NASA SP-7037(160)
April 1983

Aeronautical Engineering
A Continuing Bibliography with Indexes

National Aeronautics and Space Administration

25th Anniversary
1958-1983

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Aeronautical Engineering
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ACCESSION NUMBER RANGES

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STAR (N-10000 Series)	N83-14061 - N83-16274
IAA (A-10000 Series)	A83-16454 - A83-19623

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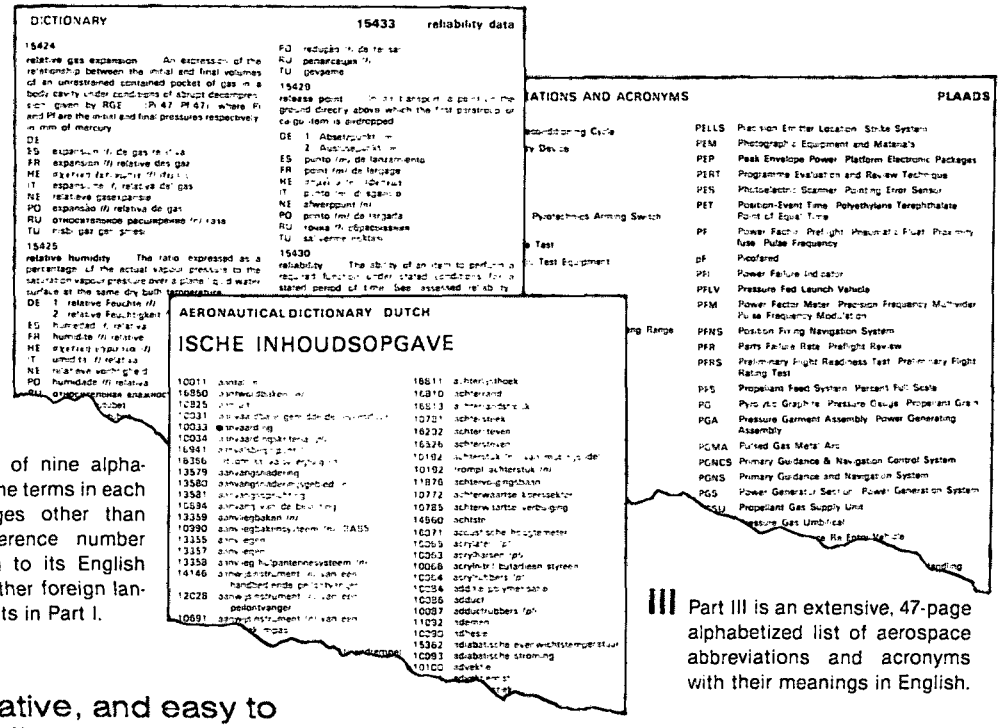

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NASA SP-7037(160)

AERONAUTICAL ENGINEERING

A CONTINUING BIBLIOGRAPHY WITH INDEXES

(Supplement 160)

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced in March 1983 in

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

NASA Scientific and Technical Information Branch 1983
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 437 reports, journal articles, and other documents originally announced in March 1983 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, and abstracts when available, are reproduced exactly as they appeared originally in *IAA* and *STAR*, including the original accession numbers from the respective announcement journals. The *IAA* items will precede the *STAR* items within each category.

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

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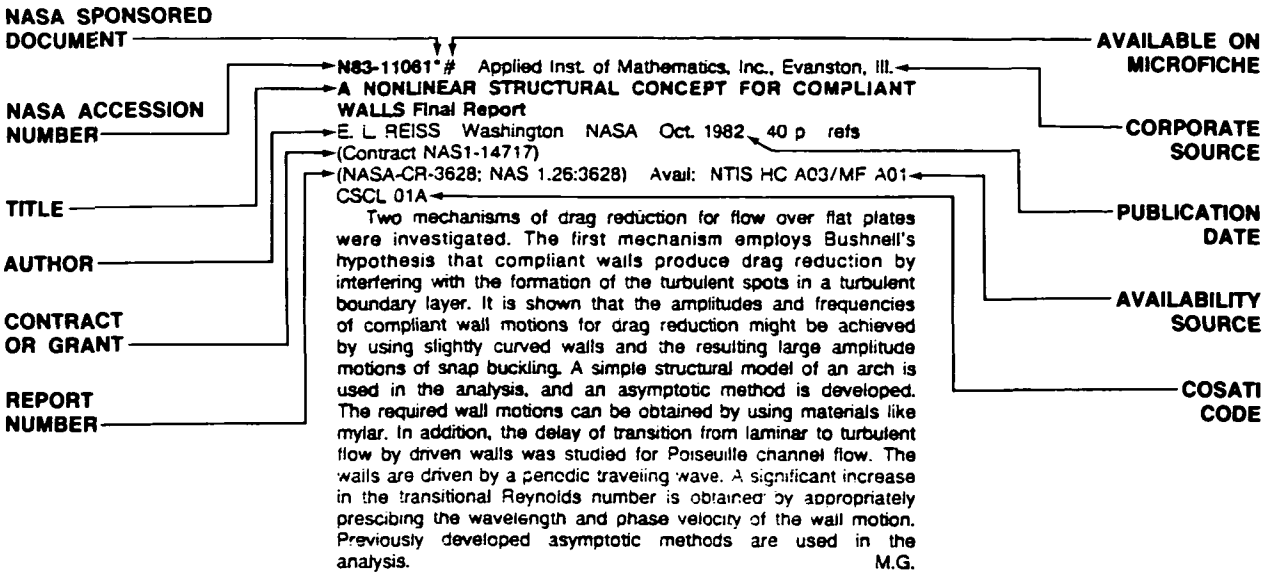

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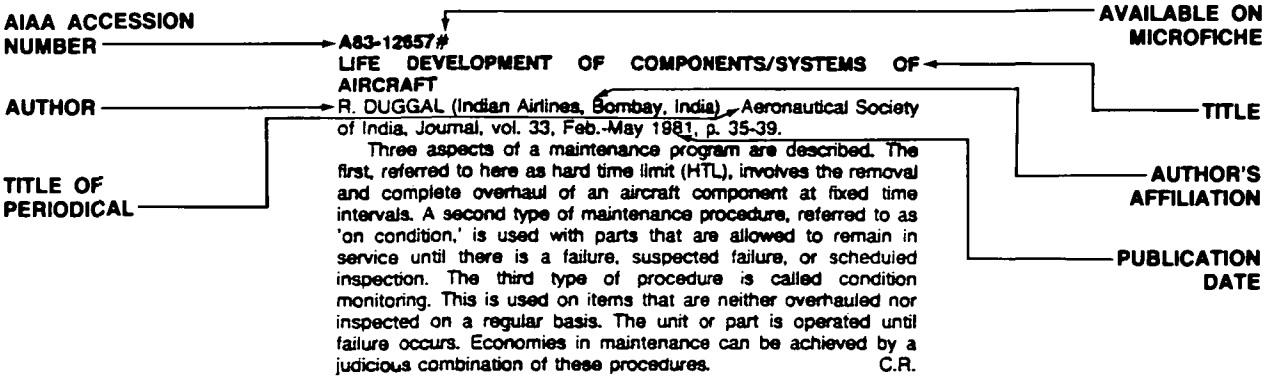

AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 160)

APRIL 1983

01

AERONAUTICS (GENERAL)

A83-16582*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NASA LEWIS RESEARCH CENTER'S PROGRAM ON ICING RESEARCH
J. J. REINMANN, R. J. SHAW, and W. A. OLSEN, JR. (NASA, Lewis Research Center, Cleveland, OH) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 10 p. refs
(AIAA PAPER 83-0204)

NASA is again actively involved in aircraft icing research. This paper briefly describes the new research activity in ice protection systems, icing instrumentation, experimental methods, analytical modeling for the above, and in-flight research. The renewed interest in aircraft icing has come about mainly because of the new need for all-weather helicopters and general aviation aircraft. Because of increased fuel costs, tomorrow's commercial transports also will require new types of ice protection systems compatible with the more efficient high by-pass and turboprop engines. And all types of aircraft require better estimates of the aeropenalties caused by ice on unprotected surfaces. (Author)

A83-16896
75TH ANNIVERSARY OF THE ESTABLISHMENT OF THE AERODYNAMIC EXPERIMENTAL INSTITUTE OF GOETTINGEN [VOR 75 JAHREN ENTSTAND DIE AERODYNAMISCHE VERSUCHSANSTALT GOETTINGEN /AVA/]
W. WUEST DFVLR-Nachrichten, vol. 37, Nov. 1982, p. 4-23. In German.

In connection with technical difficulties related to the development of airships in Germany, it was proposed by Prandtl to establish an institute for the testing of airship models. The proposal was accepted on November 9, 1907. This data has been considered as the birth date of the institute for testing models in Goettingen, which later became the Aerodynamic Experimental Institute Goettingen. A description is provided of the installations which were designed for the testing of airship models. In 1910, the first orders from aircraft manufacturers were received. The first large wind tunnel in Goettingen was constructed during the First World War. In 1919, the institute was given its present name. Salient developments related to the institute in Goettingen are discussed, giving attention to a rotating laboratory, a rotor ship, the utilization of wind power, deicers, a wind tunnel built in 1936, wings for supersonic aircraft, large wind tunnels constructed during the Second World War, and the reconstruction of the Institute beginning in 1953. G.R.

A83-17301
RADIO TECHNICAL COMMISSION FOR AERONAUTICS, TECHNICAL SYMPOSIUM AND ANNUAL ASSEMBLY MEETING, WASHINGTON, DC, NOVEMBER 18-20, 1981, PROCEEDINGS
J. ALCORN, (ED.) (Radio Technical Commission for Aeronautics, Washington, DC) Washington, DC, Radio Technical Commission for Aeronautics, 1982. 252 p
$19

The role of simulation in system design and certification is explored, taking into account a multifunction display simulation facility, the use of emulation in fault analyses of digital systems, electromagnetic environment simulation for Threat Alert and Collision Avoidance System (TCAS) Avionics, and DC-9 Super 80 digital flight guidance system simulation techniques for certification. The role of simulators in pilot training is examined, giving attention to total simulation for airline applications, the role of simulation in general aviation, computer-based presimulator training, improving simulation training through research, and the JA37 (VIGGEN) pilot training concepts ATD preliminary use and 'signs' of effectiveness. Topics related to the design and control of software-dominated systems are also discussed. G.R.

A83-18075
THE REMANUFACTURERS
J. M. RAMSDEN Flight International, vol. 123, Jan. 1, 1983, p. 29-33.

An examination of the costs, components, and business processes involved in retrofits of passenger aircraft at the end of the design lifetime is presented. Aircraft considered for refurbishment undergo an investigation guided by the Supplementary Structural Inspections Documents to determine necessary work to assure continued airworthiness. A 707 can be purchased, reoutfitted, and flying again for under $2 million, which is noted to be cheap compared to purchase of a new aircraft with the same capabilities. An example is given of reinforcements necessary for a 707 tailplane and center-section. Re-engining is discussed, with particular emphasis on the high market availability of serviceable JT3Ds. M.S.K.

A83-18384
HELICOPTER EVOLUTION
B. KELLEY *American Helicopter Society, Journal*, vol. 28, Jan. 1983, p. 3-9.

The evolution of the helicopter is discussed in the context of a theory of process called the Arc of Process. This theory covers the progressive loss and regaining of freedom on the part of the inventor during the development and implementation of an invention. The development of helicopter engines, rotor system bearings, controls, and materials is related in this context. Some predictions about the future of flight are made. C.D.

A83-18808#
V/STOL - A PRACTICAL WEAPON SYSTEM
A. R. YACKLE Astronautics and Aeronautics, vol. 21, Jan. 1983, p. 18-25, 33.

The AIAA V/STOL Technical Committee report assessing the operational capabilities demonstrated to date by aircraft such as the Soviet YAK 36 and British Harrier recommends that the AV-8B variant of the Harrier be introduced by the U.S. Navy, Air Force and Marine Corps in groups of three to four squadrons, in order

to investigate the ability of the Harrier to fulfill the most diverse mission requirements. Although the AV-8B has not been optimized for missions other than attack, the use of an existing aircraft for this purpose will minimize the costs of a comprehensive performance assessment. It is also suggested that future development programs should emphasize short take-off-vertical landing operation, with additional programs addressing the design of advanced propulsion systems, a sea-control role airframe configuration, and sea-based platforms such as assault carriers and converted battleships. O.C.

A83-18963
THE ROLE OF THE RESEARCH ESTABLISHMENTS IN THE DEVELOPING WORLD OF AEROSPACE
T. H. KERR (Royal Aircraft Establishment, Farnborough, Hants., England) Aeronautical Journal, vol. 86, Dec. 1982, p. 359-369.

The role of defence R&D establishments in the developement of a weapon system is more complex and less publicized than their pure research role. Attention is given to the chronology of R&D management in Britain, including the duration and percentage cost of the main stages in project development. A draft target for the functions and performance of a new weapon system is generated through interactions of the Service Staffs and feasibility study researchers in the R&D establishments. After operational analyses have led to approval, the Systems Controller coordinates and funds the intramural and extramural work required for the feasibility study to establish project costs and time scales. If the study confirms project feasibility, a staff requirement describing the functions, performance and operating environment of the weapons system is prepared. As development work proceeds, R&D establishment involvement diminishes. Case studies of this process are given which include helicopter agility development, helicopter rotor design, an air combat simulator, a missile demonstrator, a thermal imaging system, and the operational analysis of land/air engagements. O.C.

A83-19410
THE TRANSPORT AIRCRAFT OF TOMORROW - A SINGLE ELEMENT OF AN OVERALL SYSTEM [L'AVION DE TRANSPORT DE DEMAIN - ELEMENT D'UN SYSTEME LUI-MEME]
P. LECOMTE (Societe Nationale Industrielle Aerospatiale, Paris, France) (International Council of the Aeronautical Sciences and American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Seattle, WA, Aug. 22-27, 1982.) L'Aeronautique et l'Astronautique, no. 96, 1982, p. 3-16. In French. refs

The development of commercial air transport systems is reviewed, with consideration given to continuing delays in feeder traffic to the airport and at the airport itself, the presence of competition from high speed trains, and to evolutionary changes in aircraft. The various experiences a passenger encounters en route to the airport, through the terminal, and in-flight are summarized, noting potential obstacles on the way. Progress in aircraft equipment and performance is traced from 1937-82, with mention made of the increases in on-board electrical power, propulsion, and hydraulics for aircraft control systems. Evolution of digital flight control systems, radionavigation, automatic landing systems, and cockpit avionics are projected into the future. Attention is given to the capacities and functions of expanding on-board computer systems and to an experimental program on the Concord. Aircraft safety is discussed, together with the effects of computer control on longitudinal stability and the structural requirements for transport aircraft. M.S.K.

N83-14061*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AN ANALYTICAL AND EXPERIMENTAL COMPARISON OF THE FLOW FIELD OF AN ADVANCED SWEPT TURBOPROP
H. E. NEUMANN, L. J. BOBER, J. S. SERAFINI, and L. K. CHANG (Purdue Univ., Lafayette, Ind.) 1983 16 p refs Presented at the 21st Aerospace Sci. Conf., Reno, Nev., 10-13 Jan. 1983; sponsored by AIAA Original contains color illustrations
(NASA-TM-83037; E-1481; NAS 1.15:83037; AIAA-83-0189)
Avail: NTIS HC A02/MF A01 CSCL 01B

An argon ion laser velocimeter with four beams was used to measure the detailed flow-field of an advanced eight blade propeller with 45% of tip sweep in an 8x6 foot supersonic wind tunnel. Data were obtained at a free stream Mach number of 0.8, the design advance ratio of 3.06 and a power coefficient of 1.8. Data are presented for inlet flow, exit flow, flow within the blades and flow slightly outside the blade tips. The data are compared to a lifting line theory. In general, the results of the comparison are considered favorable. R.J.F.

