. KAVEH (Minnesota, University, Minneapolis, MN) IN: Airborne reconnaissance VII; Proceedings of the Meeting, San Diego, CA, August 23, 24, 1983 . Bellingham, WA, SPIE - The International Society for Optical Engineering, 1983, p. 142-149. refs

An adaptive scheme for optical target detection is presented which enables an airborne radar to process more return information during every scan while maintaining a constant false alarm rate by fixing a threshold adaptive to the type of clutter that is encountered. The system consists of three basic units: an adaptive decorrelator, a clutter classifier, and a constant false alarm rate processor. Each of these units can be implemented digitally using microprocessors, which results in better reliability and easy integration with existing operational radar systems. The system is specially designed to detect weak signals from stationary objects and is a good candidate for ECCM applications. V.L.

A85-24268
EVALUATING DEFEAT MECHANISMS OF ELECTRO-OPTICAL SYSTEMS ONBOARD REMOTELY PILOTED VEHICLES
E. R. CRAINE, M. A. LANCASTER, R. M. RANSIER, and K. D. VOIGT (Bell Technical Operations Corp., Tucson, AZ) IN: Airborne reconnaissance VII; Proceedings of the Meeting, San Diego, CA, August 23, 24, 1983 . Bellingham, WA, SPIE - The International Society for Optical Engineering, 1983, p. 159-163. Army-supported research.

With increased interest in the use of remotely piloted vehicles for airborne reconnaissance, there has been an increased awareness of the importance of electrooptical systems as applied to these vehicles. This interest is further heightened by technical advances in the development of applicable detectors in visual through infrared bands. Numerous types of countermeasures, as well as natural phenomena, are potentially capable of defeating these systems. Controlled laboratory and field measurements of the behavior of electrooptical systems in the presence of obscurants or active interferers represent a potentially useful technique for determining first-order efects of interferers on system operation. A facility possessing this capability is discussed which is of potential value to developers and users of remotely piloted vehicles. Author

A85-24937
PASSIVE MILLIMETER WAVE IMAGING FOR GUIDANCE APPLICATIONS
J. O. HOOPER (U.S. Navy, Electronic Warfare Dept., China Lake, CA) IN: Millimeter wave technology II; Proceedings of the Meeting, San Diego, CA, August 23, 24, 1983 . Bellingham, WA, SPIE - The International Society for Optical Engineering, 1983, p. 74-80. refs

Microwave radiometric (Micrad) systems provide a unique combination of features such as passive, day/night, adverse weather operation, and potential low cost. Aspects of Micrad imaging are discussed, Taking into account the development of a millimeter wave radiometric imaging system, and the collection of extensive image data over a variety of terrain types and during different weather conditions. The considered airborne system consists primarily of an array of three rotating narrow beam parabolic antennas spaced 120 deg apart, a hybrid radio frequency (RF) parametric amplifier and superheterodyne receiver, and image processing and display subsystems. A description is given of details of Micrad map-matching guidance processes. G.R.

A85-25853#
THE AFA COMPUTERIZED MISSION PLANNING SYSTEM
A. DECKER and H.-J. NIESSNER Dornier-Post (English Edition) (ISSN 0012-5563), no. 4, 1984, p. 18-20.

The proprietary computerized mission planning system designated 'AFA' both facilitates and shortens the process by

which modern fighter aircraft tasks are analyzed to yield fuel and time requirements for the individual sectors of a mission, on the basis of the aircraft's flight manual. The input of planning data for mission performance and navigation into the airborne avionics system is also improved. The present AFA has been developed for the Alpha Jet trainer's weapons system and is currently being expanded for the more complex Tornado multimission fighter's weapons system. The hardware employed by the AFA includes a 130-Mbyte computer and connections with up to eight planning stations. O.C.

A85-25854#
MAINTENANCE COMPUTER FOR TORNADO
U. SCHULZ Dornier-Post (English Edition) (ISSN 0012-5563), no. 4, 1984, p. 24-28.

A development history is presented for the Tornado multirole fighter aircraft's maintenance computer, which has its basis in an already existing crash recorder's Data Acquisition Unit (DAU)-1C. The DAU-1C unit will calculate actual, flight-dependent life cycles for engine and structural components, store logistics data for 'limited life' items, detect and store limits exceeding preprogrammable parameters, and store all results and parameters in nonvolatile memory. Memory data will be transmitted and edited by way of a standard interface on request from ground support equipment. O.C.

N85-17984# CAE Electronics Ltd., Montreal (Quebec).
THE FIBER-OPTIC HELMET-MOUNTED DISPLAY
B. WELCH and M. SHENKER *In* AF Human Resources Lab. The IMAGE 3 Conf. Proc. p 345-361 Sep. 1984
(AD-P004330) Avail: NTIS HC A22/MF A01 CSCL 01B

The feasibility of the fiber optic helmet mounted display (FOHMD) concept has been demonstrated on a breadboard system installed on a simulator at the Air Force Human Resources Laboratory (AFHRL). Behavioral and engineering evaluation are currently being conducted to determine the optimum design specification for an Engineering Prototype scheduled for completion in late 1984. This paper describes the significant engineering aspects of the FOHMD together with the exploratory program for improving its performance. Author (GRA)

N85-17985# CAE Electronics Ltd., Montreal (Quebec).
BINOCULAR OVERLAP IN A FIBER OPTIC HELMET MOUNTED DISPLAY
R. KRUK and T. M. LONGRIDGE *In* AF Human Resources Lab. The IMAGE 3 Conf. Proc. p 363-378 Sep. 1984
(AD-P004331) Avail: NTIS HC A22/MF A01 CSCL 01B

Target detection, motion detection, and flight performance were compared under conditions of 25 and 45 binocular overlap using only the low resolution background channels of a fiber optic helmet mounted display (FOHMD). In experiments 1 and 2, eight experienced fighter pilots viewed aircraft targets which either approached ownship or moved vertically in the field of view, respectively, at various angles of off axis eccentricity. As an additional task, pilots flew the system as an air combat simulator and were required to track, engage, and destroy an airborne target. The results indicated target and motion detection and binocularly displayed targets were superior to that of monocularly displayed targets. There was no significant difference in target detection or motion detection between the two overlap conditions, per se, nor between left and right fields of view. In both overlap conditions, performance was degraded within 5 of the lateral edges of the field of view, and suppression was evident in contralateral fields in the areas of optical frame overlap. However, the latter effects were combined nearer the central viewing area for the 25 deg overlap condition. No significant differences were noted in the supplementary air combat task as a function of overlap, but structured debriefing data indicated loss of target imagery is less of a problem with the larger overlap. It is concluded that greater than 25 deg binocular overlap should be utilized in follow-on systems. Author (GRA)

N85-18055# Army Aeromedical Research Lab., Fort Rucker, Ala.
THE EFFECT OF MODIFIED SPECTACLES ON THE FIELD OF VIEW OF THE HELMET DISPLAY UNIT OF THE INTEGRATED HELMET AND DISPLAY SIGHTING SYSTEM
W. E. MCLEAN and C. E. RASH Sep. 1984 34 p
(AD-A148693; USAARL-84-12) Avail: NTIS HC A03/MF A01 CSCL 17H

A study was conducted to establish the effect of wearing modified aviator spectacles, either for laser protection or refractive error correction, on the field-of-view available with the Helmet Display Unit (HDU) of the Integrated Helmet and Display Sighting System (IHADSS). The determining factors of the available field were found to be helmet fit, eye fixation direction, and eye relief distance. The study concluded that when these factors are optimized, the wearing of the modified spectacles does not result in a loss of field-of-view. GRA

N85-18986# Boeing Military Airplane Development, Seattle, Wash.
PICTORIAL FORMAT DISPLAY EVALUATION Final Technical Report, Sep. 1981 - Sep. 1983
T. C. WAY, M. E. HORNSBY, J. D. GILMOUR, R. E. EDWARDS, and R. E. HOBBS Wright-Patterson AFB, Ohio AFWAL May 1984 183 p Original contains color illustrations
(Contract F33615-81-C-3610)
(AD-A149252; AFWAL-TR-84-3036) Avail: NTIS HC A09/MF A01 CSCL 01D

Two sequential simulation studies were conducted to evaluate the usability and acceptability of pictorial format displays for fighter aircraft; to determine whether usability and acceptability were affected by display mode--color or monochrome; and to recommend format changes based on the simulations. Government-furnished formats were modified for dynamic display on CRTs in a simulator cockpit to support a representative mission scenario with surface and air threats. Objective performance data, subjective pilot ratings and comments were collected, and the formats were revised on the basis of this data. In the Basic Pictorial Display Evaluation study, pictorial formats were implemented and evaluated for flight, tactical situation, system status, engine, stores management and emergency status displays. In the Threat Warning Study, the number of threats, and the amount and type of threat information were increased. A total of thirty USAF and Navy pilots in the two studies flew mission simulations with color and monochrome versions of the displays. In general, the pilots found the pictorial format displays, and the specific implementation used in these studies quite acceptable, and preferred the color over the monochrome versions. GRA

N85-18987# Department of the Navy, Washington, D. C.
AIRSPEED SENSING PRESSURE VALVE SYSTEM Patent Application
P. AYOUB, inventor (to Navy) 29 Jun. 1984 19 p
(AD-D011472; US-PATENT-APPL-SN-627307) Avail: NTIS HC A02/MF A01 CSCL 13K

The present invention relates generally to a system for deploying a parachute during ejection of an occupant from a disabled aircraft, and more particularly to a fail-safe means of sensing airspeed in such a system. It is a general purpose and object of the present invention to provide a simple, yet effective airspeed sensor, used in a system for deploying a parachute during ejection of an occupant from a disabled aircraft, which stores peak dynamic pressure in order to selectively delay parachute deployment as a function of airspeed and altitude at ejection. GRA

N85-18988# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
TECHNICAL EVALUATION REPORT ON THE 46TH SYMPOSIUM OF THE AVIONICS PANEL ON SPACE SYSTEM APPLICATIONS TO TACTICAL OPERATIONS
J. STATSINGER (Aerospace Corp., El Segundo, Calif.) Loughton, England Sep. 1984 16 p Symp. held in Hampton, Va., 17-20 Oct. 1983
(AGARD-AR-203; ISBN-92-835-1478-5) Avail: NTIS HC A02/MF A01

The highlights are presented of the NATO Secret AGARD Avionics Panel Symposium on space system applications to tactical operations, which convened in order to accomplish the following: (1) provide an overview of tactical needs which are effectively addressed by space systems; (2) characterize the various existing and potential space systems with emphasis on those attributes which are most related to tactical needs; (3) assess the advantages and limitations of space systems in supporting combat operations; (4) investigate the interaction of space assets with ground and mobile resources and the consequent operational issues; and (5) discuss future trends in space technology and their relationship to evolving combat needs. R.S.F.

N85-19664# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Industrial Engineering and Operations Research.
ELECTRONIC DISPLAYS: THEIR STRENGTHS AND WEAKNESSES FOR ADVANCED HIGH PERFORMANCE AIRCRAFT
H. L. SNYDER and R. H. BOGLE *In* AGARD Human Factors Considerations in High Performance Aircraft 11 p Nov. 1984 refs
Avail: NTIS HC A09/MF A01

Various aircraft cockpit display technologies are compared on the basis of maximum size, maximum spatial resolution, available colors, luminance, and luminance range. The specific technologies considered are CRT, plasma discharge, electroluminescent, liquid crystal, electrochromic, and light emitting diode. The technological parameters of the cockpit displays are discussed with respect to visual task compatibility and flight crew needs and performance. R.S.F.

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.

A85-23191#
FUEL EFFECTS ON THE TF30 ENGINE (ALTERNATE TEST PROCEDURE)
P. A. KARPOVICH (U.S. Naval Air Propulsion Test Center, Trenton, NJ) and A. I. MASTERS (United Technologies Corp., Pratt and Whitney Group, West Palm Beach, FL) American Society of Mechanical Engineers and Institute of Electrical and Electronics Engineers, Joint Power Generation Conference, Toronto, Canada, Oct. 1-4, 1984. 7 p. refs
(ASME PAPER 84-JPGC-GT-1)

The objective of the Alternate Test Procedure (ATP) is to develop the capability to qualify new fuels for Navy aircraft use with a minimum of testing. The effect of fuel composition and properties on engine performance and component life has been shown to vary significantly from one engine configuration to another. The P&WA approach to the ATP has been to define fuel effects on the TF30 engine and then apply the methodology to other engines of interest to the Navy. Investigations of the TF30 conducted under the ATP Program and other Navy and Air Force Contracts have produced one of the most complete fuel effect characterizations available for any gas turbine engine. Major fuel effects which have been quantified are the relationships of lubricity to main fuel control reliability, viscosity and volatility to main burner and augmentor ignition limits, and hydrogen content to smoke and combustor life. The effects of fuel properties and composition on combustion efficiency and elastomeric seal life were found to be of secondary importance. Remaining uncertainties are the effects of fuel properties on turbine life and fuel nozzle fouling rate. Author

A85-23978
A STUDY OF CHARACTERISTICS OF THE 'LONG' HYDRODYNAMIC DAMPERS OF GAS TURBINE ENGINE ROTORS WITH ALLOWANCE FOR LUBRICANT TURBULIZATION AND CAVITATION IN THE DAMPER CLEARANCE [ISSLEDOVANIE KHARAKTERISTIK 'DLINNYKH' GIDRODINAMICHESKIKH DEMPFEROV ROTOROV GTD S UCHETOM TURBULIZATSII I KAVITATSII SMAZKI V DEMPFERNOM ZAZORE]
A. I. BELOUSOV, V. B. BALIAKIN, and IU. A. RAVIKOVICH Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 3, 1984, p. 11-14. In Russian.

A method is presented for calculating the dynamic characteristics of 'long' hydrodynamic dampers for the case of lubricant discontinuities and turbulence in the damper clearance. It is shown that a lubricant film discontinuity reduces the tangential component of the hydrodynamic force and gives rise to a radial component. Lubricant turbulization increases the hydrodynamic force and pressure amplitude in the damper clearance. V.L.

A85-23979
THE EFFECTIVENESS OF THE INITIAL TWIST OF THE AIR IN THE BLADE COOLING SYSTEMS OF GAS TURBINES [OB EFFEKTIVNOSTI PREDVARITEL'NOI ZAKRUTKI VOZDUKHA V SISTEMAKH OKHLAZHDENIIA RABOCHIKH LOPATOK GAZOVYKH TURBIN]
E. N. BOGOMOLOV and V. V. ELIZAROV Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 3, 1984, p. 15-19. In Russian.

Experimental data on the effectiveness of the initial twist of the cooling air at the inlet of the rotor of a turbine are analyzed. It is shown that the effectiveness of the initial twist is largely determined by the viscous interaction between the rotating air and the turbine disk. A method for selecting the initial twist parameters with allowance for the interaction between the disk and the cooling air is presented. V.L.

A85-23983
FLOW PARAMETERS IN A CHAMBER DURING THE MIXING OF WAKES [PARAMETRY POTOKA V KAMERE PRI SMESHENII SPUTNYKH STRUI]
V. N. GRUZDEV Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 3, 1984, p. 33-37. In Russian. refs

Changes in the static pressure inside a cylindrical mixing chamber, with all inhomogeneities completely equalized, are investigated analytically and experimentally. It is shown that the change in the momentum of nonuniform flow which occurs when a nozzle is attached to the cylindrical chamber, is due to a change in the static pressure over the flow cross-section. It is also shown that losses in the outlet ducts of turbojet and bypass engines can be calculated from the thrust developed by flow with a given nonuniformity expanding into a medium with a known pressure. This provides an alternative to using the mean full pressure. V.L.

A85-23984
A STUDY OF HEAT TRANSFER DURING THE INJECTION OF WATER INTO THE COOLING AIR OF A TURBINE BLADE [ISSLEDOVANIE TEPLOOBMENA PRI VPRYSKE VODY V VOZDUKH, OKHLAZHDAIUSHCHII TURBINNUIU LOPATKU]
V. P. DANILCHENKO, V. E. REZNIK, and IU. G. TIMAEV Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 3, 1984, p. 38-41. In Russian. refs

Heat transfer in a turbine blade is investigated experimentally for the case of water injection into the cooling air, and the results are compared with the case of cooling by pure air. It is shown

that the presence of up to 10 percent of fully evaporated water in the steam-air mixture does not effect the intensity of heat transfer in a turbine blade. This conclusion is valid for both mean and local heat transfer coefficients. V.L.

A85-23986
ANALYTICAL PREDICTION OF THE THERMAL STATE OF FLIGHT VEHICLE ENGINE CHAMBERS WITH INTERNAL FILM COOLING UNDER CONDITIONS OF PULSED OPERATION [K RASCHETNOMU PROGNOZIROVANIIU TEPLOVOGO SOSTOIANIIA KAMERY DVIGATELEI LETATEL'NYKH APPARATOV S VNYTRENNIM PLENOCHNYM OKHLAZHDENIEM PRI IMPUL'SNOM REZHIME RABOTY]
N. N. KOVALNOGOV, E. A. MIRONOV, and V. N. VORONIN Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 3, 1984, p. 44-47. In Russian.

The internal film cooling of the chamber of a liquid-propellant rocket engine operating in pulsed mode is investigated analytically, with emphasis on the probable mechanism of film separation and low-temperature wall layer breakdown. A method for predicting the maximum-intensity engine regimes is proposed which involves numerical calculation of the two-dimensional unsteady temperature field in the chamber wall, with boundary conditions of heat transfer on the internal surface of the wall undergoing cyclic changes. V.L.

A85-23987
AN EXPERIMENTAL STUDY OF THE ROTATING STALL STRUCTURE IN AN AXIAL-FLOW COMPRESSOR [OPYTNOE IZUCHENIE STRUKTURY ZON VRASHCHAINSHCHEGOSIA SRYVA OSEVOGO KOMPRESSORA]
P. V. KOROLEV Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 3, 1984, p. 47-51. In Russian.

Results of an experimental study of stall in the isolated first stage of the compressor of a bypass engine based on thermoanemometry and low-inertial pressure measurements are reviewed. Particular attention is given to the nonsychronicity of flow perturbations resulting from a rotating stall. The mechanisms responsible for the stall motion across the main flow are examined. V.L.

A85-23989
AN APPROXIMATE METHOD FOR CALCULATING FLOW IN THE MIXING CHAMBERS OF BYPASS ENGINES UNDER CONDITIONS OF INCOMPLETE MIXING OF GAS FLOWS [PRIBLIZHENNYI METOD RASCHETA TECHENIIA V KAMERAKH SMESHANIIA TRDD PRI NEPOLNOM PEREMESHIVANII GAZOVYKH POTOKOV]
V. A. NEMYKIN and V. M. TREMBACH Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 3, 1984, p. 59-65. In Russian. refs

A method is proposed for determining gas flow parameters for the mixing chambers of bypass engines with allowance for the effect of incomplete mixing. An analytical model is developed on the basis of an experimentally determined physical flow pattern. The method proposed here is verified experimentally for mixing chambers of various geometries. V.L.

A85-23993
ELEMENTS OF THE FUNCTIONAL DECOMPOSITION OF AIRCRAFT TURBOMACHINES DURING THEIR SYNTHESIS USING A COMPUTER-AIDED BLADE DESIGN SYSTEM [ELEMENTY FUNKTSIONAL'NOI DEKOMPOZITSII AVIATSIONNYKH TURBOMASHIN KAK OB'EKTY SINTEZA V SAPR KONSTRUKTSII LOPATOK]
B. M. ARONOV Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 3, 1984, p. 79-81. In Russian. refs

An analysis of the structure of machines indicates that the boundaries of the functional elements do not coincide with the boundaries of machine parts and assembly units. This is demonstrated for the case of the blade rings of turbomachines, blade root fittings, and blade cooling devices as related to parts of the rotor and the stator. It is shown that the difference between the elements of functional and object decompozitions affects the criteria and the sequence of the synthesis procedure. V.L.

A85-23995
THE EFFECT OF THE OPERATING PARAMETERS ON THE TEMPERATURE FIELD OF GAS FLOW BEHIND A SYSTEM OF RADIAL STABILIZERS [VLIIANIE REZHIMNYKH PARAMETROV NA TEMPERATURNOE POLE GAZOVOGO POTOKA ZA SISTEMOI RADIAL'NYKH STABILIZATOROV]
IU. N. BASHKATOV, A. D. DEKHTIARENKO, IU. P. MARCHUKOV, and V. V. SAMELIUK Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 3, 1984, p. 85-87. In Russian.

Experiments have been carried out to investigate the formation of temperature fields behind a system of radial flame stabilizers in a 100 x 240-mm section of a combustion chamber. It is found that the formation of the radial temperature field is largely determined by fuel distribution over the stabilizer height and by the wall air curtains of the flame tube. Characteristics of the radial inhomogeneities of the temperature field are presented for a given fuel distribution over the stabilizer height. V.L.

A85-23999
THE USE OF GROOVES IN THE HOUSINGS OF AXIAL-FLOW COMPRESSORS WITH INCREASED RADIAL CLEARANCES [PRIMENENIE NADROTORNYKH USTROISTV PRI UVELICHENNYKH RADIAL'NYKH ZAZORAKH V OSEVOM KOMPRESORE]
V. N. ERSHOV, A. P. EFIMENKO, and V. IU. NEZYM Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 3, 1984, p. 93, 94. In Russian.

A series of experiments has been carried out to investigate the effect of grooves in the outer compressor housing on the aerodynamic characteristics of axial-flow compressors with various radial clearances. The aerodynamic characteristics of the compressors are compared in the maximum efficiency region with an accuracy of 0.5 percent and a confidence level of 95 percent. It is shown that, starting at a certain clearance, the use of grooves increases the maximum efficiency of the compressor. V.L.

A85-24000
A STUDY OF THE STABILITY OF COMBUSTION IN A SMALL STRAIGHT-FLOW COMBUSTION CHAMBER [ISSLEDOVANIE USTOICHIVOSTI GORENIIA V MALORAZMERNOI KAMERE SGORANIIA PRIAMOTOCHNOGO TIPA]
A. N. KULIAPIN and V. B. RUTOVSKII Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 3, 1984, p. 96-98. In Russian.

It is shown experimentally that in small straight-flow combustion chambers with mechanical stabilizers, an increase in the shading coefficient above 0.54 results in unstable combustion. This result is consistent with experimental data for large ramjet engines. Like in the case of the conventional combustion chambers of ramjet engines, vibrations in small straight-flow combustion chambers can be successfully damped by using an antivibration shield. V.L.

A85-24001
AN EXPERIMENTAL STUDY OF THE HYDRAULIC CHARACTERISTICS OF AIR FLOW IN THE COOLING SLOTS OF THE NOZZLE GUIDE VANES OF GAS TURBINE ENGINES [EKSPERIMENTAL'NOE ISSLEDOVANIE GIDRAVLICHESKIKH KHARAKTERISTIK TECHENIIA VOZDUKHA V SHCHELEVYKH KANALAKH OKHLAZHDENIIA SOPLOVOI LOPATKI GTD]
V. I. LOKAI, A. S. LIMANSKII, and V. V. RUMIANTSEV Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 3, 1984, p. 98-100. In Russian.

Experiments have been carried out using a specially designed test bench to determine the relationship between the hydraulic resistance of the cooling slots of nozzle guide vanes and flow parameters in the region of hydrodynamic stabilization. Experimental results are presented in graphical form for the Reynolds number range 5000-15,000. An analysis of experimental results yields an expression relating the friction resistance coefficient, averaged over the length of the hydrodynamic stabilization region, to the Reynolds number. V.L.

A85-24004
A STUDY OF THE STRUCTURE OF THE PRIMARY ZONE OF CYLINDRICAL COMBUSTION CHAMBERS [ISSLEDOVANIE STRUKTURY PERVICHNOI ZONY TSILINDRICHESKIKH KAMER SGORANIIA]
V. A. SYCHENKOV, V. M. IANKOVSKII, and V. M. ZAKHAROV Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 3, 1984, p. 105-107. In Russian.

Air distribution in the flame pipe and, in particular, the amount of air delivered to the primary zone of the combustion chamber are investigated experimentally and analytically using a flow model for the primary zone proposed in an earlier study (Chumachenko et al., 1979). It is shown that the characteristics of fuel burnout in the primary zone in the case where fuel and air are fed separately differ from those in the case where fuel and air are premixed and then fed into the primary zone. It is also shown that heat release in the primary zone reduces the amount of the incoming air. V.L.

A85-24020
MULTILEVEL METHODS IN THE DYNAMICS OF THE ROTORS OF AIRCRAFT ENGINES [MNOGOUROVNEVYE METODY V DINAMIKE ROTOROV AVIATSIONNYKH DVIGATELEI]
A. S. VOLMIR, V. F. MIKHNEV, A. E. TIKHOMIROV, and V. I. KHORKHORDIN (Voenno-Vozdushnaia Inzhenernaia Akademiia, Moscow, USSR) Prikladnaia Mekhanika (ISSN 0032-8243), vol. 20, Dec. 1984, p. 58-63. In Russian. refs

The use of the method of multilevel superelements for the analysis of the dynamic characteristics of the rotor components of a gas-turbine engine operating under conditions of temperature gradients and substantial centrifugal loads is discussed. Some results are presented on the frequencies and modes of the natural vibrations of rotor components. V.L.

A85-24569#
DISPERSION PROCESS OF JET ENGINE EXHAUST PLUME
A. NISHI (Miyazaki University, Kirishima, Japan) and T. SAWADA (Osaka Prefecture University, Sakai, Japan) JSME, Bulletin (ISSN 0021-3764), vol. 27, Dec. 1984, p. 2833-2838. refs

To obtain the basic data for assuming the source position of atmospheric diffusion of the jet engine exhaust plume, a full scale field test was done at Chitose Airport for use in the air pollution assessment of the proposed New Kansai Airport. An engine of airbus was examined under a few operating modes. An observation net of about 100 meters wide and 25 meters high was constructed perpendicular to the jet axis, instrumented at several levels with sensors for velocity, temperature, and concentration of pollutants. A model test was carried out in the laboratory to get the more widely applicable data and some of the results were compared with those of the field tests. The bending path of the jet axis by a crosswind was determined and a penetration length was estimated from the field test. The decays of maximum velocity and temperature as well as the jet spreads were determined from both field and model tests. Author

A85-24646
FOR THE EIGHTIES AND BEYOND
T. FORD Aircraft Engineering (ISSN 0002-2667), vol. 56, Dec. 1984, p. 2-4.

An evaluation is made of recently incorporated design changes and their performance enhancement consequences for the RB 211-535 E4 turbofan engines, which have begun to be retrofitted on 757 airliners. The E4 variant incorporates wide chord fan blades, an improved efficiency engine core, and an integrated nozzle assembly, to yield 40,000 lb of thrust. An important aspect of the 535 family of engines is their seven-module construction concept for ease of maintenance and repair. In the high pressure compressor system, the compressor rotor blades and stators have tip end bends to improve aerodynamic efficiency and consequent pressure ratio. O.C.

A85-25180
NASA RESEARCHERS BELIEVE EFFORTS COULD YIELD SPEEDS OF MACH 12
J. K. GORDON Aviation Week and Space Technology (ISSN 0005-2175), vol. 122, Feb. 25, 1985, p. 52, 53.

Hypersonic wind tunnel tests being conducted by NASA for fixed geometry supersonic combustion ramjet ('scramjet') powerplant configurations have pointed to the feasibility of aircraft cruising at Mach numbers as high as 12. Initial applications for this propulsion technology may be seen in novel missile designs with exceptional range capabilities. In manned vehicles, the integration of engines into fuselage surfaces has led to consideration of a rectangular engine cross section; this would allow the placement of modular scramjet units side by side. An intake cowl design is being investigated for such a powerplant which, despite its fixed surfaces, creates effects at varying Mach numbers that are equivalent to those of a more complex, variable geometry engine inlet. O.C.

A85-25211#
ANALYSIS OF STARTING PERFORMANCE OF THE SINGLE SHAFT GAS TURBINES BY THEORY OF SIMILARITY
W. NI (Qinghua University, Beijing, People's Republic of China) and S. LI (Third Beijing Heat Plant, Beijing, People's Republic of China) Journal of Engineering Thermophysics, vol. 5, Nov. 1984, p. 326-328. In Chinese, with abstract in English.

The start is one of the main criteria of reliability of gas turbines. The starting process is closely linked with the parameters of the ambient and the alternations of the starting devices. In this paper a useful method for controlling the starting performance by theory of similarity is discussed. The analytical results coincide fairly well with the data obtained from long-period operation of single shaft gas turbines. Author

A85-25212#
CALCULATION AND ANALYSIS OF THE OFF-DESIGN PERFORMANCE OF SPLIT SHAFT GAS TURBINE
S. ZHAO (Qinghua University, Beijing, People's Republic of China) Journal of Engineering Thermophysics, vol. 5, Nov. 1984, p. 332-334. In Chinese, with abstract in English.

In this paper, on the basis of the calculated off-design performance of a split shaft gas turbine, discussion is carried out about some aspects of the performance of the split shaft gas turbine, showing that the equilibrium running zone is very narrow. Some measures are used so that the machines can run steadily at idle. Author

A85-25223#
A EXPERIMENT METHOD TO DETERMINE THE AIR DISTRIBUTION OF THE HOLES ALONG THE FLAMETUBE OF GAS TURBINE COMBUSTOR
B. ZHANG (Beijing Institute of Aeronautics and Astronautics, Beijing, People's Republic of China) Journal of Engineering Thermophysics, vol. 5, Nov. 1984, p. 409-411. In Chinese, with abstract in English.

A85-25442* Washington Univ., Seattle.
AN EXPERIMENTAL INVESTIGATION AND NUMERICAL PREDICTION OF THERMOMECHANICAL PHENOMENA IN HIGH SPEED ROTOR TIP RUBBING
A. F. EMERY, S. ETEMAD, J. WOLAK, and S. R. CHOI (Washington, University, Seattle, WA) IN: Numerical methods in thermal problems. Volume 3 Proceedings of the Third International Conference, Seattle, WA, August 2-5, 1983 . Swansea, Wales, Pineridge Press, 1983, p. 1040-1049. refs
(Contract NAG3-7)

A thermomechanical study of the intermittent rubbing of a rotor blade tip and a casing seal is carried out taking into account the existence of thermal contact resistance. The effect of the thermal properties of a plasma sprayed coating on the blade tip is studied. The influence of a variable heat generation and variable thermal contact resistance at the blade tip as it passes along the path of rubbing is also discussed. Author

A85-25622
COOLING OF A TURBINE PROFILE IN THE CASE OF AIR INJECTION THROUGH POROUS AREAS [OKHLAZHDENIE TURBINNOGO PROFILIA PRI VDUVE VOZDUKHA CHEREZ PORISTYE UCHASTKI]
V. D. SOVERSHENNYI and S. V. LEONOV (Moskovskii Aviatsionnyi Institut, Moscow, USSR) Promyshlennaia Teplotekhnika (ISSN 0204-3602), vol. 6, no. 6, 1984, p. 19-22. In Russian.

The problem of the cooling of the surface of a profile is examined for the case where air is injected through individual porous areas and also through a system of porous areas following in close succession. A system of boundary layer equations with laminar, transition, and turbulent flow region is solved numerically, and cooling is calculated with and without allowance for heat overflow along the surface. The efficiency of cooling is determined for various air injection conditions. V.L.

A85-25623
CALCULATION OF THE FULL COOLING EFFICIENCY OF THE PERFORATED WALL OF A GAS TURBINE NOZZLE GUIDE VANE [K RASCHETU POLNOI EFFEKTIVNOSTI OKHLAZHDENIIA PERFORIROVANNOI STENKI SPOLOVOI LOPATKI GAZOVOI TURBINY]
E. N. BOGOMOLOV and V. I. ORLOVA Promyshlennaia Teplotekhnika (ISSN 0204-3602), vol. 6, no. 6, 1984, p. 30-37. In Russian. refs

A method is proposed for calculating the thermal state of a perforated nozzle guide vane under conditions of nonisothermal injection with allowance for the effect of coolant jets on heat transfer from the main flow. The method is based on a generalization of the available experimental data and an approximate solution to the heat transfer problem for a perforated wall covered by a thin heat-insulating layer. V.L.

A85-25976
DESIGN AND EXPERIMENTAL EVALUATION OF PROPFAN INLETS
B. L. HINSON (Lockheed-Georgia Co., Marietta, GA) Society of Automotive Engineers, Aerospace Congress and Exposition, Long Beach, CA, Oct. 15-18, 1984. 10 p. refs
(SAE PAPER 841477)

A wind-tunnel test program has been carried out to investigate the high-speed aerodynamic characteristics of advanced turboprop inlets. Both flush and boundary-layer-diverter scoop inlets were designed and tested with an advanced 8-bladed propfan at Mach numbers up to 0.80. Considerably better inlet pressure recoveries were observed for the configuration with the boundary layer diverter. The overall recovery level for both inlets was significantly higher, however, than indicated by previous analyses. Both inlet models showed good agreement with predicted cowl surface pressure distributions, thus validating the design methods. V.L.

A85-25980
USE OF EXPANDED AIDS IN ENGINE HEALTH MONITORING ON THE CF6-80 ENGINE FOR THE A310 AIRBUS
W. A. NEESE (General Electric Co., Aircraft Engine Business Group, Cincinnati, OH) Society of Automotive Engineers, Aerospace Congress and Exposition, Long Beach, CA, Oct. 15-18, 1984. 15 p.
(SAE PAPER 841505)

The description of a condition-monitoring system for the CF6-80 engine and the related auxiliary systems is presented. The system is an on-engine part of the Airborne Integrated Data System with the main objective of early in-flight fault detection and overall engine monitoring. The on-wing Turbine Engine Module Performance Estimation Routine (TEMPER) analyzes the efficiency and the pumping capacity of the fan, low-pressure and high-pressure compressors, and low-pressure and high-pressure turbines. Other features of the system include the takeoff margin assessment, control schedule analysis, vibration trend analysis, under-cowl leak detection, and fuel-consumption survey. The immediate benefits of the system include substantial savings of fuel. L.T.

A85-25981
LIVING WITH EICAS - OPERATIONAL EXPERIENCE TO DATE ON THE 757 AND 767
D. BRODERSON (Boeing Co., Seattle, WA) and U. GUSTAFSSON (United Air Lines, Inc., Chicago, IL) Society of Automotive Engineers, Aerospace Congress and Exposition, Long Beach, CA, Oct. 15-18, 1984. 9 p.
(SAE PAPER 841506)

The performance of EICAS, the digital CRT Engine Indication and Crew Alerting System which replaces the conventional engine gages and separate warning indicators in the two-crew cockpit of the 757/767 aircraft, during its first year of service is reviewed from the perspectives of the manufacturer and the airline. The design concept and implementation of EICAS are presented and illustrated with diagrams and photographs; two nuisance indications, four CRT problems, and the measures taken to eliminate them are described; and the generally acceptable reliability and the need to improve the performance of the built-in test equipment are documented. The desirability of some changes in the types and amounts of information available on EICAS and in the form of its presentation, of increased programming flexibility and allowance for customer-specific software, and of improved maintenance procedures is indicated. T.K.

A85-25982
INTRODUCTION INTO COMMERCIAL SERVICE FOR ELECTRONIC CONTROLS USED ON LARGE TURBOFAN ENGINES
R. W. BRIGGS (United Technologies Corp., Hamilton Standard Div., Windsor Locks, CT) and W. F. OPDENBROUW (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. 14 p.
(SAE PAPER 841507)

Engine-mounted digital electronics installed on large turbofan engines in operation for two years are considered. The EEC103 system's developmental history, design criteria, reliability considerations, and maintenance concepts are detailed. Customer record indicates a mean time between failures of over 35,000 hr or about 10 years of service; those production units experiencing malfunctions consisted of 37.5 percent with failures due to ambient temperature, 19.1 percent due to vibration testing, and 43.4 percent due to thermal cycle testing. Thirteen airliners are presently operating with the EEC103. Block diagrams are included. L.T.

A85-25984* General Electric Co., Cincinnati, Ohio.
ALTITUDE TESTING OF A FLIGHT WEIGHT, SELF-COOLED, 2D THRUST VECTORING EXHAUST NOZZLE
W. H. WOOTEN, J. T. BLOZY, D. W. SPEIR (General Electric Co., Cincinnati, OH), and R. A. LOTTIG (NASA, Lewis Research Center, Cleveland, OH) Society of Automotive Engineers, Aerospace Congress and Exposition, Long Beach, CA, Oct. 15-18, 1984. 11 p.
(SAE PAPER 841557)

The Augmented Deflector Exhaust Nozzle (ADEN) was tested in PSL-3 at NASA-Lewis Research Center using an F404 engine. The ADEN is a flight weight Single Expansion Ramp Nozzle with thrust vectoring, an internal cooling system utilizing the available engine fan flow, and a variable area throat controlled by the engine control system. Test conditions included dry and max A/B operation at nozzle pressure ratios from 2.0 to 15.0. High nozzle pressure loading was simulated to verify structural integrity at near maximum design pressure. Nozzle settings covered the full range in throat area and + or - 15 deg deflection angle. Test results demonstrated expected aerodynamic performance, cooling system effectiveness, control system stability, and mechanical integrity. Author

A85-26017
THE EVOLUTION OF HIGH-THRUST TURBOJET ENGINE TECHNOLOGY [L'EVOLUTION DE LA TECHNOLOGIE DES TURBOREACTEURS DE FORTE PUISSANCE]
R. BOUILLET (SNECMA, Paris, France) L'Aeronautique et l'Astronautique (ISSN 0001-9275), no. 107, 1984, p. 29-46. In French.

The operational characteristics of polyvalent military engines and engines for subsonic commercial aircraft are considered. The technical evolution of commercial engines is examined in terms of specific performances, reliability and safety, and service-life, while specific performances, pilotability, and reliability-maintenance are examined for military engines. Design compromises for the commercial engine have led to configurations for a by-pass engine with a large by-pass ratio, a high compression rate, and moderately high inlet temperatures; for the military engine, they have led to afterburner configurations with a small by-pass ratio, a moderate compression ratio, and very high afterburner and combustion temperatures. Engine design formulas are examined with respect to the complete engine and its major components. The technical evolution of turbulent engines over the next decade is projected. M.D.

A85-26024
AN ENGINE FOR A LIGHT HELICOPTER [MOTORISATION POUR HELICOPTERE LEGER]
J.-C. MARTIN, C. PANTEL (Saint-Etienne, Ecole Nationale d'Ingenieurs, Saint-Etienne, France), P. PRUDHOMME LACROIX, and Y. VINCENT (Aerospatiale, Division Helicoptere, La Courneuve, Seine-Saint-Denis, France) L'Aeronautique et l'Astronautique (ISSN 0001-9275), no. 109, 1984, p. 28-45. In French. refs

Possible design configurations of an engine for a new light helicopter are analyzed with an eye to defining a unit that will have as wide an applicability as possible. The design effort must account for the engine power rating, coupling, rotational speed, SFC, dynamic characteristics, dimensions, thrust/weight figure of merit and adaptability to aeronautical needs. Attention is given to rotary and alternating piston engines derived from automotive propulsion and the loads expected from driving a rotor and under autorotation. The kinematics and positioning of the engine are considered, as is the choice between horizontal and vertical orientation, which affects the transmission design. The study indicates that the design of a vertically-mounted engine is far enough along and is promising enough to build a prototype for testing. M.S.K.

A85-26274
CIVIL TURBOFAN ENGINES
M. HIRST Air International (ISSN 0306-5634), vol. 28, March 1985, p. 126-131.

A development history and comparative performance assessment is presented for the major families of U.S. and British commercial airliner-powering turbofan engines. In these powerplants, a substantial portion of the combustion gas stream that would be exhausted by a turbojet is used to power turbine stages that will in turn drive a large diameter fan. Attention is given to the state-of-the-art PW2037 engine, already powering 757 airliners, the RB.211-535E4, also intended to compete for the 757's market, and the CF6-80C2, which has been chosen for the A-300-600 Airbus. A tabulation is presented of the most pertinent performance data for extant civil turbofans, encompassing dry thrust, mass flow, dimensions and weights, overall pressure ratio, bypass ratio, specific fuel consumption, mass flow, specific thrust, and aircraft applications to date. O.C.

A85-26275
PROPELLERS FOR THE FUTURE
J. G. RUSSELL (Dowty Rotol, Ltd., Gloucester, England) Exxon Air World, vol. 36, no. 3, 1984, p. 26-30.

An account is given of the materials properties, performance criteria and economic consequences associated with the design, construction and operation of new-generation turboprop commercial aircraft rotors which employ higher numbers of blades than in the past, and use composite blade materials. The development of 6-8 blade rotors is driven by increasing turboprop engine power, which must be transferred to the airstream without excessive rotor tip speeds or power loadings. Despite their greater simplicity, the new propellers and their hub systems are inherently safer than their predecessors, which would not pass the contemporary Failure Modes and Effects Analysis process that is a requirement for commuter aircraft certification. Trends towards the use of contrarotating and swept-tip blade rotors are projected. O.C.

A85-26316#
MODEL TESTS OF PHASE-LOCKED PROPELLER INSTALLATIONS
W. G. RICHARZ (Toronto, University, Downsview, Ontario; Carleton University, Ottawa, Canada) and B. R. DALE (Toronto, University, Downsview, Ontario, Canada) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 23rd, Reno, NV, Jan. 14-17, 1985. 5 p. refs
(AIAA PAPER 85-0001)

The re-emergence of propellers as primary propulsion units of large high speed transport aircraft has generated renewed interest in the control of propeller noise. The interior noise problem in particular requires new and innovative techniques of noise control in order to achieve the sizable noise reductions needed. The concept of phase-locked or synchrophased propellers appears to offer potential benefits. Thus, a parametric study is being undertaken to help assess the technology. To this end a model test facility has been built. This paper describes the apparatus and presents data on the unsteady pressures on a circular fuselage due to the near-field of a propeller. Author

N85-18056# National Aerospace Lab., Tokyo (Japan).
RESEARCH AND DEVELOPMENT FOR SEMI-SPHERICAL INFLOW CONTROL DEVICE
H. KOBAYASHI, T. TORISAKI, M. MORITA, S. NAKAYAMA, A. YOSHIDA, M. SASAKI, S. SEKINE, S. SHINDO, and H. TAKAGI Sep. 1984 20 p refs In JAPANESE; ENGLISH summary
(NAL-TR-833; ISSN-0389-4010) Avail: NTIS HC A02/MF A01

Difference of aero-engine fan noise levels between static and flight engine testing is due to inflow distortion and atmospheric turbulence during static engine testing. Therefore, a semi-spherical inflow control device (ICD) was developed in order to simulate flight fan noise in static tests by the reduction of inflow distortion and turbulence. Based on fundamental data acquired for design and construction of an ICD, a 4 m dia. semi-spherical ICD for an actual turbofan engine was designed and built. Tests confirmed that it was a good flight fan noise simulator. Author

N85-18057*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL AND ANALYTICAL STUDY OF CERAMIC-COATED TURBINE-TIP SHROUD SEALS FOR SMALL TURBINE ENGINES
T. J. BIESIADNY, G. E. MCDONALD, R. C. HENDRICKS, J. K. LITTLE, R. A. ROBINSON (AVSCOM Research and Technology Labs, Cleveland, Ohio), G. A. KLANN (AVSCOM Research and Technology Labs, Cleveland, Ohio), and E. LASSOW (Howmet Turbine Components Corp., Whitehall, Mich.) Jan. 1985 32 p refs
(NASA-TM-86881; E-2343; NAS 1.15:86881; USAAVSCOM-TR-C-19) Avail: NTIS HC A03/MF A01 CSCL 21E

The results of an experimental and analytical evaluation of ceramic turbine tip shrouds within a small turbine engine operating environment are presented. The ceramic shrouds were subjected to 1001 cycles between idle and high power and steady-state conditions for a total of 57.8 engine hr. Posttest engine inspection revealed mud-flat surface cracking, which was attributed to microcracking under tension with crack penetration to the ceramic and bond coat interface. Sections and micrographs tend to corroborate the thesis. The engine test data provided input to a thermomechanical analysis to predict temperature and stress profiles throughout the ceramic gas-path seal. The analysis predicts

cyclic thermal stresses large enough to cause the seal to fail. These stresses are, however, mitigated by inelastic behavior of the shroud materials and by the microfracturing that tensile stresses produce. Microfracturing enhances shroud longevity during early life but provides the failure mechanism during life but provides the failure mechanism during extended life when coupled with the time dependent inelastic materials effects. Author

N85-18058*# Pratt and Whitney Aircraft Group, East Hartford, Conn. Commercial Engineering.
STUDY OF CONTROLLED DIFFUSION STATOR BLADING Final Report
R. F. BEHLKE, J. D. BROOKY, and E. CANAL Mar. 1983 134 p refs
(Contract NAS3-22008)
(NASA-CR-167995; NAS 1.26:167995; PWA-5698-77) Avail: NTIS HC A07/MF A01 CSCL 21E

Tests were conducted on a high tip speed, highly loaded front compressor stage having low aspect ratio rotor and stator airfoils. The stator airfoils were designed by the controlled diffusion procedure recently developed by P&WA for designing transonic cascade airfoils. The rotor blades consisted of multiple-circular-arc airfoil sections. The stage had a tip speed of 442 m/sec (1450 ft/sec), a hub/tip ratio of 0.597, a rotor aspect ratio of 1.3, and a stator aspect ratio of 1.45. At design speed the rotor-stator stage achieved an adiabatic efficiency of 89.1% at design flow and pressure ratio. Surge margin was 14%. The stage efficiency exceeded the design goal by 0.6 percentage points. The rotor efficiency was 92.4%, exceeding design by 0.3 percentage points. The controlled diffusion stator demonstrated a lower minimum loss over the multiple-circular-arc stator from the root to 70 percent span. A surge diffusion factor of 0.72 was reached at both the rotor tip and the stator root. The NAS3-22008 program demonstrated its intent: high efficiency and loading levels with low aspect ratio blades and the controlled diffusion stator in the unfavorable front stage environment. Author

N85-18059# Naval Postgraduate School, Monterey, Calif.
AN ANALYTIC MODEL OF GAS TURBINE ENGINE INSTALLATIONS M.S. Thesis
S. M. EZZELL Sep. 1984 225 p
(AD-A148708) Avail: NTIS HC A10/MF A01 CSCL 21E

An interactive computer simulation of marine gas turbine installations including intake and exhaust ducting for the engine and module cooling has been developed. A one-dimensional analysis was used in determining the pressure losses of the ducting. The pressure losses along with the ambient conditions and desired power setting define a unique operating point for the system. The computer model predicts operating parameters for this point by an inerative matching technique. GRA

N85-18060# Southwest Research Inst., San Antonio, Tex.
EXPLORATORY DEVELOPMENT OF ADVANCED SURFACE FLAW DETECTION METHODS Final Report, 1 Jun. 1982 - 31 Oct. 1984
R. E. BEISSNER, G. L. BURKHARDT, and F. N. KUSENBERGER Sep. 1984 139 p
(Contract F33615-82-C-5020)
(AD-A148757; SWRI-15-7106; AFWAL-TR-84-4121) Avail: NTIS HC A07/MF A01 CSCL 21E

Development of the electric current perturbation (ECP) method for application to surface flaw detection in the retirement-for-cause (RFC) inspection system is described. Physical constraints imposed by material properties and complex geometrical features of F100 engine parts are discussed as background for the selection and preparation of specimens for experimental optimization of ECP probe design. Experimental flaw detection data are presented for simple laboratory specimens, specimens designed to simulate complex geometry features of concern in F100 engine inspection, and finally, for actual engine parts. Results demonstrate that the detection of flaws even smaller than 0.010 in. long by 0.005 in. deep is possible in blade slots. Also, from experimental data obtained in blade slot scans, preliminary estimates of the probability of detection as a function of flaw size are provided. Based on data reported here, it is concluded that ECP method has been demonstrated with the breadboard system to have the inherent sensitivity and repeatability to meet RFC requirements regarding flaw detection capability and system compatibility, and is now ready for more extensive evaluation in an actual inspection environment. GRA

N85-18061# Rolls-Royce Ltd., Derby (England).
CURRENT STATUS OF TRAILING EDGE LOSS CALCULATION FOR A TURBINE BLADE
H. BRYNER 15 Nov. 1984 27 p refs Transl. into ENGLISH from Ver. Deut. Ing. Ber. (Baden, Switzerland), no. 264, 1976 p 203-214
(PNR-90244; TRANS-12432/TLT-00947) Avail: NTIS HC A03/MF A01

Methods for calculating trailing edge loss of a turbine blade are reviewed. Theoretical results reproduce well for certain cascade and turbine tests for smaller values of relative trailing edge thickness (delta 0). For thicker trailing edges the assumptions as met in the theoretical derivation of the losses are less and less well fulfilled, so that an increasing deviation of the actual trailing edge losses from those calculated appears plausible. Since the base pressure region widens with increasing delta 0 and exerts an increasingly strong influence on the exit flow, base pressure must be included in the theoretical analysis for thick trailing edges in order to approximate well test results. Author (ESA)

N85-18062# Rolls-Royce Ltd., Derby (England).
DEVELOPMENT OF HIGH TEMPERATURE CERAMIC PARTS FOR VEHICULAR GAS TURBINES
W. HUETHER and W. KRUEGER 19 Nov. 1984 58 p refs Transl. into ENGLISH from Bundesmin. fuer Forsch. u. Technol., Bonn Rept. BMFT-FB-T-84-006, Jan. 1984 70 p Original language doc. announced as N84-24812
(PNR-90245; TRANS-17654/TLT-00948; BMFT-FB-T-84-006)
Avail: NTIS HC A04/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 15

Ceramic components for a truck gas turbine were designed and tested. A combustion chamber variant of SiC + Si survives a running time of 22.3 hr without damage under pressure conditions with cyclic load. The inlet cone of fabricated design remains free of cracks in all test runs. Stator varieties were tested under atmospheric conditions at 1650 K. No damage occurs in stator segments. Integral stators shrouds crack. A metallic disk with set-in ceramic blades survives 5000 load cycles from 0 to 465 m/sec circumferential speed with reference to the blade central cross section without damage in the cold spin test. Blades of HPSN and RBSN were tested in the hot spin test (maximum gas temperature 1470 K). Ultrasonic countersinking and shape-grinding ceramic processing methods were developed. Author (ESA)

N85-18207# Joint Publications Research Service, Arlington, Va.
ON SELECTING BYPASS MIXERS FOR TURBOFAN ENGINES Abstract Only
B. D. FISHBEYN *In its* USSR Rept.: Eng. and Equipment (JPRS-UEQ-85-001) p 18 10 Jan. 1985 Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved.: Aviats. Tekhn. (USSR), no. 3, Jul. - Sep. 1983 p 94-96
Avail: NTIS HC A03

The performance of turbofan engines can be enhanced by boosting the bypass ratio up to 6.5 to 7.0 in bypass mixing systems. A factor taking into account the energy losses of the mixed streams was adduced and used in writing an expression for the relative change in the output impulse. Equations were then derived for the best case bypass ratio and curves were plotted to determine the isodynamic lines for turbofan engines with bypass ratios of between 0.5 and 8.0 for various increases in the output impulse. When the bypass ratio is greater than 2.0, the maximum possible relative rise in the output impulse falls off continually and is approximately 220% lower when the ratio is 8 than when it is 2.0. However, because of the increase in the thrust gain with the increase in the bypass ratio, the relative gain in the thrust is

nearly constant. Turbofan engines with high bypass ratios of 4 to 8 can achieve the maximum thrust increase by means of an efficient mixer. R.S.F.

N85-18208# Joint Publications Research Service, Arlington, Va.
INFLUENCE OF SETTING ANGLE OF JET COOLING NOZZLES ON TEMPERATURE AND STRESS STATE OF A TURBINE WHEEL Abstract Only
V. V. ZHUYKOV, Y. I. LASHUK, and Y. I. YUNKEROV *In its* USSR Rept.: Eng. and Equipment (JPRS-UEQ-85-001) p 18-19 10 Jan. 1985 Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved.: Aviats. Tekhn. (USSR), no. 3, Jul. - Sep. 1983 p 77-80
Avail: NTIS HC A03

Turbine wheels in gas turbine engines are cooled by coolant jets directed onto the disk surface. The setting angle of the jet nozzles has an impact on the heat transfer coefficients in the blasted region of the wheel. The temperature and stress states of the turbine wheel of a full scale, small gas turbine engine were analyzed mathematically. The temperature distribution over the center line of the meridianal section of a wheel was plotted for nozzle setting angles of 60 deg and 90 deg. The mounting of the nozzles at the optimum angle with respect to the end face surface reduces the average disk temperature by more than 30 K. Setting the nozzles at an angle of 60 deg increases the disk strength reserve by up to 5% in the region of maximum stresses and up 5.3% in the nozzle mounting area. The distribution of the radial and tangential stresses was also plotted over the section line of the wheels for the two setting angles of 60 deg and 90 deg.
R.S.F.

N85-18210# Joint Publications Research Service, Arlington, Va.
EXPERIMENTAL STUDY OF AERODYNAMIC SHIELDING OF TURBOJET ENGINE AIR INTAKE AGAINST EXHAUST GASES Abstract Only
M. M. VYSOKOGORETS, M. S. GILYAZOV, V. A. KOSTERIN, and M. G. KHABIBULLIN *In its* USSR Rept. Eng. and Equipment (JPRS-UEQ-85-001) p 20 10 Jan. 1985 Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved.: Aviats. Tekhn. (USSR), no. 3, Jul. - Sep. 1983 p 60-63 Original language document was announced in IAA as A84-25567
Avail: NTIS HC A03

The use of an aerodynamic shield is a promising method for preventing the entry of high-temperature exhaust gases into the intake of a turbojet engine during the landing of aircraft equipped with reverse-thrust devices. The objective of the study reported here was to investigate experimentally the efficiency of aerodynamic shielding by a single circular jet issuing in the plane of symmetry of the intake at 90 deg to the surface of the runway. The mean temperature at the pair intake is determined as a function of the total air pressure and of the critical flow rate of the shielding air for a turbojet engine intake model. V.L. (IAA)

N85-18219# Joint Publications Research Service, Arlington, Va.
ON LIMITS OF APPLICABILITY OF LINEAR MODELS TO DYNAMICS OF GAS CHANNELS IN AIRCRAFT ENGINES Abstract Only
A. V. BAYKOV *In its* USSR Rept.: Eng. and Equipment (JPRS-UEQ-85-001) p 30-31 10 Jan. 1985 Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved.: Aviats. Tekhn. (USSR), no. 3, Jul. - Sep. 1983 p 101-104
Avail: NTIS HC A03

The analysis of the dynamics of gas channels in aircraft engines is usually based on the equations of gas dynamics in a linear approximation. The various linearizations of the initial equations described in the literature are sometimes contradictory. An approach to the study of nonlinear oscillations based on an analysis of Burgers equation from nonlinear acoustics is presented which permits precise solutions in order to ascertain the effect of various factors on the propagation of finite amplitude oscillations in engine channels. A simple diagram plotting a coefficient which accounts for gas motion through the channel as a function of a factor describing the attenuation of oscillations in the system is used to illustrate the areas of applicability of various linear models. The diagrams show the areas where convective transport, frictional resistance, gas motion in the channel, gas flow oscillation amplitude or nonlinear effects must be considered or can be disregarded.
Author

N85-18989# Department of the Air Force, Washington, D.C.
ONE-PIECE HPTR BLADE SQUEALER TIP Patent Application
R. L. HORVATH, inventor (to Air Force) 1 Jun. 1984 12 p (AD-D011452; US-PATENT-APPL-SN-616380) Avail: NTIS HC A02/MF A01 CSCL 21E

An improved high pressure turbine rotor blade and tip cap structure is provided which comprises a tip end closure for the blade bonded to the end wall of the blade casting and including a base plate member and a pair of upstanding side walls defining a peripheral contour coincidental with and faired to the cambered side walls of the casting, the base plate member having a plurality of radially outwardly opening passageways therethrough and disposed along the chord of the blade and communicating with a channel included in the radially outwardly facing surface of the casting along a chord of the blade, the passageways disposed along axes at angles to the base plate whereby coolant fluid flowing therethrough is directed against the tip side wall surfaces; an opening is provided through the end wall of the casting in the form of a slit or a plurality of holes along the chord of the blade and intersecting the channel, to define an outlet through the end wall for passage of coolant fluid through the blade.
Author (GRA)

08

AIRCRAFT STABILITY AND CONTROL

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

A85-23723
RELIABILITY AND PRECISION OF THE ACTUATING MECHANISMS OF AIRCRAFT CONTROL SYSTEMS [NADEZHNOST' I TOCHNOST' MEKHANIZMOV PRIVODOV SISTEM UPRAVLENIIA LETATEL'NYMI APPARATAMI]
M. N. SLIUDIKOV Moscow, Izdatel'stvo Mashinostroenie, 1984, 352 p. In Russian. refs

The book is concerned with the effect of operating conditions on the precision and reliability of the actuating mechanisms of aircraft control systems and automatic devices. Methods are presented for calculating quantitative indices of precision and the time of trouble-free operation. The discussion covers the effect of friction, wear, and lubrication on the reliability of mechanical drives and methods of reducing the wear of joints; computer-aided analysis of the strength of gear drives; and the vibration damping of on-board equipment. V.L.