N83-14062# Clemson Univ., S.C. Dept. of Industrial Management.
COST FUNCTIONS FOR AIRFRAME PRODUCTION PROGRAMS Final Report
N. K. WOMER and T. R. GULLEDGE Jul. 1982 201 p refs
(Contract F33615-81-K-5116; N00014-75-C-0451)
(AD-A119788) Avail: NTIS HC A10/MF A01 CSCL 14A

The research objectives were: (a) develop, test, and illustrate the use of a significant new approach to estimating the cost of an airframe production program using already collected data on Air Force airframes; and (b) provide the Air Force with a calibrated tool capable of providing timely answers to significant problems of program management. The researcher developed a model based on the four production cost drivers of learning by doing, learning over time, the speed of the production line, and production line length. It focuses on the production of an individual airframe as a function of its start date and its planned delivery date, and includes technical features of both the airframe production program and the contractor's behavior. The model is estimated from data on the C-141 program, and is used to evaluate the effect of several small changes to the delivery schedule for the C-141. This analysis shows the sensitivity of the model to delivery schedule changes. It also illustrates one of the important ways that the model may be used in program management. A detailed investigation of estimating the model on data from other programs revealed that its parameters are very stable from one program to another, and the parameters can be estimated from early actual data on a new program. Ways to combine the model with a cost estimating relation (CER) and update these estimates with early actual data are discussed in this report. These techniques are applied to data from the F-102 program and the F-5/T-38 program. GRA

N83-14063# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CHINESE AVIATION IN THE EYES OF AMERICAN EXPERTS
C. GARROY 29 Jul. 1982 11 p Transl. into ENGLISH from Hangkong Zhishi (China), no. 10, 1981 p 18-19
(AD-A118961; FTD-ID(RS)T-0607-82) Avail: NTIS HC A02/MF A01

The history of aeronautics and aerospace industry in the peoples republic of China was surveyed. Topics discussed are: production of airplanes, production of aircraft engines; research and development, and testing of aircraft engines. GRA

02

AERODYNAMICS

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

A83-16454#
AN EXPERIMENTAL STUDY OF THE UNSTEADY RESPONSE OF THE ROTOR BLADES OF AN AXIAL FLOW COMPRESSOR OPERATING IN THE ROTATING STALL REGIME
D. K. DAS (New York, State University, Utica, NY) and S. C. OZCANLI American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 8 p. refs
(AIAA PAPER 83-0001)

Rotating stall is an unsteady phenomenon in axial flow compressors. The axisymmetry of the flow is distorted due to rotating stall cells around the circumference. This periodic distortion may lead to eventual structural damage of the compressor as well as loss in its performance. This paper describes the results of an experimental investigation on the unsteady response of the rotor blades as well as the flow field upstream of the rotor in the rotating stall regime of a lightly loaded axial flow compressor with a hub/tip ratio of 0.5. High response miniature pressure transducers were used both on the rotor blade static tappings and on the cylindrical 3-hole probes used for the measurement of the flow field at the inlet of the compressor. (Author)

A83-16455*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL EVALUATION OF SHOCKLESS SUPERCRITICAL AIRFOILS IN CASCADE
D. R. BOLDMAN, A. E. BUGGELE, and L. M. SHAW (NASA, Lewis Research Center, Cleveland, OH) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 11 p. refs
(AIAA PAPER 83-0003)

Surface Mach number distributions, total pressure loss coefficients, and schlieren images of the flow are presented over a range of inlet Mach numbers and air angles. Several different trailing edge geometries were tested. At design conditions a leading edge separation bubble was observed resulting in higher losses than anticipated. The minimum losses were obtained at a negative incidence condition in which the flow was accelerating over most of the supercritical region. Relatively minor differences in losses were measured with the different trailing edge geometries studied. (Author)

A83-16457#
VIBRATION OF AIRFOILS IN SINUSOIDAL OBLIQUE GUST
T. NAGASHIMA and Y. TANIDA (Tokyo, University, Tokyo, Japan) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 8 p. refs
(AIAA PAPER 83-0005)

A linearized theory has been developed to provide check results for advancing numerical calculations of unsteady lift and moment of airfoils vibrating in subsonic sinusoidal oblique gusts. The airfoils are thin flat plates of infinite span and may be in cascade. The gust response curves, varying flow Mach number and spanwise gust wave number, are presented. The obliqueness of the gust wave front with respect to the airfoil leading edge is found to be very influential upon the aerodynamic lift and moment. (Author)

A83-16459#
PAN AIR APPLICATIONS TO COMPLEX CONFIGURATIONS
A. CENKO (Grumman Aerospace Corp., Bethpage, NY) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 11 p. refs
(AIAA PAPER 83-0007)

Predictions obtained using the PAN AIR computer code are compared with test data for a supersonic tactical aircraft configuration (STAC), the Space Shuttle configuration (SSC), a planar-wing weapon (PWW) store configuration, and a cruciform-fin weapon configuration. The PAN AIR predictions are also compared with predictions obtained from the Woodward code for the STAC and the Boppe code for the SSC, as well as with experimental data on the behavior of the PWW store in the STAC flowfield. A cost-effective option for store trajectories (COST) is described, and an application of the COST procedure is discussed. Results are evaluated for an application of the PAN AIR code to the PWW store in the STAC carriage position. It is shown that PAN AIR provides good correlations with test data for regions where linear theory is valid and yields reasonable estimates of store behavior in complex aircraft flowfields at both subsonic and supersonic speeds. F.G.M.

A83-16460#
PAN AIR VERSUS S/HABP - AN EVALUATION OF TWO DIVERSE APPROACHES TO SUPERSONIC MISSILE AERODYNAMIC ANALYSIS
J. E. GREGOIRE (McDonnell Douglas Astronautics Co., St. Louis, MO) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 10 p. refs
(AIAA PAPER 83-0008)

The Advanced Panel Pilot Code (PAN AIR) and the Supersonic/Hypersonic Arbitrary Body Program (S/HABP) have been evaluated as prediction tools for missiles in the supersonic Mach regime. Predictions using both codes are compared with wind tunnel test data for axisymmetric and arbitrary shaped bodies. Both longitudinal and lateral-directional comparisons are made in the 2.0-4.0 Mach regime. The geometry models and setup procedures are described for both codes. The rationales for selection of methods in employing each code are explained. A general evaluation is made for suitability of use in predicting supersonic missile aerodynamics. The evaluation is based on difficulty of setup, sensitivity of results to the setup, procedures used, cost in terms of computer execution time, range of applicability and accuracy of predictions. The conclusion reached is that the S/HABP is more generally applicable to supersonic missile aerodynamic predictions because of its high angle of attack capability and low cost. PAN AIR, however, is recommended in areas where S/HABP is weak such as lateral-directional predictions and calculations in the lower supersonic Mach regime. (Author)

A83-16489*# Missouri Univ., Rolla.
AERODYNAMIC INVESTIGATION OF CLOSELY COUPLED LIFTING SURFACES WITH POSITIVE AND NEGATIVE STAGGER FOR GENERAL AVIATION APPLICATIONS
B. P. SELBERG (Missouri-Rolla, University, Rolla, MO) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 8 p. refs
(Contract NAG1-26)
(AIAA PAPER 83-0057)

Aerodynamic closely coupled lifting surfaces were investigated for both conventional tail aft configurations and canard configurations to determine whether positive stagger or negative stagger had more attractive aerodynamic characteristics. An inviscid multi-element vortex panel program was used in conjunction with a momentum integral boundary layer program to predict two-dimensional aerodynamic characteristics. A multi-element vortex lattice program was used for three-dimensional characteristics. Pressure distributions, transition location, momentum thickness, two- and three-dimensional drag, and boundary layer separation were compared for the positive and negative stagger case. For staggers less than six the results demonstrated that positive stagger configurations are aerodynamically superior. (Author)

A83-16507#
AUGMENTATION OF FIGHTER AIRCRAFT LIFT AND STOL CAPABILITY BY BLOWING OUTBOARD FROM THE WING TIPS
M. M. BRIGGS and R. G. SCHWIND (Nielsen Engineering and Research Inc., Mountain View, CA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 10 p. refs
(Contract F49620-82-C-0061)
(AIAA PAPER 83-0078)

Parametric low-speed wind tunnel testing of low-aspect-ratio half-span wings with outboard-blowing wing-tip jets has augmented fighter aircraft lift and STOL capability. At angle of attack typical of fighter aircraft takeoff, the wing-tip jets were found to augment the lift coefficient of aspect ratio to wings by 25-35%. At low angles of attack, wing lift coefficients were augmented by up to 60%, although lift augmentation decreased in inverse proportion to wing angle of attack. By diverting 70% of the engine bypass airflow to the wing tips, predicted takeoff and landing distances were reduced by 15%. Up to 15,000 ft-lbs of roll control torque is available by diverting different amounts of bypass air to each wing tip. S.C.S.

A83-16509#
CIRCULATION CONTROLLED STOL WING OPTIMIZATION
J. L. LOTH and M. BOASSON (West Virginia University, Morgantown, WV) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 10 p. refs
(AIAA PAPER 83-0082)

Circulation control by blowing over a rounded trailing surface has been shown to efficiently achieve STOL capability. The method likewise yields a powerful lift control, roll control by differential flowing and good visibility in a level approach attitude. An internal wall jet ejector significantly improves the aerodynamics of the high-lift airfoil. The ejector also provides flap cooling air and increases the exposed exit slot area. The commercial application of circulation control will require in-flight conversion from the rounded trailing surface configuration to a low-drag sharp trailing edge cruise configuration. S.C.S.

A83-16510*# Stanford Univ., Calif.
THE PERFORMANCE OF A CIRCULATION CONTROL AIRFOIL AT TRANSONIC SPEEDS
N. J. WOOD (Stanford University, Stanford, CA) and J. A. CONLON (NASA, Ames Research Center, Moffett Field, CA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 9 p. refs
(AIAA PAPER 83-0083)

A two-dimensional wind tunnel test has been performed on a small circulation control airfoil section equipped with trailing edge blowing. The model was mounted in the NASA-Ames 2 x 2 ft transonic wind tunnel and tested at speeds up to free-stream Mach equals 0.75 for a range of incidences. Jet pressure ratios up to 3 (relative to tunnel static conditions) were evaluated together with the effects of Reynolds number. Normal force and pitching moment coefficients were calculated from surface pressures using a Scanivalve pressure measuring system. Drag force coefficients were calculated from wake rake pressures. The results obtained indicated that this airfoil was capable of producing useful lift at high subsonic Mach numbers. Some changes in the stall characteristics were apparent at above free-stream Mach equals 0.4 and some dependence between lift augmentation and incidence was observed. There also appeared to be a significant Reynolds number effect on the airfoil drag performance. (Author)

A83-16511*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
EFFECTS OF VARIOUS EMPENNAGE PARAMETERS ON THE AERODYNAMIC CHARACTERISTICS OF A TWIN-ENGINE AFTERBODY MODEL
L. D. LEAVITT (NASA, Langley Research Center, Transonic Aerodynamics Div., Hampton, VA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 11 p. refs
(AIAA PAPER 83-0085)

An experimental investigation to determine the effects of various empennage parameters on aft-end drag and tail interference drag characteristics of a twin-engine, axisymmetric nozzle, afterbody model has been conducted in the Langley 16-Foot Transonic Tunnel. Model variables included: horizontal tail location; vertical tail location, toe angle, cant angle, configuration (single and twin) and airfoil (Symmetrical and cambered); and tail booms. Tests were conducted over a Mach number range from 0.6 to 1.2 and over an angle-of-attack range from -2 to 10 deg. Nozzle pressure ratio was varied from jet off to approximately 10.0. (Author)

A83-16513*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
PROPULSION INSTALLATION CHARACTERISTICS FOR TURBOFAN TRANSPORTS
W. P. HENDERSON and J. C. PATTERSON, JR. (NASA, Langley Research Center, Transonic Aerodynamics Div., Hampton, VA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 12 p. refs
(AIAA PAPER 83-0087)

Several investigations have been conducted in the Langley 8-Foot Transonic Pressure Tunnel and the Langley 16-Foot Transonic Tunnel to investigate propulsion integration characteristics for turbofan transport aircraft. These studies have focused on reducing the interference drag for conventional underwing, overwing, upper surface and wing aft-mounted engine nacelle installations. The experimental data presented in this paper will illustrate the difficulties associated with properly integrating nacelles and pylons with advanced supercritical wings. In addition guidelines for integrating the nacelle/pylons to eliminate adverse interference effects and possibly achieve favorable interference are discussed. (Author)

A83-16514*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
DEVELOPMENTS IN THE NASA TRANSPORT AIRCRAFT LAMINAR FLOW PROGRAM
R. D. WAGNER and M. C. FISCHER (NASA, Langley Research Center, Hampton, VA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 12 p. refs
(AIAA PAPER 83-0090)

The NASA transport aircraft laminar flow program is assessed including on-going work and future research. The on-going program is discussed with reference to the advanced swept LFC airfoil tests, wind surface panel development, and leading edge flight tests. Among the areas of research considered are the variable sweep transition flight test, laminar flow wing aerodynamic design, and efficient laminar flow structures. S.C.S.

A83-16515#
ON THE TRANSONIC AERODYNAMIC CHARACTERISTICS OF 10 PERCENT THICK AIRFOILS WITH A PLAIN FLAP
D. L. ANTANI, E. R. BEEMAN, and W. S. BOWMAN (Northrop Corp., Aircraft Div., Hawthorne, CA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 11 p. refs
(AIAA PAPER 83-0091)

Transonic wind tunnel tests have been conducted to investigate the influence of Mach number and Reynolds number on the aerodynamic characteristics of 10 percent thick airfoils and also to determine the effectiveness of a plain trailing-edge flap on each airfoil. Results show that the lift curve slope and flap

effectiveness undergo reversals at small angle of attack and flap deflection at transonic Mach numbers. The effect of Reynolds number on these adverse aerodynamic phenomena is not significant. It was found that reducing the trailing-edge angle and blunting the trailing-edge have favorable effects on lift and flap effectiveness; however, there is a drag penalty associated with the second approach. (Author)

A83-16518*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A COMPARISON OF TRIM DRAG FOR CONVENTIONAL AND SUPERCRITICAL WINGS
P. F. JACOBS (NASA, Langley Research Center, Hampton, VA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 10 p.
(AIAA PAPER 83-0094)

The magnitude of the trim drag incurred by advanced supercritical wings and conventional wide-body wings at cruise conditions are investigated. Experiments were performed in a transonic pressure tunnel at a Mach number of 0.82 with a conventional wide-body wing and supercritical wing with high aspect ratio (9.80) using one of three low-tail configurations or two T-tail configurations in order to determine the effects of horizontal tail size, location, camber and static margin. Drag measurements indicate trim drag for the supercritical wing not to be significantly higher than for the conventional wing, although the minimum drag values for the supercritical wing occurred at lower static margins than for conventional wings. Both wings exhibited a reduction in trim drag with reduced cambered tail size, and greater minimum drag increments for cambered tails than for symmetrical tails. Lower trim-drag increments were also observed for the T-tail configuration than the low tails. The increase in lift-drag ratio for the supercritical wing over the conventional wing amounted to 11% for the best tail configurations. A.L.W.

A83-16525*# Ohio State Univ., Columbus.
AN ANALYTICAL EVALUATION OF THE ICING PROPERTIES OF SEVERAL LOW AND MEDIUM SPEED AIRFOILS
M. B. BRAGG and G. M. GREGOREK (Ohio State University, Columbus, OH) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 16 p. refs
(Contract NAG3-28)
(AIAA PAPER 83-0109)

A droplet trajectory computer code is used to analyze the water droplet impingement characteristics of several low and medium speed airfoils. The results are reported in terms of the airfoil maximum impingement efficiency, and limits of impingement. The airfoils are analyzed for angles of attack of -4 to 12 degrees, and modified inertia parameters of 0.01 to 1.0. These data are then used to evaluate the effect of airfoil geometry: leading edge radius, maximum thickness, maximum camber, and angle of attack on airfoil icing characteristics. Airfoils from the NACA four digit series to the new NASA NLF airfoils are considered. The strongest correlations were seen between airfoil leading edge radius and maximum local collection efficiency, thickness and total collection efficiency, and camber and the limits of impingement. (Author)

A83-16537*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A MULTIGRID METHOD FOR THE EULER EQUATIONS
D. C. JESPERSEN (NASA, Ames Research Center, Computational Fluid Dynamics Branch, Moffett Field, CA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 13 p. refs
(Contract NAS2-9891)
(AIAA PAPER 83-0124)

A multigrid algorithm has been developed for the numerical solution of the steady two-dimensional Euler equations. Flux vector splitting and one-sided differencing are employed to define the spatial discretization. Newton's method is used to solve the nonlinear equations, and a multigrid solver is used on each linear problem. The relaxation scheme for the linear problems is symmetric Gauss-Seidel. Standard restriction and interpolation operators are employed. Local mode analysis is used to predict the convergence rate of the multigrid process on the linear problems. Computed results for transonic flows over airfoils are presented. (Author)

A83-16540#
MEASUREMENTS OF THE NEAR WAKE OF AN AIRFOIL IN UNSTEADY FLOW
E. E. COVERT, P. F. LORBER, and C. M. VACZY (MIT, Cambridge, MA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 11 p. refs
(Contract AF-AFOSR-80-0282)
(AIAA PAPER 83-0127)

A series of measurements has been made of the velocities in the near wake of an airfoil in an unsteady flow generated by rotating an elliptic cylinder near the trailing edge. Ensemble averages of the tangential and normal velocity components and of three Reynolds stresses were determined for reduced frequencies based on semichord up to 6.4, angles of attack of 0 and 10 deg, Reynolds numbers of 700,000 and 1,450,000, and chordwise positions from 1.025 to 1.2. In this region, the airfoil wake is distinct from the wake of the elliptic cylinder. The mean and unsteady velocities and Reynolds stresses diffuse rapidly, so that the distinction between the contributions due to the two boundary layers on the airfoil surfaces, apparent at the 1.025 chordwise position, has largely disappeared by 1.20. (Author)

A83-16544#
UNSTEADY FLOW SEPARATION AND ATTACHMENT INDUCED BY PITCHING AIRFOILS
M. C. ROBINSON and M. W. LUTTGES (Colorado, University, Boulder, CO) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 15 p. refs
(Contract AF-AFOSR-81-0037)
(AIAA PAPER 83-0131)

The dynamics of induced, separated vortices generated from sinusoidal airfoil oscillations were examined across a range of unsteady flow parameters. Leading edge vortical initiation, development, and interaction with trailing edge vorticity were summarized via stroboscopic flow visualization and hotwire anemometry. Results indicate the sensitivity of vortical development at both leading and trailing edges to reduced frequency parameter and magnitude of oscillation angle. Certain optimal parametric conditions resulted in dramatic interactions of leading and trailing edge vorticity. At diminished oscillation angles, separated flow attachment was evident in the absence of the large induced vortical structures characteristic of large oscillation amplitudes. (Author)

A83-16573#
EVALUATION OF MISSILE AERODYNAMIC CHARACTERISTICS FOR DIVERSIFIED CONFIGURATIONS USING RAPID PREDICTION TECHNIQUES
J. SUN and R. M. CUMMINGS (Hughes Aircraft Co., Canoga Park, CA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 15 p. refs
(AIAA PAPER 83-0180)

A general overview of aerodynamic predictive methodology was made. Nine state-of-the-art rapid prediction codes were surveyed and the NSWC Aeroprediction and NEAR Missile II codes were selected for detailed evaluation. The ability and weakness of the codes to predict six-component aerodynamics of a diverse range of missile configurations (Sparrow III, Army Generalized, Maverick, and WASP) was examined. In general, both codes compared favorably in predicting longitudinal aerodynamics for angles of attack less than 10-15 degrees. Both codes possess thorough and compatible methodology bases. Improvement, extension, and unification of these two codes can lead to an aerodynamics prediction capability for generalized axisymmetric missile geometries. (Author)

A83-16574#
MISSILE DATCOM STATUS REPORT - BODY AND FIN ALONE METHODOLOGY
S. R. VUKELICH (McDonnell Douglas Astronautics Co., St. Louis, MO) and J. E. JENKINS (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 9 p. refs
(AIAA PAPER 83-0181)

The study includes a summary of those component buildup techniques selected for axisymmetric bodies and isolated fins. It is noted that these techniques were chosen on the basis of extensive comparisons to test data and their wide configuration applicability. Most of the techniques are theoretical or theoretically based; they are shown to provide aerodynamic predictions that are suitable for preliminary missile design. A methods handbook is part of the development program. It is noted that either the handbook or the computer code can be used to implement the techniques. In summarizing the selected axisymmetric body methods, a 'case study' at supersonic speeds is included to illustrate the depth of the analyses performed. The methods being analyzed for isolated fin panels are surveyed. C.R.