A85-25520
FLIGHT-MANAGEMENT SYSTEMS [FLIGHT-MANAGEMENT-SYSTEME]
I. SIMON (Magyar Legikozlekedesi Vallalat, Budapest, Hungary) Technisch-Oekonomische Information der Zivilen Luftfahrt (ISSN 0232-5012), vol. 20, no. 6, 1984, p. 194-200, 190, 206. In German.

The development of computerized flight-management systems (FMSs) to implement fuel-saving measures and reduce cockpit-crew workloads is reviewed. The history of FMSs is traced; the operating principles and characteristics of simple advisory FMSs, fully integrated optimized FMSs, and advanced integrated FMSs for all flight phases are summarized and illustrated with diagrams and graphs; and the effectiveness of different types of FMS is evaluated. Fuel savings of 1.6-2.9 percent are found for a typical advisory FMS, with larger savings (up to 4.5 percent) predicted for integrated FMSs. The crew workload reductions for a simple portable

calculator, an advisory FMS, and an integrated FMS are estimated as 19, 21, and 65 percent, respectively. T.K.

A85-25521
THE IMPORTANCE OF AIRCRAFT CENTER-OF-GRAVITY POSITION FOR FLIGHT CONTROL [ZUR BEDEUTUNG DER LAGE DES FLUGZEUGSCHWERPUNKTES FUER DIE FLUGZEUGFUEHRUNG]
U. UNGER (Interflug Gesellschaft fuer Internationalen Flugverkehr mbH, Berlin, East Germany) Technisch-Oekonomische Information der Zivilen Luftfahrt (ISSN 0232-5012), vol. 20, no. 6, 1984, p. 201-204, 206. In German.

The effects of forward and aft positioning of the center of gravity (CG) of a passenger aircraft on its flight characteristics are investigated for the case of the Tu-134A. The possibility of significant forward CG shift in the course of a typical flight as the result of improper loading is indicated; the effects of forward CG on the elevator deflections required at landing are shown in graphs; and the effectiveness of tailplane adjustment in improving the longitudinal steerability with forward CG is evaluated. Practical recommendations for pilots and crew are included. T.K.

A85-26018
ACTIVE CONTROL OF HELICOPTER VIBRATIONS THROUGH MULTICYCLIC CONTROLS [CONTROLE ACTIF DES VIBRATIONS SUR HELICOPTERE PAR COMMANDES MULTICYCLIQUES]
M. POLYCHRONIADIS and M. ACHACHE (Aerospatiale, Division Helicopteres, Marignane, Bouches-du-Rhone, France) L'Aeronautique et l'Astronautique (ISSN 0001-9275), no. 107, 1984, p. 47-57. In French.

A research program developed to test active vibration damping on an SA 349 Gazelle by applying higher harmonic controls to the main rotor blades is discussed. The origin and consequences of helicopter vibrations are analyzed. The two principles of the program include: the activation of the nonrotating swash plate which generates the higher harmonic control and the selection of a self-adaptive system which determines and generates the optimum higher harmonic control. The system and its installation on board the SA 349 helicopter are described and the main results obtained within the framework of the program are presented. Two algorithms, a deterministic adaptive algorithm and a stochastic adaptive regulator, are developed and simulated. It is shown that the algorithms lead to significant reductions of the vibratory level (of the order of 80 percent in the case of the stochastic regulator). Tests carried out on a rotor test stand demonstrate the satisfactory operation of the system, validate the logic of the algorithms, and constitute an important stage of the harmonic control system before the test flights which are planned for 1985. M.D.

A85-26323#
DEVELOPMENT OF ADVANCED FIGHTER FLIGHT CONTROLS USING FLIGHT SIMULATORS
D. C. ANDERSON, K. E. SANDERS, M. R. GRISWOLD (General Dynamics Corp., Fort Worth, TX), and C. B. HOLDING AIAA, AHS, and ASEE, Aircraft Design, Systems, and Operations Meeting, San Diego, CA, Oct. 31-Nov. 2, 1984. 11 p.
(AIAA PAPER 84-2441)

The flight simulator is assuming more and more importance in all phases of evolution of modern, integrated fighter flight control systems. Recent experience in the development of the AFTI/F-16 flight controls supports this notion, and illuminates simulator requirements and techniques which facilitate successful control system development. The subject of this paper is the simulator requirements and methodology envisioned for next generation fighter controls design, implementation, testing, and evaluation. Trends established in the AFTI program are representative in establishing these needs. The degree of control system maturation which may be expected from current simulation resources is discussed in the light of recent experience. Flight simulation and flight testing are shown to be complementary activities in the final stages of flight control development. Author

N85-17965# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
ALTITUDE CONTROL USING ACTION-DEMANDING INTERACTIVE DISPLAYS: TOWARD AN ACTIVE PSYCHOPHYSICS
R. WARREN and G. R. MCMILLAN *In* AF Human Resources Lab. The IMAGE 3 Conf. Proc. p 37-51 Sep. 1984
(AD-P004311) Avail: NTIS HC A22/MF A01 CSCL 01B

Ecological approaches to perception and action emphasize the importance of exploration and manipulation for obtaining useful information. This seems to apply to the demanding task of low altitude flight. However, the ecological approach currently uses the same passive methods used in traditional psychophysics: observers may only respond to a display in a manner which does not affect the display (e.g., yes/no or scaling judgments). Observers generally cannot manipulate the display to provide information which they, and not the experimenter, determine. A new methodology which both permits and demands observer action is needed for active performance. This paper outlines the beginnings of an active psychophysics and illustrates the techniques with an experiment designed to evaluate altitude holding in the presence of a gust. Initially, the techniques borrow heavily from those in manual tracking studies. The displays are a joint function of experimenter chosen initial conditions, observer control inputs, and a continuous gust disturbance. Sum-of-sines forcing functions and human operator describing functions are highlighted.
Author (GRA)

N85-17979# General Electric Co., Daytona Beach, Fla. Simulation and Control Systems Dept.
CONTROL SYSTEMS ANALYSIS PROGRAM: A TOOL FOR ANALYSIS OF THE GE-VSCDP (GENERAL ELECTRIC-VISUAL SYSTEM COMPONENT DISPLAY PROGRAM) IMAGE DISPLAY SYSTEM
C. CHI and E. POLLAK *In* AF Human Resources Lab. The IMAGE 3 Conf. Proc. p 267-278 Sep. 1984
(AD-P004325) Avail: NTIS HC A22/MF A01 CSCL 01B

CSAP is a simulation program used to analyze the performance of the GE-VSCDP image display system. It has been used to define some unknowns and to analyze the AOI/BG image's shear effect and dynamic distortion due to finite servo velocity. Of major importance, it is used to optimize the image display system to minimize the displacement error between the center of CIG image and the center and the servo projector. Author (GRA)

N85-18063 Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
ACTIVE CONTROL OF FORWARD SWEPT WINGS WITH DIVERGENCE AND FLUTTER AEROELASTIC INSTABILITIES Ph.D. Thesis
K. E. GRIFFIN 1984 150 p
Avail: Univ. Microfilms Order No. DA8425340

Simple active control laws to suppress aeroelastic flutter and divergence on forward-swept advanced composite wings are studied. Two selected wing designs are used as examples where leading-and trailing-edge flaps are used as control devices. These flaps are actuated using simple feedback signals from acceleration, velocity, and displacement sensors. Root locus plots of the characteristic roots from the transformed equations of motion are used to determine the aeroelastic stability of each feedback controlled configuration. The transformed aerodynamic forces are expressed as Pade Approximants obtained from a least-squares fitting scheme of sinusoidal generalized aerodynamic forces. With a leading-edge flap and elastic displacement sensing an increase of divergence speed of approximately 25% is demonstrated. A 30% increase in flutter was achieved with a trailing-edge flap and acceleration sensing. If high flutter speeds are provided for the uncompensated wing before active control is applied, a better wing design may be available for active control divergence.
Dissert. Abstr.

N85-18064 Kansas Univ., Lawrence.
THEORY OF WING ROCK Ph.D. Thesis
C. H. HSU 1984 112 p
Avail: Univ. Microfilms Order No. DA8424298

A theory is developed for predicting wing-rock characteristics. From available data, it can be concluded that wing rock is triggered by flow asymmetries, developed by negative or weakly positive roll damping, and sustained by nonlinear aerodynamic roll damping. A new nonlinear aerodynamic model that includes all essential aerodynamic nonlinearities is developed. The Beecham-Titchener method is applied to obtain approximate analytic solutions for the amplitude and frequency of the limit cycle based on three-degree-of-freedom equations of motion. An iterative scheme is developed to calculate the average aerodynamic derivatives and dynamic characteristics at limit cycle conditions. Good agreement between theoretical and experimental results is obtained. Dissert. Abstr.

N85-18990*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A METHOD FOR ESTIMATING THE ROLLING MOMENT DUE TO SPIN RATE FOR ARBITRARY PLANFORM WINGS
W. A. POPPEN, JR. Jan. 1985 23 p refs
(NASA-TM-86365; NAS 1.15:86365) Avail: NTIS HC A02/MF A01 CSCL 01C

The application of aerodynamic theory for estimating the force and moments acting upon spinning airplanes is of interest. For example, strip theory has been used to generate estimates of the aerodynamic characteristics as a function of spin rate for wing-dominated configurations for angles of attack up to 90 degrees. This work, which had been limited to constant chord wings, is extended here to wings comprised of tapered segments. Comparison of the analytical predictions with rotary balance wind tunnel results shows that large discrepancies remain, particularly for those angles-of-attack greater than 40 degrees. Author

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.

A85-22652
FIELD MEASUREMENTS WITH A COHERENT TRANSVERSELY EXCITED ATMOSPHERIC CO2 LASER RADAR
J. M. CRUICKSHANK, D. BONNIER, P. PACE, V. LAROCHELLE, and H. HENSHALL (Defence Research Establishment Valcartier, Courcelette, Quebec, Canada) IN: Coherent infrared radar systems and applications II; Proceedings of the Meeting, Arlington, VA, April 7, 8, 1983 . Bellingham, WA, SPIE - The International Society for Optical Engineering, 1983, p. 29-38. refs

The experimental Infrared Ranging and Tracking System has been developed for evaluating the capabilities of TEA-CO2 laser radars with heterodyne detection for the ranging and tracking of air targets. This system has been used in field measurements for investigating the return signal fluctuations resulting from atmospheric turbulence and target induced speckle. Results are presented for measurements on single glint and diffuse reference targets with the system operating in both the heterodyne and direct modes of detection. The feasibility of angle tracking has been demonstrated, but additional effort is required for determining system capabilities. The long-range performance of a TEA-CO2 laser radar with heterodyne detection was demonstrated by detecting returns with a high signal-to-noise ratio from mountains at 24.4 km. Author

A85-23675
PUBLIC-USE HELIPORT PLANNING - A STATE-OF-THE-ART REPORT
A. DERHOHANNESIAN (Hoyle, Tanner and Associates, Inc., Londonderry, NH) Airport Forum (ISSN 0002-2802), vol. 13, Dec. 1984, p. 47-50.

The considerable growth in helicopter use of the last decade has aggravated problems associated with the number and the operating procedures of public heliports in the U.S., most of which are privately owned and operated with little federal or local government involvement. Attention is presently given to the status of policy formulation and implementation in such matters as heliport size and the positions of helicopters within heliports, space-related factors of safety, flight path management, rooftop facility operations, and capacity evaluation. Also noted are the results to date of comprehensive heliport planning studies undertaken by U.S. cities and state agencies. O.C.

A85-25513
AIRCRAFT COCKPIT WORK STATION AS EXEMPLIFIED BY A FLIGHT SIMULATOR [ARBEITSPLATZ FLUGZEUGCOCKPIT AM BEISPIEL DES FLUGSIMULATORS]
H. FREIDRICH (Dornier GmbH, Friedrichshafen, West Germany) (Technischer Ueberwachungs-Verein Rheinland, Institut fuer Unfallforschung, and Deutsche Gesellschaft fuer Ortung und Navigation, Kolloquium 'Leitwarten', Cologne, West Germany, Oct. 16, 17, 1984) Ortung und Navigation (ISSN 0474-7550), vol. 25, no. 3, 1984, p. 488-508. In German. refs

Some point of general interest regarding the use of an aircraft cockpit as a pilot work station are addressed using the results of continuing flight simulation studies. The flight simulator is discussed as a significant aid in the development of an aircraft, in research on flight technology, and in training of pilots. C.D.

A85-25920
USAF DOUBLES ENGINE-TEST CAPABILITY - $625 MILLION BOOST FOR ARNOLD FACILITY
B. WANSTALL Interavia (ISSN 0020-5168), vol. 40, Feb. 1985, p. 138-141.

A description of the Aeropropulsion Systems Test Facility (ASTF) at the U.S. Air Force Arnold Engineering and Development Center (AEDC) is presented, detailing operational capabilities expected from the ASTF upon its completion in September 1985. The ASTF will add two large jet-engine test cells to the center, which can be run concurrently. Some of the capabilities projected for the ASTF include simulated air speeds of up to M 3.8, thrust of 75,000 lb, maximum power of 388 MW, and air temperatures of up to 550 C. Other facilities which comprise the AEDC include the Engine Test Facility with 11 test cells to accomodate propulsion testing of aircraft, missiles, satellites, and space vehicles; the Von Karman Gas Dynamics Facility with four supersonic wind tunnels for testing at up to M 10 (reentry temperatures and pressures can be reproduced); and the Propulsion Wind Tunnel with two closed-circuit wind tunnels with 16 x 16-ft test sections. L.T.

A85-26381*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THE NASA ALTITUDE WIND TUNNEL - ITS ROLE IN ADVANCED ICING RESEARCH AND DEVELOPMENT
B. J. BLAHA and R. J. SHAW (NASA, Lewis Research Center, Cleveland, OH) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 23rd, Reno, NV, Jan. 14-17, 1985. 20 p. Previously announced in STAR as A85-15758. refs
(AIAA PAPER 85-0090)

Currently experimental aircraft icing research is severly hampered by limitations of ground icing simulation facilities. Existing icing facilities do not have the size, speed, altitude, and icing environment simulation capabilities to allow accurate studies to be made of icing problems occurring for high speed fixed wing aircraft and rotorcraft. Use of the currently dormant NASA Lewis Altitude Wind Tunnel (AWT), as a proposed high speed propulsion and adverse weather facility, would allow many such problems to

be studied. The characteristics of the AWT related to adverse weather simulation and in particular to icing simulation are discussed, and potential icing research programs using the AWT are also included. Author

N85-17963# Air Training Command, Nellis AFB, Nev.
USING A LIMITED FIELD OF VIEW SIMULATOR TO INSTRUCT HIGH SPEED, LOW ALTITUDE FLYING SKILLS
M. MILLER *In* AF Human Resources Lab. The IMAGE 3 Conf. Proc. p 7-20 Sep. 1984
(AD-P004309) Avail: NTIS HC A22/MF A01 CSCL 05I

This paper describes the use of an A-7 Vital IV (three screen) visual simulator in a low altitude training program. This program is the first to use such a simulator in the training of tactical fighter pilots to operate in the low altitude environment. The program is part of the syllabus used in the Air National Guard, Fighter Weapons School program for highly experienced A-7D pilots. The Low Altitude Training portion of this syllabus consists of 12 hours of academic instruction, a 1 hour simulator and a two phase flying program of at least two aircraft sorties. This paper discusses the simulator profile, explains each task, how it is accomplished and provides a subjective evaluation of its effectiveness. The paper identifies the training limitations imposed by such a low fidelity visual system, recommends several additional uses within the existing capability of the simulator, and identifies several minimum criteria for any full mission simulator. Author (GRA)

N85-17964# Dayton Univ., Ohio. Research Inst.
VISUAL PERCEPTUAL ASPECTS OF LOW LEVEL HIGH SPEED FLIGHT AND FLIGHT SIMULATION
R. S. KELLOGG and M. MILLER *In* AF Human Resouces Lab. The IMAGE 3 Conf. Proc. p 21-36 Sep. 1984
(AD-P004310) Avail: NTIS HC A22/MF A01 CSCL 05I

The low level high speed flight arena has opened up as a very important one in the past several years. Weapon systems and tactics developments have forced the acquisition of pilot skills in low level, high speed flight. In order to remain undetected and complete his mission, the pilot is forced to fly below enemy radar. This carries with it the constant threat of contact with the ground, which is of course as lethal as enemy missiles. As a consequence of this necessity to fly low and fast, a thorough going training program has been under development for the past three years at the 162nd Fighter Weapons School, USAFR, Tucson, Arizona, in collaboration with the Human Resources Laboratory, Williams AFB, Arizona. The purpose of the present paper is to describe in some detail the visual/perceptual aspects of low level, high speed flight as they are currently viewed by the developers of this program. The flighter simulator has already begun to play an important role in this training program, and this role will certainly expand with the fast developing simulator technology in conjunction with better understanding of the training requirements. GRA

N85-17966# LTV Aerospace Corp., Dallas, Tex.
LOW ALTITUDE HIGH SPEED FLIGHT SIMULATION USING VIDEO DISC TECHNOLOGY
V. DEVARAJAN, J. T. HOOKS, JR., and D. C. MCGUIRE *In* AF Human Resources Lab. The IMAGE 3 Conf. Proc. p 53-65 Sep. 1984
(AD-P004312) Avail: NTIS HC A22/MF A01 CSCL 01B

The LTV Aerospace and Defense Company's visual technology uses video discs as direct access and storage devices of video data obtained from a series of discrete photographs of the gaming area. Each discrete photograph is electronically scanned, converted to video data, formated and stored on video disc. When needed for display, the data is retrieved from video disc, processed and manipulated to display the correct perspective view of the terrain relative to the position and attitude of the simulated aircraft. The pilot has complete freedom of route and attitude within the gaming area. Extensions to the basic video disc technology are currently under development to provide visual simulation of low level tactical missions. This paper describes the algorithm modifications and hardware/software design issues involved in real time generation of low-level/high-speed scenes. Descriptions are also provided of a non-real time emulation of the concepts and hardware design. Author (GRA)

N85-17967# Tactical Airlift Training Group (34th), Little Rock AFB, Ark.
SIMULATING SPEED AND HEIGHT CUES IN THE C-130 WEAPON SYSTEM TRAINER
M. J. SIEVERDING *In* AF Human Resources Lab. The IMAGE 3 Conf. Proc. p 69-77 Sep. 1984
(AD-P004313) Avail: NTIS HC A22/MF A01 CSCL 01B

The C-130 Weapon System Trainer (WST) at Little Rock AFB, Arkansas is, perhaps, the most realistic full mission simulator in DoD. Much of its realism and training value comes from the ability of its full color, CGI visual system to provide speed and altitude cue while flying low level over a real world visual data base (VDB) of more than 50,000 square nautical miles. The C-130 aircraft is navigated visually while flying at approximately 250 knots and 300 feet above the ground. Visual ground references in the C-130 WST must realistically reflect chart information and provide the visual cues necessary for confident flight above the ground contour. This paper describes various types of speed and height cues and highlights the major attributes of the C-130 WST visual system that give these cues during a typical C-130 WST mission profile. Many internal conclusions and observations are admittedly subjective, based on several years of system use and thousands of hours of flying time, and not confirmed by hard data from the behavioral sciences community. The rate of technological change has far outpaced our ability to quantify its impact on human factors under controlled and statistically sound conditions. Those offices with the authority to procure and apply new simulator technology are quite reasonably hesitant to provide funding without such proof. However, the presumed benefits of using new technology can sometimes outweigh the risk of using that technology without analytic proof of its benefits. Funding actions may at times be the result of intuitive judgment and visceral reaction, but full acceptance and application of new technology requires analytic proof of its impact on human factors. GRA

N85-17968# Grumman Aerospace Corp., Bethpage, N.Y.
PRODUCING HIGH SCENE CONTENT WITH PERSPECTIVE VALIDITY
G. Y. GARDNER and R. S. RULON *In* AF Human Resources Lab. The IMAGE 3 Conf. Proc. p 79-94 Sep. 1984
(AD-P004314) Avail: NTIS HC A22/MF A01 CSCL 01B

Maintaining perspective validity in visual displays is essential to providing proper training cues. Perspective validity has many aspects, including correct perspective transformation of geometric shapes, exact determination of surface priority relationships, accurate shading of curved as well as planar surfaces, consistent mapping of texture patterns onto scene surfaces, and proper representation of aerial perspective. This paper describes the mathematical models used in Grumman's nonedge computer image generation CIG technology to maintain perspective validity in all its aspects. Author (GRA)

N85-17974# Societe Anonyme d'Etudes et Realisations Nucleaires, Limeil-Brevannes (France).
SODERN VISUALIZATION SYSTEM (SVS) FOR FLIGHT SIMULATION
F. X. DOITTAU, J. R. HURIET, and M. TISSOT *In* AF Human Resouces Lab. The IMAGE 3 Conf. Proc. p 193-203 Sep. 1984
(AD-P004320) Avail: NTIS HC A22/MF A01 CSCL 01B

The Titus light valve is actually a two-dimension analogical memory which is electronically controlled. It is well adapted to flight simulation requirements because it supplies high resolution, high brightness, flicker-free images. The SVS (SODERN Visualization System) uses three Titus light valves to project full color images at 30 Hz rate. Already developed models supply good quality images; further improvements are foreseen in near future, especially for geometrical resolution. GRA

N85-17975# Essex Corp., Alexandria, Va.
AN OVERVIEW OF THE RESEARCH PROGRAM AT THE VISUAL TECHNOLOGY RESEARCH SIMULATOR
G. LINTERN, D. C. WIGHTMAN, and D. P. WESTRA *In* AF Human Resources Lab. The IMAGE 3 Conf. Proc. p 205-221 Sep. 1984
(AD-P004321) Avail: NTIS HC A22/MF A01 CSCL 01B

The behavioral research program at the Visual Technology Research Simulator is in its sixth year. Although research has emphasized visual issues in simulator training of flight skills, other hardware and instructional technology issues have been explored. This paper outlines significant features of the program's research plan and summarizes the major results. GRA

N85-17978# General Electric Co., Daytona Beach, Fla.
DESIGN CONSIDERATIONS FOR AN EYE TRACKED AOI (AREA OF INTEREST) DISPLAY SYSTEM
F. B. NEVES *In* AF Human Resources Lab. The IMAGE 3 Conf. Proc. p 255-266 Sep. 1984
(AD-P004324) Avail: NTIS HC A22/MF A01 CSCL 01B

The potential benefits of using an Area of Interest (AOI) display for high performance out-the-window visual simulation is evidenced by the current activity in this display technology. The AOI concept can be implemented in many versions. In each AOI display type a complex tradeoff of performance parameters must be considered. A review of these considerations will be discussed in this paper concentrating upon the display versus the CIG. The display being developed for the Visual System Component Development Program (VSCDP) by the General Electric Company (GE) is an AOI display concept. The major features of the display system and the current status of the display development will be discussed.
Author (GRA)

N85-17980# Singer Co., Silver Spring, Md. Link Simulation Systems Div.
PROGRESS REPORT ON AN EYE-SLAVED AREA-OF-INTEREST VISUAL DISPLAY
H. M. TONG and R. A. FISHER *In* AF Human Resources Lab. The IMAGE 3 Conf. Proc. p 279-294 Sep. 1984
(AD-P004326) Avail: NTIS HC A22/MF A01 CSCL 01B

A dome-projection real-image system based on an eye-slaved area-of-interest (AOI) concept has been under development for some time at the Link Flight Simulation Division of The Singer Company. The Link approach provides a high-resolution area set within a wide-field-of-view background. The display image is presented to the trainee using light valve projection on a dome screen, with the high-resolution AOI inset slaved to the trainee's eye line of sight. The display development program at Link has progressed past the system integration phase and is undergoing proof-of-concept test and evaluation. The system approach and preliminary test findings are discussed in this paper.
Author (GRA)

N85-17981# Rediffusion Simulation, Inc., Arlington, Tex.
AIR COMBAT VISUAL SIMULATION USING A HEAD SLAVED PROJECTOR
P. M. MURRAY, G. J. OLIVE, M. E. ROBERTS, and O. WYNN *In* AF Human Resources Lab. The IMAGE 3 Conf. Proc. p 295-311 Sep. 1984
(AD-P004327) Avail: NTIS HC A22/MF A01 CSCL 01B

An experimental system is described which is aimed at providing a low cost air combat training capability by the use of a head coupled projector giving a wide angle display with a high resolution central region and a low resolution peripheral region.
Author (GRA)

N85-17982# KFO Associates, Inc., Wyckoff, N.J.
A SECOND GENERATION WAVIDS (WIDE ANGLE VIRTUAL IMAGE DISPLAY SYSTEM)
A. COX and W. V. DYKES *In* AF Human Resources Lab. The IMAGE 3 Conf. Proc. p 315-329 Sep. 1984
(Contract N61339-83-C-0096)
(AD-P004328) Avail: NTIS HC A22/MF A01 CSCL 01B

A second generation WAVIDS (Wide Angle Virtual Image Display System) has been designed using Fresnel lenses. The instantaneous field of view is 75 degrees, and the total field of view is 90 degrees, with an eye-clearance of 38.0 inches. The correction of spherical aberration, coma and astigmatism leads to a design with 30% negative distortion. An auxiliary optical system has, therefore, been designed which takes an undistorted image and introduces a compensating 30% distortion. As a result an undistorted image is viewed through the WAVIDS. GRA

N85-17986# Boeing Military Airplane Development, Wichita, Kans.
BAFFLED EYE AND CONFOUNDED BRAIN OR USING VISUAL ILLUSIONS TO TRAIN BLIND PILOTS
R. E. CLAPP *In* AF Human Resources Lab. The IMAGE 3 Conf. Proc. p 391-404 Sep. 1984
(AD-P004332) Avail: NTIS HC A22/MF A01 CSCL 09B

The extremely simplified and stylized scene construction in current computer image generation technology, together with scene dynamics shortcomings present display technology with a grossly inadequate real world simulation (one that can be truly called illusionary). Nor is current display technology in better shape. Due to confusion existing within the simulation industry over resolution of the displays, visual systems are underspecified or underdesigned by a factor of about 4 times. This is in addition to low brightness and contrast of saturated colors. If the pilot saw in the real world what he sees in the simulator he would be legally blind! These factors are discussed in some detail and possible improvements are suggested. Author (GRA)

N85-17991# Singer Co., Lancing (England).
MILITARY APPLICATIONS OF THE SINGER LINK-MILES IMAGE VISUAL SYSTEM
D. H. GEERE and T. CRAMPIN *In* AF Human Resources Lab. The IMAGE 3 Conf. Proc. p 455-474 Sep. 1984
(AD-P004337) Avail: NTIS HC A22/MF A01 CSCL 01B

This report has discussed the evolution of the IMAGE system both from technological and human factors standpoints. The results of this approach have been to attempt optimum matching of available technologies to meet training requirements. In systems terms it is appropriate to consider the user as the LIVEWARE. Hence the ideal system is an appropriate blend of hardware, software and liveware. GRA

N85-17992# General Electric Co., Daytona Beach, Fla.
AVTS (ADVANCED VISUAL TECHNOLOGY SYSTEM): A HIGH FIDELITY VISUAL SIMULATOR
R. L. FERGUSON *In* AF Human Resources Lab. The IMAGE 3 Conf. Proc. p 455-474 Sep. 1984
(AD-P004338) Avail: NTIS HC A22/MF A01 CSCL 01B

The Advanced Visual Technology System (AVTS) was developed under the auspices of the Air Force human resources laboratory (AFHRL) to satisfy the demanding TACAIR mission visual system requirements. In particular, the requirement for low level flight through a high density, wide FOV, rolling terrain environment with a large number of moving models on and above the terrain surface posed a formidable system design problem. New developments were required in the critical areas of VDB structure, feature selection, priority, load management and blending to achieve the requisite scene content. This paper will discuss the advancements made in these areas, and show that an integrated system design process was essential to the success of the project. Author (GRA)

N85-18038# Joint Publications Research Service, Arlington, Va.
AIRPORT GROUND EQUIPMENT UNDER DEVELOPMENT AT RIGA
I. AFANASYEV *In its* USSR Rept.: Transportation (JPRS-UTR-85-003) p 29-30 12 Feb. 1985 Transl. into ENGLISH from Vozdushnyy Transport (USSR), 27 Nov. 1984 p 2
Avail: NTIS HC A06/MF A01

The quality of ground support equipment at airports is discussed. The complexity of design and the degree of automation of industrial processes is growing and the work loads are increasing. Under these conditions the need for reliable mechanisms is crucial. Methods to improve productivity are discussed. B.G.