A83-16577#
,A TRANSONIC ANALYSIS OF PROPFAN SLIPSTREAM EFFECT ON A SUPERCRITICAL WING
J. P. NARAIN (Lockheed-Georgia Co., Marietta, GA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 8 p. refs
(AIAA PAPER 83-0186)

The effect of a propfan slipstream over a finite wing has been investigated using a full-potential analysis. The velocity field of the slipstream is generated either from experimental pressure ratio and swirl angle data or from analytical methods. Although the slipstream introduces a rotational flow over the wing, its effect can be analyzed by a potential flow analysis provided slipstream velocities are nearly uniform, and are small compared to the free-stream velocities. Inviscid and viscous theoretical predictions are compared with experimental data with satisfactory outcome. (Author)

A83-16578#
DESIGN OF OPTIMUM PROPELLERS
C. N. ADKINS and R. H. LIEBECK (Douglas Aircraft Co., Long Beach; Southern California, University, Los Angeles, CA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 10 p. refs
(AIAA PAPER 83-0190)

Improvements have been made in the equations and computational procedures for the design of propellers and wind turbines of maximum efficiency. These eliminate the small angle approximation and many of the 'lightly loaded' approximations prevalent in the classical design theory. Though wake contraction is still neglected, certain viscous terms have been added to the induced velocities which are important at low Reynolds numbers or high profile drag. An iterative scheme is introduced for accurate calculation of the vortex displacement velocity and the flow angle distribution. Momentum losses due to radial flow can be estimated by either the Prandtl or Goldstein momentum loss function. For the less complex Prandtl function, the 'lightly loaded' approximation can be eliminated for both design and analysis. The methods presented here now bring into exact agreement the procedures for design and analysis even when applied to cases of low Reynolds number and large disk loading. Furthermore, the exactness of this agreement makes possible an empirical verification of the Betz condition that a constant displacement velocity across the wake provides a design of maximum propeller efficiency. (Author)

A83-16595#
NUMERICAL SIMULATION OF WING-FUSELAGE AERODYNAMIC INTERACTION
J. S. SHANG (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 11 p. refs
(AIAA PAPER 83-0225)

Numerical solutions of the mass-averaged Navier-Stokes equations were accomplished for a wing-body configuration at a nominal Mach number of six and a Reynolds number of fifteen million. The computations were performed on a CRAY-1 computer utilizing a grid consisting of 56,730 points. The wing-fuselage configuration is comprised of a tangent-ogive forebody and highly swept wedge delta wing. The present results using a branch-cut mesh system were verified by comparing with experimental measurements. An improvement in numerical resolution over the previous solution utilizing a wrap-around grid distribution is clearly demonstrated. The flow field structure is delineated by identifying the shock wave systems, and the cross-flow velocity field. (Author)

A83-16602*# Grumman Aerospace Corp., Bethpage, N.Y.
A MULTI-GRID METHOD FOR THE COMPUTATION OF VISCID/INVISCID INTERACTIONS ON AIRFOILS
R. E. MELNIK, H. R. MEAD (Grumman Aerospace Research and Development Center, Bethpage, NY), and A. JAMESON (Grumman Aerospace Research and Development Center, Bethpage, NY; Princeton University, Princeton, NJ) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 18 p. refs
(Contract NAS1-12426)
(AIAA PAPER 83-0234)

An improved version of the 'GRUMFOIL' code has been developed for the computation of airfoil flows. The method employs a conservative difference scheme for the potential equation, integral methods for the boundary layer, and viscous coupling conditions that fully account for the wake and strong interaction effects at trailing edges. The improved version uses Jameson's 'MAD' scheme to accelerate convergence of the inviscid solution, an improved 2nd order artificial viscosity and far field 'TARE' correction to reduce spatial truncation errors and Carter's semi-inverse method for the viscous solution. Results are presented which demonstrate a factor of ten reduction in computing cost. (Author)

A83-16603#
THREE-DIMENSIONAL EULER EQUATION SIMULATION OF PROPELLER-WING INTERACTION IN TRANSONIC FLOW
D. L. WHITFIELD (Mississippi State University, Mississippi State, MS) and A. JAMESON (Princeton University, Princeton, NJ) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 8 p. Research sponsored by the Lockheed-Georgia Co. refs
(AIAA PAPER 83-0236)

A method is presented for the computation of propeller-wing interaction in transonic rotational flow. The approach is to use the three-dimensional time-dependent Euler equations with force terms included to simulate the propeller. Viscous-inviscid interaction on the wing surface is included by coupling the three-dimensional Euler equations with the two-dimensional compressible turbulent inverse integral boundary-layer equations. Numerical solutions are compared with experimental data for a 32 deg swept supercritical wing without a propeller simulator, wing with a propeller simulator producing thrust only, and wing with a propeller simulator producing thrust and swirl in each direction. (Author)

A83-16618#
A MULTI-GRID METHOD FOR TRANSONIC WING ANALYSIS AND DESIGN
P. RAJ (Lockheed-California Co., Burbank, CA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 11 p. Research supported by the Lockheed-California Independent Research and Development Program. refs
(AIAA PAPER 83-0262)

A fixed full-multigrid, full-approximation scheme has been incorporated into the solution algorithm of the full-potential finite-difference code, FLO22, widely used for analyzing wings of arbitrary planforms in transonic flows. The computational efficiency of the code is significantly enhanced by this modification. More accurate simulation of flow fields, especially for tapered wings, results from the use of planform conforming mesh. In addition to improved analysis capability, the new code, labeled FLO22.5, contains a design option. All or some of the sections of a wing are computationally recontoured to achieve a desired pressure distribution. The surface modification is dictated by the difference between the distributions obtained by analyzing the baseline geometry and the specified target pressure levels. (Author)

A83-16619#
JET WING VORTEX LATTICE THEORY WITH NONLINEAR WAKE AND TIP FLOWS
Z. L. CHEN and J. M. WU (Tennessee, University, Tullahoma, TN) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 8 p. refs
(AIAA PAPER 83-0263)

A three-dimensional nonlinear method applied to determine the aerodynamic performance of a jet flap wing has been developed. The method utilizes the system of bound vortices and free vortices with vortex lattices to represent wing, jet-wake and tip vortices. The interactions among all vortices are taken into account in the present calculation. The solutions include chordwise and spanwise load distribution from which sectional and total aerodynamic quantities are derived. The jet-wake sheet and the tip vortex shape, determined simultaneously are all nonlinear. The solutions derived from the present method agree reasonably well with other theoretical results and available data for jet wing performance. (Author)

A83-16622#
ADVANCES IN METHODS FOR PREDICTING STORE AERODYNAMIC CHARACTERISTICS IN PROXIMITY TO AN AIRCRAFT
A. CENKO, R. MEYER, F. TESSITORE (Grumman Aerospace Corp., Bethpage, NY), R. DYER (USAF, Wright Aeronautical Laboratories, Wright-Patterson, AFB, OH), and L. LIJEWSKI (USAF, Armament Laboratory, Eglin AFB, FL) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 10 p. refs
(Contract F33615-82-C-3007)
(AIAA PAPER 83-0266)

The results of a wind tunnel test are presented which indicate that the Influence Function Method (IFM) technique can be used at subsonic/transonic speeds. A new calibration technique was applied to three stores: the Planar Wing Weapon, air-to-ground stores, and the GBU-15 cruciform wing store. These stores were tested in proximity to an F-15 model at the centerline and under the pylon. Data were obtained for Mach numbers from 0.6 to 1.2 at a tunnel until Reynolds number of 2.5 million per foot. The IFM method is shown to provide excellent predictions of side force and yawing moment, and may also be applicable to drag and rolling moment predictions. The technique's utility can be enhanced by employing theoretical methods for store calibration and aircraft flowfield determination. C.D.

A83-16667#
SUBSONIC SURFACE PANEL METHOD FOR AIRFRAME ANALYSIS AND WING DESIGN
J. D. HAWK and D. R. BRISTOW (McDonnell Aircraft Co., St. Louis, MO) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 10 p. refs
(AIAA PAPER 83-0341)

A subsonic three-dimensional surface singularity panel method has been developed for designing wing section geometries from prescribed pressure distributions and accurately analyzing the potential flow about complex airframe geometries. While there are many methods that can solve for the potential flow field, it is believed that no other methods can accurately and efficiently design the wing from a given surface pressure distribution. The design method presented herein is the logical extension of an accurate subsonic potential flow analysis method and an extremely efficient perturbation analysis method. The purpose of this paper is to describe the basic mathematical approach of each of these methods and to present several examples which show their accuracy and efficiency. (Author)

A83-16676#
PREDICTION OF LINE SAIL DURING LINES-FIRST DEPLOYMENT
J. W. PURVIS (Sandia National Laboratory, Albuquerque, NM) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 7 p. Research supported by the U.S. Department of Energy. refs
(AIAA PAPER 83-0370)

A numerical simulation of lines-first canopy deployment is presented that can accurately predict the undesirable phenomenon of line sail, or fish hooking, at high angles of attack. A finite-element approach is used in which the canopy and the suspension lines are modeled as flexible distributed-mass structures connected to a forebody of finite mass. Both normal and tangential aerodynamic forces are taken into account, including the effects of line grouping and line twist; extraction of the deployment bag from the forebody is also modeled. The simulation is verified by comparisons with experimental data and is used to investigate a solution for a system with a line-sail problem. It is shown that the major cause of line sail is the relative magnitude of the suspension-line aerodynamic forces and the pilot-chute drag when the freestream flow is not aligned with the deployment direction. F.G.M.

A83-16686*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
INVESTIGATION OF THE EFFECTS OF UPSTREAM SIDEWALL BOUNDARY-LAYER REMOVAL ON A SUPERCRITICAL AIRFOIL
A. V. MURTHY, C. B. JOHNSON, E. J. RAY, P. L. LAWING, and J. J. THIBODEAUX (NASA, Langley Research Center, Hampton, VA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 11 p. refs
(AIAA PAPER 83-0386)

Sidewall boundary-layer effects have been investigated by applying partial upstream sidewall boundary-layer removal in the Langley 0.3-m Transonic Cryogenic Tunnel. Over the range of sidewall boundary-layer displacement thickness of these tests the influence on pressure distributions was found to be small for subcritical conditions; however, for supercritical conditions the shock position was affected by the sidewall boundary layer. For these tests, with and without boundary-layer removal, comparisons with predictions of the GRUMFOIL computer code indicated that Mach number corrections due to the sidewall boundary layer improves the agreement for both subcritical and supercritical conditions. The results show the necessity for accounting for sidewall effects even when the top and bottom wall effects are small. (Author)

A83-16706*# Vigyan Research Associates, Inc., Hampton, Va.
SEGMENTED VORTEX FLAPS
D. M. RAO (Vigyan Research Associates, Inc., Hampton, VA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 10 p. NASA-supported research. refs
(AIAA PAPER 83-0424)

Segmented vortex flaps were suggested as a means of delaying the vortex spill-over causing thrust loss over the outboard region of single-panel flaps. Also proposed was hinge-line setback for exploiting leading-edge suction in conjunction with vortex flaps to improve the overall thrust per unit flap area. These two concepts in combination were tested on a 60-deg cropped delta wing model. Significant improvement in flap efficiency was indicated by a reduction of the flap/wing area from 11.4% of single-panel flap to 6.3% of a two segment delta flap design, with no lift/drag penalty at lift coefficients between 0.5 and 0.7. The more efficient vortex flap arrangement of this study should benefit the performance attainable with flaps of given area on wings of moderate leading-edge sweep. (Author)

A83-16707*# Grumman Aerospace Corp., Bethpage, N.Y.
A SUPERSONIC MANEUVER WING DESIGNED FOR NONLINEAR ATTACHED FLOW
W. H. MASON, M. J. SICLARI (Grumman Aerospace Corp., Bethpage, NY), D. S. MILLER, and J. L. PITTMAN (NASA, Langley Research Center, High Speed Aerodynamics Div., Hampton, VA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 12 p. refs
(Contract NAS1-15351)
(AIAA PAPER 83-0425)

A wing designed using the concept of attached supercritical crossflow for supersonic maneuvering aircraft wings has been built and tested. The detailed wing shape was determined using nonlinear potential flow computational aerodynamics methods to obtain a specified target pressure distribution. The test results showed that the target pressures were essentially obtained and that the drag-due-to-lift values at maneuver lift coefficients were considerably less than those expected using linear theory design procedures. The paper provides a detailed description of the wing design and test, and an analysis of the results. (Author)

A83-16708*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
LOW-SPEED INVESTIGATION OF THE MANEUVER CAPABILITY OF SUPERSONIC FIGHTER WINGS
K. W. HOM, O. A. MORRIS, and D. E. HAHNE (NASA, Langley Research Center, Hampton, VA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 11 p. refs
(AIAA PAPER 83-0426)

A low-speed investigation of wings suitable for supersonic fighter application was undertaken to understand the flow regions developed by these wings through flow visualization and to evaluate areas in which low-speed testing could provide information for extrapolation to higher Mach numbers and Reynolds numbers. This study involved cranked wings of highly-swept inboard panels and outboard panel of various sweeps with leading- and trailing-edge devices. Both theoretical and experimental results with flow visualization are presented. Flow visualization results show that a mixed flow condition (vortex flow on the highly-swept inboard section and attached flow on the cranked outboard section) is possible for wings with low sweep (20 deg) outboard cranked sections. Lift and drag measurements on the planar (no flap deflection) wings show good agreement with theoretical results for leading-edge vortex flow. There is little or no change in planar wing performance at maneuver conditions due to outboard sweep effects. Results also show that for cambered wings (flap deflected) only small improvements in performance over flat wings were obtained at high-lift maneuver conditions. (Author)

A83-16775#
FLOW SIMULATIONS FOR GENERAL NACELLE CONFIGURATIONS USING EULER EQUATIONS
H. C. CHEN, N. J. YU, P. E. RUBBERT (Boeing Co., Seattle, WA), and A. JAMESON (Princeton University, Princeton, NJ) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 10 p. Research supported by the Boeing Independent Research and Development Program. refs
(AIAA PAPER 83-0539)

An Euler code has been developed for the analysis of general three-dimensional nacelle configurations. Including flow-through and powered nacelles. Flow-through nacelle geometry takes into account a fan cowl and a center body. Powered nacelle components include the outer cowl, spinner, fan face, fan exit plane, and core cowl geometry. In a powered nacelle simulation, either the mass flux or the static pressure can be prescribed at the fan face. The total pressure, total temperature, and flow direction are specified at the turbine or fan exit plane, and the exhaust plume emerges naturally as part of the global solution. Comparisons of the results with a panel solution and test data show very good agreement. Specific problems associated with high angle of attack flows are discussed, including the appearance of artificial inviscid separation. The cause and cure of such phenomena are described. (Author)

A83-16781#
INVESTIGATIONS ON THE EFFECTS OF DISCRETE WINGTIP JETS
J. M. WU, A. VAKILI, Z. L. CHEN (Tennessee, University, Tullahoma, TN), and F. T. GILLIAM (Arnold Engineering Development Center, Arnold Air Force Station, TN) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 12 p. refs
(Contract F33615-81-K-3034)
(AIAA PAPER 83-0546)

A quantitative measurement of the results of this interaction on wing aerodynamic performance is made in a low-speed wind tunnel. Surface pressure measurements suggest improvements on the wing with discrete jets blowing. The jet-blowing coefficient is of the order of 0.001. Detailed flow field observations of interactions between the wingtip jets and the flow around the wingtip are made in a water tunnel study. A fairly complex flow interaction phenomena is observed with the jet blowing. Several types of peculiarly behaving secondary vortices are observed. Certain vortices spin around axes perpendicular to the main tip vortex and certain vortices are periodic. Such secondary vortices have a pronounced influence on the tip vortex flow. In addition, a simple analytical model is considered for the comparison with the wind tunnel data. The study is seen as indicating that the wingtip jets, if applied properly, could be developed as a viable means of improving and controlling the wingtip flow field. C.R.

A83-16792#
EVOLUTION OF AIRCRAFT TRAILING VORTICES IN A STRATIFIED FLUID
T. SARPKAYA and S. K. JOHNSON (U.S. Naval Postgraduate School, Monterey, CA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, AIAA,. 11 p. DARPA-supported research. refs
(AIAA PAPER 83-0564)

The evolution of trailing vortices in stratified and unstratified water was experimentally investigated for the cases of two rectangular and three delta wings, determining vortex trajectories as a function of relative depth, normalized time, stratification parameter, and relative vortex core size. Results obtained show that vortices rise only to a finite height as they gradually decay under the influence of turbulence, sinusoidal instability, and vortex breakdown, where the effect of stratification is to reduce vortex lifespan and maximum attained height. The determination of trailing vortex lifespan is attempted through several approximate analyses. O.C.

A83-16828#
TRANSONIC WING-BODY CALCULATIONS USING EULER EQUATIONS
R. K. AGARWAL and J. E. DEESE (McDonnell Douglas Research Laboratories, St. Louis, MO) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983. 16 p. Research supported by the McDonnell Douglas Independent Research and Development Program. refs (AIAA PAPER 83-0501)

Computation of inviscid transonic flows containing strong shock waves or a complex vortex structure call for solution of the Euler equations instead of the full potential equation as a physical model. In this paper, transonic wing-body computations are performed in the Euler approximation. For these computations, Jameson's wing-alone Euler code (FLO-57), based on an explicit Runge-Kutta time-marching finite-volume procedure and employing a combination of second- and fourth-order dissipation, variable-time steps, and enthalpy damping to speed up convergence to steady state, is modified for treating wing-body combinations. The modified FLO-57 code is written in modular form and coupled with a nearly conformal 3-D code which generates body conforming C-type grids for wing-fuselage combinations. The calculations are performed on a CYBER 205 as well as on the Floating Point Systems (FPS) Array Processor AP-164 and are compared with experimental data and potential-flow computations. (Author)

A83-16882
CALCULATION OF FUNDAMENTAL AERODYNAMIC DERIVATIVES OF AIRCRAFT
Z. SKODA Zprava VZLU, no. Z-39, 1982, p. 1-11.

A new procedure is developed for calculating the fundamental aerodynamic derivatives of an aircraft which is based on the assumption of an ideal gas and an aircraft assembled from thin airfoils. First, a general mathematical formulation for the problem of the motion of an aircraft in an ideal gas is presented. The equations describing the flow of gas past the aircraft are then linearized, as are the boundary conditions for the solution of these equations. The solution is reduced to a system of integral equations for unsteady longitudinal and lateral motions which make it possible to determine the interaction of a system of lifting surfaces and calculate the basic aerodynamic characteristics of an aircraft as a single unit. In contrast to the existing methods which rely on hydrodynamic models of the lifting surfaces, the present method deals directly with the load (i.e., pressure distribution on the surface of the aircraft) and the geometry of the aircraft. V.L.

A83-17317#
STUDIES OF AEROFOILS AND BLADE TIPS FOR HELICOPTERS
J.-J. THIBERT and J.-J. PHILIPPE (ONERA, Chatillon-sous-Bagneux, Hauts-de-Seine, France) (NATO, AGARD, Meeting on Prediction of Aerodynamic Loads on Rotorcraft, London, England, May 17-19, 1982.) La Recherche Aerospatiale (English Edition), no. 4, 1982, p. 27-40. refs

An assessment is presented of the results obtained to date by a long term research program undertaken in 1974 for the improvement of understanding of helicopter rotor blade aerodynamics and the refinement of performance prediction codes. Attention is given to progress made in the cases of novel airfoil profiles and blade tip designs. The performance of the family of airfoils derived from the design methodology developed has been validated by wind tunnel tests as well as comparisons with conventional airfoils and theoretical predictions. The blade tip study results presented emphasize designs which improve advancing blade behavior, as a means of achieving improvements in overall rotor performance. O.C.

A83-17408
AERODYNAMIC DRAG IN TWO-PHASE FLOWS
B. A. BALANIN, V. A. LASHKOV, and E. P. TRAKHOV (Leningradskii Gosudarstvennyi Universitet, Leningrad, USSR) (Gazodinamika i Teploobmen, no. 6, 1981, p. 19-26.) Fluid Mechanics - Soviet Research, vol. 10, Jan.-Feb. 1981, p. 15-21. Translation.

The results of experimental studies on the aerodynamic drag of spheres in subsonic two-phase flows are presented. It was found that below a certain solids concentration in the gas flow the drag of a sphere increases linearly with concentration. The drag coefficient of a sphere is a function of the size of the particles, being maximum at specific particle sizes. (Author)

A83-17412
A THREE-DIMENSIONAL HYPERSONIC GAS FLOW OVER A SLENDER WING
V. I. BOGATKO (Leningradskii Gosudarstvennyi Universitet, Leningrad, USSR) (Gazodinamika i Teploobmen, no. 6, 1981, p. 53-58.) Fluid Mechanics - Soviet Research, vol. 10, Jan.-Feb. 1981, p. 47-52. Translation.

Several analytical examples are presented of application of the semi-inverse method to obtaining solutions to the steady-state problem of hypersonic gas flow over a slender wing. Consideration is given to a flow with the shock wave attached along the full breadth of the wing leading edge, to a shock with a parabolic cross-section over the entire leading edge, and to a flow with the shock wave attached only at the leading point. The examples are noted to be useful for verifying numerical models of flows over wings and for determining the parameters for flows over slender wings. M.S.K.

A83-17413
FLOW OVER FLAT AND AXISYMMETRIC BODIES MOVING AT HIGH VARIABLE VELOCITIES
E. A. POTEKHINA (Leningradskii Gosudarstvennyi Universitet, Leningrad, USSR) (Gazodinamika i Teploobmen, no. 6, 1981, p. 59-66.) Fluid Mechanics - Soviet Research, vol. 10, Jan.-Feb. 1981, p. 53-59. Translation.

The thin shock layer technique is employed to examine the motion of an airfoil and a body of revolution at high, variable velocities. An attached shock wave is considered in terms of Lagrangian variables in order to define a set of gasdynamics equations to account for the motion of the gas in the shock layer between the front of the leading-edge shock wave and the surface of the body. The shape of the shock wave front at the leading edge is formulated and boundary conditions are defined. It is shown that the motion of a gas particle along the body's generatrix is a second order ordinary differential equation with no general solution. Further analysis is provided for conditions of constant acceleration, demonstrating a method for obtaining the pressure and enthalpy in the zero approximation. M.S.K.

A83-17847
EXISTENCE AND UNIQUENESS OF SHOCK-FREE TRANSONIC FLOW PAST SYMMETRICAL THIN WINGS AT ZERO INCIDENCE
P. NIYOGI (Indian Institute of Technology, Kharagpur, India) Acta Mechanica, vol. 45, no. 3-4, 1982, p. 177-184. refs

Questions regarding the existence of steady inviscid shock-free transonic supercritical flow past thin profiles and wings are of basic interest. For a prescribed free-stream supercritical Mach number and a thin body shape, no mathematical answer is known to thy question of existence and uniqueness. The present investigation is concerned with the three-dimensional case of steady inviscid irrotational supercritical transonic flow past a thin symmetrical wing at zero incidence. According to the boundary conditions, the resultant flow velocity at the wing surface is tangential to the surface and the perturbation potential and its derivatives vanish at a large distance from the wing. A proof of existence and uniqueness is considered along with the existence and uniqueness of discontinuous solutions. G.R.

A83-17902#
APPLICATION OF THE PANAIR PRODUCTION CODE TO A COMPLEX CANARD/WING CONFIGURATION
J. DEHART (Rockwell International Corp., Columbus, OH), K. R. CRAMER, and S. MILLER (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 11 p. refs
(AIAA PAPER 83-0009)

The analysis of research model canard/wing interaction aerodynamics by means of the first version of the PANAIR computer code has yielded total force and moment predictions which are not in agreement with wind tunnel data. This may be due to an inadequate modeling of the body, rather than any inherent deficiency of the method, in view of the satisfactory agreement of incremental canard effects with force, moment and pressure data from the attached flow regime. Stable and reliable supersonic solutions call for computing times that are large by comparison with low order paneling methods, due to the required doublet continuity at panel and network edges. O.C.

A83-17905*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
THREE-DIMENSIONAL EULER SOLUTIONS FOR LONG-DUCT NACELLES
W. B. COMPTON, III (NASA, Langley Research Center, Transonic Aerodynamics Div., Hampton, VA) and J. L. WHITESIDES (George Washington University, Hampton, VA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 11 p. refs
(AIAA PAPER 83-0089)

A three-dimensional Euler-equation computational technique has been developed to solve for the transonic flow past flow-through nacelles. The technique employs an approximately-factored alternating-direction implicit numerical algorithm and a radiation treatment of the outflow boundary. Studies are presented which show that the radiation treatment gives better numerical convergence than the condition of specifying the pressure at the outflow boundary. Calculations made with the technique are presented for a long-duct turbofan engine nacelle at a Mach number of 0.80 and angles of attack of 0 deg and 4 deg. Good agreement is shown between the computational results and wind-tunnel data. Problem areas are identified and recommendations are made for further numerical studies.
(Author)

A83-18404#
AERODYNAMIC ESTIMATION TECHNIQUES FOR AEROSTATS AND AIRSHIPS
S. P. JONES (TCOM Corp., Columbia, MD) and J. D. DELAURIER (Toronto, University, Toronto, Canada) (Lighter-than-Air Systems Technology Conference, Annapolis, MD, July 8-10, 1981, Collection of Technical Papers, p. 122-130.) Journal of Aircraft, vol. 20, Feb. 1983, p. 120-126. refs
(Previously cited in issue 17, p. 2877, Accession no. A81-38542)

A83-18405#
FINITE-VOLUME SOLUTIONS TO THE EULER EQUATIONS IN TRANSONIC FLOW
W. SCHMIDT (Dornier GmbH, Friedrichshafen, West Germany), A. JAMESON (Princeton University, Princeton, NJ), and D. WHITFIELD (Mississippi State University, Mississippi State, MS) Journal of Aircraft, vol. 20, Feb. 1983, p. 127-133. Research supported by the Bundesministerium fuer Verteidigung and Bundesministerium fuer Forschung und Technologie. refs
(AIAA PAPER 81-1265)

An efficient numerical method for the solution of the two- and three-dimensional transonic Euler equations has been used to compute the flow over airfoils, wings, and wing-body combinations. For two-dimensional flow, the Euler equation code has been coupled with an inverse boundary-layer integral method to compute viscous flow over transonic airfoils with shocks. All Euler methods are using the same mesh systems (0 or C type) as well-established full-potential codes which can optionally also provide initial solutions. This allows for detailed comparisons with the full-potential solutions. Results are discussed in detail for lifting and nonlifting airfoils as well as the DFVLR-F4 transonic transport configuration.
(Author)

A83-18410*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
EFFECTS OF SPANWISE BLOWING AND REVERSE THRUST ON FIGHTER LOW-SPEED AERODYNAMICS
J. W. PAULSON, JR., D. W. BANKS, and P. F. QUINTO (NASA, Langley Research Center, Subsonic Aerodynamics Branch, Hampton, VA) Journal of Aircraft, vol. 20, Feb. 1983, p. 159-164. refs
(Previously cited in issue 07, p. 963, Accession no. A82-19203)

A83-18426#
AN INVESTIGATION OF THE AERODYNAMICS OF AN RAE SWEPT TIP USING A MODEL ROTOR
P. G. WILBY (Royal Aircraft Establishment, Farnborough, Hants., England) and J. J. PHILIPPE (ONERA, Chatillon-sous-Bagneux, Hauts-de-Seine, France) (European Helicopter Forum, 8th, Aix-en-Provence, France, Aug. 31-Sept. 3, 1982.) ONERA, TP no. 1982-76, 1982. 15 p.
(ONERA, TP NO. 1982-76)

The paper presents results of model testing of a swept tip of RAE design for a helicopter rotor at the ONERA S2 wind tunnel. Tests were conducted with a swept tip of 30 deg sweep back to both leading and trailing edges over about one chord length of the blade and rounded-off corners, as well as with a straight tip planform, mounted on a low-aspect-ratio blade. Pressure transducers located at 85 percent, 90 percent and 95 percent rotor radius were used to measure upper and lower surface distributions at a tip speed of 210 m/sec and forward speeds from 70 to 97 m/sec. The power coefficient is found to increase less rapidly with speed for the swept tip than for the straight tip, which is accounted for by a lower shock strength and a further forward shock position over the major portion of the supercritical flow sector for the swept tip. The measured relative differences between swept and straight tips are shown to correspond to those predicted by the method used in tip design, although theoretical and experimental values did not agree due to the failure to include time-dependent effects in the calculations. A.L.W.

A83-19412
PARIETAL JETS. II - A PROBLEM OF HYPERSUSTENTATION [LES JETS PARIETAUX. II - UN PROBLEME D'HYPERSUSTENTATION]
L. ROSENTHAL (Centre de Documentation de l'Armement, Paris, France) L'Aeronautique et l'Astronautique, no. 96, 1982, p. 23-34. In French. refs

Various analytical techniques for determining the critical value coefficient for parietal jet intakes as a function of the jet motion, the sectional area of the wing affected by the jet, and the mass expelled by the jet are examined and tested in various applications. The coefficient is employed to ascertain the flow separation location on the wing. The values are continuously changed until the separation point is moved to the trailing edge. Examples discussed include the Coanda effect utilized on the YC-14, An-72, and QSRA aircraft, helicopter blades, a car engine, missile guidance, and fluid pumps. Further fundamental research is recommended on the concept of adherence. M.S.K.

A83-19582*# Boeing Commercial Airplane Co., Seattle, Wash.
TRANSONIC FLOW SIMULATION OF PROP-FAN CONFIGURATIONS
S. S. SAMANT, N. J. YU, and P. E. RUBBERT (Boeing Commercial Airplane Co., Seattle, WA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 7 p. NASA-supported research. refs
(AIAA PAPER 83-0187)

This paper presents the results of a study that used a three-dimensional transonic analysis method to analyze flow around a wing-mounted prop-fan configuration. The transonic analysis method employs a cell-oriented finite volume approach to solve the full potential equation in conservative form over a numerically generated surface-fitted grid. The propeller slipstream effects are simulated using a linearized transpiration boundary condition. The results of analyses of flow over clean wing/body, wing/body/nacelle, and wing/body nacelle with slipstream are compared to test data. (Author)

A83-19590#
BOUNDARY LAYER CALCULATIONS IN THE INVERSE MODE FOR INCOMPRESSIBLE FLOWS OVER INFINITE SWEPT WINGS
S. RADWAN and S. G. LEKOUDIS (Georgia Institute of Technology, Atlanta, GA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 13 p. Research supported by the Lockheed-Georgia Co. refs
(AIAA PAPER 83-0454)

The three-dimensional boundary layer equations for laminar and turbulent flow are solved in the inverse mode under the ideal and approximate infinite yawed cylinder assumptions. A modification of the Keller-box is used in order to suppress oscillations in the solution. The turbulence is modeled by the use of an anisotropic eddy-viscosity formula. The computed results are compared with the experimental data, and the capability of the scheme to allow marching into the region of three-dimensional separated flow is demonstrated. It is found that this scheme reproduces the measured data with reasonable accuracy, including the region of three-dimensional separation. N.B.

A83-19591#
A NUMERICAL TRANSFORMATION SOLUTION PROCEDURE FOR CLOSELY COUPLED CANARD-WING TRANSONIC FLOWS
V. SHANKAR (Rockwell International Science Center, Thousand Oaks, CA) and T. GOEBEL (Rockwell International Corp., Los Angeles, CA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 12 p. Research supported by the Rockwell International Corp. refs
(AIAA PAPER 83-0502)

The transonic closely coupled canard-wing interaction has been modeled, using modified small disturbance theory. A novel numerical mapping procedure has been applied to treat the leading and trailing edges of the canard-wing as constant coordinate lines in the computational domain. This is a local mapping concept, in contrast to the global mapping procedures such as the wing shearing transformation, which require an embedded grid system. In this new procedure, the interaction between the canard and the wing is direct and equally valid for mild and strongly coupled canard-wing arrangements. The procedure can also handle canard-wing arrangements with dihedral and wings with canted winglet system. Results are presented for a closely coupled canard-wing research model showing excellent comparisons with experimental data even for angles of attack up to 8 degrees. (Author)

N83-14064# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
APPLIED COMPUTATIONAL TRANSONIC AERODYNAMICS
Aug. 1982 108 p refs
(AGARD-AG-266; ISBN-92-835-1431-9) Avail: NTIS HC A06/MF A01

A review of state of the art computational fluid dynamics as applied to the transonic computational design of combat and airlift aircraft is given. The theoretical fluid dynamics bases on which computer programs are based are discussed. Viscous interactions, computational procedures used in aerodynamic design, and advanced concepts are discussed. R.J.F.

N83-15263*# California Polytechnic State Univ., San Luis Obispo. Dept. of Aeronautical and Mechanical Engineering.
WIND TUNNEL TESTS OF A FREE-WING/FREE-TRIMMER MODEL Final Report
D. R. SANDLIN NASA Dec. 1982 47 p refs
(Contract NSG-4020)
(NASA-CR-170394; NAS 1.26:170394) Avail: NTIS HC A03/MF A01 CSCL 01A

The riding qualities of an aircraft with low wing loading can be improved by freeing the wing to rotate about its spanwise axis. A trimming surface also free to rotate about its spanwise axis can be added at the wing tips to permit the use of high lift devices. Wind tunnel tests of the free wing/free trimmer model with the trimmer attached to the wing tips aft of the wing chord were conducted to validate a mathematical model developed to predict the dynamic characteristics of a free wing/free trimmer aircraft. A model consisting of a semispan wing with the trimmer mounted on with the wing on an air bearing and the trimmer on a ball bearing was displaced to various angles of attack and released. The damped oscillations of the wing and trimmer were recorded. Real and imaginary parts of the characteristic equations of motion were determined and compared to values predicted using the mathematical model. A.R.H.