N85-18039# Joint Publications Research Service, Arlington, Va.
IMPROVEMENTS IN KAZAN AIRPORT EQUIPMENT, FACILITIES
Y. TSIPIN *In its* USSR Rept.: Transportation (JPRS-UTR-85-003) p 34-36 12 Feb. 1985 Transl. into ENGLISH from Vozdushnyy Transport (USSR), 29 Nov. 1984 p 3
Avail: NTIS HC A06/MF A01

Improvement of equipment reliability and dependability at Kazan Airport is discussed. Adoption of an automatic landing circle control service should free the air traffic controller from superfluous mechanical work and focus his attention on air traffic control. B.G.

N85-18040# Joint Publications Research Service, Arlington, Va.
IMPROVEMENTS UNDER WAY AT GORKIY AIRPORT
V. DEBERDEYEV *In its* USSR Rept.: Transportation (JPRS-UTR-85-003) p 37-39 12 Feb. 1985 Transl. into ENGLISH from Vozdushnyy Transport (USSR), 4 Dec. 1984 p 1
Avail: NTIS HC A06/MF A01

Improvements at Gorkiy Airport consist of the following: approach, landing, and take-off console controls; special fuel lines; new light signaling equipment; a second runway; and lengthening the existing runway. B.G.

N85-18065# National Aerospace Lab., Tokyo (Japan).
HIGH PRESSURE COMBUSTION TEST FACILITY FOR GAS TURBINE RESEARCH
T. TAMARU, K. SHIMODAIRA, S. HORIUCHI, T. SAITO, and S. HAYASHI Mar. 1984 28 p refs In JAPANESE; ENGLISH summary
(NAL-TR-801; ISSN-0389-4010) Avail: NTIS HC A03/MF A01

A new high pressure combustion test facility was constructed in the National Aerospace Laboratory, Tokyo, to assist the national project for developing a high efficiency combined cycle gas turbine. It enables continuous combustion tests by an air mass flow of 4 kg/s at a pressure of 5./53 MPa and a temperature of 736 K in the design condition. Two kinds of fuel, i.e., natural gas and kerosene, are available for tests at a maximum supply pressure of 10 MPa. Details of the planning of the facility and the structure are described. In designing the building, special care was taken to prevent anticipated noise pollution of the surrounding area. Test runs, made early in the spring of 1983, proved successful. Author

N85-18066# National Aerospace Lab., Tokyo (Japan).
FLOW QUALITY OF NAL 2-DIMENSIONAL TRANSONIC WIND TUNNEL. PART 2: EXTENSIVE AND SYSTEMATIC PRESSURE FLUCTUATIONS STUDY IN THE SETTLING CHAMBER, TEST SECTION AND SECOND THROAT OF THE NAL 2-D TRANSONIC WIND TUNNEL
S. SAKAKIBARA, H. MIWA, Y. OGUNI, M. SATO, and H. KANDA Sep. 1984 32 p refs In JAPANESE; ENGLISH summary
(NAL-TR-836-PT2; ISSN-0389-4010) Avail: NTIS HC A03/MF A01

To obtain a better understanding of the characteristic of the facility disturbances and identification of their sources, detailed pressure fluctuation measurements were made in the settling chamber, the test section and the second throat of the NAL two dimensional transonic wind tunnel. In order to identify the test section wall slot effects, the following measurements were made; keeping the side wall slot (for wake survey probe trav..) open measurements were made with the transonic slots (top and bottom walls) both open and closed; then, conversely, keeping the transonic slots open measurements were made with the side wall slot open and closed. The pressure fluctuations of the flow at these locations in the wind tunnel were measured by means of wall or sting mounted ultra miniature pressure sensors. The data, which represented a frequency range from about 15 Hz to 25 kHz, have been analyzed in the form of broadband sound pressure levels, root mean square fluctuations of pressure coefficient and spectra of pressure fluctuations. There is a brief discussion of each item. B.W.

N85-18067*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THE ALTITUDE WIND TUNNEL (AWT): A UNIQUE FACILITY FOR PROPULSION SYSTEM AND ADVERSE WEATHER TESTING
R. CHAMBERLIN 1985 21 p refs Presented at the 23rd Aerospace Sci. Meeting, Reno, Nevada, 14-17 Jan. 1985; sponsored by AIAA
(NASA-TM-86921; E-2415; NAS 1.15:86921; AIAA-85-0314)
Avail: NTIS HC A02/MF A01 CSCL 14B

A need has arisen for a new wind tunnel facility with unique capabilities for testing propulsion systems and for conducting research in adverse weather conditions. New propulsion system concepts, new aircraft configurations with an unprecedented degree of propulsion system/aircraft integration, and requirements for aircraft operation in adverse weather dictate the need for a new test facility. Required capabilities include simulation of both altitude pressure and temperature, large size, full subsonic speed range, propulsion system operation, and weather simulation (i.e., icing, heavy rain). A cost effective rehabilitation of the NASA Lewis Research Center's Altitude Wind Tunnel (AWT) will provide a facility with all these capabilities. Author

N85-18068*# Vigyan Research Associates, Inc., Hampton, Va.
THE GENERATION OF ROLLING MOMENTS WITH THE SUPERCONDUCTING SOLENOID MODEL
M. J. GOODYEAR Jan. 1985 24 p refs
(Contract NAS1-17919)
(NASA-CR-172520; NAS 1.26:172520) Avail: NTIS HC A02/MF A01 CSCL 14B

The superconducting solenoid model is a pilot model core for levitation in a wind tunnel magnetic suspension system. This type of core would replace the ferromagnetic core typically installed in the model fuselage. For suspension purposes, the solenoid is operated upon by a set of electromagnets surrounding the wind tunnel which are to support and restrain the model at required positions and orientations under the influence of powerful aerodynamic disturbances. The subject of providing sources of magnets rolling moment for use when spanwise magnets, which can be used for winged models, are not available is covered. Several methods have emerged for generating a rolling moment based on the use of additional superconducting loops or magnetic poles positioned around or within the solenoid. Predictions of the moment capacities of superconducting loops in models sized for a large wind tunnel are presented. An existing prototype superconducting model proved a suitable vehicle for demonstrating and calibrating, at a smaller scale, some of the other roll elements based on magnetic pole devices. Calibration data are included. Author

N85-18069*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
INITIAL INVESTIGATION OF CRYOGENIC WIND TUNNEL MODEL FILLER MATERIALS
H. F. RUSH and G. C. FIRTH Jan. 1985 23 p refs
(NASA-TM-86363; NAS 1.15:86363) Avail: NTIS HC A02/MF A01 CSCL 14B

Various filler materials are being investigated for applicability to cryogenic wind tunnel models. The filler materials will be used to fill surface grooves, holes and flaws. The severe test environment

of cryogenic models precludes usage of filler materials used on conventional wind tunnel models. Coefficients of thermal expansion, finishing characteristics, adhesion and stability of several candidate filler materials were examined. Promising filler materials are identified. Author

N85-18070# Army Construction Engineering Research Lab., Champaign, Ill.
PROTOTYPE CONCEPT DESIGN FOR US ARMY TYPE 3A AIR TRAFFIC CONTROL TOWER (ATCT) Final Report
T. R. NAPIER and M. E. LIERMAN Oct. 1984 143 p
(AD-A148840; CERL-TR-P-85/02) Avail: NTIS HC A07/MF A01 CSCL 01E

In April 1983, the U.S. Army Air Traffic Control Activity requested the U.S. Army Construction Engineering Research Laboratory to develop a prototype concept design for a Type 3a Air Traffic Control Tower (ATCT). The design was to be for a prefabricated, modular, and transportable building system that could be fabricated, placed in storage, deployed, and erected in a variety of configurations. This report documents the development of functional requirements for the Type 3a ATCT, as well as considerations for its prefabrication, transportation, and erection. The report also presents the prototype concept design for the Type 3a ATCT. The design includes architectural drawings as well as descriptions of the building system's construction approach and materials. Information needed to acquire these facilities is presented, including recommendations for a One-Step or Two-Step procurement approach and guidance to Corps personnel for executing this approach. Finally, the report provides an outline for bid documentation, including an outline specification for the building system. GRA

N85-18071# European Space Agency, Paris (France).
THE S2MA WIND TUNNEL AT THE MODANE-AVRIEUX AERODYNAMIC TEST CENTER
J. LAVERRE and F. CHARPIN Sep. 1984 75 p refs Transl. into ENGLISH of "La Soufflerie S2MA du Centre d'Essais Aerodyn. de Modane-Avrieux" Rept. ONERA-NT-1983-5 ONERA, Paris, 1983 Original Language document announced as N84-25735
(ESA-TT-862; ONERA-NT-1983-5) Avail: NTIS HC A04/MF A01

A continuous pressurized S2MA wind tunnel with a 1.75 x 1.77 sq m transonic section (Mach 0.1 to 1.3) and a 1.75 x 1.935 sq m supersonic section (Mach 1.5 to 3.1) is presented. Supports used are described, and tests which illustrate the possibilities of the facility are listed. Instrumentation as well as data acquisition and processing are summarized. Schematics are included. Author (ESA)

N85-18991*# National Aeronautics and Space Administration, Washington, D. C.
AERONAUTICAL FACILITIES CATALOGUE. VOLUME 1: WIND TUNNELS
F. E. PENARANDA, comp. and M. S. FREDA, comp. Jan. 1985 421 p 2 Vol.
(NASA-RP-1132; NAS 1.61:1132) Avail: NTIS HC A18/MF A01 CSCL 14B

Domestic and foreign wind tunnel facilities are enumerated and their technical parameters are described. Data pertinent to managers and engineers are presented. Facilities judged comparable in testing capability are noted and grouped together. Several comprehensive cross-indexes and charts are included. R.S.F.

N85-18992# National Aerospace Lab., Tokyo (Japan).
WALL INTERFERENCE ESTIMATION OF THE NAL'S TWO-DIMENSIONAL WIND TUNNEL
H. SAWADA, S. SAKAKIBARA, M. SATOU, and H. KANDA Aug. 1984 25 p refs In JAPANESE; ENGLISH summary
(NAL-TR-829; ISSN-0389-4010) Avail: NTIS HC A02/MF A01

Experiments with airfoil models at high subsonic speeds were carried out in the NAL's Two Dimensional Wind Tunnel. The models were NACA0012 and GK-75-06-12 in airfoil. There were two NACA0012 models with chord lengths of 250mm. The upper and lower walls of the test section of the tunnel are slotted. The open area ratio of the slotted walls was set at 3 and 10% in the tests. In the tests of the smaller NACA0012 model, the total pressure of the uniform flow was set at 1,667 times that for the larger NACA0012 model. Thus the test Reynolds number was set at the same value for tests of the two different size models. The data obtained were corrected by the wall interference correction method developed at NAL. Pressure measured along the upper and lower walls is used in this method. The correction method works very well in the range tested. In addition, the wall interference characteristics of the NAL's Two Dimensional Wind Tunnel were examined at the same time. B.W.

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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.

A85-23200*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A HIGH ENERGY STAGE FOR THE NATIONAL SPACE TRANSPORTATION SYSTEM
A. J. STOFAN (NASA, Lewis Research Center, Cleveland, OH) International Astronautical Federation, International Astronautical Congress, 35th, Lausanne, Switzerland, Oct. 7-13, 1984. 12 p. Previously announced in STAR as N84-32411.
(IAF PAPER 84-15)

The Shuttle/Centaur is an expendable hydrogen/oxygen cryogenic upper stage for use with the National Space Transportation System. It is a modification of the existing Atlas/Centaur which was used by NASA since 1966 to launch interplanetary and earth orbital payloads for numerous organizations. Two configurations of the Shuttle/Centaur are being developed. Vehicle capability includes placing approximately 4500 kg (10,000 lb) in geostationary orbit, and initial applications will be for the interplanetary Galileo and Ulysses Missions in 1986. The Shuttle/Centaur development program is discussed, the configurations and performance are described, and the unique integration and operations requirements related to the Shuttle are indicated. Design changes to the current Atlas/Centaur required for Shuttle operation are described here, and include those related to Orbiter cargo bay dimensions, environment, and safety considerations. Author

N85-18082# National Aerospace Lab., Tokyo (Japan).
A STUDY ON A MEDIUM-SIZED ROCKET WITH BURNOUT FRAME
Y. MUTOH Jul. 1984 64 p refs In JAPANESE; ENGLISH summary
(NAL-TR-821; ISSN-0389-4010) Avail: NTIS HC A04/MF A01

A medium-sized single stage solid-propellant meteorological rocket is described which ejects a 4 Kg radio sonde with a parachute at an altitude of 60 Km to gather wind speed, direction, and temperature data on the upper stratosphere and mesosphere. After the mission, the rocket motor, including fins and nose cone, burn to ash. Therefore there is no danger that any of the system will fall to the earth and cause damage. The rocket is 140 mm in diameter, 3000 mm long and weighs 70 Kg when provided with a standard sounding sonde. However, the exact length and weight vary with the type of payload, whether metal chaff, silver-iodide, etc. There are two basic configurations of this rocket system, one for high altitude meteorology, the other for scattering AgI in weather modification projects. The latter is also used for ejecting chaff in radar-location experiments. Author

N85-18995*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
INVESTIGATION OF SURFACE TENSION PHENOMENA USING THE KC-135 AIRCRAFT
W. S. ALTER Oct. 1982 16 p refs
(NASA-TM-82508; NAS 1.15:82508) Avail: NTIS HC A02/MF A01 CSCL 22A

The microgravity environment of the KC-135 aircraft was utilized in three experiments designed to determine the following: (1) the feasibility of measuring critical wetting temperatures; (2) the effectiveness of surface tension as a means of keeping the cushioning heat transfer liquid in the furnace during ampoule translation; and (3) whether a non-wetting fluid would separate from the ampoule wall under low gravity conditions. This trio of investigations concerning surface phenomena demonstrates the effectiveness of the KC-135 as a microgravity research environment for small-scale, hand-held experiments. R.S.F.

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CHEMISTRY AND MATERIALS

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

A85-24161* Akron Univ., Ohio.
PLASTIC FLOW OF PLASMA SPRAYED CERAMICS
J. PADOVAN, B. T. F. CHUNG, M. J. BRAUN (Akron, University, Akron, OH), G. MCDONALD, R. C. HENDRICKS (NASA, Lewis Research Center, Cleveland, OH), and R. L. MULLEN (Case Western Reserve University, Cleveland, OH) IN: Deformation of ceramic materials II; Proceedings of the International Symposium on Plastic Deformation of Ceramic Materials, University Park, PA, July 20-22, 1983 . New York, Plenum Press, 1984, p. 473-485. refs

The plastic flow of plasma-sprayed ZrO2-8Y2O3 ceramic has been measured at temperatures up to 1250 C and compared to the plastic flow of pressed and sintered ZrO2-8Y2O3. Plasma spraying of binary oxide ceramics is found to result in a metastable state which is inelastic at high temperature but can also be stabilized or devitrified through heat treating so as to decrease plastic properties. The mechanical properties of the as-plasma sprayed and devitrified ceramic sheet material was measured. An improved algorithm that incorporates the inherently nonlinear thermomechanical field equations was used to determine the influence of inelastic material behavior on the thermomechanical response of ceramic coated seal components. Significant creep was found during the thermal shock and steady heating periods with insufficient time during thermal quench to reverse the process, thereby inducing significant residual stresses into the components. C.D.

A85-24229
ENGINEERING CERAMICS
R. J. BROOK and F. L. RILEY (Leeds, University, Leeds, England) Materials and Design (ISSN 0261-3069), vol. 5, Oct.-Nov. 1984, p. 208-211.

An evaluation is made of the development status of binary oxide, titanate, carbide, and nitride ceramics, with emphasis on emerging applications in industrially important areas where exceptional high temperature mechanical properties are required. One such major field of applications is in ceramic high temperatures mechanical components for reciprocating and gas turbine-type engines, whose surface temperatures often reach 1300 C. Ceramics prominent in current considerations for such uses are silicon nitride, silicon carbide, zirconia, and alumina. O.C.

A85-24809
HIGH PERFORMANCE COMPOSITE MATERIALS: NEW APPLICATIONS AND INDUSTRIAL PRODUCTION; PROCEEDINGS OF THE FOURTH INTERNATIONAL CONFERENCE AND EXHIBITION, BORDEAUX, FRANCE, OCTOBER 17-20, 1983
G. JUBE, ED., A. MASSIAH, ED., R. NASLAIN, ED., and M. POPOT, ED. Conference sponsored by the Society for the Advancement of Materials and Process Engineering and Ministere de l'Industrie et de la Recherche. Chatou, Yvelines, France, Society for the Advancement of Materials and Process Engineering, 1983, 390 p. For individual items see A85-24810 to A85-24822.

In the present conference, attention is given to the development status of carbon fibers and their composites, the comparative performance of high modulus fibers, the application of aramid fibers to hybrid composite materials, pultrusion techniques, the applications of thermoplastic matrices, mechanical consequences of damage growth in composites, the crash energy absorption properties of composite structural elements, advanced composite tubular structures for antenna reflectors, and composite material applications in aircraft primary structures. Also discussed are low friction carbon-carbon materials, composite applications in deep sea environments, new developments in filament winding technology, biomedical applications of carbon fibers, fracture maps for fibrous composites, the viscoelastic analysis of carbon/epoxy composites, novel precursors for SiC materials, and improved handling methods for organic matrices. O.C.

A85-24810
CURRENT STATUS OF CARBON FIBER AND COMPOSITE DEVELOPMENT
M. HIRATA (SOFICAR, Paris-La-Defense, Hauts-de-Seine, France), J. MATSUI, and H. S. MATSUDA (Toray Industries, Inc., Tokyo, Japan) IN: High performance composite materials: New applications and industrial production; Proceedings of the Fourth International Conference and Exhibition, Bordeaux, France, October 17-20, 1983 . Chatou, Yvelines, France, Society for the Advancement of Materials and Process Engineering, 1983, p. 21-29. refs

Advanced types of carbon fibers, such as TORAYCA T 400, X 550, X 600 and X 630, have been developed to meet the growing technical requirements for the use of carbon fiber composites in the primary structures of aircraft. In parallel with carbon fiber development, a new epoxy formulation is discussed which can improve the allowable design strain of carbon fiber composites, including impact resistance and hot-wet compression properties. Moreover, new woven forms of carbon fiber, so-called 'noncrimp' woven fabric (NCW) and three-dimensional knit-bonded fabrics, are also discussed. Author

A85-24815
CRASH ENERGY ABSORPTION PROPERTIES OF COMPOSITE STRUCTURAL ELEMENTS
D. C. BANNERMANN and C. M. KINDERVATER (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Institut fuer Bauweisen- und Konstruktionsforschung, Stuttgart, West Germany) IN: High performance composite materials: New applications and industrial production; Proceedings of the Fourth International Conference and Exhibition, Bordeaux, France, October 17-20, 1983 . Chatou, Yvelines, France, Society for the Advancement of Materials and Process Engineering, 1983, p. 155-167. refs

An investigation was conducted into the crash energy absorption properties of filament wound tubes and stringer stiffened and sandwich beam sections. Quasi-static and impact axial crushing were examined together with various trigger mechanisms required to initiate and maintain stable energy absorbing failure modes. These failure modes along with specific energies of absorption, crush load uniformities, impact effects, and influences of foam fillings are discussed and compared to aluminum elements. Author

A85-24820
THE SEPCARB CARBON-CARBON MATERIALS, FRICTION MATERIALS
B. BROQUERE (Societe Europeenne de Propulsion, Division Propulsion a Poudre et Composites, Saint-Medard-en-Jalles, Gironde, France) IN: High performance composite materials: New applications and industrial production; Proceedings of the Fourth International Conference and Exhibition, Bordeaux, France, October 17-20, 1983 . Chatou, Yvelines, France, Society for the Advancement of Materials and Process Engineering, 1983, p. 253-260.

An account is given of the performance levels achieved since 1970 in the development of carbon-reinforced carbon-matrix materials for high friction, low wear applications such as aircraft disk brakes. These materials, designated 'SEPCARB', have been employed in the brake disks of the Mirage 2000 fighter. It is estimated that by comparison with conventional metallic disk brakes, a weight reduction of 600 kg is obtainable for a six-passenger aircraft using SEPCARB disks. O.C.

A85-25084
IMPACT FRACTURE OF THERMALLY TEMPERED GLASS HELICOPTER WINDSHIELDS
M. M. ABOU EL LEIL (United Technologies Research Center, East Hartford, CT), F. A. CAMARATTA, and R. R. DIGENOVA (United Technologies Corp., Sikorsky Aircraft Div., Stratford, CT) American Ceramic Society, Communications (ISSN 0002-7820), vol. 68, Jan. 1985, p. C-18 to C-21. refs
(ACS PAPER 41-G-83F)

In-service fracture of helicopter windshields was studied. Simulated catastrophic fracture tests were conducted by firing alumina and steel spheres onto stationary tempered and as-received glass panels. The results were studied by Hertzian analysis and modified Auerbach's relations. Thermally tempered glass shows much higher impact resistance than that estimated from superposition of residual stresses. Subcritical impact sites exhibit slow crack growth in tempered plates, eventually leading to fracture of the entire plate. Author

A85-25268
INTERNATIONAL PERSPECTIVE ON CERAMIC HEAT ENGINES
E. M. LENOE (U.S. Army, Materials and Mechanics Research Center, Watertown, MA) and J. L. MEGLEN (Engineering and Economics Research, Inc., Vienna, VA) American Ceramic Society Bulletin (ISSN 0002-7812), vol. 64, Feb. 1985, p. 271-275. refs
(ACS PAPER 1/JIII-84)

An evaluation of the U.S. advanced ceramics industry by the Department of Commerce's Office of Industry Assessment notes that the U.S. has largely lost the electronic ceramics component business to Japan, and is unlikely to regain it. A widening gap is seen in this evaluation between the U.S. and Japan in the second major industrial category of advanced engineering ceramics. The primary U.S. weakness in ceramics competition with Japan is seen to inhere not in the creativity of basic research, but in the implementation of manufacturing technology and the availability of capital investment. O.C.

A85-25269
EVOLUTION IN THE U.S. OF CERAMIC TECHNOLOGY FOR TURBINE ENGINES
D. W. RICHERSON (Garrett Turbine Engine Co., Phoenix, AZ) American Ceramic Society Bulletin (ISSN 0002-7812), vol. 64, Feb. 1985, p. 282-286. refs
(ACS PAPER 3-JIII-84)

Thermal efficiency improvements which result in reductions of engine size and fuel consumption are being sought through the use of highly refractory ceramic materials in gas turbine components which can survive high mechanical and thermal stresses in the harsh chemical environment of high temperature, high velocity combustion gases. Attention is presently given to the evolution of ceramic turbine technology in the U.S. NASA has conducted two Advanced Gas Turbine (AGT) research programs since 1979; one of these has yielded the AGT101 SiC radial inflow turbine rotor, whose stresses and temperature distributions are presently noted. The AGT101 engine incorporates a rotary ceramic regenerator and all-ceramic hot gas flow surfaces. O.C.

A85-25961
CORROSION-INHIBITING GAS-TURBINE ENGINE LUBRICANT. I ACCELERATED TEST DEVELOPMENT AND VALIDATION
P. A. WARNER, W. J. PURVIS (United Technologies Corp., Pratt and Whitney Group, West Palm Beach, FL), and W. E. WARD (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) American Society of Lubrication Engineers, Annual Meeting, 39th, Chicago, IL, May 7-10, 1984. 6 p.
(ASLE PREPRINT 84-AM-5D-3)

A program was undertaken to develop an accelerated test procedure for evaluating the relative corrosion protection provided by candidate corrosion-inhibited gas-turbine engine lubricants. Several test parameters were investigated, including various humidifying solutions, air flow rates, residence times, and test coupon surface preparations, which resulted in the development of a one-hour vapor-phase corrosion test, the Corrosion Rate Evaluation Procedure (CREP). The CREP was validated through general correlations with test results from the humidity cabinet corrosion test described in MIL-C-8188C. A sequential sampling plan, based on a statistical evaluation of CREP data, provided an efficient means for screening candidate corrosion-inhibiting fluids. The development and validation of the CREP and the sequential sampling plan are discussed in this paper. Author

A85-25962
CORROSION-INHIBITING GAS-TURBINE ENGINE LUBRICANT. II - FLUID FORMULATION AND EVALUATION
P. A. WARNER (United Technologies Corp., Pratt and Whitney Group, West Palm Beach, FL), W. E. WARD, and G. A. BEANE, IV (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) American Society of Lubrication Engineers, Annual Meeting, 39th, Chicago, IL, May 7-10, 1984. 7 p. refs
(ASLE PREPRINT 84-AM-5D-4)

The corrosion-inhibiting capability of over one hundred candidate materials was assessed using the Corrosion Rate Evaluation Procedure (CREP). The candidate inhibitors were evaluated in single-additive and two-additive combinations formulated into a qualified MIL-L-7808H fluid. Several physical property measurements, including total acid number, flash point, and foaming characteristics, were used to screen various candidate inhibitors and inhibitor combinations. The more promising formulations were selected and evaluated further against the MIL-L-7808H specification limits for highand low-temperature viscosity, evaporation, corrosion and oxidation stability, and deposit formation. The best candidate formulation displayed a corrosion-inhibiting capability superior to MIL-C-8188C qualified fluids and met all of the MIL-L-7808H specification requirements, except that of total acid number which, although high, was considered acceptable. Author

A85-25964
CHEMICAL NATURE OF WEAR DEBRIS
R. E. KAUFFMAN, C. S. SABA, W. E. RHINE (Dayton, University, Dayton, OH), and K. J. EISENTRAUT (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) American Society of Lubrication Engineers and American Society of Mechanical Engineers, Lubrication Conference, San Diego, CA, Oct. 22-24, 1984. 7 p. refs
(ASLE PREPRINT 84-LC-3A-1)

Depending upon the mechanism of wear occurring within aircraft gas-turbine engines, different types of wear debris are expected to be produced in lubricating oils. A procedure was developed to identify the chemical nature of these wear species. The procedure involves filtration and solvent extraction techniques, followed by spectrometric analysis to separate and quantify the different chemical forms of the wear metal debris. The chemical form of some of the most critical wear species are identified as metallic, oxide, and metallo-organic species. The development and

application of the procedure to identify and quantify the wear debris of Cu, Fe, and Mg in aircraft lubricating oils are discussed.
Author

A85-26279
STABILIZING T-6 FUEL WITH ANTIOXIDANT MIXTURES [STABILIZATSIIA TOPLIVA T-6 SMESIAMI ANTIOKISLITELEI]
I. A. GOLUBEVA, T. P. VISHNIAKOVA, T. V. POPOVA, and L. P. GUTNIKOVA (Moskovskii Institut Neftekhimicheskoi i Gazovoi Promyshlennosti, Moscow, USSR) Khimiia i Tekhnologiia Topliv i Masel (ISSN 0023-1169), no. 1, 1985, p. 16, 17. In Russian. refs

Antioxidant mixtures based on N,N'-di(3,5-di-tert-butyl-4-oxybenzyl) urea (additive KF-1) were investigated to determine their stabilizing effect on T-6 jet fuel. To determine the efficiency of the antioxidant mixtures, fuel samples were repeatedly (12 times) heated at 120 C; the acidity of the fuel, its optical density, and its peroxide number were determined at the end of each test. A synergistic effect was observed for mixtures based on KF-1 with diethylene glycol ether and with other phenosanes. This effect is ascribed to the oxidation inhibiting action of the reaction products of the initial antioxidants. V.L.

A85-26280
DETERMINATION OF THE SERVICE LIFE OF OILS IN AIRCRAFT GAS TURBINE ENGINES [USTANOVLENIE SROKOV SLUZHBY MASEL V AVIATSIONNYKH GAZOTURBINNYKH DVIGATELIAKH]
O. A. LEBEDEV, P. A. MIKHEICHEV, and A. V. VILENKIN (Gosudarstvennyi Nauchno-Issledovatel'skii Institut Grazhdanskoi Aviatsii, Moscow, USSR) Khimiia i Tekhnologiia Topliv i Masel (ISSN 0023-1169), no. 1, 1985, p. 31-33. In Russian. refs

With a view to increasing the service life of oils in the gas turbine engines of civil aircraft, the physicochemical and service characteristics of oils have been studied as a function of the service period. Results are presented for the mineral oils MS-8P, MK-8P, and MN-7.5U, with allowance made for the operating temperature of the engines. As a result of the study, the oil change period has been extended for certain classes of engines, and a standard procedure has been adopted for determining the service life of oils used in the gas turbine engines of civil aircraft. V.L.

N85-18101# Exxon Research and Engineering Co., Linden, N.J. Corporate Research-Technology Feasibility Center.
RADIATION/CATALYTIC AUGMENTED COMBUSTION Final Scientific Report, 1 Apr. 1981 - 31 Mar. 1983
A. E. CERKANOWICZ and I. D. CRANE May 1984 108 p
(Contract F49620-81-C-0028; AF PROJ. 2308)
(AD-A148758; AFOSR-84-1129TR) Avail: NTIS HC A06/MF A01 CSCL 21E

Two novel concepts for extending aircraft operational range have been researched under this contract. They are radiative and catalytic augmentation techniques. The feasibility of utilizing these techniques to alter (augment) combustion initiation and reaction kinetics which restrict combustor operation via limits on flammability, flame propagation, ignition and stability has been investigated. Both techniques have demonstrated the potential to improve combustion processes. The radiative technique under laboratory static conditions has successfully ignited fuel-air mixtures, and has enhanced combustion processes, utilizing pulsed and continuous vacuum ultraviolet light sources. Similarly, the catalytic technique has broadened stability limits under normally difficult fuel lean, low temperature conditions. Complementary efforts have focused on the developement of analytical capabilities required for modeling the radiative and catalytic techniques.
Author (GRA)

N85-18225# Joint Publications Research Service, Arlington, Va.
FRG FIRMS JUMP INTO MARKET FOR AUTO, AIRCRAFT CERAMICS
In its West Europe Rept.: Sci. and Technol. (JPRS-WST-85-003) p 1-3 18 Jan. 1985 Transl. into ENGLISH from Industriemag. (Munich), 15 Oct. 1984 p 97; 100
Avail: NTIS HC A05/MF A01

Production engineering and marketing concerns for constructive ceramics for engine construction and machine construction are discussed. The springboard for marketing research is to be provided by a pilot plant which is now being set up by the porcelain manufacturer in the Upper Franconian city fo Naila. Tailored construction components made of ceramic materials to support high stresses in engine construction, machine construction and plant construction as well as in energy and environment technology are described. B.W.

N85-19073*# Michigan Technological Univ., Houghton.
EFFECTS OF MAR-M247 SUBSTRATE (MODIFIED) COMPOSITION ON COATING OXIDATION COATING/SUBSTRATE INTERDIFFUSION M.S. Thesis. Final Report
B. H. PILSNER Feb. 1985 126 p refs
(Contract NAG3-216)
(NASA-CR-174851; NAS 1.26:174851) Avail: NTIS HC A07/MF A01 CSCL 11F

The effects of gamma+gamma' Mar-M247 substrate composition on gamma+beta Ni-Cr-Al-Zr coating oxidation and coating/substrate interdiffusion were evaluated. These results were also compared to a prior study for a Ni-Cr-Al-Zr coated gamma Ni-Cr-Al substrate with equivalent Al and Cr atomic percentages. Cyclic oxidation behavior at 1130 C was investigated using change in weight curves. Concentration/distance profiles were measured for Al, Cr, Co, W, and Ta. The surface oxides were examined by X-ray diffraction and scanning electron microscopy. The results indicate that variations of Ta and C concentrations in the substrate do not affect oxidation resistance, while additions of grain boundary strengthening elements (Zr, Hf, B) increase oxidation resistance. In addition, the results indicate that oxidation phenomena in gamma+beta/gamma+gamma' Mar-M247 systems have similar characteristics to the I gamma+beta/gamma Ni-Cr-Al system.
Author

N85-19076*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THE B2 ALUMINIDES AS ALTERNATIVE MATERIALS
J. R. STEPHENS 1984 26 p refs Presented at the Fall Meeting of the Mater. Res. Soc., Boston, 26-30 Nov. 1984
(NASA-TM-86937; E-2451; NAS 1.15:86937) Avail: NTIS HC A03/MF A01 CSCL 11F

The potential of the B2 aluminides as structural material alternatives for the strategic element containing superalloys currently used in gas turbine engines is being explored with emphasis on the equiatomic Fe and Ni aluminides. Although Co is a strategic material, the equiatomic Co aluminide is also being studied to gain a more complete understanding of these fourth period intermetallics. Research focuses on initial processing techniques such as ingot melting, power metallurgy, and rapid solidification with and without additional thermomechanical processing; high temperature deformation - primarily compressive creep; compositional effects within the binary B2 aluminides; third-element alloying addition effects on high temperature strength and oxidation resistance, and near room temperature ductility as influenced by processing, alloying, and grain size. Various programs now underway are reviewed and some highlights of research results are presented. A.R.H.

N85-19153# Department of the Navy, Washington, D. C.
ADHESIVE JOINT FORMATION UNDER FIELD CONDITIONS Patent Application
L. H. PEEBLES, JR., inventor (to Navy) 30 Jul. 1984 20 p
(AD-D011478; US-PATENT-APPL-SN-635866) Avail: NTIS HC A02/MF A01 CSCL 11A

This invention relates to a method for effecting repairs of the damaged components of a machinery in the field which would otherwise require high temperature treatment of the damaged components to form a metal-oxide epoxy joint in a shop. The method includes preparing a repair patch which includes a metal sheet with the metal oxide layer thereon, applying a thin high performance protective coating thereover, covering thereof with a sacrificial backing sheet and then curing the adherent-top coat backing sheet to form a highly durable bonded system which can be stored until needed. At the time of repair the backing sheet is removed by sanding or grit blasting and the adherent is applied to the structure to be repaired under ordinary temperature conditions. GRA

N85-19175*# General Electric Co., Lynn, Mass. Aircraft Engine Business Group.
ANALYTICAL FUEL PROPERTY EFFECTS: SMALL COMBUSTORS, PHASE 2 Final Report
T. G. HILL, J. D. MONTY, and H. L. MORTON Mar. 1985 45 p
(Contract NAS3-22829)
(NASA-CR-174848; NAS 1.26:174848; R85AEB014) Avail: NTIS HC A03/MF A01 CSCL 21D

The effects of non-standard aviation fuels on a typical small gas turbine combustor were studied and the effectiveness of design changes intended to counter the effects of these fuels was evaluated. The T700/CT7 turboprop engine family was chosen as being representative of the class of aircraft power plants desired for this study. Fuel properties, as specified by NASA, are characterized by low hydrogen content and high aromatics levels. No. 2 diesel fuel was also evaluated in this program. Results demonstrated the anticipated higher than normal smoke output and flame radiation intensity with resulting increased metal temperatures on the baseline T700 combustor. Three new designs were evaluated using the non standard fuels. The three designs incorporated enhanced cooling features and smoke reduction features. All three designs, when burning the broad specification fuels, exhibited metal temperatures at or below the baseline combustor temperatures on JP-5. Smoke levels were acceptable but higher than predicted. R.S.F.

N85-19176*# Lockheed-California Co., Burbank. Commercial Advanced Design Div.
STUDY OF ADVANCED FUEL SYSTEM CONCEPTS FOR COMMERCIAL AIRCRAFT AND ENGINES Final Report
E. F. VERSAW, G. D. BREWER, W. D. BYERS, H. W. FOGG, D. E. HANKS, and J. CHIRIVELLA (Ergo-Tech, Inc.) Jan. 1983 142 p refs
(Contract NAS3-23271)
(NASA-CR-174752; NAS 1.26:174752) Avail: NTIS HC A07/MF A01 CSCL 21D

The impact on a commercial transport aircraft of using fuels which have relaxed property limits relative to current commercial jet fuel was assessed. The methodology of the study is outlined, fuel properties are discussed, and the effect of the relaxation of fuel properties analyzed. Advanced fuel system component designs that permit the satisfactory use of fuel with the candidate relaxed properties in the subject aircraft are described. The two fuel properties considered in detail are freezing point and thermal stability. Three candidate fuel system concepts were selected and evaluated in terms of performance, cost, weight, safety, and maintainability. A fuel system that incorporates insulation and electrical heating elements on fuel tank lower surfaces was found to be most cost effective for the long term. R.S.F.

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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.

A85-23194#
UNSTEADY FLOW AT THE OUTLET OF THE HIGH SPECIFIC SPEED CENTRIFUGAL COMPRESSOR IMPELLER
F. KANO and T. SHIRAKAMI (Kobe Steel, Ltd., Kobe, Japan) American Society of Mechanical Engineers and Institute of Electrical and Electronics Engineers, Joint Power Generation Conference, Toronto, Canada, Oct. 1-4, 1984. 8 p. refs
(ASME PAPER 84-JPGC-GT-10)

The unsteady flow at the outlet of the high-specific-speed mixed-flow impeller was studied. The flow is strongly influenced by the impeller blading. On the other hand, the flow influences the performance of the stationary vanes downstream of the impeller. The flow path at the outlet of the mixed-flow impeller is inclined to the axial direction and is curved in the meridional plane. The study was carried out to develop the 30 MW centrifugal compressor. This compressor is used in the field of coal gasification, geothermal power generation, etc. The distributions of flow velocity, pressure, and temperature of three-dimensional flow were measured using a high-sensitivity pressure transducer and a total temperature probe. The flow was surveyed across the entire passage at about ten axial locations including the endwall boundary layer. A theoretical analysis was also carried out using the linearized Navier-Stokes equation. Author

A85-23387#
THE PROBLEM OF GRADUAL OPENING IN WAVE ROTOR PASSAGES
S. EIDELMAN (Science Applications International Co., McLean, VA; U.S. Naval Postgraduate School, Monterey, CA) Journal of Propulsion and Power (ISSN 0748-4658), vol. 1, Jan.-Feb. 1985, p. 23-28. refs

The influence on the flow pattern of the gradual passage opening in the wave rotor is studied on the basis of numerical simulation. It is found that, in most cases, significant volume of the passage will have rotational flow, which should lead to the mixing between the driver and driven gases. In some cases, losses will occur also as a result of the multiple reflection of the shock and pressure waves from the passage walls. It is shown that the interface between driven and driver gas will be oblique to the passage walls, when the passage opens gradually, and the interface can retain its obliqueness to the walls. Author

A85-23628
CHARACTERISTICS OF GAS-LUBRICATED SPHERICAL SPIRAL GROOVE BEARINGS
Y. SATO (Saitama University, Urawa, Japan), H. MAKINO, and A. TAMURA (Tokyo Institute of Technology, Tokyo, Japan) (Japan Society of Lubrication Engineers, Journal, vol. 28, no. 3, 1983, p. 221-227) Japan Society of Lubrication Engineers, Journal - International Edition (ISSN 0389-5483), no. 5, 1984, p. 53-58. Translation. refs

The characteristics of gas-lubricated spherical spiral groove bearings are studied theoretically. Perturbation solutions about the radially concentric position are obtained for small vibration amplitude. Results indicate that the axial load capacity and the axial stiffness increase linearly with the rotor speed while the axial damping coefficient becomes negative when the rotor speed exceeds a critical value. Therefore, instability is possible in the axial direction as well as in the radial direction. Experiments were performed to speeds of 70,000 rpm. No sign of bearing instability was detected. Theoretically, in the axial direction this bearing rotor

system is stable well above 70,000 rpm. Fair agreement between theory and experiment was achieved for predicting load and axial displacement. Author

A85-23711
FATIGUE CRACK GROWTH UNDER VARIABLE AMPLITUDE LOADING
H. FUEHRING (Lahmeyer International GmbH, Frankfurt am Main, West Germany) and T. SEEGER (Darmstadt, Technische Hochschule, Darmstadt, West Germany) IN: Subcritical crack growth due to fatigue, stress corrosion and creep . London and New York, Elsevier Applied Science Publishers, 1984, p. 109-133. refs

The paper is subdivided into four main parts. The first one introduces the phenomenological aspects of variable amplitude (VA) crack growth. By means of test results concerning simple load sequences the most typical load interaction effects are discussed. In the second part, the continuum mechanics' background of those nonlinear crack growth effects is explained by means of an advanced analytical approach. The major parameters of spectrum loading are pointed out in the next part of the paper and illustrated by typical test results. The fourth and last part is concerned with advanced concepts for analytical estimates of spectrum crack growth and their results in view of prediction accuracy, required empirical constants and area of application. Author

A85-23844
TURBULENCE SUPPRESSION IN FREE TURBULENT SHEAR FLOWS UNDER CONTROLLED EXCITATION. II - JET-NOISE REDUCTION
A. K. M. F. HUSSAIN (Houston, University, Houston, TX) and M. A. Z. HASAN (Catholic University of America, Washington, DC; Houston, University, Houston, TX) Journal of Fluid Mechanics (ISSN 0022-1120), vol. 150, Jan. 1985, p. 159-168. refs
(Contract NSF MEA-81-11676)

The existence of a range of Strouhal numbers (St), over which controlled excitation produces reduction of far-field jet noise, is argued experimentally. The noise suppression, for St values of 0.01 to 0.02 (based on the exit momentum thickness of the shear layer), is uniform over the entire spectral range except for 1/2(f) and the excitation frequency. The apparatus used consisted of a 4-cm air jet in a chamber anechoic down to 75 Hz, with dimensions 7.6 x 5 x 5 m between the tips of 61-cm long wedges. Hot-wire measurements in the noise-producing region of the jet reveal that the noise suppression is a direct consequence of turbulence suppression, produced by early saturation and breakdown of maximally growing instability modes. L.T.

A85-24002
DETERMINAITON OF THE ANGLES OF FLOW INCIDENT ON THE ROTATING CASCADE OF A REVERSING DEVICE [OPREDELENIE UGLOV NATEKANIIA NA POVOROTNUIU RESHETKU REVERSIVNOGO USTROISTVA]
D. V. MAKLAKOV and V. V. ROGALEV Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 3, 1984, p. 100-102. In Russian.

An analysis is made of steady-state potential flow of an ideal incompressible fluid from a duct with a flap and a rotating cascade simulating the meridional cross-section of a reversing device located in the bypass exhaust of a bypass engine. Circulation over the blades of the cascade is determined from the Zhukovskii-Chaplygin condition of velocity limitation at the sharp trailing edges of the blades. The problem is then reduced to that of solving the Dirichlet problem for a harmonic function in a region with known boundaries. The model proposed here is shown to be sufficiently accurate for engineering estimates. V.L.

A85-24055
SOME SCHEMES FOR INTRODUCING AN ELECTRON BEAM INTO A DENSE GAS [NEKOTORYE SKHEMY VVODA ELEKTRONNOGO PUCHKA V PLOTNYI GAZ]
S. M. BABENKO and A. S. PLESHANOV IN: Kinetics of low-temperature plasma and gas lasers . Moscow, Izdatel'stvo Nauka, 1984, p. 160-171. In Russian. refs

A scheme for the pumping of a laser by an electron beam moving relative to the active medium is examined. The problem of plane two-dimensional gas flow through a bounded region with heat release, equivalent to the straight motion of the beam at constant velocity, is solved analytically. A scheme is proposed whereby the electron beam is introduced into a dense gas through aerodynamic windows. The effect of the perturbations produced by the beam on gas flow in an aerodynamic window with a rarefaction wave is analyzed. V.L.

A85-24098#
ANALYSIS OF THE TRANSIENT AND STEADY-STATE HEAT TRANSFER IN ROTARY REGENERATIVE HEAT EXCHANGER
Z. REN, S. WANG (Qinghua University, Beijing, People's Republic of China), and Q. CHEN (Anshan Institute of Thermal Engineering, Anshan, People's Republic of China) Journal of Engineering Thermophysics, vol. 5, Aug. 1984, p. 269-274. In Chinese, with abstract in English. refs

The theoretical analysis and calculation of the transient and periodic steady-state temperature distribution of the rotor material and fluids in a rotary regenerator are reported. The transient temperature distribution of the fluids is also measured in a test regenerator, and the results obtained by the numerical method agree with those of the experimental measurement. The effect of the conduction of the rotor material on the temperature distribution is also evaluated. The mathematic model presented in this paper provides a theoretical basis for the optimum design of the regenerator. Author

A85-24251
AIRBORNE RECONNAISSANCE VII; PROCEEDINGS OF THE MEETING, SAN DIEGO, CA, AUGUST 23, 24, 1983
J. R. BATZLER, ED. (U.S. Department of Defense, Washington, DC) and P. HENKEL, ED. (General Dynamics Corp., St. Louis, MO) Meeting sponsored by SPIE - The International Society for Optical Engineering. Bellingham, WA, SPIE - The International Society for Optical Engineering (SPIE Proceedings. Volume 424), 1983, 197 p. For individual items see A85-24252 to A85-24270.

Among the topics discussed are U.S. Air National Guard reconnaissance, RF-5E aircraft production development and flight testing, the RS-700 series of IR line scanners, a comparison of dioptric, catoptric, and catadioptric reconnaissance lenses tailored for silicon CCD detectors, the automation and recording of an image interpreter's mensuration tasks for man-made objects, the SIRIUS advanced concept for photointerpretation, soft copy imagery interpretation capability, and data annotation techniques for film and electrooptic sensors. Also discussed are recent advances in airborne video/data recording, the use of an optical disk as a data storage system for reconnaissance, the application of microchannel plates in low light level high speed imaging systems, digital processing methods for linescan imagery, an adaptive target detection technique for an airborne mm-wave seeker design, first-order performance prediction techniques for CCD scanning imagers, evaluation methods for defeat systems in RPV electrooptical systems, and agricultural monitoring from high altitude powered platforms. O.C.

A85-24259
SIRIUS - AN ADVANCED CONCEPT FOR PHOTO-INTERPRETATION
J. L. PETIT (Matra Technology, Inc., Electro-Optic Systems Div., Los Gatos, CA) IN: Airborne reconnaissance VII; Proceedings of the Meeting, San Diego, CA, August 23, 24, 1983 . Bellingham, WA, SPIE - The International Society for Optical Engineering, 1983, p. 71-78.

Sirius, a computerized image-interpretation console developed to process digital SLAR and IR-electrooptical-camera images and digitized photographic images from the Mirage-type reconnaissance aircraft of the French air force, is characterized and illustrated with block diagrams. The design requirements are reviewed; the FILOU film-observation table used with Sirius is described; the general features of Sirius and the outline of a typical interpretation operation are given; and the function keys of the Sirius keyboard are listed in a table. T.K.

A85-24262
DATA ANNOTATION TECHNIQUES FOR FILM AND ELECTRO-OPTIC SENSORS
D. L. TRONE (Miletus Associates, Inc., Albuquerque, NM) IN: Airborne reconnaissance VII; Proceedings of the Meeting, San Diego, CA, August 23, 24, 1983 . Bellingham, WA, SPIE - The International Society for Optical Engineering, 1983, p. 100-103.

Data recording systems for film sensors exist in many forms from cathode ray tube (CRT) displays to complex light emitting diode (LED) arrays. Recent developments have not only eliminated the need for the CRT displays, but have greatly simplified the complex LED arrays. Additionally, electro-optical sensors with video formats often require data annotation. This paper provides an overview of some of the techniques of annotating film and video formats. Author

A85-24284
DETECTION OF MOVING VEHICLES IN THERMAL IMAGERY OBTAINED FROM A MOVING PLATFORM
A. V. FORMAN, JR., M. M. MOORE, R. PATTON, and A.J. SPIESSBACH (Martin Marietta Aerospace, Orlando, FL) IN: Applications of digital image processing VI; Proceedings of the Meeting, San Diego, CA, August 23-26, 1983 . Bellingham, WA, SPIE - The International Society for Optical Engineering, 1983, p. 136-147. refs

Automatic recognition of ground vehicles from an airborne platform can be greatly enhanced by an algorithm that accurately extracts the velocity of these vehicles when they are moving. The moving scene elements can be separated from the stationary (background) scene elements by accurately registering the stationary scene elements in successive images of the image sequence. In this paper, alternative techniques are described and demonstrated for each of the steps in a generic symbolic registration procedure. Output results are presented for a thermal closing sequence and for a side looking tracking sequence. These results show promise not only for accurate measurement of object velocity, but for accurate passive ranging as well. Author

A85-24565#
STUDY OF A BOUNDED JET FLOW CONSIDERING THE INITIAL TURBULENCE - EXPERIMENTS WITH A NOZZLE HAVING ASPECT RATIO OF 3
T. NOZAKI (Kagoshima University, Kagoshima, Japan), M. NAKASHIMA (Kagoshima National College of Technology, Kagoshima, Japan), and K. HATTA (Chubu University, Kasugai, Japan) JSME, Bulletin (ISSN 0021-3764), vol. 27, Dec. 1984, p. 2730-2738. refs

According to the experimental results concerned with jet flow from nozzles contracted on two sides and on four sides in the region bounded by two parallel flat plates, behavior of the flow depends considerably on the nozzle shape and the initial turbulence intensity. The variance and the degree of deformation of the velocity profile between the flat plates and the displacement thickness of boundary layer developed on them are newly introduced in this paper. By using these measures, it has been found that the extent of the secondary flow induced by the flat plates can be estimated quantitatively. Furthermore, the velocity profile of a bounded jet in the streamwise direction is similar to that of a two-dimensional jet approximately regardless of the distance from the bounding plate, except for a flow with small initial turbulence intensity with the nozzle contracted on all sides. Author

A85-24647
FULLY-AUTOMATIC FLEXIBLE MANUFACTURING CELL FOR TURBINE BLADES
P. L. TAYLOR (Amchem Co., Ltd., Loughborough, Leics., England) Aircraft Engineering (ISSN 0002-2667), vol. 56, Dec. 1984, p. 8, 9.

The fully automatic manufacturing cell presently discussed, which can operate unattended for long periods while machining aircraft gas turbine blades, consists of three identical electrical discharge machines, a carousel for the storage of cassettes of electrodes, an ultrasonic cleaning unit, and an inspection machine. All units can be serviced by a single robot that carries out all the material transfer operations and tool changing. The manufacturing cell has been designed to produce a particular turbine blade, and encompasses facilities for the changing of fixtures, electrodes and control systems in order to accommodate modifications of blade design. O.C.

A85-24899
A FACETTING MODEL OF TARGET GLINT
P. SINAUD (Thomson-CSF, Bagneux, Hauts-de-Seine, France) IN: International Radar Symposium, Bangalore, India, October 9-12, 1983, Proceedings . Bangalore, India, Institution of Electronics and Telecommunication Engineers, 1983, p. 484-488.

This paper deals with target noise within the general frame of system modeling. It has been implemented in order to generate realistic target motion and, simultaneously, the amplitude and angle target noises as seen by a short range tracking radar. Author

A85-24983
TRANSFORMATION OF ACOUSTIC OSCILLATIONS INTO THE EDDY ONES IN TURBULENT FLOWS
N. N. IANENKO, S. P. BARDAKHANOV, and V. V. KOZLOV (Akademiia Nauk SSSR, Institut Teoreticheskoi i Prikladnoi Mekhaniki, Novosibirsk, USSR) IN: Turbulence and chaotic phenomena in fluids; Proceedings of the International Symposium, Kyoto, Japan, September 5-10, 1983 . Amsterdam, North-Holland, 1984, p. 427-432. refs

The transformation of acoustic disturbances into eddy disturbances is studied experimentally for the following two cases: turbulent wake and turbulent boundary layer past a backward step. The measurements of the amplitude and phase of the disturbances show the presence of a determined structure of the flow. The transformation from acoustic to eddy disturbances is shown to be intensified by the spatial inhomogeneity of the mean flow. Author

A85-25119
STATISTICAL TREATMENT OF MULTIPLY CENSORED SAMPLES IN FATIGUE TESTING
M. N. STEPNOV, L. V. AGAMIROV, and I. A. INOZEMTSEVA (Moskovskii Aviatsionnyi Tekhnologicheskii Institut, Moscow, USSR) (Zavodskaia Laboratoriia, vol. 50, July 1984, p. 53-56) Industrial Laboratory (ISSN 0019-8447), vol. 50, no. 7, Jan. 1985, p. 695-698. Translation. refs

A method for processing a multiply censored sampling in accelerated fatigue testing is proposed whereby the multiply censored sampling is reduced to a singly censored one for which a method for estimating the parameters and tables already exists. In particular, a method for reducing a triply censored sampling to a singly censored sampling is demonstrated, and it is shown that the method does not lead to systematic errors in the estimates of the mathematical expectation and of the rms deviation. V.L.