N83-15264*# Lehigh Univ., Bethlehem, Pa. Dept. of Mechanical Engineering and Mechanics.
CRITICAL REVIEW OF THE TRAILING EDGE CONDITION IN STEADY AND UNSTEADY FLOW. BLADE FLUTTER IN COMPRESSORS AND FANS: NUMERICAL SIMULATION OF THE AERODYNAMIC LOADING
S. F. RADWAN, D. O. ROCKWELL, and S. H. JOHNSON Dec. 1982 149 p refs
(Contract NSG-3162)
(NASA-CR-169705; NAS 1.26:169705) Avail: NTIS HC A07/MF A01 CSCL 01A

Existing interpretations of the trailing edge condition, addressing both theoretical and experimental works in steady, as well as unsteady flows are critically reviewed. The work of Kutta and Joukowski on the trailing edge condition in steady flow is reviewed. It is shown that for most practical airfoils and blades (as in the case of most turbomachine blades), this condition is violated due to rounded trailing edges and high frequency effects, the flow dynamics in the trailing edge region being dominated by viscous forces; therefore, any meaningful modelling must include viscous effects. The question of to what extent the trailing edge condition affects acoustic radiation from the edge is raised; it is found that violation of the trailing edge condition leads to significant sound diffraction at the tailing edge, which is related to the problem of noise generation. Finally, various trailing edge conditions in unsteady flow are discussed, with emphasis on high reduced frequencies. Author

N83-15265*# Ohio State Univ., Columbus. Dept. of Aeronautical and Astronautical Engineering.
WIND TUNNEL EVALUATION OF AIR-FOIL PERFORMANCE USING SIMULATED ICE SHAPES Final Report
M. B. BRAGG, R. J. ZAGULI, and G. M. GREGOREK Nov. 1982 172 p refs
(Contract NAG3-28)
(NASA-CR-167960; NAS 1.26:167960) Avail: NTIS HC A08/MF A01 CSCL 01A

A two-phase wind tunnel test was conducted in the 6 by 9 foot Icing Research Tunnel (IRT) at NASA Lewis Research Center to evaluate the effect of ice on the performance of a full scale general aviation wing. In the first IRT tests, rime and glaze shapes were carefully documented as functions of angle of attack and free stream conditions. Next, simulated ice shapes were constructed for two rime and two glaze shapes and used in the second IRT tunnel entry. The ice shapes and the clean airfoil were tapped to obtain surface pressures and a probe used to measure the wake characteristics. These data were recorded and processed, on-line, with a minicomputer/digital data acquisition system. The effect of both rime and glaze ice on the pressure distribution, Cl, Cd, and Cm are presented. Author

N83-15266*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
WIND-TUNNEL STUDIES OF THE EFFECTS OF STIMULATED DAMAGE ON THE AERODYNAMIC CHARACTERISTICS OF AIRPLANES AND MISSILES
M. L. SPEARMAN Dec. 1982 24 p refs
(NASA-TM-84588; NAS 1.15:84588) Avail: NTIS HC A02/MF A01 CSCL 01A

As an aid in assessing the aerodynamic effects of battle damage that might be sustained by military airplanes or missiles, several wind tunnel investigations were performed at the Langley Research Center in which damage was simulated with models by the removal of all or parts of the wing and tails. Results of the investigations indicate that the loss of a major part of the vertical tail will probably result in the loss of an airplane in any speed range. The loss of major parts of the horizontal tail generally results in catastrophic instability in the subsonic range but, at low supersonic speeds, and for some planform configurations at subsonic speeds, may allow stable flight to the extent that the airplane might return to friendly territory before the pilot must eject. The results further indicate that major damage to the wing, up to the point of the complete removal of one wing panel, and major damage to the horizontal tail may be sustained without necessarily causing the loss of the airplane or pilot. Author

N83-15269# Transportation Systems Center, Cambridge, Mass.
CHICAGO MONOSTATIC ACOUSTIC VORTEX SENSING SYSTEM. VOLUME 4: WAKE VORTEX DECAY Final Report, Oct. 1976 - Dec. 1979
D. C. BURNHAM and J. N. HALLOCK Jul. 1982 203 p refs 4 Vol.
(AD-A120081; DOT/TSC/FAA-79/18-4;
DOT/FAA/RD-79/103-VOL-4) Avail: NTIS HC A10/MF A01 CSCL 20D

A monostatic acoustic vortex sensing system (MAVSS) was installed at Chicago's O'Hare International Airport to measure the strength and decay of aircraft wake vortices from landing aircraft. The MAVSS concicts of an array of acoustic antennas which measure the vertical profile up to 60 m altitude of the vertical component of the wind. The decay in wake vortex strength is measured as the vortex passes over successive antennas in the array. Volume 1 (published in October 1979, 32 pages) described the MAVSS principles of operation, the hardware developed, and the data reduction methods employed. Volume 2 (published in September 1981, 162 pages) described the analysis of MAVSS data to exaMINE WHETHER LANDING B-707 and DC-8 aircraft need to remain divided into Heavy and Large categories on the basis of the wake vortex hazard. Volume 3 (published in January 1982, 25 pages) summarized the results of Volume 2 in terms of the safety implications of categorizing all landing B-707s and DC-8s as Large aircraft. In this volume, the statistical methods used to understand wake vortex decay are described and the data on all common jet transport aircraft are presented. GRA

N83-15271# Sandia Labs., Albuquerque, N. Mex. Advanced Energy Projects Div.
DARRIEUS ROTOR AERODYNAMICS
P. C. KLIMAS 1981 11 p refs Presented at 5th Biennial Wind Energy Conf. and Workshop, Washington, D.C., 5 Oct. 1981 Original language document announced as A82-33708
(Contract DE-AC04-76DP-00789)
(DE82-003495; SAND-81-1701C; CONF-811043-7) Avail: NTIS HC A02/MF A01

Darrieus wind turbines are relatively simple devices. Fixed geometry blades, usually only two or three in number, rotate about a vertical axis providing power to ground mounted power conversion or absorption machinery. No yaw control or power regulation systems are required. This simplicity, however, does not extend to the rotor's aerodynamics. The blade elements travel along circular paths through air whose relative speed and direction are constantly changing. The blade elements operate both unstalled and stalled with aerodynamic stall providing the rotor's inherent power regulation. The blade elements encounter their own wakes and those generated by other elements. These features combine to cause the thorough analysis of Darrieus rotor aerodynamics to be a challenging undertaking. DOE

03

AIR TRANSPORTATION AND SAFETY

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

A83-18403*# Dayton Univ., Ohio.
AERODYNAMIC PENALTIES OF HEAVY RAIN ON LANDING AIRPLANES
P. HAINES and J. LUERS (Dayton, University, Dayton, OH) Journal of Aircraft, vol. 20, Feb. 1983, p. 111-119. NASA-supported research. refs
(Previously announced in STAR as N82-30298)

A83-18415*# Dayton Univ., Ohio.
HEAVY RAIN INFLUENCE ON AIRPLANE ACCIDENTS
J. LUERS and P. HAINES (Dayton, University, Dayton, OH) Journal of Aircraft, vol. 20, Feb. 1983, p. 187-191. NASA-supported research. refs

The aerodynamic effects of heavy rain on two windshear accidents have been evaluated according to the theoretical results of Haines and Luers (1983). A number of other accidents in which the presence of low-level windshear was a distinct possibility are also discussed. The results indicate that there are two major types of rain-related accidents. In one, the aircraft touches down prior to the runway because increased drag and momentum loss make the aircraft descend below glide slope. In the other, the aircraft loses airspeed while attempting a go-around in the heavy rain environment. S.C.S.

A83-19150
FUEL SAVINGS IN AIR TRANSPORT
J. L. RENTEUX and H. SCHROEDER Airport Forum, vol. 11, Dec. 1982, p. 36-40.

A summary of conclusions reached in a report by Eurocontrol on civil aircraft fuel conservation measures implementable by ATC is presented. The types of aircraft were categorized together with flight statistics. The average European flight was determined to be 320 nm, with total fuel consumed annually amounting to 16 Mtons. Routing changes were projected to save 4% of the total fuel consumed. Delays, if ameliorated, could account for 1,5% savings, while flight profile changes, if minimized, offer a 3.5-4.5%

reduction. In total, from 4.9-5.8% of consumption can be saved in the short term, and an additional 4% in the medium term, i.e., 1985. Various additional steps, including improved training for ATCs, links between the flight management computer and the ground-based computers, and start-up and take-off procedures improvements are outlined. D.H.K.

A83-19584#
RESEARCH ON CONTAMINATED WINGS, CURRENT ISSUES
T. NARK (Boeing Commercial Airplane Co., Seattle, WA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 7 p.
(AIAA PAPER 83-0277)

Design requirements and initial steps to institute wind tunnel tests of the effects of wintertime conditions and consequent icing on aircraft wings are described. Noting that the meteorological conditions which lead to icing must be identified for accurate testing, a requirement is also cited of defining the frost shapes that affect airfoil aerodynamics. It is suggested that a relationship may exist between frost shapes and sand grain shapes, which have already been extensively documented. Experiments are suggested for measuring frost surface roughness as turbulent boundary layer profiles, as well as determining how frost roughness causes early flow separation. Methods of utilizing grit trip strips for wind tunnel testing of roughness parameters are discussed. Finally, it is recommended that the effects of the use of thixotropic type II deicing fluids on wing aerodynamics be investigated. D.H.K.

N83-14074# Comptroller General of the United States, Washington, D.C.
AIRCRAFT THRUST/POWER MANAGEMENT CAN SAVE DEFENSE FUEL, REDUCE ENGINE MAINTENANCE COSTS, AND IMPROVE READINESS
29 Jul. 1982 51 p refs
(GAO/PLRD-82-74) Avail: NTIS HC A04/MF A01

It was found that the Department of Defense could achieve additional savings in aircraft fuel and reduce engine maintenance costs by making greater use of reduced power takeoffs and climbs by fighter aircraft. It is recommended that effective local initiatives be better identified, reviewed, and implemented whenever possible. R.J.F.

N83-14075# General Accounting Office, Washington, D. C. Community and Economic Development Div.
THE CHANGING AIRLINE INDUSTRY: A REPORT, 1981 Status Report
24 Jun. 1982 34 p refs Supersedes CED-81-103
(GAO/CED-82-94; B-197119; CED-81-103) Avail: NTIS HC A03/MF A01; SOD HC $3.25

Changes in the airline industry since passage of the Airline Deregulation Act of 1978 are discussed. Airline traffic; fares; profits; productivity; air service patterns, including service to small communities; and the safety records of domestic passenger airlines before and after the start of deregulation are considered. S.L.

N83-14076*# Spectrum Technology, Inc., Virginia Beach, Va.
SINGLE PILOT IFR ACCIDENT DATA ANALYSIS Final Report
D. F. HARRIS and J. A. MORRISETE Washington NASA Nov. 1982 102 p refs
(Contract NAS1-16920)
(NASA-CR-3650; NAS 1.26:3650) Avail: NTIS HC A06/MF A01 CSCL 01C

The aircraft accident data recorded and maintained by the National Transportation Safety Board for 1964 to 1979 were analyzed to determine what problems exist in the general aviation single pilot instrument flight rules environment. A previous study conducted in 1978 for the years 1964 to 1975 provided a basis for comparison. The purpose was to determine what changes, if any, have occurred in trends and cause-effect relationships reported in the earlier study. The increasing numbers have been tied to measures of activity to produce accident rates which in turn were analyzed in terms of change. Where anomalies or unusually high accident rates were encountered, further analysis was conducted to isolate pertinent patterns of cause factors and/or experience levels of involved pilots. The bulk of the effort addresses accidents in the landing phase of operations. A detailed analysis was performed on controlled/uncontrolled collisions and their unique attributes delineated. Estimates of day vs. night general aviation activity and accident rates were obtained. M.G.

N83-14077*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
LIGHTNING ATTACHMENT PATTERNS AND FLIGHT CONDITIONS FOR STORM HAZARDS, 1980
B. D. FISHER, G. L. KEYSER, JR. (Air Force Systems Liaison Office, Langley, Va.), and P. L. DEAL Dec. 1982 71 p refs Prepared in cooperation with Lightning Technologies, Inc.
(Contract NAS1-15884)
(NASA-TP-2087; L-15438; NAS 1.60:2087) Avail: NTIS HC A04/MF A01 CSCL 01C

As part of the NASA Langley Research Center Storm Hazards Program, 69 thunderstorm pentrations were made in 1980 with an F-106B airplane in order to record direct strike lightning data and the associated flight conditions. Ground based weather radar measurements in conjunction with these penetrations were made by NOAA National Severe Storms Laboratory in Oklahoma and by NASA Wallops Flight Center in Virginia. In 1980, the airplane received 10 direct lightning strikes; in addition, lightning transient data were recorded from 6 nearby flashes. Following each flight, the airplane was thoroughly inspected for evidence of lightning attachment, and the individual lightning attachment points were plotted on isometric projections of the airplane to identify swept flash patterns. This report presents pilot descriptions of the direct strikes to the airplane, shows the strike attachment patterns that were found, and discusses the implications of the patterns with respect to aircraft protection design. The flight conditions are also included. Finally, the lightning strike scenarios for three U.S. Air Force F-106A airplanes which were struck during routine operations are given in the appendix to this paper. Author

N83-14078*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NASA LEWIS RESEARCH CENTER'S PROGRAM ON ICING RESEARCH
J. J. REINMANN, R. J. SHAW, and W. A. OLSEN, JR. 1982 17 p refs Proposed for presentation at the 21st Aerospace Sci. Conf., Reno, Nev., 10-13 Jan. 1983; sponsored by AIAA and presented at the 1st Intern. Workshop on Atmospheric Icing of Struct., Hanover, N.H., 1-3 Jun. 1982; sponsored by EPRI and the Army Cold Regions Research and Engineering Lab.
(NASA-TM-83031; E-1469; NAS 1.15:83031; AIAA-83-0204)
Avail: NTIS HC A02/MF A01 CSCL 01C

The helicopter and general aviation, light transport, and commercial transport aircraft share common icing requirements: highly effective, lightweight, low power consuming deicing systems, and detailed knowledge of the aeropenalties due to ice on aircraft surfaces. To meet current and future needs, NASA has a broadbased icing research program which covers both research and engineering applications, and is well coordinated with the FAA, DOD, universities, industry, and some foreign governments. Research activity in ice protection systems, icing instrumentation, experimental methods, analytical modeling, and in-flight research are described. A.R.H.

N83-14079# Naval Air Development Center, Warminster, Pa. Aircraft and Crew Systems Technology Directorate.
PRELIMINARY DEVELOPMENT OF THE XV (EX-VEE) AIRCREW RESTRAINT
D. LORCH 11 May 1982 33 p refs
(Contract WO584001)
(AD-A118991; NADC-82106-60) Avail: NTIS HC A03/MF A01 CSCL 01C

High-performance aircraft undergoing air combat maneuvers often subject air crewman to acceleration loads which displace them so far out of position that they can no longer control their aircraft. The XV restraint harnesss is being designed to reduce

vertical (Z) displacement of aircrewmen in ejection seat equipped aircraft; it is also a parachute harness. Initial testing indicates that the XV restraint harness provides improvement over the MA-2 torso harness for inflight acceleration loads. In addition, it is adjustable for all size crewmen, is seat mounted, and provides either manual or automatic release of the parachute, survival kit, and harness upon water immersion. Author (GRA)

N83-15272# Kappa Systems, Inc., Arlington, Va.
SAFETY BENEFITS ANALYSIS OF GENERAL AVIATION COCKPIT STANDARDIZATION Final Report, Jun. 1981 - Sep. 1982
B. E. BEDDOW, S. BERGER, and C. E. ROBERTS, JR. Atlantic City, N.J. FAA Dec. 1982 115 p refs
(Contract DTFA03-81-C-00058)
(FAA-CT-82-143) Avail: NTIS HC A06/MF A01

Detailed analyses were performed on a sample of 200 accident cases drawn from the National Transportation Safety Board files which contain 2,011 accidents in the period 1975-1979 due to the specified causes. The flight environment, aircraft and pilot characteristics, and their interrelation were fully considered in studies of accident causes. The accident pilot group which contained many high time pilots with advanced certificates was found less qualified with regard to recent night flying and instrument flight time. Fuel systems for all makes and model aircraft of the sample were found to contain great diversity in location of components and operating modes. Powerplant controls are not as diverse in design but still do not conform totally to recommended optimization guidelines. Preventability is determined by identification of standardization guidelines applied to the controls, instruments, and arrangements. Average accident costs are determined by a severity index breakdown and then carefully extrapolated to the full accident data base. Cumulative accident cost reductions are found for a 10 year future period. A proposal for alleviating the pilot nonfamiliarity with specific makes and models is included. In this area, an advisory approach is found preferable to certification and rating structural changes. Author

N83-15273*# Massachusetts Inst. of Tech., Cambridge. Flight Transportation Lab.
THE US AVIATION SYSTEM TO THE YEAR 2000
R. A. AUSTROTAS Jul. 1982 123 p refs
(Contract NAS1-15268)
(NASA-CR-166010; NAS 1.26:166010; FTL-R82-6) Avail: NTIS HC A06/MF A01 CSCL 01C

The aviation system of the U.S. is described. Growth of the system over the past twenty years is analyzed. Long term and short term causes of air travel are discussed. The interaction of economic growth, airline yields, and quality of service in producing domestic traffic is shown. Forecasts are made for airline and general aviation growth. Potential airline scenarios are presented. S.L.

04

AIRCRAFT COMMUNICATIONS AND NAVIGATION

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

A83-16494#
CLOSED-LOOP EIGENVALUE SELECTION FOR REDUCED AUTOPILOT SENSITIVITY TO RADOME ERRORS
M. E. HOUGH (Analytic Sciences Corp., Reading, MA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 10 p. refs
(Contract F08635-81-C-0301)
(AIAA PAPER 83-0062)

Based on analysis of the effects of radome errors on autopilot performance, a coupled autopilot-guidance design approach is presented for reducing fixed-gain autopilot sensitivity to radome errors. For a specified control structure, it is shown that a third-order differential system specifies the short-period longitudinal autopilot dynamics. Assuming proportional navigation guidance, explicit analytic solutions for the step response to radome-corrupted guidance commands are presented. The effect of radome errors on nominal autopilot stability, response time, and steady-state gain is discussed. Based on these results and the analytic solutions, the closed-loop eigenvalues are selected to reduce sensitivity to bounded variations in the radome error slope parameter. Numerical results are presented at two flight conditions. C.D.

A83-16625#
DECOUPLING OF HIGH GAIN MULTIVARIABLE TRACKING SYSTEMS
D. B. RIDGELY, S. S. BANDA (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, OH), and J. J. DAZZO (USAF, Institute of Technology, Wright-Patterson AFB, OH) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 10 p. refs
(AIAA PAPER 83-0280)

The problem of obtaining a transducer matrix which yields both the tracking and decoupling of outputs of high gain multivariable control systems is considered. The tracking requirements and the conditions under which decoupling of outputs is possible are given. A procedure for selecting the design parameters is described. A new synthesis procedure for decoupling is described when the matrix B (as defined by Falb and Wolovich) is singular. The procedure is illustrated through numerical examples for several fighter aircraft while performing a number of maneuvers. (Author)

A83-16866
ASPJ UPDATE COUNTERS THE CHANGING THREAT
A. S. KAUFMAN (ITT Corp., ITT Avionics Div., Nutley, NJ) and D. RICE (Westinghouse Electric Co., Baltimore, MD) Military Electronics/Countermeasures, vol. 8, Oct. 1982, p. 25, 26.