A85-25128*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A PERSPECTIVE OF THEORETICAL AND APPLIED COMPUTATIONAL FLUID DYNAMICS
P. KUTLER (NASA, Ames Research Center, Applied Computational Aerodynamics Branch, Moffett Field, CA) AIAA Journal (ISSN 0001-1452), vol. 23, March 1985, p. 328-341. Previously cited in issue 05, p. 632, Accession no. A83-16477. refs

A85-25147#
TWO-DIMENSIONAL DEFORMING FINITE ELEMENT METHODS FOR SURFACE ABLATION
M. HOGGE and P. GERREKENS (Liege, Universite, Liege, Belgium) AIAA Journal (ISSN 0001-1452), vol. 23, March 1985, p. 465-472. Previously cited in issue 14, p. 2012, Accession no. A83-32773. refs

A85-25224#
LASER-THREE-SLICE (L3S) VELOCIMETER AND APPLICATIONS IN AERODYNAMICS FLOW FIELD MEASUREMENTS
J. WANG, Y. SONG, Y. LI, and Z. LIU (Chinese Academy of Sciences, Institute of Engineering Thermophysics, Beijing, People's Republic of China) Journal of Engineering Thermophysics, vol. 5, Nov. 1984, p. 418-422. In Chinese, with abstract in English. refs

A new type of the time-flight velocimeter is reported. The probe volume of this velocimeter corresponds to the three fringes of the LDV (Laser Doppler Velocimeter). The flow velocity is derived from the transit time of the particles which pass through the three slices with known beam separations. The instrument retains the major advantages of the time-flight method, e.g., high signal/noise ratio, low requisition of frequency response of the signal processor. On the other hand, it has some merits of LDV such as the possibility for measuring the unsteady flow field. Measurements utilizing this new velocimeter within a stepping exit flow field of a rectangular wind tunnel and in the wake of a bluff-body flame stabilizer are partially presented. Author

A85-25331
DIGITAL OPTICAL TRANSDUCERS FOR HELICOPTER FLIGHT CONTROL SYSTEMS
R. O. STANTON (U.S. Army, Applied Technology Laboratory, Fort Eustis, VA) IN: Fiber optics and laser sensors; Proceedings of the Meeting, Arlington, VA, April 5-7, 1983 . Bellingham, WA, SPIE - The International Society for Optical Engineering, 1983, p. 122-129. refs
(Contract N00163-80-C-0080; DAAK51-80-C-0029; DAAK51-80-C-0028; DAAK51-80-C-0033; DAAK51-80-C-0032; DAAK51-80-C-0031; DAAK51-80-C-0030; DAAK51-82-C-0002)

Two variations of each of three types of digital optical transducers have been developed to provide the technology base for a digital optical flight control system for US Army helicopters. The transducer types are rotary position, linear position, and differential hydraulic pressure and all are electrically passive at the transducer location. The development and test of these six transducers has led to the selection of a reflective, time delay multiplexed concept using a single interconnecting fiber for use on the Advanced Digital Optical Control System Flight Demonstrator Program (ADOCS FDP). Author

A85-25455
THE DEVELOPMENT AND USE OF FREE PISTON WIND TUNNELS
J. L. STOLLERY (Cranfield Institute of Technology, Cranfield, Beds.; Royal Armament Research and Development Establishment, Fort Halstead, Kent, England) and R. J. STALKER (Royal Armament Research and Development Establishment, Fort Halstead, Kent, England) IN: Shock tubes and waves; Proceedings of the Fourteenth International Symposium on Shock Tubes and Shock Waves, Sydney, Australia, August 19-22, 1983 . Sydney, Australia, Sydney Shock Tube Symposium Publishers, 1984, p. 41-50. refs

Eggers et al. (1955) have clearly demonstrated the application of free piston compression in wind-tunnel design. Cox and Winter (1957) developed the gun tunnel concept and substituted compressed air for explosive powder as the means of driving the piston. The characteristics of free piston motion are examined, and a comparison between the gun tunnel and shock-tunnel operating cycles is conducted, taking into account the performance of a number of gun and shock tunnels operating in the UK. Attention is given to the isentropic 'light' piston tunnels (ILPT's), the cryogenic ILPT, the Stalker tube, and some examples of research in the UK and Australia using free-piston wind tunnels. G.R.

A85-25477
A STUDY OF THE PULSATION DRIVING MECHANISM IN PULSATING COMBUSTORS
Y. GOLDMAN and Y. M. TIMNAT (Technion - Israel Institute of Technology, Haifa, Israel) IN: Shock tubes and waves; Proceedings of the Fourteenth International Symposium on Shock Tubes and Shock Waves, Sydney, Australia, August 19-22, 1983 . Sydney, Australia, Sydney Shock Tube Symposium Publishers, 1984, p. 326-330. refs

Experiments performed in a facility consisting of a Schmidt-type pulsating combustor, in which high-speed photographs were taken and pressure, temperature and gas composition measured, showed that the air supply conditions at the inlet and the volume of the combustor strongly influence the oscillation frequency. From the measurements, the existence of two separate regions, one containing cold air and the other containing fuel-rich gas, was found, and a pressure-volume diagram was drawn, showing the effect of chemical energy release and heat supply during the compression stroke and differentiating it from the expansion. A model of the interaction between the cyclic combustion process and the acoustic oscillations of the gas volume within the chamber and the tail-pipe is presented. The conditions for chemical energy release that result in high-pressure amplitude are described. Author

A85-25482* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
DEVELOPMENT AND PERFORMANCE OF THE NASA LANGLEY RESEARCH CENTER EXPANSION TUBE/TUNNEL, A HYPERSONIC-HYPERVELOCITY REAL-GAS FACILITY
C. G. MILLER and J. J. JONES (NASA, Langley Research Center, Hampton, VA) IN: Shock tubes and waves; Proceedings of the Fourteenth International Symposium on Shock Tubes and Shock Waves, Sydney, Australia, August 19-22, 1983 . Sydney, Australia, Sydney Shock Tube Symposium Publishers, 1984, p. 363-373. refs

A85-25621
HEAT TRANSFER IN THE CASE OF JET FLOW PAST AN ARBITRARILY NONISOTHERMAL SURFACE [TEPLOOBMEN PRI STRUINOM OBTEKANII PROIZVOL'NO NEIZOTERMICHNOI POVERKHNOSTI]
O. A. GRECHANNYI, Z. I. NAGOLKINA, and V. A. SINATOS (Akademiia Nauk Ukrainskoi SSR, Institut Tekhnicheskoi Teplofiziki, Kiev, Ukrainian SSR) Promyshlennaia Teplotekhnika (ISSN 0204-3602), vol. 6, no. 6, 1984, p. 3-10. In Russian. refs

An analysis is made of the general problem of heat transfer in the case of laminar jet flow of an incompressible fluid past a plane solid surface. An exact analytical solution is obtained by using the method of the parametric integration of the energy

equation in the boundary layer. The characteristics of heat transfer in the case of jet flow past arbitrarily nonisothermal bodies are investigated over a wide range of Prandtl numbers; heat transfer coefficients are calculated. V.L.

A85-25941#
A COMBINED VISUALIZATION-ANEMOMETRY STUDY OF THE TURBULENT DRAG REDUCING MECHANISMS OF TRIANGULAR MICRO-GROOVE SURFACE MODIFICATIONS
E. V. BACHER and C. R. SMITH (Lehigh University, Bethlehem, PA) American Institute of Aeronautics and Astronautics, Shear Flow Control Conference, Boulder, CO, Mar. 12-14, 1985. 11 p. USAF-supported research. refs
(AIAA PAPER 85-0548)

Flow visualization and hot-film anemometry studies have been conducted to investigate the influence of small-scale (15 viscous wall units) streamwise surface riblets on the structure, surface drag, and bursting characteristics of a turbulent boundary layer. Visualization studies indicate that the familiar low-speed streak structure forms above the riblet surface, but that spanwise streak spacing is increased by 40 percent over flat plate flows. Fluid within the riblets is observed to move very slowly, with lateral transport of fluid becoming negligible near the riblet surface. Profiles of mean velocity and turbulence statistics indicate that the overall character of the turbulent flow over the riblet surface is similar to that over a flat plate. A momentum balance indicates that the surface drag for the riblet surface is approximately 25 percent lower than a flat plate flow, with more momentum retained in the logarithmic region above the grooved plate than above the flat plate. Comparative examination of turbulence bursting using the VITA technique revealed no difference in the burst frequency for the riblet surface; however, ensemble averaged velocity behavior indicates the presence of a more organized bursting behavior above the riblet surface. A model suggesting how the riblets affect momentum transport in the near-wall is hypothesized. Author

A85-25947*# Systems and Applied Sciences Corp., Hampton, Va.
THE PERFORMANCE OF SMOOTH-WALL DRAG REDUCING OUTER-LAYER DEVICES IN ROUGH-WALL BOUNDARY LAYERS
P. R. BANDYOPADHYAY (Systems and Applied Sciences Corp., Hampton, VA) American Institute of Aeronautics and Astronautics, Shear Flow Control Conference, Boulder, CO, Mar. 12-14, 1985. 11 p. refs
(Contract NAS1-17296)
(AIAA PAPER 85-0558)

The boundary layer drag on a 0.28 m x 0.91 m flat-plate was measured to evaluate the performance of smooth-wall drag reducing outer-layer devices in rough-wall boundary layers up to a chord Reynolds number, Re(c) of 17,000. The devices were a pair of thin flat ribbons placed in tandem. The wall conditions examined were smooth, transverse-groove roughnesses having cavity width/depth ratios of 0.7 (d-type) and 3 (k-type), and sandpaper roughness (k-type) of grit sizes 180, 50 and 36. The area-averaged wall-drag was reduced compared to the respective normal levels for all wall conditions. All k-type rough walls exhibited a comparable level of drag reduction (about 7 percent) which was lower than that in the smooth-wall. The d-type rough-wall exhibited a transitional behavior in that the drag reduction dropped from the smooth-wall level to that of the k-type roughnesses with increase in the flow speed. In further experiments on a 6 meter long sandpaper roughened wall and with a pair of symmetric airfoil devices in tandem at an Re(c) of 77,500, it was possible to recover the device drag penalty fully, but no net drag reduction was achieved. The apparent loss of performance of the devices in a rough-wall is explained in terms of their inability to alter the pressure component of the drag in a significant way. Author

A85-25950*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ACTIVE TRANSITION FIXING AND CONTROL OF THE BOUNDARY LAYER IN AIR
L. MAESTRELLO (NASA, Langley Research Center, Hampton, VA) American Institute of Aeronautics and Astronautics, Shear Flow Control Conference, Boulder, CO, Mar. 12-14, 1985. 9 p. refs
(AIAA PAPER 85-0564)

Active transition of flow over an airfoil surface and feedback control by sound is investigated in a wind tunnel at Caltech. Laminar instability forced by localized time dependent nonintrusive narrow heating strip causes abrupt changes in velocity to trigger instant transition at favorable pressure gradient. At zero and adverse pressure gradients these changes are only marginal. Feedback control by sound interaction at nearly normal incidence produces significant reduction in velocity perturbation in regions of transition. This reduction is in part at the expense of an increase in background disturbance since it is not possible to restore the flow to its undisturbed state. Author

A85-25957
THE DYNAMICS OF BALL SEPARATORS IN BALL BEARINGS. II - RESULTS OF OPTIMIZATION STUDY
C. R. MEEKS (Hughes Aircraft Co., El Segundo, CA) American Society of Lubrication Engineers, Annual Meeting, 39th, Chicago, IL, May 7-10, 1984. 8 p. refs
(Contract F33615-78-C-5196; DARPA ORDER 3576)
(ASLE PREPRINT 84-AM-6C-3)

The dynamic equations of motion of ball-bearing separators were solved using certain simplifications to make computer analysis feasible from a cost point of view. A typical turbine engine bearing, employing solid lubrication, was used for a trade-off and optimization study of ball-separator design. The effects of varying geometric parameters of the separator were studied, along with different friction and traction coefficients and operating speeds of the bearing. The computer analysis indicated that the ball-pocket collision forces are significantly affected by the geometry of the ball separator (particularly the working clearances), and are also sensitive to the traction and friction coefficients of the materials and lubricant system. Author

A85-26019
LASER ANEMOMETRY - BEYOND LABORATORY TECHNIQUES [ANEMOMETRIE LASER - AU-DELA DE LA TECHNIQUE DE LABORATOIRE]
A. HECKEL (Crouzet, S.A., Division Aerospatial, Valence, Drome, France) L'Aeronautique et l'Astronautique (ISSN 0001-9275), no. 107, 1984, p. 61-64. In French.

Laser Doppler anemometry (LDA) which is of interest in laboratory velocity measurements due to its remote sensing capabilities, is discussed. Two kinds of LDA exist: one based on the Doppler effect which includes the reference beam technique and the fringe technique, and one based on the time-of-flight measurement. The differences between laser anemometry techniques in the laboratory and in the atmosphere are explored. It is shown that in the laboratory, wavelengths of the visible spectrum are used, whereas in atmospheric anemometry, infrared wavelengths are used because of their better penetration capability and safety. The work involved in order to modify laboratory anemometers for use as portable anemometers includes improvements in sensitivity and resistance. Results of an airborne experiment are presented. LDA has applications in velocity measurements on aircraft, in the detection of wind gradients and turbulences, and in wind-shear measurement near runways. M.D.

A85-26249
SIMULATING 'THE RIGHT STUFF'
M. A. FISCHETTI and C. TRUXAL IEEE Spectrum (ISSN 0018-9235), vol. 22, March 1985, p. 38-47.

The present investigation is mainly concerned with simulators employed in the training of pilots in the Armed Services and other

military personnel, taking into account certain problems and approaches for overcoming them. The use of simulators for training programs has a number of advantages compared to training involving a use of the actual equipment. Questions arise, however, regarding the value of such a training. Thus, it has been said that, while simulators gave students practice in manual skill, they could not teach them to handle the stress of being in a real aircraft. It has also been argued that some tasks are not represented accurately enough for proper training. In response to this criticism, the capacity of the simulators has been greatly improved. However, this development leads to problems related to the cost of simulator training. Attention is given to better visuals for flight simulators, the current generation of graphics imagery and expected improvements, possibilities for reducing flight simulator costs, and advances due to progress in microcomputers. G.R.

N85-17949*# Southern Methodist Univ., Dallas, Tex.
SOME STRUCTURAL FEATURES OF UNSTEADY SEPARATING TURBULENT SHEAR FLOWS
R. L. SIMPSON *In* AFOSR Proc. of the Workshop on Unsteady Separated Flow p 90-96 1984
(Contract NSG-2354)
(AD-P004164) Avail: NTIS HC A09/MF A01 CSCL 20D

Some physical features of unsteady separating turbulent boundary layers are presented for practical Reynolds numbers and reduced frequencies for helicopter and turbomachinery flows. Upstream of detachment in moderate amplitude flows, the flow is quasi steady, i.e., the phase averaged flow is described by the steady-free stream flow structure. Results show that oscillation waveform and amplitude strongly influence the detached flow behavior. GRA

N85-17958# University of Southern California, Los Angeles.
GENESIS OF UNSTEADY SEPARATION
C. M. HO *In* AFOSR Proc. of the Workshop on Unsteady Separated Flow p 165-168 1984
(Contract F49620-82-K-0019)
(AD-P004173) Avail: NTIS HC A09/MF A01 CSCL 20D

Unsteady separation is a problem of great technical importance but with little basic understanding. A very limited amount of experimental data is available because of the difficulties involved in measuring the temporally evolving separated flows. In this presentation we first examine the flow field of a downstream moving separation in detail and then we explore the possibility of applying the learned physical mechanism to the upstream moving separation problems and to the unsteady separation on a lifting surface.
Author (GRA)

N85-17976# Rediffusion Simulation, Inc., Arlington, Tex.
THE USE OF LASERS IN WIDE-ANGLE VISUAL SYSTEMS
B. BARBER *In* AF Human Resources Lab. The IMAGE 3 Conf. Proc. p 223-237 Sep. 1984
(AD-P004322) Avail: NTIS HC A22/MF A01 CSCL 01B

Performance requirements and associated problems of wide-angled displays are discussed, and possible solutions based on the use of lasers outlined. Included, is a helmet-mounted projector system currently being built for the Naval Training Equipment Center. Author (GRA)

N85-18200# Joint Publications Research Service, Arlington, Va.
USSR REPORT: ENGINEERING AND EQUIPMENT Abstracts Only
10 Jan. 1985 41 p Transl. into ENGLISH from various Russian articles
(JPRS-UEQ-85-001) Avail: NTIS HC A03

Various topics in the areas of engineering and equipment are investigated in this U.S.S.R. report. Topics covered include: (1) turbine and engine design; (2) navigation and guidance systems; (3) fluid mechanics; and (4) mechanics of solids.

N85-18204# Joint Publications Research Service, Arlington, Va.
INFLUENCE OF NORMALIZED FREQUENCY ON TIME-DEPENDENT AERODYNAMIC CHARACTERISTICS OF VANE BLADING PROFILES Abstract Only
V. I. GNESIN and S. V. YERSHOV *In its* USSR Rept.: Eng. and Equipment (JPRS-UEQ-85-001) p 15-16 10 Jan. 1985 Transl. into ENGLISH from Probl. Mashinostr. (Kiev), no. 19, Nov. 1983 p 88-91
Avail: NTIS HC A03

Time dependent flow through mutually moving vane blading profiles is characterized by the frequency k = fz sub 1 b/2V, where f is the angular velocity of the rotor, z sub 1 is the number of blades of the fixed cascade, b is the working blade chord and V is the relative flow velocity. Different normalized frequencies can be obtained by changing the angular velocity fz sub 1 of the step nonuniformity wave along the casacade front in the gap between the guides and the rotor; fz sub 1 = 0 applies to the quasisteady state flow hypothesis. This paper proposes a method of specifying the normalized frequency, which ascertains its impact on the time dependent parameters of the vane blading while observing Mach number similitude and geometric similitude. A complete system of time dependent equations of gas dynamics and the explicit finite difference scheme of S. K. Godunov is applied to the case of two mutually moving cascades with the following characteristics in a normalized frequency range of k = 0 to 6; z sub 1 = 66, z sub 2 for the working cascade (rotor) = 110, relative nozzle cascade step is t sub 1/b sub 1 = 0.49, that of the rotor is t sub 2 b sub 2 = 0.57, the rotor speed is 157 rad/sec and the ratio of the static pressure per stage to the total pressure is p sub 2/p sub 0 = 0.16. B.W.

N85-18206# Joint Publications Research Service, Arlington, Va.
ON ONE DESIGN PRINCIPLE OF SURGE PROTECTOR FOR GAS TURBINE ENGINE COMPRESSOR Abstract Only
M. M. SHAKIRYANOV *In its* USSR Rept.: Eng. and Equipment (JPRS-UEQ-85-001) p 17 10 Jan. 1985 Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved.: Aviats. Tekhn. (USSR), no. 3, Jul. - Sep. 1983 p 97-99
Avail: NTIS HC A03

Gas dynamic instability in the compressors of gas turbine engines, i.e., surging, can cause the failure of the compressor and the entire engine. The design is described for a surge detection and correction system based on the parameter L sub a/k(C sub a) flow parameters K is a throttling resistance coefficient. L sub a is expressed in terms of the length and cross section of the intake pipe and the air density in the pipe; C sub a is in terms of the air density and volume and the speed of sound following the delivery pipe. A specific algorithm is derived which describes the gas dynamic state of the engine and a block diagram of an antisurging system is presented. The proposed protector detects surging quickly with a sharp change in the temperature or pressure at the engine intake. When surge oscillations are due to other factors, the pressure increase following the compressor changes, which also actuates the protector. R.S.F.

N85-18209# Joint Publications Research Service, Arlington, Va.
IMPROVEMENT OF GAS TURBINE ENGINE PERFORMANCE BY WATER INJECTION INTO TURBINE COOLING AIR Abstract Only
G. M. GORELOV, V. P. DANILCHENKO, and V. Y. REZNIK *In its* USSR Rept.: Eng. and Equipment (JPRS-UEQ-85-001) p 19-20 10 Jan. 1985 Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved.: Aviats. Tekhn. (USSR), no. 3, Jul. - Sep. 1983 p 19-20 Original language document was announced in IAA as A84-25569
Avail: NTIS HC A03

Two methods of reducing the temperature of the cooling air in a high-pressure turbine, one involving injection of water and the other the use of a heat exchanger, are analyzed. It is shown that even for moderate relative cooling depths of the blades (0.4-0.5), the injection of water into the cooling system makes it possible to substantially reduce the specific fuel consumption of the engine. The use of a heat exchanger, however, leads to a noticeable

increase in fuel consumption during cruising flight due to hydraulic losses. V.L. (IAA)

N85-18212# Joint Publications Research Service, Arlington, Va.
CALCULATING HEAT TRANSFER COEFFICIENTS FOR TURBINE PROFILES TAKING SURFACE CURVATURE AND ELEVATED FLOW TURBULENCE INTO ACCOUNT Abstract Only
V. D. SOVERSHENNYY and S. P. CHIKOVA *In its* USSR Rept.: Eng. and Equipment (JPRS-UEQ-85-001) p 21-22 10 Jan. 1985 Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved.: Aviats. Tekhn. (USSR), no. 3, Jul. - Sep. 1983 p 38-42 Original language document was announced in IAA as A84-25561
Avail: NTIS HC A03

Local coefficients of heat transfer to a turbine profile are determined with allowance for surface curvature and high flow turbulence by integrating numerically partial differential equations for the boundary layer. It is assumed that the boundary layer contains zones of laminar, transition, and turbulent flows. A closed system of equations is obtained by using full transport coefficients. The heat transfer coefficients calculated for turbulences of 0.45 and 5.9% are found to be in good agreement with experimental data. V.L. (IAA)

N85-18213# Joint Publications Research Service, Arlington, Va.
CORRECTION OF ENGRAVING STAMP FOR FORMING BLANKS OF GAS TURBINE ENGINE BLADES Abstract Only
V. Y. ZYKOV, A. F. PAVLOV, L. T. KAZAKOVA, and F. S. YUNUSOV *In its* USSR Rept.: Eng. and Equipment (JPRS-UEQ-85-001) p 22 10 Jan. 1985 Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved.: Aviats. Tekhn. (USSR), no. 3, Jul. - Sep. 1983 p 27-32 Original language document was announced in IAA as A84-25559
Avail: NTIS HC A03

In precision die forging of gas turbine blades it is essential that the configuration of the die be corrected to allow for the deformations resulting from residual stresses. A correction procedure is proposed here which involves developing a mathematical model describing the surface of the blade, calculating the coordinates of the forged blank profile, calculating the coefficients of the polynomials describing the blank profile, and correcting the impression of the die. The correction algorithm has been implemented in software written in FORTRAN 4. V.L. (IAA)

N85-18215# Joint Publications Research Service, Arlington, Va.
USE OF BRAKING STAGES FOR CONTROL OF TURBINE SPEED Abstract Only
Y. M. POGODIN, A. M. TOPUNOV, and A. I. CHERNOV *In its* USSR Rept.: Eng. and Equipment (JPRS-UEQ-85-001) p 23-24 10 Jan. 1985 Transl. into ENGLISH from Sudostr. (Leningrad), no. 6, Jun. 1984 p 20-22
Avail: NTIS HC A03

The external characteristics of small turbines on ships can be varied through reduction of the limiting specific speed. The object is to obtain a steep efficiency speed curve asymmetric with respect to the maximum efficiency point. A special device to cut into the operation as required was developed. The device is a brake inserted into the diaphragm of an intermediate guide stage between two runner stages. It consists of two adjoining ring segments, a shorter one which carries vanes oriented relative to the nozzle for maximum efficiency in the base mode of operation, and another approximately 40% longer which carries vanes with their concave side in the direction of rotation for braking. The theoretical principle was tested with two such braking stages in a turbine operating at two speed levels. E.A.K.

N85-18218# Joint Publications Research Service, Arlington, Va.
TURBULENT JET FLOW IN A CHANNEL WITH A CIRCULATION REGION Abstract Only
G. A. GLEBOV and V. N. PETROV *In its* USSR Rept.: Eng. and Equipment (JPRS-UEQ-85-001) p 30 10 Jan. 1985 Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved.: Aviats. Tekhn. (USSR), no. 3, Jul. - Sep. 1983 p 104-105 Original language document was announced in IAA as A84-25583
Avail: NTIS HC A03

An approximation method is proposed for calculating flows resulting from the interaction between a turbulent jet and a slipstream inside a duct, including the case where a back stream is formed near the wall. In accordance with the approach proposed here, the velocity profile in the mixing region is determined using the well known method of the polynomial approximation of the Reynolds shear stress profile in the duct cross-sections. The flow parameters are then determined using integral equations of flow rate and momentum. The results obtained using the approximation method are found to be in good agreement with experiment data. V.L. (IAA)

N85-18234 British Broadcasting Corp., Kingswood (England). Engineering Div.
THE SUSCEPTIBILITY OF AERONAUTICAL NAVIGATIONAL AIDS TO INTERFERENCE FROM ADJACENT-BAND BROADCAST TRANSMISSIONS
G. H. MILLARD Nov. 1984 18 p refs
(BBC-RD-1984/12) Avail: BBC, Kingswood Warren, Tadworth, Surrey, Engl.

Measurements to determine the susceptibility of some airborne navigation receivers to interference from VHF/FM sound transmissions are described. The measurements were designed to investigate both the response to interference radiated in-band and to intermodulation in the receivers. R.S.F.

N85-18282 Georgia Inst. of Tech., Atlanta.
ANALYSIS OF SUDDEN EXPANSION FLOW IN A TWO-DIMENSIONAL DUCT WITH AND WITHOUT SIDE-WALL INJECTION USING THE K-EPSILON TURBULENCE MODEL Ph.D. Thesis
J. C. R. RICHARDSON 1984 356 p
Avail: Univ. Microfilms Order No. DA8424628

Cold flow modeling of the solid fuel ramjet combustor flow field was carried out by numerical analysis. An incompressible, two dimensional turbulent backward facing step flow with and without gas injection through the step inside wall was used to simulate the combustor flow. Mean velocities, pressure turbulence kinetic energy, energy dissipation rate, mean concentrations of the injected species and the time averaged turbulent fluctuations of the concentrations were calculated. The Reynolds stresses were derived from the predictions. For the gas injection case, three gases were considered. A range of uniform injection rates were used in the analysis. The predictions by the TEACH-GT code of the flow field without gas injection were compared with three different sets of experimental data. Reattachment length, mean velocities, turbulence intensities, and Reynolds stresses were the variables used for comparisons. Dissert. Abstr.

N85-18287 Notre Dame Univ., Ind.
TURBULENT BOUYANT FLOW AND PRESSURE VARIATIONS AROUND A CIRCULAR CYLINDER IN A CROSS UNIFORM FLOW NEAR THE GROUND Ph.D. Thesis
H. S. KOU 1984 247 p
Avail: Univ. Microfilms Order No. DA8425272

A numerical analysis is made to improve our physical understanding of the turbulent buoyant flow near a circular cylinder close to the ground and also to determine the corresponding pressure variations and oscillations at the cylinder surface. It is based on an upwind finite difference scheme to solve the governing equations with a combination of Cartesian and cylindrical coordinates. The model developed is then used to simulate the shear flow over an aircraft fuselage immersed in a nearby fire on the ground. The results in terms of the velocity, temperature, smoke

concentration, and pressure fields are obtained over a range of parameters including the fire size, strength and location, the fuselage size and elevation, and the shear flow velocity and distribution. A major influence on the physical phenomenon is the relative strength of buoyant flow due to the fire as compared to that of the shear flow. Dissert. Abstr.

N85-18292*# Pennsylvania State Univ., State College. Applied Research Lab.
THE BOUNDARY LAYER ON COMPRESSOR CASCADE BLADES Semiannual Progress Report, 1 Jun. - 1 Dec. 1984
S. DEUTSCH and W. C. ZIERKE 1984 47 p refs
(Contract NSG-3264)
(NASA-CR-174369; NAS 1.26:174369) Avail: NTIS HC A03/MF A01 CSCL 20D

The flow field about an airfoil in a cascade at chord Reynolds number (R sub C) near 50,000. The program is experimental and combines laser Doppler anemometry (LDA) with flow visualization techniques in order to obtain detailed flow data (e.g., boundary layer profiles, points of separation and the transition zone) on a cascade of highly-loaded compressor blades. The information provided is to serve as benchmark data for the evaluation of current and future compressor cascade predictive models, in this way aiding in the compressor design process. The completed pressure surface mean velocity profiles, as well as two detailed near wake velocity profiles, all at a single incidence angle are provided. B.G.

N85-18311# LTV Aerospace and Defense Co., Dallas, Tex. Vought Missiles and Advanced Programs Div.
MOBILE ACCELERATOR NEUTRON RADIOGRAPHY SYSTEM Final Report, Feb. 1978 - Dec. 1983
W. E. DANCE, S. F. CAROLLO, and H. M. BUMGARDNER Watertown, Mass. Army Materials and Mechanics Research Center Oct. 1984 149 p
(Contract DAAG46-78-C-0007)
(AD-A148808; REPT-3-56000/4R-169; AMMRC-TR-84-39) Avail: NTIS HC A07/MF A01 CSCL 14E

The use of neutron radiography for the inspection and maintenance of large structures such as aircraft has been delayed by the absence of a mobile system particularly suited to the requirements of field use. This report describes the production, extensive field testing, evaluation and disposition of the first mobile neutron radiography system to satisfy the majority of requirements for field use. The system is based upon the concept of a mobile on-off neutron radiography system based on a sealed-tube ion accelerator as neutron source demonstrated earlier by the Vought Corporation. Primary features of the system are its self-propelled mobility, versatile positioning capability scaled to Army helicopter dimensions, an on-off beam capability, exposure capability measured in minutes, and suitability for AMMRC laboratory and field use. Included in the report are a description of all components of the system, an evaluation of the operation of the system, an evaluation of its radiographic capabilities, a description of installation elements for the AMMRC site, and recommendations for next-generation systems. Author (GRA)

N85-18348# AiResearch Mfg. Co., Torrance, Calif.
OPEN-CYCLE CENTRIFUGAL VAPOR-COMPRESSION HEAT PUMP Annual Report, Mar. 1983 - Feb. 1984
T. L. ILES, L. R. BURGEIER, and J. E. STANKO Apr. 1984 72 p Sponsored by Gas Research Inst.
(PB85-113405/GAR; GRI-84/0085) Avail: NTIS HC A04/MF A01 CSCL 13A

The design and an open-cycle high-lift contrifugal steam compressor system that can be efficiently retrofitted to existing multi-effect and high-temperature differential evaporators while maintaining the cost benefits of a single-stage centrifugal compressor are described. Test activities condusted to demonstrate the energy saving and cost benefits of driving the compressor with a natural-gas fueled gas turbine engine are report. The turbine exhaust will be used for final drying of the product that was evaporated. GRA

N85-18375*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NASA LEWIS RESEARCH CENTER/UNIVERSITY GRADUATE RESEARCH PROGRAM ON ENGINE STRUCTURES
C. C. CHAMIS 1985 18 p Presented at the 30th Intern. Gas Turbine Conf. and Exhibit, Houston, Tex., 17-21 Mar. 1985; *sponsored by ASME*
(NASA-TM-86916; E-2393; NAS 1.15:86916) Avail: NTIS HC A02/MF A01 CSCL 20K

NASA Lewis Research Center established a graduate research program in support of the Engine Structures Research activities. This graduate research program focuses mainly on structural and dynamics analyses, computational mechanics, mechanics of composites and structural optimization. The broad objectives of the program, the specific program, the participating universities and the program status are briefly described. Author

N85-18396# Sandia Labs., Albuquerque, N. Mex.
ALTERNATIVE SHOCK CHARACTERIZATIONS FOR CONSISTENT SHOCK TEST SPECIFICATIONS
T. J. BECA *In* Shock and Vibration Information Center The Shock and Vibration Bull. 54, Pt. 2 p 109-130 Jun. 1984 refs Previously announced as N84-13619
Avail: SVIC, Code 5804, Naval Research Lab., Washington, D.C. 20375 CSCL 20K

Three methods of analyzing transient acceleration time histories which represent promising alternatives to shock response spectra as the basis for deriving consistent shock test specifications were evaluated. The limitations of shock spectra are discussed. The shock analysis techniques include: (1) ranked peaks in the acceleration time history; (2) root mean square acceleration as a function of time; and (3) root mean square acceleration as a function of frequency. These shock characterizations provide the parameters necessary to develop a new shock test specification technique. The new method of shock test specification is demonstrated using drop table and decaying sinusoid shock test inputs. Test specifications using the standard method of shock spectrum enveloping are also derived. Beneficial aspects of utilizing these alternative shock anaysis techniques instead of shock spectra are presented and the evaluation of conservatism associated with different shock test specification techniques is emphasized. Author

N85-18410# Ibaraki Univ., Hitachi (Japan).
DISCRETE MODIFICATIONS TO CONTINUOUS DYNAMIC STRUCTURAL SYSTEMS
Y. OKADA, B. P. WANG (Texas Univ., Arlington), and W. D. PILKEY (Virginia Univ., Charlottesville) *In* Shock and Vibration Information Center The Shock and Vibration Bull. 54, Pt. 3 p 29-34 Jun. 1984 refs
Avail: SVIC, Code 5804, Naval Research Lab., Washington, D.C. 20375 CSCL 20K

The problem of introducing discrete elements such as springs or masses continuous dynamic systems is considered. A method is developed for the efficient analysis of such modified systems. After a transfer matrix analysis of the original system, appropriate transfer matrices are condensed and stored. Then the effect of the discrete modifications is introduced. The proposed technique is applied to a helicopter model. E.A.K.

N85-18435# Rolls-Royce Ltd., Derby (England).
STUDY OF RESIDUAL STRESSES INTRODUCED INTO TA6ZRD (685) CYLINDERS BY QUENCHING
S. DENIS (Ecole des Mines, Nancy) 14 Nov. 1984 23 p refs Transl. into ENGLISH of French Doc. Rept. Trans-16684/TLT-00921
(PNR-90240; TRANS-16684/TLT-00921) Avail: NTIS HC A02/MF A01

A model for predicting the residual stresses introduced into titanium alloy cylinders by quenching was developed. The model shows that the first order stress level is relatively low under practical alloy treatment conditions and that the core tensile stresses are the result of a shrinkage effect due to surface zones under

compression and are not more than a few millimeters thick. Residual stresses are due to plastic deformation caused by quenching from the commencement of cooling when the alloy is still in the beta phase in the center of the part. It is advisable to prevent the deformation of such stresses by using a quenching technique which gives fairly slow cooling at high temperatures provided that such cooling is compatible with the metallurgy of the alloy. Removal of a relatively thin layer of metal by machining tends to release the residual tensile stresses in the center.
Author (ESA)

N85-19269# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
PROPAGATION INFLUENCES ON DIGITAL TRANSMISSION SYSTEMS: PROBLEMS AND SOLUTIONS
J. BLYTHE, ed. Loughton, England Oct. 1984 510 p refs In ENGLISH and FRENCH Symp. held in Athens, 4-8 Jun. 1984
(AGARD-CP-363; ISBN-92-835-0367-8) Avail: NTIS HC A22/MF A01

Papers and session summaries are presented which examine propagation effects having an influence on the performance of digital systems, including: noise levels, and system sensitivities to noise; man-made interference types and system sensitivities to man-made interference; and multipath effects; dispersion, fading rates, medium coherent bandwidth, channel models, and system sensitivities to these. Systems designed to counter these effects, including the various kinds of adaptive systems are also reviewed.

N85-19273# Rome Air Development Center, Griffiss AFB, N.Y.
EHF AIR-TO-AIR COMMUNICATIONS
P. N. EDRAOS *In* AGARD Propagation Influences on Digital Transmission Systems 16 p Oct. 1984 refs
Avail: NTIS HC A22/MF A01

The use of the extremely high frequency (EHF) oxygen-absorption frequency band for low-detectability air-to-air communications has been proposed at various times; the development of such an EHF short-range air-to-air communications system is considered. The protection to the communications system is provided by the cumulative oxygen absorption characteristics of the atmospehre. System considerations are dealt with parametrically; the effects of aircraft velocity, altitude, antenna coverage, transmitter power, and so forth, are discussed with regard to impact on range, frequency, acquisition time, data rate, etc. A baseline system is submitted; link power budget calculations are made for the baseline, resulting in estimates for maximum allowable attenuation; system performance is assessed for a number of situations. Emphasis is on communications and the problems involved in the design and implementation of an EHF air-to-air digital voice system, concentrating on the propagation influences and constraints. M.G.

N85-19359 Minnesota Univ., Minneapolis.
EFFECT OF INCLINATION, TRANSVERSE INTERTIP SPACING, AND LOGITUDINAL PITCH ON CROSSFLOW HEAT TRANSFER FROM AN ARRAY OF FINNED TUBES Ph.D. Thesis
F. SAMIE 1984 170 p
Avail: Univ. Microfilms Order No. DA8424739

Experiments were performed to investigate the heat transfer characteristics of a circumferentially finned, crossflow heat exchanger. Three aspects of the heat transfer were examined. The first was the effect of inclining a single tube at an angle of attack to the crossflow. The secoind dealt with the transverse intertip spacing S sub T in a single-row heat exchanger, while the third focused on the longitudinal intertip spacing S sub L and array pattern (in-line or staggered) in a double-row heat exchanger. For the entire investigations, the freestream Reynolds number ranged from 7,500 to 32,000. The Nusselt number for the single tube displayed a moderate increase with increasing inclination angle, about 20 percent for a 40 degree inclination. The single-row Nusselt number and pressure drop increased rapidly with decreasing S sub T at a fixed freestream Reynolds number but was less sensitive to S sub T at fixed minimum-area Reynolds number. Dissert. Abstr.

N85-19363*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL STUDY OF CERAMIC COATED TIP SEALS FOR TURBOJET ENGINES
T. J. BIESIADNY, G. A. KLANN (Army Research and Technology Labs., Cleveland), E. S. LASSOW (Howmet Corp., Whitehall, Mich.), M. MCHENRY (Army Aviation Logistics School, Fort Eustis, Va.), G. MCDONALD, and R. C. HENDRICKS 1985 22 p refs Presented at the 9th Ann. Conf. on Composites and Advan. Ceram. Mater., Cocoa Beach, Fla., 20-24 Jan. 1985; sponsored by the American Ceramic Society
(NASA-TM-86939; E-2457; NAS 1.15:86939; USAAVSCOM-TM-84-C-2) Avail: NTIS HC A02/MF A01 CSCL 20D

Ceramic gas-path seals were fabricated and successfully operated over 1000 cycles from flight idle to maximum power in a small turboshaft engine. The seals were fabricated by plasma spraying zirconia over a NiCoCrAlX bond boat on the Haynes 25 substrate. Coolant-side substrate temperatures and related engine parameters were recorded. Post-test inspection revealed mudflat surface cracking with penetration to the ceramic bond-coat interface. Author

N85-19365*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A MULTISTAGE TIME-STEPPING SCHEME FOR THE NAVIER-STOKES EQUATIONS Final Report
R. C. SWANSON and E. TURKEL Feb. 1985 37 p refs
(Contract NAS1-17070)
(NASA-CR-172527; ICASE-84-62; NAS 1.26:172527) Avail: NTIS HC A03/MF A01 CSCL 20D

A class of explicit multistage time-stepping schemes is used to construct an algorithm for solving the compressible Navier-Stokes equations. Flexibility in treating arbitrary geometries is obtained with a finite-volume formulation. Numerical efficiency is achieved by employing techniques for accelerating convergence to steady state. Computer processing is enhanced through vectorization of the algorithm. The scheme is evaluated by solving laminar and turbulent flows over a flat plate and an NACA 0012 airfoil. Numerical results are compared with theoretical solutions or other numerical solutions and/or experimental data. Author

N85-19368# Department of the Air Force, Washington, D.C.
VIBRATION ISOLATED COLD PLATE ASSEMBLY Patent Application
R. T. DOLBEARE, inventor (to Air Force) 31 Oct. 1984 12 p
(AD-D011444; US-PATENT-APPL-SN-666786) Avail: NTIS HC A02/MF A01 CSCL 20K

A vibration isolated cold plate assembly is described having a cold plate cover and a base interconnected together by means of a pair of elongated, rectangular-shaped elements made of elastomeric material. The elongated elements form there between a channel through which a coolant flows in communication with a plurality of cooling fins which are secured only to the undersurface of the cold plate cover. Electronic components are mounted on the upper surface of the cold plate cover and are held thereon in a vibration isolated environment while simultaneously having any excess heat dissipated therefrom. Author (GRA)

N85-19378# Massachusetts Inst. of Tech., Cambridge.
STUDY OF DEPOSITION CONTROL USING TRANSPIRATION Technical Progress Report
J. F. LOUIS and H. KOZLU Oct. 1984 6 p
(Contract DE-AC21-83MC-20334)
(DE85-002339; DOE/MC-20334/T12) Avail: NTIS HC A02/MF A01

The introductory experimental phase of a study to determine the conditions under which transpiration may be used to avoid the deposition of small particles was undertaken. The application of this work is to control the deposition of small particles over a

surface kept at a temperature below the melting point of compounds likely to exist in the combustion products. Laser beam attenuation methods were used to measure the distribution of glass beads, ranging in size from 1 to 37 microns in a wind tunnel's flow atmosphere. The method of laser beam attenuation measurements is sound and gives indications of its suitability for continued use in modeling applications of this nature. G.L.C.

N85-19380# Oak Ridge National Lab., Tenn.
OPTIMIZATION OF A GROUND COUPLED HEAT PUMP
V. D. BAXTER and M. A. CATAN (Brookhaven National Lab.) 1984 12 p refs Presented at the 7th Heat Pump Technol. Conf., Tulsa, Okla., 15 Oct. 1984
(Contract DE-AC02-76CH-00016; DE-AC05-84OR-21400)
(DE85-000273; CONF-8410153-1) Avail: NTIS HC A02/MF A01

A cooperative analytical project has optimized a horizontal ground coil heat pump system for the Pittsburgh climate. This is the first step in the exploration of several advanced designs including various ground coil devices and advanced heat pump components. The project made use of new and existing design tools to simulate system performance and determine first cost. The system life cycle cost was minimized while constraining the system to meet the design day cooling load using a function minimizing program. Among the system parameters considered were: air-to-refrigerant frontal area, air-to-refrigerant fin pitch, air-to-refrigerant air flowrate, compressor displacement, liquid-to-refrigerant coil length, liquid-to-refrigerant coil diameter, ground coil fluid flowrate, ground coil length, and ground coil depth are described. DOE

N85-19417*# Texas A&M Univ., College Station. Turbomachinery Labs.
THEORY VERSUS EXPERIMENT FOR THE ROTORDYNAMIC COEFFICIENTS OF ANNULAR GAS SEALS. PART 1: TEST FACILITY AND APPARATUS
D. W. CHILDS, C. E. NELSON, C. NICKS, J. SCHARRER, D. ELROD, and K. HALE 1983 32 p refs
(Contract NAS8-33716; F49620-82-K-0033)
(NASA-CR-174409; NAS 1.26:174409) Avail: NTIS HC A02/MF A01 CSCL 11A

A facility and apparatus are described for determining the rotordynamic coefficients and leakage characteristics of annular gas seals. The apparatus has a current top speed of 8000 cpm with a nominal seal diameter of 15.24 cmn (6 in). The air supply unit yields a seal pressure ratio of approximately 7. An external shaker is used to excite the test rotor. The capability to independently calculate all rotordynamic coefficients at a given operating condition with one excitation frequency are discussed. Author

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GEOSCIENCES

Includes geosciences (general); earth resources; energy production and conversion; environment pollution; geophysics; meteorology and climatology; and oceanography.

A85-24090#
ON MATCHING AMONG WIND TURBINES, LOADS AND SITES
H. GAO (University of Science and Technology of China, Hefei, People's Republic of China) Journal of Engineering Thermophysics, vol. 5, Aug. 1984, p. 230-232. In Chinese, with abstract in English.

This paper studies the matching among wind turbines, loads and sites. The optimum velocity ratio between the wind turbine and load is discussed. A capacity factor of wind turbine is defined. The optimal values of starting wind speed are given. Author

A85-24903
PULSED DOPPLER RADARS FOR WEATHER OBSERVATION AND FLIGHT SAFETY ENHANCEMENT
P. R. MAHAPATRA (Indian Institute of Science, Bangalore, India) IN: International Radar Symposium, Bangalore, India, October 9-12, 1983, Proceedings . Bangalore, India, Institution of Electronics and Telecommunication Engineers, 1983, p. 507-512. refs

The advantages of weather observation by Doppler radar are discussed. Methods of estimating Doppler spectral moments are outlined. Special areas and problems associated with coherent radar observation of weather phenomena are touched upon. The usefulness of a national network of Doppler weather radars is brought out. Weather effects on aviation safety are outlined. Doppler weather radar is effective in detecting windshear and turbulence in air terminal areas. System aspects of air weather radars are noted. Author

A85-25594
ULTRASHORT-WAVE RADAR SUBSURFACE SOUNDING OF SEA ICE AND EARTH COVERS [RADIOLOKATSIONNOE PODPOVERKHNOSTNOE ZONDIROVANIE MORSKOGA L'DA I ZEMNYKH POKROVOV NA UL'TRAKOROTKIKH VOLNAKH]
M. I. FINKELSHTEIN Akademiia Nauk SSSR, Vestnik (ISSN 0002-3442), no. 9, 1984, p. 20-28. In Russian.

N85-17970# Michigan Univ., Ann Arbor.
AUTOMATED AND INTERACTIVE DATA BASE GENERATION
B. OHMANN and B. FOWLER *In* AF Human Resources Lab. The IMAGE 3 Conf. Proc. p 109-124 Sep. 1984
(AD-P004316) Avail: NTIS HC A22/MF A01 CSCL 08B

Until the mid 70's, visual simulation had been limited to small areas, primarily airfields and aircraft carriers, and complexity of the data bases was quite restricted due to the limited capacity of the image generators. Today training simulators require realistic terrain and gaming areas encompassing hundreds of thousands of miles, yet need accurate highly detailed insets for nap-of-the-earth flights. This paper will discuss improvements in data base generation technology which have allowed gaming area realism to keep pace with rapid advancement of Image Generator capabilities. Author (GRA)

N85-17971# Evans and Sutherland Computer Corp., Salt Lake City, Utah.
GEOGRAPHIC SUBDIVISION AND TOP LEVEL DATA STRUCTURES, COLUMBUS, MAGELLAN, AND EXPANDING CIG (COMPUTER IMAGE GENERATION) HORIZONS
L. C. CLARK and M. R. PAFFORD *In* AF Human Resources Lab. The IMAGE 3 Conf. Proc. p 129-149 Sep. 1984
(AD-P004317) Avail: NTIS HC A22/MF A01 CSCL 08B

Recent advances in CIG technology have made it possible to accommodate the production of very large map correlate visual data bases of homogeneous feature density. Inherent in the top level design of a visual data base is a strategy for geographic subdivision. This strategy is implemented in a top level data structure which is processed by the CIG hardware to determine which portions of a visual data base to display. The top level data structure also dictates how the visual data base must be modeled. Since a visual data base is typically constructed in a 3D Cartesian coordinate system, the problems historically associated with round to flat Earth map projections are also encountered in top level data structures. There are also constraints imposed by the CIG system used. We will review the standard methods of geographic subdivision and discuss their limitations when applied to training requirements. We will explore a new strategy for geographic subdivision of a visual data base utilizing the military UTM and UPS grid systems and the leverage derived from innovative modeling techniques; i.e., semiautomatic generation of terrain DLMS data, and strategies for reusing common scene elements. We will discuss how these concepts are currently being implemented into visual data base design and will show how an extrapolation of these trends can be applied to the problem of whole Earth navigation training. GRA

N85-18447# Sandia Labs., Albuquerque, N. Mex.
TEST PLAN FOR THE FOREST-ECHO EXPERIMENT
D. A. JELINEK Jul. 1984 12 p refs
(Contract DE-AC04-76DP-00789)
(DE84-017175; SAND-83-2195) Avail: NTIS HC A02/MF A01

A test plan to determine the characteristics of the average radar echo from a number of forested terrains is described. The data required to do this will be obtained by using a very narrow pulse width (20 ns) radar and associated hardware on board a helicopter. Data will be taken as the helicopter makes straight and level passes over each terrain at a number of altitudes. Both deciduous and conifer forests will be overflown at different times of the year to determine the effect of seasonal changes. The hardware that will be used and the procedure that will be followed to gather the data are described. The theoretical statistical characteristics of the radar's video output and the amount of intrapulse and interpulse correlation expected are given. DOE

N85-18474# JRB Associates, McLean, Va.
ENVIRONMENTAL AND ENERGY AUDITS OF AIR FORCE GOVERNMENT OWNED-CONTRACTOR OPERATED INSTALLATIONS
B. J. BURGHER, J. D. MARGOLIS, and D. E. SANDERS *In* American Defense Preparedness Association Proc. of the Environ. Systems Symp. (13th) p 37-43 22 Mar. 1984
(AD-P004138) Avail: NTIS HC A14/MF A01 CSCL 13B

Environmental and energy audits conducted for the Air Force Systems Command, Aeronautical Systems Division (ASD) by JRB Associates of McLean, Virginia resulted in substantial environmental benefits and identified opportunities for energy and material conservation and recovery. This effort has allowed ASD to target resources, substantiate funding requests, develop remedial strategies and track progress of environmental and energy management activities. This paper presents a review of the study completed for ASD in October, 1983. Author (GRA)

N85-18475# Hart (Fred C.) Associates, Inc., New York, N.Y.
STRATEGIES FOR PREPARING AND SUBMITTING A PART B APPLICATION FOR A DOD FACILITY
W. K. TUSA *In* American Defense Preparedness Association Proc. of the Environ. Systems Symp. (13th) p 44-55 22 Mar. 1984
(AD-P004139) Avail: NTIS HC A14/MF A01 CSCL 13B

The United States Environmental Protection Agency (EPA) has issued regulations to ensure the protection of human health and the environment through the appropriate management of hazardous wastes under Subtitle C of the Resource Conservation and Recovery Act of 1976 (RCRA). Those regulations require most facilities that treat, store or dispose of hazardous waste to obtain a RCRA permit. The application for this permit consists of two parts, Part A and Part B. Facilities in existence before November 1980 were required to submit the Part A application by November 19, 1980. These facilities were granted interim status under the regulations, which permits them to continue operations until final administrative action is taken on their permit. This requires the submittal of a detailed Part B permit application. The permit application must contain sufficient information to assure EPA that the facility design, operation and proposed closure and post-closure plans will satisfy the applicable permitting standards. The Part B process is complex, uncertain and inherently subjective. While the level of uncertainties is decreasing, the applicant can minimize the uncertainties by aggressively managing the process. The applicant must plan his strategy, pay particular attention to details and follow through daily if necessary. The long-term cost savings alone should justify the increased attention given to management of the Part B application process. GRA

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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.

A85-24085
AN EMPIRICAL STUDY OF THE METHODOLOGY FOR REAL-TIME AIR TRAFFIC CONTROL SYSTEM SIMULATION TESTING
E. P. BUCKLEY, B. D. DEBARYSHE (FAA, Technical Center, Atlantic City, NJ), N. HITCHNER (Computer Sciences Corp., El Segundo, CA), and P. KOHN (Sanders Associates, Inc., Nashua, NH; Computer Sciences Corp., El Segundo, CA) Journal of Test and Evaluation, vol. 5, Oct. 1984, p. 20-25.

It is pointed out that in the history of air traffic control simulation very few studies of methodology as such have been accomplished, although many measures of performance have been suggested and used. The present investigation is concerned with the performance measures per se, in contrast to studying a system or procedure. Basic aspects of the simulation of air traffic control are examined, and a description is given of inter-related methodological experiments conducted in 1979 and 1980. One experiment had the objective to examine the relative importance of en route sector geometry and traffic density in determining performance measurements. The design of the second experiment focused on collecting a great deal of data in a single sector-density combination. It is concluded that data from experiments directly aimed at methodological issues can be useful for improved planning of tests of ATC candidate systems. G.R.

A85-24509#
CAD SYSTEMS FOR KNOWLEDGE TRANSFER [CAD-SYSTEMEN VOOR OVERDRACHT VAN KENNIS]
W. LOEVE and R. F. VAN DEN DAM (Nationaal Lucht- en Ruimtevaartlaboratorium, Amsterdam, Netherlands) Bedrijf en Techniek (ISSN 0005-7614), vol. 37, May 1983, p. 1-5. In Dutch.

The development of computer networks to facilitate the integration of experimental research (in laboratories and wind tunnels) with the design of aircraft and spacecraft using CAD techniques) is discussed, with a focus on the network of the Netherlands Nationaal Lucht- en Ruimtevaartlaboratorium (NLR). Functional requirements for the network infrastructure include prompt availability of a wide variety of data, the ability to compress data to different levels of detail, an interactive CAD process with total operator control over both alphanumeric and graphic information, and high-speed processing; organizational requirements include ongoing adaptibility and hardware continuity. The NLR network, linking the two main laboratories and the institutional and commercial partners of NRL, is illustrated with block diagrams and characterized. T.K.