Program and systems steps implemented by the Navy, Air Force, and contractor managers to continuously upgrade the Airborne Self-Protection Jammer System (ASPJ) for countering changing ECM threats are described. A revised threat list is produced annually by a joint service steering committee, which has access to laboratory and field development, testing, and simulation results from ongoing operations dedicated to that purpose. New systems and equipment progress through engineering development model to prototype model stages. Existing ASPJ hardware has been designed to be modular and modifiable at the shop repair assembly level. Each ASPJ system includes signal measurement, ECM signal sources, and ECM technique generation, in addition to two levels of software configured to allow for 40% reservice, plus expansion. A program has also been devised for performance simulation assessment. M.S.K.

A83-16867
FIBER-OPTIC TECHNOLOGY TAKES TO THE AIR
T. J. URBANIK (LSI Avionic Systems Corp., Advanced Development, West Caldwell, NJ) Military Electronics/Countermeasures, vol. 8, Oct. 1982, p. 32, 34-36.

The requirements, prototype programs, and areas requiring further study for the wide-scale use of fiber optics in military avionics applications are outlined. Broad use of fiber optics has become more attractive since the loss/mile of cable has been limited to 10 dB. Fiber optics have been successfully tested in an A-7, showing a reduction in wiring weight from 31.9 lb to 2.7 lb. A total of 21 flights with an A-7D has shown no message errors between on-board computers and remote terminals. A fiber-optic receiver has become part of the production model of the AV-8B aircraft. Fiber optics can handle frequencies higher than 100 THz, are temperature resistant, immune to EMP hazards, and consume little power. Fused crystabolite has been demonstrated to be radiation proof, while silica fibers lose some dynamic range in proportion to exposure damage. M.S.K.

A83-16900
DEVELOPMENT OF INERTIAL NAVIGATION AND ITS EMPLOYMENT IN MEASUREMENT TECHNOLOGY [ENTWICKLUNG DER TRAEGHEITSNAVIGATION UND IHR EINSATZ IN DER MESSTECHNIK]
B. STIELER (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Institut fuer Flugfuehrung, Braunschweig, West Germany) DFVLR-Nachrichten, vol. 37, Nov. 1982, p. 65-69. In German.

The origin of inertial navigation can be traced to developments occurring at the turn of the century. Anschuetz-Kaempfe obtained a patent for a gyrocompass in 1905. Investigations conducted in Germany during the Second World War led to a gyrocompass which required only a time of 12 minutes to align itself in the true north-south direction. Developments occurring in Germany in the area of inertial navigation are discussed, taking into account also the utilization and further improvement of the resulting technology in connection with the development of rockets in the U.S. after the Second World War. A description is presented of the evolution of strapdown sensors and systems, giving attention to developments in Germany and the U.S. An investigation is conducted regarding the employment of inertial navigation systems in aviation measurement technology. The concept for a reference system suitable for applications in connection with the DLS microwave landing system is discussed, taking into consideration an integration of the inertial navigation system with radio and optical trajectory measurement systems. G.R.

A83-17304#
ELECTROMAGNETIC ENVIRONMENT SIMULATION FOR TCAS AVIONICS
J. MICHAELS (Republic Electronics, Inc., Melville, NY) In: Radio Technical Commission for Aeronautics, Technical Symposium and Annual Assembly Meeting, Washington, DC, November 18-20, 1981, Proceedings. Washington, DC, Radio Technical Commission for Aeronautics, 1982, p. 43-53.

It is pointed out that today's electronic technology can provide a realistic, accurate, and extremely flexible simulation of the electromagnetic environment expected to be encountered by Threat Alert and Collision Avoidance Systems (TCAS). A description is presented of the requirements which a simulator has to satisfy in order to properly certify, test, train, and perform field service on TCAS avionics projected for availability by the FAA in the 1984 time frame. The simulator must provide a realistic environment which is accurate, dynamic, adaptable, and repeatable. A minimum operator interface is desired. This is accomplished by using a keyboard for manual entry and a tape or disk for scenario inputs. Attention is given to the simulator environment, environment dynamics, simulated modes, simulation techniques, system tests, simulator parameters, and the test configuration. The described simulator is capable of fully testing both TCAS-I and TCAS-II avionics. G.R.

A83-17305#
DC-9 SUPER 80 DIGITAL FLIGHT GUIDANCE SYSTEM SIMULATION TECHNIQUES FOR CERTIFICATION
H. R. URLING (Sperry Corp., Sperry Flight Systems, Phoenix, AZ) In: Radio Technical Commission for Aeronautics, Technical Symposium and Annual Assembly Meeting, Washington, DC, November 18-20, 1981, Proceedings. Washington, DC, Radio Technical Commission for Aeronautics, 1982, p. 55-69.

The development of modern automatic flight control and flight guidance systems has always depended to a certain extent upon the use of simulators. However, the role of simulation has become particularly significant in connection with the design, development, and certification of the digital flight guidance system (DFGS) for the DC-9 Super 80. The DFGS provides a full flight regime autopilot/flight director in addition to thrust rating computation, full time autothrottle, cruise yaw damper, altitude alerting, autoreserve thrust, mode annunciation, and extensive on-aircraft maintenance testing. Also included are autoland and ground rollout functions to provide fail passive performance and safety in accordance with FAA Advisory Circular 20-27A and FAR 25.1309. Attention is given to the validation facility, aspects of software development, monitoring effectiveness, reversion mode testing, processor failure modes and effects analysis, and the past time simulation facility. G.R.

A83-17311#
SOFTWARE DESIGN FOR THE DOUGLAS DC-9 SUPER 80 DIGITAL FLIGHT GUIDANCE SYSTEM
R. G. CACERES (Douglas Aircraft Co., Long Beach, CA) In: Radio Technical Commission for Aeronautics, Technical Symposium and Annual Assembly Meeting, Washington, DC, November 18-20, 1981, Proceedings. Washington, DC, Radio Technical Commission for Aeronautics, 1982, p. 127-143.

The DC-9 Super 80, which was placed into revenue service in 1980, introduced significant new features into commercial aviation. The primary functions provided by the digital flight guidance system (DFGS) are related to the automatic pilot, the flight director, the cruise yaw damper, Mach trim compensation, full flight regime autothrottle/speed control, thrust rating, automatic reserve thrust, mode annunciation, onboard status/test capability, engine pressure ratio synchronization, and altitude alert. Aspects of software program design are considered, taking into account aspects of subroutine size distribution. Software module descriptions are provided, giving attention to the executive, input processing, input voting and selection, state estimation, guidance and stability, output processing, the maintenance test, monitoring, general use, and logic. Aspects of memory resource distribution are also investigated, and questions regarding the execution time are explored. G.R.

A83-17312#
APPLICATION OF SOFTWARE DESIGN STANDARDS TO COMMERCIAL AIRCRAFT EQUIPMENT
J. W. WARD (Boeing Commercial Airplane Co., Seattle, WA) In: Radio Technical Commission for Aeronautics, Technical Symposium and Annual Assembly Meeting, Washington, DC, November 18-20, 1981, Proceedings. Washington, DC, Radio Technical Commission for Aeronautics, 1982, p. 145-164.

A description is provided of the software standards used during the development of airborne digital equipment for two new commercial transport aircraft. The development and application of software standards for these aircraft is particularly significant because of the fact that for the first time almost all of the major systems in a new aircraft involve digital control and indication. Airline and industry requirements for the new generation of digital equipment were formulated in parallel with the requirements for software design, test, and configuration management standards. The software functional, operational, performance, and design requirements are provided in the form of specification control drawings and software requirements documents. Attention is given to software design configuration management, software testing, and details of software standards application. G.R.

A83-17726
AIR TRAFFIC MANAGEMENT - CURRENT PROBLEMS AND FUTURE CONCEPTS; PROCEEDINGS OF THE SPRING CONVENTION, LONDON, ENGLAND, MAY 12, 13, 1982
Convention sponsored by the Royal Aeronautical Society. London, Royal Aeronautical Society, 1982. 151 p.

The present conference on problems and prospects in air traffic management focuses on the British National Air Traffic Services (NATS). Among the topics discussed are the impact on airport operations of the growth of the portion of the civil aviation fleet made up by wide-bodied aircraft, the reconciliation of military and civil air traffic control requirements, NATS plans for implementing highly automated air traffic control centers for London, Scottish domestic airspace and oceanic airspace, air traffic management research underway at the Royal Signals and Radar Establishment, and the consideration of human factors in the design of future air traffic control systems. Also considered are the capability and potential role of airborne avionics in air traffic management, and a projection of concepts for future air traffic management over Europe. O.C.

A83-17727#
NATS - TAKING STOCK
B. HUXLEY (National Air Traffic Services, London, England) In: Air traffic management - Current problems and future concepts; Proceedings of the Spring Convention, London, England, May 12, 13, 1982. London, Royal Aeronautical Society, 1982. 9 p.

Britains's National Air Traffic Services (NATS) were created in December, 1962 for the purpose of integrating military and civil air traffic control in a way that involved no preferential treatment for either. Although a single airspace management system capable of serving both air defence and air traffic control was never implemented, and military and civil air traffic operations are conducted separately despite coordination, an integrated service has in effect been formed in virtue of the office of the Controller, NATS, which is served by a joint military/civil headquarters. An assessment is given of this organizational structure's policies with respect to route capacity, special commercial requirements, military and recreational requirements, environmental interests, and future demand. O.C.

A83-17728#
AIR TRAFFIC MANAGEMENT - THE IMPACT AT THE AIRPORT
G. A. CHAMPNISS (British Airports Authority, London, England) In: Air traffic management - Current problems and future concepts; Proceedings of the Spring Convention, London, England, May 12, 13, 1982. London, Royal Aeronautical Society, 1982. 5 p.

The introduction of wide bodied aircraft has led to the adoption of increased separation standards in order to minimize the effects of wake turbulence. This use of increased separation standards, while of relatively minor significance when the total number of movements by wide bodied aircraft is low, results in a significant reduction in the sustainable capacity of a dedicated landing runway as the proportion of such aircraft increases. The reduction of separation standards currently in use without adverse effects on safety may be achieved by means of more efficient airport surface movement guidance and control,which optimizes the capacity of a given runway. The aircraft whose impact will be most strongly felt are the 757, 767 and 737, all new generation airliners capable of Category III visibility conditions operations which will require airport facilities to accomodate their expanded capabilities. O.C.

A83-17729#
NATIONAL AIR TRAFFIC SERVICES IMPLEMENTATION PLANS
P. H. HEMMING (National Air Traffic Services, London, England) In: Air traffic management - Current problems and future concepts; Proceedings of the Spring Convention, London, England, May 12, 13, 1982. London, Royal Aeronautical Society, 1982. 3 p.

The most significant elements of the British National Air Traffic Services (NATS) Plan, which will be implemented over the coming decade, are described. The Plan is aimed at improving the capacity of NATS in view of long term growth forecasts, responding to changes in the pattern of traffic demand, improving system safety, and contributing to fuel conservation wherever practicable. The first major project contemplated is the modernization of the London Air Traffic Control Center at West Drayton, including the greatest possible use of an IBM 9020D computer. Other projects are the further development of the Scottish Domestic Airspace Control Center, and the incorporation by the Oceanic Air Traffic Control Center of a novel Flight Data Processing System. O.C.

A83-17730
AIR TRAFFIC MANAGEMENT RESEARCH AT THE ROYAL SIGNALS AND RADAR ESTABLISHMENT
J. L. GOODWIN (Royal Signals and Radar Establishment, Malvern, Worcs., England) In: Air traffic management - Current problems and future concepts; Proceedings of the Spring Convention, London, England, May 12, 13, 1982. London, Royal Aeronautical Society, 1982. 10 p.

A description is given of research facilities and efforts at Britain's Royal Signals and Radar Establishment, which may be characterized as 40 per cent concerned with systems and air traffic management (ATM) techniques, 40 per cent with secondary surveillance radar development, and 20 per cent with computing and other laboratory facilities. Advanced ATM elements include improved radar surveillance data and communications, especially with regard to data display and updating facilities for the controllers, increased use of automated assistance to the controller, and an improved understanding of human factors in the system so that the optimum mix of human and machine capabilities can be formulated. Flowchart representations are given of idealized and realistic versions of the ATM control loop, the departure flow regulator cell of a centralized, coordinating ATM sector, and a novel arrivals planning concept. O.C.

A83-17731#
THE CAPABILITY AND POTENTIAL ROLE OF AIRBORNE AVIONIC SYSTEMS IN AIR TRAFFIC MANAGEMENT
R. R. NEWBERY (Royal Aircraft Establishment, Bedford, England) In: Air traffic management - Current problems and future concepts; Proceedings of the Spring Convention, London, England, May 12, 13, 1982. London, Royal Aeronautical Society, 1982. 10 p. refs

An assessment is presented of techniques for navigation, control, displays and flight management currently under development in Britain, along with results of the Civil Avionics Program. The greatest obstacles to future progress identified in the areas mentioned are such communications interfaces as the data input between air crews and flight systems and between the aircraft and ground systems. Computing and display systems may ultimately be developed to form part of a ramp-to-ramp air traffic management system. More immediate plans of the present Program are concentrated on improving the interface between flight systems represented by those of the BAC 1-11 airliner and a simulated future air traffic control system for the southeast of England O.C.

A83-17733#
THE IMPACT OF NEW AIR TRAFFIC SYSTEMS ON THE FLIGHT DECK
A. L. BLACKMAN (Smiths Industries, Ltd., Wembley, Middx., England) In: Air traffic management - Current problems and future concepts; Proceedings of the Spring Convention, London, England, May 12, 13, 1982. London, Royal Aeronautical Society, 1982. 8 p.

A review of the ARINC 700 avionics systems being introduced to the flight deck with the certification of the 767, 757, and Airbus A310 aircraft is presented. The all-digital equipment includes a Flight Management System (FMS), an Electronic Flight Instrument System (EFI), the ACARS digital data link, and the Airborne Separation Assurance System ARINC 730. The FMS provides the interface between the crew and the aircraft systems, and also maintains the aircraft in the most economic flight mode, even in response to ATC constraints. The EFI produces solid-state displays of altitude, direction and horizontal situation with shadow mask CRTs. Air velocity and ATC constraints are also given. ARINC 730 is still under development. The ARINC 700 series provides a data link capability for centralized frequency selection for VHFs, VORs, ILSs, ADFs, transponders, and HF radios. Further evolutions of cockpit design are discussed, noting that either increased size or increased numbers of displays will be necessary. M.S.K.

A83-17734#
SOME ADVANCES IN GROUND SYSTEMS FOR AIR TRAFFIC CONTROL
A. CARNELL (Racal-Decca Navigator, Ltd., New Malden, Surrey, England) In: Air traffic management - Current problems and future concepts; Proceedings of the Spring Convention, London, England, May 12, 13, 1982. London, Royal Aeronautical Society, 1982. 8 p.

ATC systems under the control of a minicomputer at the Vienna Airport are described. Radar controllers are provided with a synthetic data display and a light pen, allowing for range setting, off-centering, map selection, and track filtering. The data displays include graphical display of tracks, touch input command areas, visibility, D.F. data, wind speeds, and abbreviated flight plan data.

An Airport Surface Detection system is also present, permitting monitoring of aircraft and vehicles at the airport surface. Displays of the surface are generated from 15 kHz radar signals. A developmental system employing the X band (9 GHz) in operation at Edinburgh is described, noting its higher performance in rain, dust, and blowing sand. M.S.K.

A83-17735#
AIR TRAFFIC FLOW MANAGEMENT OVER EUROPE
H. GUNTHER (EUROCONTROL, Brussels, Belgium) In: Air traffic management - Current problems and future concepts; Proceedings of the Spring Convention, London, England, May 12, 13, 1982. London, Royal Aeronautical Society, 1982. 15 p.

The types of air traffic delays experienced in Europe are discussed, together with steps taken to ameliorate the problems and the limitations of existing systems. Problems have included desires by the carriers to reduce mileage and flight level constraints, rerouting resulted from saturation of airport capacities, shortages of ATC equipment and personnel, and a lack of coordination between civil and military air carriers, as well as labor problems becoming acute during periods of greatest flight traffic. The problems have been eased by the introduction of radar to facilities which previously did not have radar, the formation of one-way routes, and flow control, specifically route orientation, flight level allocation, the imposition of flow rates, and requiring permission be requested along a flight path before take-off. The air traffic flow management concept was developed to establish a region-wide optimum air traffic flow. A centralized flight data network receives flight plans up to the midnight before the flight, then accepts or refuses the flight plans and offers alternative routes. M.S.K.

A83-18378
ESTIMATION OF HELICOPTER AND TARGET MOTION FOR THE ADVANCED ATTACK HELICOPTER FIRE CONTROL SYSTEM
R. S. BUCY (Southern California, University, Los Angeles, CA), S. J. ASSEO, and D. A. WEISSENBERGER (Hughes Helicopters, Inc., Culver City, CA) American Helicopter Society, Journal, vol. 27, Jan. 1982, p. 16-24.
(Contract DAAJ01-77-C-0064; AF-AFOSR-3100)

The problem of estimating helicopter and target motion for the Advanced Attack Helicopter fire control system is formulated using the Kalman-Bucy one-step predictor. Dynamic models for the helicopter and target are developed based on point mass and correlated random accelerations. Observations include own ship velocity and acceleration, range, line-of-sight (LOS) angles and rates. The estimation problem is formulated in moving LOS coordinates, where the dynamic models depend on the LOS rate vector, which is assumed noise-free and constant in the sampling interval. The nine-state helicopter estimator is omitted and helicopter velocity and acceleration measurements are used directly in the evaluation of the target state estimator performance. A scenario-based simulation program and test data on ground vehicle motion are used in the evaluation. The effects of various error sources, including sensor noise and LOS rate gyro noise, are investigated. It is shown that target state estimates perpendicular to the LOS which affect the predicted future target position, are quite good as opposed to the target estimated along the LOS. (Author)

A83-18627
AIRFRAME MULTIPATH EFFECTS IN AIRBORNE ADAPTIVE ANTENNA ARRAYS
M. J. SIDFORD (Royal Aircraft Establishment, Farnborough, Hants., England) In: International Conference on Antennas and Propagation, 2nd, York, England, April 13-16, 1981, Proceedings. Part 1. London, Institution of Electrical Engineers, 1981, p. 149-152.