N85-17972# Evans and Sutherland Computer Corp., Salt Lake City, Utah.
CIG (COMPUTER IMAGE GENERATION) DATA BASES IN AN INSTANCE: BITS AND PIECES
J. L. COSTENBADER *In* AF Human Resources Lab. The IMAGE 3 Conf. Proc. p 151-163 Sep. 1984
(AD-P004318) Avail: NTIS HC A22/MF A01 CSCL 01B

Strategies may be developed to reuse bits and pieces of CIG data base models and map them throughout the data base to create a one to one real world correspondence. The net effect is that data base development costs are reduced and the amount of required on-line data storage is decreased. Further, scene densities may be increased to take full advantage of image generator capabilities and are not degraded by lack of on-line storage availability. This notion implies that there exists a library of CIG models of standard cultural features that may be mapped

or instanced throughout the geographic region. Further, the geographic region itself is a terrain model made up of instanced pieces derived from the Digital Landmass System (DLMS) data base, Digital Terrain Elevation Data (DTED). Another implication is that the image generator (IG) is capable of run time replication of these models throughout the data base. This concept of a library of cultural features ties closely to data provided by the Defense Mapping Agency (DMA) in the (DLMS) data base, 2nd Edition as well as the prototype specification to support High Resolution/Terrain Analysis Applications. This paper will show methods used to develop a collection of Bits and Pieces of real world cultural features and how to use information from DMA data tapes to map these features onto the terrain. The nature of the IG hardware used to achieve these results will also be discussed. GRA

N85-17989# Naval Training Equipment Center, Orlando, Fla.
ON-BOARD COMPUTER IMAGE GENERATOR (CIG) APPLICATIONS
D. R. BREGLIA and D. B. COBLITZ *In* AF Human Resources Lab. The IMAGE 3 Conf. Proc. p 431-437 Sep. 1984
(AD-P004335) Avail: NTIS HC A22/MF A01 CSCL 09B

Current training of military pilots fails to provide the complex visual environment associated with expected combat conditions. In addition, the training systems which provide the highest fidelity to combat are not available often enough to all pilots who require maintenance of volatile combat skills. Onboard visual simulation using computer image generation is a technology which is ripe for exploitation for training. Training scenarios and development implications of onboard visual simulation are discussed.
Author (GRA)

N85-17990# Rediffusion Simulation, Inc., Arlington, Tex.
CIG (COMPUTER IMAGE GENERATOR) GOES TO WAR: THE TACTICAL ILLUSION
J. B. HOWIE and M. A. COSMAN *In* AF Human Resources Lab. The IMAGE 3 Conf. Proc. p 439-454 Sep. 1984
(AD-P004336) Avail: NTIS HC A22/MF A01 CSCL 01B

Simulation can play a decisive role in preparing pilots to survive and prevail in such a situation; however, realistic simulation of a complex multithreat tactical environment has remained an elusive goal of computer generated imagery. Current systems have been unable to present both the quantity and quality of visual cues required to train effectively in all phases of the tactical combat experience. Recent advances in CIG technology have created a system which reaches new levels of realism and effectiveness in such a task. The CT5A system can provide a dense, navigationally specific terrain model of large geographic extent, while providing a substantial reserve of processing capability which can be used to present a rich dynamic environment. Within this environment a number of ground and airborne tactical threats can be simultaneously active. Unique features within the CT5A system allow the orchestration of complex tactical effects such as missiles, cannon, tracers, flak and bomb impacts. Special modeling, shading and coloration strategies allow the presentation of very high fidelity aircraft models to support midair refueling, formation flight and target, acquisition/recognition. Many dynamic scene elements can be simultaneously active in both independent and chained motions, with proper occulting and realistic behavior maintained. We will discuss the various features of the CT5A system which make such simulations possible, and will present dynamic visual examples of these and other tactical scenarios. GRA

N85-19702*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SUBOPT: A CAD PROGRAM FOR SUBOPTIMAL LINEAR REGULATORS Final Report
P. J. FLEMING Feb. 1985 18 p refs
(Contract NAS1-17070)
(NASA-CR-172536; NAS 1.26:172536; ICASE-85-6) Avail: NTIS HC A02/MF A01 CSCL 09B

An interactive software package which provides design solutions for both standard linear quadratic regulator (LQR) and suboptimal linear regulator problems is described. Intended for time-invariant continuous systems, the package is easily modified to include sampled-data systems. LQR designs are obtained by established techniques while the large class of suboptimal problems containing controller and/or performance index options is solved using a robust gradient minimization technique. Numerical examples demonstrate features of the package and recent developments are described. Author

N85-19712# Denver Research Inst., Colo.
INTERACTIVE GRAPHICS SIMULATOR: DESIGN, DEVELOPMENT AND EFFECTIVENESS/COST EVALUATION Final Report, Apr. 1981 - Sep. 1984
W. J. PIEPER, J. J. RICHARDSON, K. R. HARMON, and R. A. KELLER Dec. 1984 138 p
(Contract F33615-81-C-0006)
(AD-A149417; AFHRL-TR-84-38) Avail: NTIS HC A07/MF A01 CSCL 05I

This report covers the design, development, implementation, and evaluation of a new task and videodisc-based simulator, the Interactive Graphics Simulator (IGS). The test vehicle was the 6883 Converter Flight Control Test Station and its associated training course at Lowry AFB, Colorado. The computer-based simulator provided for task emulation of job planning tasks, as well as for equipment manipulation tasks. The simulation system provided a means of on-line task analysis, of simulation development from the task data base, of presenting simulations to students, and of adapting simulation presentation to the level of student achievement. Simulation lessonware covered both procedural equipment operation and troubleshooting activities. A comparative study was performed with 22 students using the actual equipment trainer (AET) during training and 21 students using the IGS. Evaluation of the outcomes included training effectiveness analyses based on a conventional ATC block test, on a hands-on equipment operating procedures test, on a paper-and-pencil troubleshooting test, and on a predictive job performance test. The IGS-trained students performed significantly better on the troubleshooting test; however, no other significant performance differences were found. A comparison of the IGS and AET costs showed the IGS to be substantially less expensive in terms of acquisition and operating costs. Student attitudes toward the IGS were favorable, and the system operated extremely well in a standard ATC classroom environment. GRA

N85-19744# Aeronautical Research Labs., Melbourne (Australia). Aerodynamics Div.
A CONFORMAL MAPPING SUITABLE FOR PROBLEMS INVOLVING INTERACTION BETWEEN GIVEN GEOMETRIES AND KNOWN FAR FIELDS
T. TRAN-CONG Sep. 1984 26 p
(AD-A149050; ARL-AERO-TM-367) Avail: NTIS HC A03/MF A01 CSCL 12A

A conformal transformation formula using Riemann-Stieltjes integrals is derived for use with problems involving the interaction between a given finite-sized geometry and a known far field. The derivative of this transformation is non-singular in the domain considered and tends to one at infinity. A formula is derived for transformation from the unit circle to the exterior of an arbitrarily given continuous curve with bounded variation. A special case of the transformation is very similar to that of Schwarz-Christoffel. Application to the generation of aerofoils gives some fairly flexible formulae of the finite product type. Author (GRA)

N85-19775# Wisconsin Univ., Madison. Mathematics Research Center.
ROBUST KALMAN FILTERING AND ITS APPLICATIONS
I. GUTTMAN (Toronto Univ., Canada) and D. PENA (Univ. Politecnica de Madrid) Oct. 1984 36 p
(Contract DAAG29-80-C-0041)
(AD-A149044; MRC-TSR-2766) Avail: NTIS HC A03/MF A01 CSCL 12A

This paper presents a robust Kalman filtering algorithm that is obtained assuming a scale contaminated normal distribution for

the noise of the measurement equation. The mixture of normals obtained as a posterior distribution is approximated at each stage by a normal distribution with the same mean and variance. The resulting algorithm is simple, has a straightforward interpretation and seems to provide useful robust estimators in several statistical problems that are briefly reviewed. GRA

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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.

A85-22575
VIBRATIONS OF A PLATE INDUCED BY AN AERODYNAMIC TURBULENT BOUNDARY LAYER [VIBRATIONS D'UNE PLAQUE SOLLICITEE PAR UNE COUCHE LIMITE TURBULENTE AERODYNAMIQUE]
G. ROBERT (Lyon, Ecole Centrale, Ecully, Rhone, France) Academie des Sciences (Paris), Comptes Rendus, Serie II Mecanique, Physique, Chimie, Sciences de l'Univers, Sciences de la Terre (ISSN 0249-6305), vol. 299, no. 16, Nov. 28, 1984, p. 1119-1122. In French.

The measurements of vibrations induced on a thin rectangular stainless-steel plate by a turbulent boundary layer are compared to numerical predictions using Corcos' analytical expression for the wall pressure cross-spectrum. The plate is an integral part of a larger rectangular plate attached to a stainless-steel frame which is mounted on the lower horizontal wall of the working section of a wind tunnel. The measurements of the vibratory response of the plate are carried out using two piezoelectric accelerometers. Measured and calculated values of the velocity response deviation are obtained for freestream velocities of 40, 70, 100, and 130 m/s and are in agreement, especially near the boundaries of the plate where the maximum observed deviation is 2 dB. It is shown that the vibratory level of the frame is lower than the vibratory level of the plate and that the vibratory state of the working section does not noticeably affect the response of the plate. M.D.

A85-26319#
APPLICATION OF SCALING LAWS FOR THE FLYOVER JET NOISE TO THREE DEPARTURE PROCEDURES FOR THE BOEING 727-200 ADVANCED
U. MICHEL (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Berlin, West Germany) American Institute of Aeronautics and Astronautics and NASA, Aeroacoustics Conference, 9th, Williamsburg, VA, Oct. 15-17, 1984. 8 p. Research supported by the Bundesministerium fuer Verkehr. refs
(AIAA PAPER 84-2359)

Departure procedures that aim at high flyover altitudes are generally considered as beneficial for noise abatement. However, it is shown in this paper that this is not necessarily true if only the jet noise component of the aircraft's total noise is considered. Author

A85-26320#
NOISE TESTING OF AN ADVANCED DESIGN PROPELLER IN THE BOEING TRANSONIC WIND TUNNEL WITH AND WITHOUT TEST SECTION ACOUSTIC TREATMENT
B. M. GLOVER, JR., E. I. PLUNKETT, and C. D. SIMCOX (Boeing Commercial Noise Technology Laboratory, Seattle, WA) American Institute of Aeronautics and Astronautics and NASA Aeroacoustics Conference, 9th, Williamsburg, VA, Oct. 15-17, 1984. 6 p. refs
(AIAA PAPER 84-2366)

Noise tests using the NASA SR-6 advanced design propeller in the Boeing Transonic Wind Tunnel have recently been completed. Measurements were taken both with and without an acoustically treated test section. A wide range of helical tip speeds and power loadings were explored. Noise test techniques, previously not applied to advanced design propeller testing, have shown results indicating an increased level of confidence in the measured signatures. Typical results are presented along with recommendations for future noise tests and elementary empirical prediction methods for the SR-6. Author

N85-17977# Air Force Human Resources Lab., Williams AFB, Ariz.
CONSIDERATIONS IN AN OPTICAL VARIABLE ACUITY DISPLAY SYSTEM
R. B. BUNKER and R. FISHER *In its* The IMAGE 3 Conf. Proc. p 239-251 Sep. 1984
(AD-P004323) Avail: NTIS HC A22/MF A01 CSCL 01B

This paper describes an effort to establish feasibility and quantify parameters of a truly optimal simulator visual system, i.e., one that fully satisfies human visual requirements with an absolute minimum of processing and display equipment. The concept is described and compared to alternate approaches with respect to size and complexity. The current effort to define parameters required to minimize potential operator distractions is described and results to date are presented. Author (GRA)

N85-17987# Ohio State Univ., Columbus.
GLOBAL OPTICAL METRICS FOR SELF-MOTION PERCEPTION
D. H. OWEN, L. WOLPERT, L. J. HETTINGER, and R. WARREN *In* AF Human Resources Lab. The IMAGE 3 Conf. Proc. p 405-415 Sep. 1984
(Contract F33615-83-K-0038)
(AD-P004333) Avail: NTIS HC A22/MF A01 CSCL 01B

During locomotion, the entire optic array along the path of travel is continuously transformed. The nature of the transformations is informative about changes in altitude, speed, and imminence of contact with environmental surfaces. Some global optic-array variables are self scaled and some are environment scaled. By unlinking the two types of variables we have been able to empirically assess their relative usefulness for detecting change in altitude and speed. Determining the perceptual effectiveness of optical sources of information also tells us what the functional metrics are for detecting and guiding self motion. Author (GRA)

N85-18667# European Space Agency, Paris (France).
CONTRIBUTION OF THE STUDY OF LIGHT AIRCRAFT PROPELLER NOISE
H. GOUNET Sep. 1984 169 p refs Transl. into ENGLISH of "Contrib. a l'Etude du Bruit des Helices d'Avions Legers" Rept. ONERA-NT-1982-8 ONERA, Paris, 1982 Original language document announced as N84-26386
(ESA-TT-865; ONERA-NT-1982-8) Avail: NTIS HC A08/MF A01

A propeller noise prediction program was developed; a numerical application was made to determine the parameters acting on the tone acoustic level. The emitted noise is essentially caused by the mean load on the blades and the tip rotation Mach number is the major parameter of the acoustic emission. Results are confirmed by flight measurements. An assessment method for the acoustic field emitted by a propeller derived from charts was reviewed to determine its ability to predict light aircraft propeller noise. In order to predict perceived acoustic levels under acoustic certification conditions for light aircraft, ground reflection phenomena of sound waves were studied and incorporated in the computation model. Author (ESA)

N85-18669# European Space Agency, Paris (France).
COMPUTATION OF NOISE RADIATION FROM A FREE JET PERPENDICULAR TO ITS AXIS VIA LASER ANEMOMETRY MEASUREMENTS
J. MAULARD and G. ELIAS Oct. 1984 64 p refs Transl. into ENGLISH of "Calcul du Bruit Rayonne par un Jet Libre Perpendiculairement a son Axe Laser" Rept. ONERA-NT-1983-6 ONERA, Paris, 1983 Original language document announced as N84-26387
(ESA-TT-870; ONERA-NT-1983-6) Avail: NTIS HC A04/MF A01

A model for the acoustic radiation of a cylindrical free jet in a direction perpendicular to its axis of symmetry based on Lighthill's equation is presented. Aerodynamic parameters related to the power spectral densities associated with fluctuations of the velocity component perpendicular to the jet axis and fluctuations of the squared value of the velocity component were measured by laser anemometry and are expressed by an empirical formula which covers all the results obtained in the effective acoustic field of the jet. The theoretical expression of the radiated acoustic field derived from the model and including the measured aerodynamic parameters was computed. This expression does not rely on any empirical coefficient to match the calculated values and the acoustic measurements. For cold and hot sub and supersonic jets, good agreement is achieved between theory and experiment for the overall acoustic field and its power spectra density.
Author (ESA)

N85-19790*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
FLUCTUATING PRESSURES ON FAN BLADES OF A TURBOFAN ENGINE, FLIGHT TEST INVESTIGATION
J. A. SCHOENSTER Feb. 1985 26 p refs
(NASA-TP-2381; L-15700; NAS 1.60:2381) Avail: NTIS HC A03/MF A01 CSCL 20A

Miniature pressure transducers were used to measure the fluctuating pressure on the fan blades of a JT15D engine in flight to aid in understanding fan-noise generation. Although the blade pressures can be considered very useful in determining far-field noise sources in the subsonic fan-blade tip speeds, other mechanisms, and as shock waves in the transonic and supersonic fan-blade tip speeds, limit their usefulness in these higher speed ranges.
Author

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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.

A85-23799
ANNALS OF AIR AND SPACE LAW. VOLUME 8
N. M. MATTE, ED. (McGill University, Montreal, Canada) Toronto/Paris, Carswell Co., Ltd./Editions A. Pedone, 1983, 586 p. In English and French. No individual items are abstracted in this volume.

Current problems in air and space law are discussed, and the activities of various international organizations during 1983 are surveyed. Topics examined include the international unification of civil air law, liability problems in aircraft maintenance and repair, bilateral air-transport agreements, the orbit-spectrum issue, liability in space law, legal and policy aspects of space remote sensing, and the 'aerospace vehicle' as a legal concept; organizations surveyed are the ICAO, IFALPA, IATA, and Inmarsat. The texts of important court decisions from the US, Canada, and West Germany and of international and national legislation are provided. T.K.

A85-24204
TECHNOLOGY FOR PROFITABLE TRANSPORTATION
P. BURGESS (Rolls-Royce, Inc., New York, NY) (Rolls-Royce North American Symposium, San Francisco, CA, June 7, 1984) Aeronautical Journal (ISSN 0001-9240), vol. 88, Dec. 1984, p. 461-472.

The long-term development of the US airline industry is evaluated and illustrated with graphs, and future trends are identified with the aim of directing technology toward greater profitability. The rapid growth of the industry since 1945 is attributed to increased convenience, lower real-money fares, and the general increases in the US GNP. The present situation is characterized, considering the cost contributions of fuel, labor, maintenance materials, and capital and focusing on the impact of airline deregulation. Future profitable operation will require continued efforts by the aircraft manufacturers to reduce fuel consumption, especially over shorter trips using smaller-than-average aircraft.
T.K.

A85-24709
RECENT DEVELOPMENTS IN AVIATION CASE LAW
D. R. ANDERSEN (Mozley, Finlayson, Wedge and Andersen, Atlanta, GA) Journal of Air Law and Commerce (ISSN 0021-8642), vol. 49, no. 4, 1984, p. 707-769. refs

Eight aviation cases before the U.S. Supreme Court in 1983, three which received decisions, are reviewed, along with related materials. It has been decided that the FAA is the only valid registry for ownership of an aircraft, and no transfer of ownership is valid until filed in the registry. In another ruling, the Court decided that discriminatory taxes could be levied by states on out-of-state-based airlines who use in-state airports, the judgment residing on the premise that the monies are targeted for use at airports. Finally, the Court ruled that state law is supreme in establishing the health and safety standards of airport ground maintanance workers. Actions are still pending on 'in personam' jurisdiction in out-of-country aircraft accidents, liability procedures being decided in one state for accidents in another, and the validity of a manufacturer filing a claim with the federal government for indemnity claims filed by a federal employee against the manufacturer. Air carrier, insurance coverage, and damage extent and calculations rulings are also under consideration. M.S.K.

A85-24710
FIRE SAFETY IN TRANSPORT CATEGORY AIRCRAFT - LITIGATING A POST-CRASH OR IN-FLIGHT AIRCRAFT FIRE
P. M. FOSS and R. D. TEPPER Journal of Air Law and Commerce (ISSN 0021-8642), vol. 49, no. 4, 1984, p. 801-825. refs

The impact of Federal Aviation Regulations (FAR) on transport aircraft design, certification, accident investigations for liability, and the chances that passengers can survive specified accidents are discussed. The design must not be hazardous and must include doors that open from the inside or outside even if people are pressed against the inside. Ventilation must protect the crew and passengers from noxious gases and vapors. Materials should be fire suppressant or self-extinguishing and fire extinguishers and all compartments must be accessible to the crew. Fire zones which seal off flammable liquids must be installed, etc. The manufacturer may be liable even if the FAR are complied with. Techniques for conducting a post-accident fire investigation are delineated. It is noted that fire retardants in aircraft interior furnishings can generate gases more lethal than heat or other effects of cabin fires.
M.S.K.

A85-24711
DISCOVERY OF MILITARY AIRCRAFT ACCIDENT INVESTIGATION REPORTS
R. C. COYLE (Perkins, Coie, Stone, Olsen and Williams, Seattle, WA) Journal of Air Law and Commerce (ISSN 0021-8642), vol. 49, no. 4, 1984, p. 827-903. refs

The procedures and data generated by military aircraft accident investigations are examined, along with uses of the data in civil litigation. The safety investigations cover the aircraft repair history and design specifications, the crew medical history, the flight path

and all avionics states at the moment of crash. Witnesses to the incident are interviewed voluntarily and confidentially. All oral testimony is considered the privileged property of the federal government. The Freedom of Information Act is judged the better venue to obtaining heretofore privileged data than are the rules of discovery. It is doubted that a contractor's report can be entered as evidence for actions other than upgrading safety. M.S.K.

N85-17973# General Dynamics Corp., St. Louis, Mo.
THE GENERATION OF THREE-DIMENSIONAL DATA BASES USING A BUILDING BLOCK APPROACH
D. D. SMART, R. D. TEICHGRAEBER, and A. C. CHIRIELEISON *In* AF Human Resources Lab. The IMAGE 3 Conf. Proc. p 165-176 Sep. 1984
(AD-P004319) Avail: NTIS HC A22/MF A01 CSCL 01B

Simulation system visual data base designs must provide engineers and test pilots with adequate realism in mission scenarios to insure acceptable results without the luxury of long design schedules. The objective is to build large three-dimensional data bases quickly and efficiently, while generally matching terrain and landscape features. The BUILDING BLOCK approach is presented as a means to achieve this objective. An example is presented to illustrate this approach. Author (GRA)

N85-18831*# Garrett Turbine Engine Co., Phoenix, Ariz. Engineering Staff.
ADVANCED GAS TURBINE (AGT) POWERTRAIN SYSTEM DEVELOPMENT FOR AUTOMOTIVE APPLICATIONS Semiannual Progress Report, Jul. - Dec. 1983
Jun. 1984 70 p refs
(Contract DEN3-167)
(NASA-CR-174809; DOE/NASA/0167-8; NAS 1.26:174809; GARRETT-31-3725(8); SAPR-8) Avail: NTIS HC A04/MF A01 CSCL 13F

Rotor dynamic instability investigations were conducted. Forward ball bearing hydraulic mount configurations were tested with little effect. Trial assembly of S/N 002 ceramic engine was initiated. Impeller design activities were completed on the straight line element (SLE) blade definition to address near-net-shape powder metal die forging. Performance characteristics of the Baseline Test 2A impeller were closely preserved. The modified blading design has been released for tooling procurement. Developmental testing of the diffusion flame combustor (DFC) for initial use in the S/N 002 2100 F ceramic structures engine was completed. A natural gas slave preheater was designed and fabricated. Preliminary regenerator static seal rig testing showed a significant reduction in leakage and sensitivity to stack height. Ceramic screening tests were completed and two complete sets of ceramic static structures were qualified for engine testing. Efforts on rotor dynamics development to resolve subsynchronous motion were continued. A.S.B.

N85-18865# Kyoto Univ. (Japan).
PREDICTION ACCURACY OF THE TORQUES FOR ROTARY TILLAGE BY AN ANALOG TOOL
M. YAMAZAKI and T. TANAKA *In* Intern. Soc. for Terrain-Vehicle System Proc. of the 8th Intern. Conf. on the Performance of Off-Road Vehicles and Machines, Vol. 2 (AD-A148635) p 561-573 Aug. 1984
(AD-P004288) Avail: NTIS HC A18/MF A01 CSCL 02C

Performances of prototype in soil-machine systems have been investigated and predicted by scale model data using similitude theory. However, a satisfactory prediction is not attained especially in common soil conditions where distortions occur, since present knowledge of soil-machine interactions is meager. The objective of this study is to investigate the usefulness or feasibility of an analog predicting torques on rotary blades which bring about a considerable high speed interaction. An analog prediction technique developed by Schafer et al. was used. GRA

N85-18866# International Society for Terrain-Vehicle Systems, Hanover, N.H.
THE ANALYSIS ON THE DYNAMIC PERFORMANCE OF A SINGLE LUG
T. L. ZHANG and Y. J. SHAO *In its* Proc. of the 8th Intern. Conf. on the Performance of Off-Road Vehicles and Machines, Vol. 2 (AD-A148635) p 575-591 Aug. 1984
(AD-P004289) Avail: NTIS HC A18/MF A01 CSCL 13F

The lug of a rigid lugged wheel for the paddy-field tractor is the basic element to interact with soil. The lug angle has significant effect on the tractive performance of a rigid lugged wheel in rice field. This paper analyses the interaction process between lug and soil. A calculating method of soil reaction on a single lug based on the equation of passive pressure in two dimensional soil failure is presented. It is shown that there is a good agreement between the measured and predicted pull and lift forces developed by a single lug within the test range. GRA

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GENERAL

N85-18947# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany).
ACTIVITIES REPORT IN AEROSPACE IN WEST GERMANY Annual Report, 1983 [JAHRESBERICHT 1983]
H. THIMME, ed. Sep. 1984 132 p In GERMAN Original contains illustrations
(ISSN-0070-3966) Avail: NTIS HC A07/MF A01

Air traffic control, aircraft design, turbofans and turbines, nonnuclear energy, satellite communications and monitoring, Earth observation (from space), and space systems are discussed. The organization of the agency is also described as well as its relationships with the government, business, and science communities. Author (ESA)

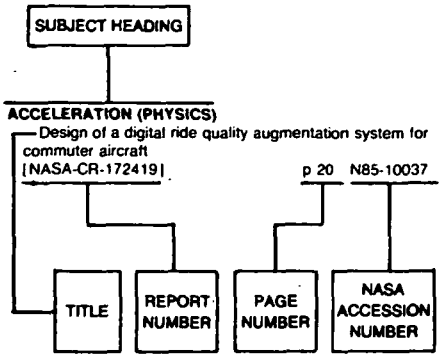
N85-18948# Deutsche Lufthansa Aktiengesellschaft, Cologne (West Germany).
DIGEST OF THE DEUTSCHE LUFTHANSA REPORT, 1983 Annual Report, 1983
1983 18 p
(ISSN-0415-603X) Avail: NTIS HC A02/MF A01

The economic states of the Lufthansa airline for the fiscal years 1982 and 1983 is summarized. Company policy is outlined. Author (ESA)

N85-19917# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
CALENDAR OF SELECTED AERONAUTICAL AND SPACE MEETINGS
Loughton, England Dec. 1984 121 p
(AGARD-CAL-84/2; ISBN-92-835-0370-8; AD-B089315L) Avail: NTIS HC A06/MF A01

Meetings, exhibitions, and education courses, held all in all parts of the world, in the field of aerospace and aeronautical research and development, as well as in directly related scientific fields, are listed. Each entry shows: the reference number; the data and location; the title and sponsor; keywords indicating main topics; and a control code for making inquiries. A subject index in is included. A.R.H.

Typical Subject Index Listing



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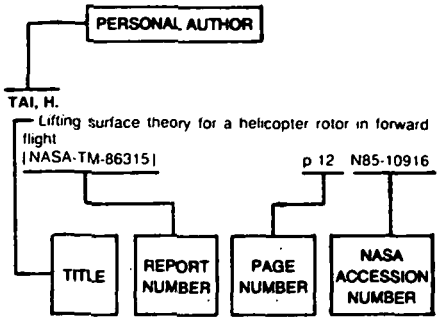
AERONAUTICAL ENGINEERING / *A Continuing Bibliography (Supplement 188)* JUNE 1985

Typical Personal Author Index Listing



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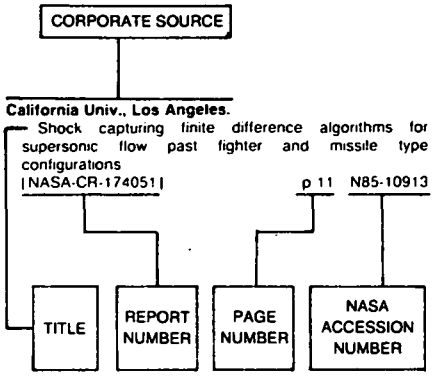

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Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
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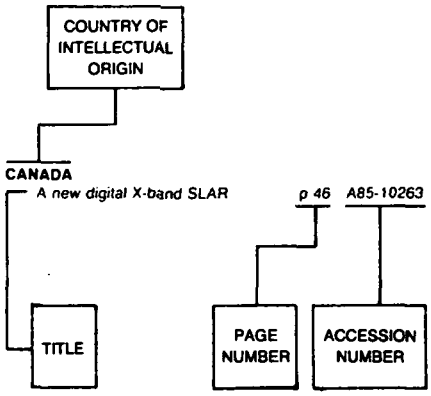

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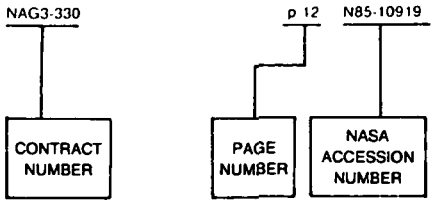

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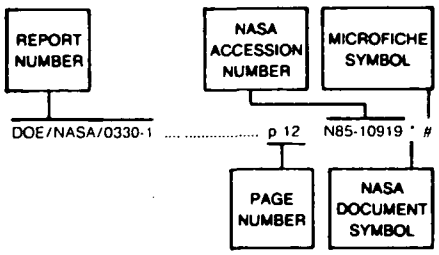

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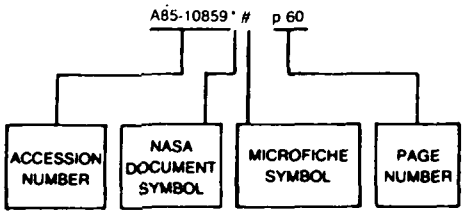

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