The deviation of the relative phase and amplitude of aircraft array elements from those calculated for a free-space array has been estimated as a function of frequency in fixed directions and as a function of direction at fixed frequency. The results presented indicate the extent of phase and amplitude perturbations caused by airframe multipath effects for a fuselage-mounted two-element array operating around 1 GHz. Differential amplitude and relative phase deviations from the free-space point source values exceed 2 dB and 20 deg, respectively, for about 30% of the frequency/direction/antenna spacing combinations measured. V.L.

A83-18632
THE APPLICATION OF SUB-OPTIMAL CONTROL METHODS TO ADAPTIVE ANTENNAS FOR AIRBORNE COMMUNICATION SYSTEMS
C. R. WARD and P. J. HARGRAVE (Standard Telecommunications Laboratories, Ltd., Harlow, Essex, England) In: International Conference on Antennas and Propagation, 2nd, York, England, April 13-16, 1981, Proceedings. Part 1. London, Institution of Electrical Engineers, 1981, p. 174-178. Research supported by the Ministry of Defence/Procurement Executive/. refs

The concept and limitations of suboptimal adaptive antenna control for communication systems are treated, noting that in these applications it is often necessary to maximize gain coverage in the aximuth plane of the antenna. Two problems are considered, the first having to do with the best use of simple weight constraint algorithms, the second dealing with an ideal configuration for optimum angular coverage. The clamped-weight adaptive solution is shown to have application to communication systems where no a priori information is available relating to the desired signal. The gain recovery is maximized with linear array configurations by clamping the weight controlling end element. This can be justified through phase leverage analysis or through recognizing the equivalence with maximum entropy spectral estimation. Circular array configurations are found to permit omniquiescent constrained solutions by two methods. It is possible to either clamp a single element or apply a directive constraint corresponding to a phase mode excitation. C.R.

A83-18645
NEAR AND FAR FIELD AIRBORNE ANTENNA PATTERN ANALYSIS
P. H. PATHAK, W. D. BURNSIDE, N. WANG, and T. CHU (Ohio State University, Columbus, OH) In: International Conference on Antennas and Propagation, 2nd, York, England, April 13-16, 1981, Proceedings. Part 1. London, Institution of Electrical Engineers, 1981, p. 247-252. refs
(Contract N00019-80-C-0050)

A method is developed for computing the patterns of an aperture or monopole antenna mounted on an aircraft. The computed fields are obtained by approximate models of the aircraft structure in conjunction with the uniform geometrical theory of diffraction. The field computations are based on accurate and efficient uniform geometrical theory of diffraction solutions for the diffraction by edges, vertices, and convex surfaces. The method of analysis can accommodate receiver range specifications varying from as close as a wavelength to the aircraft surface to the true far field, and is particularly useful since the computed on-aircraft pattern performance can be compared with measurements taken at any convenient range, including the near field. In addition, the numerical solution can be used to predict accurately the far-field performance of the on-aircraft system. The accuracy of the numerical solutions obtained with this method is demonstrated by comparison with model measurements. N.B.

A83-18646
THE ANALYSIS OF A FLAT PLATE TWIST REFLECTOR CASSEGRAIN AERIAL USING GTD
M. SCORER (Marconi Avionics, Ltd., Rochester, Kent, England) In: International Conference on Antennas and Propagation, 2nd, York, England, April 13-16, 1981, Proceedings. Part 1. London, Institution of Electrical Engineers, 1981, p. 253-257. Research supported by the Ministry of Defence (Procurement Executive).

The performance of a flat-plate twist-reflector Cassegrain antenna is analyzed within the framework of the geometrical theory of diffraction, and the results are compared with experimental data

over a wide range of beam angles. It is found that the flat-plate Cassegrain antenna is capable of good performance up to beam angles of plus or minus 100 degrees. It is also shown that the geometrical theory of diffraction provides an adequate description of the antenna performance, and the analysis programs, once written, are relatively cheap and easy to use. V.L.

A83-18647
AN ASYMPTOTIC HIGH FREQUENCY ANALYSIS OF THE RADIATION FROM SOURCES ON PERFECTLY-CONDUCTING STRUCTURES WITH AN IMPEDANCE SURFACE PATCH
P. H. PATHAK and L. ERSOY (Ohio State University, Columbus, OH) In: International Conference on Antennas and Propagation, 2nd, York, England, April 13-16, 1981, Proceedings. Part 1. London, Institution of Electrical Engineers, 1981, p. 258-264.
(Contract F19628-77-C-0107)

An asymptotic high frequency analysis is presented of the radiation from sources on a uniform surface impedance patch which partially covers a perfectly conducting plane or convex surface. Two different methods of solution are presented for analyzing problems concerning fuselage mounted airborne slot antennas in which a part of the metallic fuselage, including the slot, is covered by a thin layer of nonconducting material. In the first method, a uniform geometrical theory of diffraction ray solution is developed. In the second method, a more general solution is developed for obtaining an asymptotic estimate for the currents which are excited over just the impedance patch. The radiated field is then obtained by integrating these currents in conjunction with a simple asymptotic form of the special Green's function pertaining to the unperturbed perfectly conducting planar or convex surface. It is found that the radiation patterns calculated by these two methods agree well with independent integral equation (moment method) solutions, and a physical explanation is given for the formation of these radiation patterns. N.B.

A83-18672
RECENT EXAMPLES OF CONFORMAL MICROSTRIP ANTENNA ARRAYS FOR AEROSPACE APPLICATIONS
P. S. HALL, C. WOOD, and J. R. JAMES (Royal Military College of Science, Shrivenham, Wilts., England) In: International Conference on Antennas and Propagation, 2nd, York, England, April 13-16, 1981, Proceedings. Part 1. London, Institution of Electrical Engineers, 1981, p. 397-401. Research supported by the Ministry of Defence (Procurement Executive). refs

Recent progress on the design of microstrip conformal arrays is reported with emphasis on the major problem areas. These include: surface geometry effects on pattern control, radiation pattern degradation due to unwanted radiation, and manufacturing difficulties. The feasibility of using conformal microstrip antennas is demonstrated for two specific aerospace applications, and some environmental aspects involved are also examined. V.L.

A83-18682
RADIATION PATTERNS OF A QUARTER-WAVE MONOPOLE ON A FINITE GROUND PLANE
P. R. FOSTER and T. MILLER (British Aerospace Dynamics Group, Bristol, England) In: International Conference on Antennas and Propagation, 2nd, York, England, April 13-16, 1981, Proceedings. Part 1. London, Institution of Electrical Engineers, 1981, p. 451-455. refs

The problem of computing the theoretical radiation patterns of a quarter-wave monopole on a finite ground plane, assumed to be conducting and horizontal with the antenna on the upper side, is examined. The directivity of such a configuration can thus be obtained by integration. The dimensions of the plane varied between 5 and 200 wavelengths. The geometrical theory of diffraction is used to compute the required radiation patterns. Results show that the radiation patterns are in excellent agreement with the measured values, although the values of gain derived for computed and measured results do not agree with generally accepted results. N.B.

A83-18822#
LORAN-C RNAV - THE BEST NEAR-TERM SOLUTION TO AIR OPERATIONS IN NORTHEASTERN NORTH AMERICA
W. L. POLHEMUS (Polhemus Associates, Inc., Ann Arbor, MI) (Canadian Symposium on Navigation, 4th, Halifax, Nova Scotia, Canada, Nov. 18, 1981.) Canadian Aeronautics and Space Journal, vol. 28, Sept. 1982, p. 234-251. refs

The results of a three year effort by NASA, the DoT, and the Vermont Transporation Agency to determine the acceptability of Loran-C RNAV for flight service where ILS systems have not been implemented are reported. A nationwide survey indicated that a potential $293,000,000 in fuel savings were possible if the Loran-C RNAV system could be certified for instrument approach. An 18-month program to determine procedures, pilot workload and performance, ATC compatibility, and equipment and training requirements was initiated. A total of 104 flights and 226 hr of Loran-C RNAV operations were performed in diverse weather conditions. Measured along-track and cross-track equipment errors were 0.16 nm or less, and a 99% availability was realized. The Loran-C RNAV was concluded to meet FAA criteria for use in the national air space under VFR and IFR conditions. D.H.K.

A83-19026
HARD LIMITER PERFORMANCE AS A POLARITY DETECTOR FOR EXTREMELY POLLUTED SIGNALS
J. C. VAN DER WAL and D. VAN WILLIGEN (Delft, Technische Hogeschool, Delft, Netherlands) IEEE Transactions on Aerospace and Electronic Systems, vol. AES-18, Sept. 1982, p. 520-530. refs

For the hard limiter of the Loran-C navigation system, the effects of atmospheric and Gaussian noise, nonsynchronous and synchronous interference, and dc offset on the observation reliability are separately analyzed. The results are presented in such a form that for given input conditions of the hard limiter the observation reliability of the polarity detector can be accurately predicted. Some ways for coping with other disturbances that potentially threaten the good performance of the hard limiter are suggested. C.D.

A83-19039
EFFECTS OF FINITE WIRE SCATTERERS IN THE FIELD OF VOR
K. HIRASAWA (Tsukuba, University, Sakura, Ibaraki, Japan) IEEE Transactions on Aerospace and Electronic Systems, vol. AES-18, Sept. 1982, p. 668-674. refs

A computer-oriented general formula is developed to estimate the dynamic bearing errors of an airborne VOR receiver due to arbitrary bent finite wire scatterers located in the vicinity of a VOR. The current in those wires caused by the incident fields from the VOR is computed by a piecewise-sinusoidal reaction technique. The variations in the incident fields or the wire and the mutual coupling effects between close wires are taken into account. (Author)

N83-14080# Federal Aviation Administration, Washington, D.C. Program Engineering and Maintenance Service.
THIRD SYMPOSIUM ON TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEMS (TCAS)
1982 271 p Symp. held at Washington, D.C., 12-13 Oct. 1982 (FAA-RD-82-75) Avail: NTIS HC A12/MF A01

The Federal Aviation Administration held its third symposium on Traffic Alert and Collision Avoidance System (TCAS) in Washington, D.C., October 12-13, 1982, which was attended by representatives of organizations and airlines. This report contains twelve technical presentations describing the progress of the TCAS program. The TCAS will provide a range of capabilities and costs which will meet the requirements of all airspace users. The least complex part of the system is designed for private pilots and would cost about $2,500. The fully capable, or airline, version would cost between $45,000 and $50,000.

N83-14081# Federal Aviation Administration, Washington, D.C. Program Engineering and Maintenance Service.
TCAS PROGRAM
C. A. MILLER *In its* 3rd Symp. on Traffic Alert and Collision Systems (TCAS) p 1-4 1982
Avail: NTIS HC A12/MF A01

The Traffic Alert and Collision Avoidance System program activities are described. The essence of the TCAS concept is the provision of a separation assurance capability that is able to operate throughout the airspace without reliance on ground equipments. TCAS, like it's predecessor BCAS (Beacon Collision Avoidance System), is based on the interchange of beacon, or secondary surveillance radar, signals among aircraft. The TCAS concept envisions a range of capabilities to include TCAS I, a low cost alternative, and TCAS II which is intended to provide a comprehensive level of separation assurance in all airspace. L.F.M.

N83-14082# Federal Aviation Administration, Washington, D.C. Program Engineering and Maintenance Service.
STATUS OF MODE S IMPLEMENTATION
D. HODGKINS *In its* 3rd Symp. on Traffic Alert and Collision Avoidance Systems (TCAS) 12 p 1982
Avail: NTIS HC A12/MF A01

Mode S is an evolutionary upgrading of our present Air Traffic Control (ATC) Radar Beacon System. It will provide improved aircraft position and interference free identification and altitude data, and a new capability to communicate digitally with the aircraft via a data link. The data link is both ground-to-air and air-to-ground and is an integral part of the surveillance function. Many ATC automation enhancements are possible with the data link capability as well as other services. L.F.M.

N83-14083# Federal Aviation Administration, Washington, D.C. Program Engineering and Maintenance Service.
TCAS 2 OPERATIONAL DOCTRINE
C. A. MILLER *In its* 3rd Symp. on Traffic Alert and Collision Avoidance Systems (TCAS) 20 p 1982
Avail: NTIS HC A12/MF A01

As a result of FAA testing of the Traffic Alert and Collision Avoidance System II, conclusions are reached. These conclusions presented here are with respect to the role of traffic advisories in airborne collision avoidance systems and to flight crew response to resolution advisories. L.F.M.

N83-14084# Lincoln Lab., Mass. Inst. of Tech., Lexington.
COMPARISON OF TCAS 1 PASSIVE AND ACTIVE TRANSPONDER DETECTORS
V. A. ORLANDO *In* FAA 3rd Symp. on Traffic Alert and Collision Avoidance Systems (TCAS) 18 p 1982
Avail: NTIS HC A12/MF A01

Active and Passive Transponder Detector systems are compared. Measurements indicate that a low power Traffic Alert and Collision Avoidance System I will provide better performance than the simple passive techniques evaluated. Time sharing transponder transmitter and receiver elements make the cost of the active approach equivalent to the passive approach. L.F.M.

N83-14085# Mitre Corp., Bedford, Mass.
AIRCRAFT TRAFFIC IN THE LOS ANGELES BASIN AS RELATED TO TCAS REQUIREMENTS
N. A. SPENCER and B. P. COLLINS *In* FAA 3rd Symp. on Traffic Alert and Collision Avoidance Systems (TCAS) 11 p 1982
Avail: NTIS HC A12/MF A01

Four different flights were conducted in the Los Angeles area to collect airborne data. The instantaneous airborne count (IAC) as measured by the flight data is compared with the total daily operations of the 17 towers in the Los Angeles basin. A remarkably consistent relation was observed. Accounting for the fraction of non-transponder aircraft, it is seen that an IAC of approximately 212 aircraft corresponds with 10,000 tower operations, and the relation is linear. This together with the relation between IAC and density already established provide the rules needed to project future environments. L.F.M.

N83-14086# Lincoln Lab., Mass. Inst. of Tech., Lexington.
SURVEILLANCE TECHNIQUES FOR MINIMUM TCAS 2
J. D. WELCH *In* FAA 3rd Symp. on Traffic Alert and Collision Avoidance Systems (TCAS) 11 p 1982
Avail: NTIS HC A12/MF A01

Techniques to achieve air-to-air surveillance in high density airspace are discussed. A review of the Traffic Alert and Collision Avoidance II; (TCAS II) surveillance requirements is given and then attention is placed on Mode S and ATCRBS surveillance. Discussions of interference limiting and a summary of the TCAS II design as now envisioned follows. L.F.M.

N83-14087# Lincoln Lab., Mass. Inst. of Tech., Lexington.
VALIDATION OF MINIMUM TCAS 2 SURVEILLANCE PERFORMANCE
W. H. HARMAN *In* FAA 3rd Symp. on Traffic Alert and Collision Avoidance Systems 16 p 1982
Avail: NTIS HC A12/MF A01

The activities being used to validate the Traffic Alert and Collision Avoidance System II techniques are described. The most prominent new issues are Mode C directional interrogation and whisper-shout, which are the main techniques for avoiding synchronous garble in high density airspace. L.F.M.

N83-14088# Bendix Corp., Baltimore, Md. Communications Div.
ENHANCED TCAS 2
J. E. REED *In* FAA 3rd Symp. on Traffic Alert and Collision Avoidance Systems 17 p 1982
Avail: NTIS HC A12/MF A01

The essence of the Enhanced Traffic Alert and Collision Avoidance II system is characterized by accurate bearing, narrow sectorized interrogation control, and tailored system parameters. The Bendix approach was to apply advanced technology in three main areas: optimized system design, antenna technology, and adaptive control. L.F.M.

N83-14089# Mitre Corp., Bedford, Mass.
MINIMUM TCAS 2 THREAT DETECTION AND RESOLUTION LOGIC STATUS
A. ZEITLIN *In* FAA 3rd Symp. on Traffic Alert and Collision Avoidance Systems 20 p 1982
Avail: NTIS HC A12/MF A01

A status update on the Collision Avoidance Logic for Minimum TCAS II is given. The process of refinement continued, using data from flight tests and simulation. All problems that were observed were solved. Improved features were added. New developments and features in the logic are covered. Validation activities are also briefly described. Author

N83-14090# Federal Aviation Administration, Atlantic City, N.J.
TCAS 2 THREAT DETECTION AND RESOLUTION LOGIC TESTING
B. R. BILLMANN *In* FAA 3rd Symp. on Traffic Alert and Collision Avoidance Systems (TCAS) 19 p 1982
Avail: NTIS HC A12/MF A01

Horizontal and vertical track crossing and maneuvering are illustrated. Preprocessor incremental scenario modification is diagrammed. Level flight scenario results are provided. The impact of equal treatment for TCAS intruders, the impact on jumps in Mode C surveillance data, and closed loop pilot feedback were studied. N.W.

N83-14091# Dalmo Victor Co., Belmont, Calif.
TCAS 2
In FAA 3rd Symp. on Traffic Alert and Collision Avoidance Systems (TCAS) 37 p 1982
(DV-10496) Avail: NTIS HC A12/MF A01

Three prototype systems of the omnidirectional TCAS system which were successfully flight tested on FM Piedmont aircraft were delivered to the FAA. Author

N83-14092# Federal Aviation Administration, Washington, D.C. Program Engineering and Maintenance Service.
EVALUATION OF TCAS 2 IN AN AIR CARRIER ENVIRONMENT
W. L. HYLAND *In its* 3rd Symp. on Traffic Alert and Collision Avoidance Systems (TCAS) 16 p 1982
Avail: NTIS HC A12/MF A01

The first part of a two part cockpit simulation with the Boeing Aircraft Company to evaluate the display media and use of the TCAS information under workload, principally in IMC conditions was completed. An initial effort with Piedmont Airlines, intended to build a large data base with TCAS II in actual line operations, was completed. Author

N83-14093# Lincoln Lab., Mass. Inst. of Tech., Lexington.
UTILITY OF TRAFFIC ADVISORY INFORMATION
J. W. ANDREWS *In* FAA 3rd Symp. on Traffic Alert and Collision Avoidance Systems (TCAS) 15 p 1982
Avail: NTIS HC A12/MF A01

The findings of FAA sponsored evaluations of the operational utility of TCAS II traffic advisories are summarized. The history of previous test programs involving subject pilots and automated traffic advisories is traced. The operational context of the TCAS II automated traffic advisory is explained. Results of the testing done to date are presented. Some areas in which further testing and development will be undertaken are outlined. Author

N83-14094# Federal Aviation Administration, Washington, D.C. Program Engineering and Maintenance Service.
TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM
In its 3rd Symp. on Traffic Alert and Collision Avoidance Systems (TCAS) 6 p 1982
Avail: NTIS HC A12/MF A01

An aircraft separation assurance concept called the Traffic Alert and Collision Avoidance System (TCAS) is reviewed. The concept is based on efforts in the areas of beacon based collision avoidance systems and air-to-air/air-to-ground discrete address communications techniques utilizing Mode S message formats. The objective of the TCAS approach is to provide a range of separation assurance equipment alternatives that can provide collision protection for the full spectrum of airspace users ranging from small general aviation aircraft to large transport aircraft. Author

N83-14095# Aries Corp., McLean, Va.
PRELIMINARY SUMMARY OF PHASE 1 PIEDMONT IN-SERVICE EVALUATION OF TCAS 2
T. BERRY and T. WILLIAMSON (FAA) *In* FAA 3rd Symp. on Traffic Alert and Collision Avoidance Systems (TCAS) 11 p 1982
Avail: NTIS HC A12/MF A01

Data was collected on the operational performance of the TCAS during 928 hours of flight time. This data was generated from two sources: (1) a data recording system aboard the Boeing 727 test aircraft that recorded quantitative data generated by the TCAS each time the system detected a potential conflict and activated the system displays, and (2) qualitative comments on the system performance and utility of TCAS, prepared by cockpit observers who were skilled in jet transport operations. Author

N83-14096# Federal Aviation Administration, Washington, D.C.
SUMMARY OF DALMO VICTOR AND LINCOLN LABORATORY PWI BEARING PERFORMANCE
In its 3rd Symp. on Traffic Alert and Collision Avoidance Systems (TCAS) 13 p 1982
Avail: NTIS HC A12/MF A01

The results of bearing accuracy and tracking tests performed using the Lincoln Laboratory TCAS Experimental Unit (TEU) and the Dalmo Victor omnidirectional TCAS are summarized. The TEU data which is presented was obtained from Lincoln Laboratory flight tests in the Boston area. The TEU bearing tests were also conducted at the FAA Technical Center. Dalmo Victor omnidirectional TCAS bearing data was obtained from anechoic chamber tests at Dalmo Victor; static tests at FAA Technical Center, and flight tests at the FAA Technical Center. A bearing track from a Piedmont flight during which a resolution advisory occurred is also shown. Author

N83-14097# Electromagnetic Compatibility Analysis Center, Annapolis, Md.
MICROWAVE LANDING SYSTEM (MLS) CHANNEL PLANS AND TRAFFIC LOADING Final Report
A. KOSHAR (IIT Res. Inst., Annapolis, Md.) and J. SMITHMYER (IIT Res. Inst., Annapolis, Md.) May 1982 16 p
(DOT/FAA-RD-81-113) Avail: NTIS HC A02/MF A01

The magnitude of the maximum pulse loading situation within the STLM was reinvestigated. The results reflect two types of pulse loading interactions: air to ground loading and ground to air loading. The interrogation loading on a transponder with the desired signal interrogator (aircraft) at 22 and 7 nmi for channels 24x and 90y, respectively, is provided in tables. The loading is separated vertically into that which comes from cofrequency or adjacent-frequency undesired sources and whether the interfering interrogators are operating in the enroute or precision mode. The horizontal separation of the data in the tables reflects the relative power level between the desired and undesired interrogations at the transponder receiver input terminals. The tabulated results are analyzed. J.M.S.

N83-14098*# BioTechnology, Inc., Falls Church, Va.
A FLIGHT INVESTIGATION OF SIMULATED DATA-LINK COMMUNICATIONS DURING SINGLE-PILOT IFR FLIGHT. VOLUME 2: FLIGHT EVALUATIONS Final Report
J. F. PARKER, JR. and J. W. DUFFY Washington NASA Nov. 1982 75 p refs
(Contract NAS1-16037)
(NASA-CR-3653; NAS 1.26:3653) Avail: NTIS HC A04/MF A01 CSCL 17G

Key problems in single pilot instrument flight operations are in the management of flight data and the processing of cockpit information during conditions of heavy workload. A flight data console was developed to allow simulation of a digital data link to replace the current voice communications stem used in air traffic control. This is a human factors evaluation of a data link communications system to determine how such a system might reduce cockpit workload, improve flight proficiency, and be accepted by general aviation pilots. The need for a voice channel as backup to a digital link is examined. The evaluations cover both airport terminal area operations and full mission instrument flight. Results show that general aviation pilots operate well with a digital data link communications system. The findings indicate that a data link system for pilot/ATC communications, with a backup voice channel, is well accepted by general aviation pilots and is considered to be safer, more efficient, and result in less workload than the current voice system. S.L.

N83-14099# Federal Aviation Administration, Washington, D.C. Office of Systems Engineering Management.
SUMMARY OF THE FAA'S FUTURE NAVIGATION SYSTEM MIX EVALUATION, THROUGH MAY 1982
T. H. HIGGINS, K. D. MCDONALD, P. D. BLYTHE, L. H. HOGLE, R. BRAFF, and A. WINICK Aug. 1982 53 p refs
(AD-A119314; DOT/FAA-EM-82-24) Avail: NTIS HC A04/MF A01 CSCL 17G

This document summarizes the activities of the Federal Aviation Administration (FAA) is formulating preliminary recommendations for the navigation system or system mix that best meets civil aviation navigation requirements of the post-1995 time period. This activity is part of the FAA program described in the Federal Radionavigation Plan (FRP). The FRP specifies that a joint Department of Transportation (DoT)/Department of Defense (DoD) initial recommendation be made on the future radionavigation system mix during 1983 and that a final decision be made in 1986. The 1986 decision will then become the basis for future civil/military navigational system implementation. Author (GRA)

N83-14100# Draper (Charles Stark) Lab., Inc., Cambridge, Mass.
LOW ALTITUDE NAVIGATION AUGMENTATION SYSTEM Final Technical Report, Sep. 1980 - Aug. 1981
D. A. KOSO Wright-Patterson AFB, Ohio AFWAL Dec. 1981 114 p
(Contract F33615-80-C-1209; AF PROJ. 6095)
(AD-A119700; CSDL-R-1526; AFWAL-TR-81-1222) Avail: NTIS HC A06/MF A01 CSCL 17G

The Low Altitude Navigation Augmentation Concept provides the pilot with an electronic map display on the aircraft's HUD, so that head down operations (looking at maps or moving map displays) are not required. In addition to the display concept, bearing measurements to known landmarks can be utilized to update the navigation system and also to estimate errors between the navigation system coordinate frame and the map coordinate frame. The concept for the LANA was developed by CSDL under IR&D funding to determine the lowest performance INS usable in the LANA configuration. The simulation configuration described in this plan, however, utilizes higher performance equipment; since the higher performance equipment will be procured for the F-16 and A-10 aircraft. In this report, a plan is developed to simulate the LANA concept on an Air Force simulator. The simulation will be used to verify both system performance and pilot work load under realistic flight conditions. GRA

N83-14101# Naval Postgraduate School, Monterey, Calif.
A SENSITIVITY ANALYSIS OF THE KALMAN FILTER AS APPLIED TO AN INERTIAL NAVIGATION SYSTEM M.S. Thesis
G. G. POTTER Jun. 1982 105 p refs
(AD-A119623) Avail: NTIS HC A06/MF A01 CSCL 12A

A tactical missile with mid-course requires the use of an Inertial Navigation System (INS). Steady-state Kalman Filters (SKF) used as estimators have been proposed for use in a Strapdown INS that is considered to be cheaper and easier to implement than a gimbaled INS. This thesis further investigates the sensitivity of the SKF to inaccuracies in the filter parameters such as the dimensional stability derivatives. The analysis is expanded to explore the sensitivity of a system of higher dimension created by the augmentation of an additional state. The study has been performed by independently varying each of the filter parameters over a given range and noting the effect on the accuracy of the filter. One of the benefits of this analysis of the rms estimate errors to variations in the stability derivatives is that it reveals which derivatives need to be accurately determined to ensure stable flight.
Author (GRA)

N83-14102# Salford Univ. (England). Dept. of Aeronautical and Mechanical Engineering.
DESIGN OF HIGH-PERFORMANCE TRACKING SYSTEMS Technical Report, 15 Nov. 1980 - 30 Sep. 1981
B. PORTER Wright-Patterson AFB, Ohio AFWAL 1 Jul. 1982 174 p refs
(Contract F49620-81-C-0026; AF PROJ. 2304)
(AD-A119440; USAME/DC/120-81; AFWAL-TR-82-3032) Avail: NTIS HC A08/MF A01 CSCL 17G

Conceptually and computationally simple methods for the design of high-performance tracking systems are described. These methods are equally applicable to the design of both analogue and digital controllers, and are based upon the exploitation of a solitary system-theoretic result from the singular perturbation analysis of transfer function matrices. Illustrative examples involving the design of tracking systems incorporating both high-gain analogue controllers and fast-sampling digital controllers are presented. Author (GRA)

N83-14103# IIT Research Inst., Annapolis, Md.
EMC ANALYSIS OF A PROTOTYPE CIVIL-USE GPS RECEIVER ON FOUR AIRCRAFT CONFIGURATIONS
R. L. MULLEN Jul. 1982 73 p refs
(Contract F19628-80-C-0042; AF PROJ. 649E)
(AD-A119578; FAA-RD-82-63; FCAC-CR-82-048) Avail: NTIS HC A04/MF A01 CSCL 17G

The analysis for each aircraft addressed the potential of interference from adjacent-signal and out-of-band transmitters. Adjacent-signal transmitters aboard the four aircraft configurations consisted of Distance Measuring Equipment interrogators, Air Traffic Control Radar Beacon System transponders, Mode S transponders, and Traffic Alert and Collision Avoidance System interrogators. The out-of-band transmitters included HF, VHF, and UHF communications equipment. The electromagnetic compatibility aspects of the GPS receiver that were examined included burnout and saturation of the limiting diode in the receiver front end, interference to signal acquisition, and interference to signal code and carrier tracking. Only radiated interference coupled from the transmit antenna to the receive antenna was examined in this analysis. Conducted interference was not considered. For the specific configurations analyzed, no potential instances of burnout or saturation of the limiting diode due to signals from individual or multiple on-board transmitters were identified. For the specific configurations analyzed, no potential instances were identified in which the interfering signal from an individual on-board transmitter exceeded the GPS interference thresholds. For the specific configurations analyzed, one potential instance was identified in which the composite interfering signal from multiple on-board transmitters exceeded the GPS interference threshold for C/A signal acquisition. Alternative actions were recommended to preclude the occurrence of interference to the GPS receiver.
GRA

N83-15274# Federal Aviation Administration, Atlantic City, N.J. Technical Center.
LORAN-C EN ROUTE ACCURACIES IN THE CENTRAL APPALACHIAN REGION Final Report
F. LORGE Nov. 1982 30 p refs
(FAA-RD-82-24; FAA-CT-82-32) Avail: NTIS HC A03/MF A01

Flight tests were conducted in the central Appalachian Region of the United States to measure en route Loran-C position accuracies at low altitudes in mountainous terrain. Receivers were configured to use the Northeast and Great Lakes Chains of Loran-C transmitters during the flights while position information and receiver status were recorded. Each of the recorded Loran positions and position information derived from the inertial navigation system were compared. The results were compared against Advisory Circular (AC) 90-45A accuracy criteria for the en route phase of flight. It is concluded that both the Northeast United States Chain and the Great Lakes Chain meet AC 90-45A en route accuracy criteria over the entire flight test area. Author

N83-15275*# Ohio Univ., Athens. Avionics Engineering Center.
ENHANCED CHARACTER SIZES FOR THE VDM-1 VIDEO DISPLAY BOARD
S. M. NOVACKI, III and J. D. NICKUM Dec. 1982 17 p refs
(Contract NGR-36-009-017)
(NASA-CR-169692; NAS 1.26:169692; TM-83) Avail: NTIS HC A02/MF A01 CSCL 17G

A display enhancement implemented on the new VDM-1 video display board installed in a LORAN-C navigation receiver is addressed. Increased character size for easier viewing of the 3.75 inch diagonal CRT display is provided. Author

N83-15276*# Ohio Univ., Athens. Avionics Engineering Center.
A RF FRONT END INTERFACE AND AGC MODIFICATION
S. R. YOST Dec. 1982 16 p refs
(Contract NGR-36-009-017)
(NASA-CR-169691; NAS 1.26:169691; TM-84) Avail: NTIS HC A02/MF A01 CSCL 17G

The latest RF front end built by Burhans (Mini-L-82) was successfully interfaced to the Ohio University LORAN-C receiver.

In order for the front end to operate optimally, modifications were made to existing automatic gain control (AGC) circuitry already developed for the Ohio University LORAN-C receiver. The hardware modifications to the AGC and other interface circuitry, as well as some preliminary results are discussed. Author

N83-15277*# Ohio Univ., Athens. Avionics Engineering Center.
A MICROCOMPUTER-BASED POSITION UPDATING SYSTEM FOR GENERAL AVIATION UTILIZING LORAN-C
J. P. FISCHER May 1982 121 p refs
(Contract NGR-36-009-017)
(NASA-CR-169722; NAS 1.26:169722; TM(NASA)-85) Avail: NTIS HC A06/MF A01 CSCL 17G

Modern digital electronic technology is used to produce a device to convert Loran C to useful pilot information using a simple software algebra and low cost microprocessor devices. Results indicate that the processor based Loran C navigator has an accuracy of 1.0 nm or less over an area typically covered by a triad of Loran C stations and can execute a position update in less than 0.2 seconds. The system was tested in 30 hours of flight and proved that it can give reliable and accurate navigation information. Methods of converting time differences to position, design considerations for the microcomputer system, and the system for coordinate conversion are discussed. Testing with predetermined points and possible fixes for errors are also considered. A.R.H.

N83-15278# Air Force Geophysics Lab., Hanscom AFB, Mass.
AZIMUTH MONITORING EXPERIMENT Final Report
R. L. ILIFF, R. W. SANDS, and T. E. WIRTANEN 26 Jul. 1982 21 p refs
(AD-A120834; AFGL-TR-82-0200; AFGL-IP-311) Avail: NTIS HC A02/MF A01 CSCL 17G

With the increase in precision of inertial guidance systems has come a parallel need for techniques to monitor and measure the stability of azimuth references. These azimuth references are used to transfer astronomic direction to inertial system test platforms, for rocket engine test tracks, and for precision test facilities construction, among other requirements. Vibration damping techniques, the peculiarities of differential expansion, refraction, defraction all emphasize that we are building on a living, moving Earth, within the bottom layers of an ocean of air. Thus anything which can monitor and measure the stability of USAF's carefully surveyed azimuths will help in the progress toward precision. AFGL initiated the concept of monitoring the rotational and translational movements of directional references. GRA

N83-15279# Mitre Corp., McLean, Va.
CONFLICT MONITORING ANALYSIS OF PARALLEL OPPOSITE DIRECTION ROUTES, VOLUME 1
A. P. SMITH, III Aug. 1982 59 p refs
(Contract DTFA01-82-C-10003)
(AD-A120080; MTR-82W00114-VOL-1; FAA-EM-83-23-VOL-1)
Avail: NTIS HC A04/MF A01 CSCL 17G

A previous report (FAA-EM-80-16) described the estimates of the probability of horizontal overlap and controller intervention rate for same direction adjacent parallel routes. This work extends that methodology to opposite direction adjacent parallel routes. For both the probability of horizontal overlap and the controller intervention rate, trial results based on data are given. GRA

05

AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

A83-16472#
THE AIR FORCE FLIGHT TEST CENTER PALLETIZED AIRBORNE WATER SPRAY SYSTEM
K. J. ADAMS (USAF, Edwards AFB, CA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 5 p.
(AIAA PAPER 83-0030)

The Air Force Flight Test Center has the charter to conduct All-Weather testing on Air Force weapon systems. This testing includes airborne icing and rain. To date, a high speed (180-300 knots) NKC-135 modified for artificial ice/rain testing has been used. The Palletized Airborne Water Spray System (PAWSS) utilizing a C-130 cargo aircraft will complement the NKC-135 with a speed range of 100-180 knots (100-250 knots using a C-130H model). The PAWSS is self-contained and is built on a cargo pallet and requires no modification to its carrier aircraft. (Author)

A83-16488#
GASAP - A GENERAL AVIATION AIRPLANE ANALYSIS AND SYNTHESIS PROGRAM
H. U. MAI (Helsinki University of Technology, Esbo, Finland) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 8 p. refs
(AIAA PAPER 83-0054)

An interactive graphic program package has been written for designing and optimizing configurations of propeller-driven general aviation and light military airplanes for given performance constraints. It consists of FORTRAN programs written for a minicomputer with a plotter, comprising preliminary geometry definition, preliminary aerodynamic analysis, wing and engine sizing, and parametric studies. Parabolic drag polar corrected for propeller efficiency and slipstream effects is used in performance prediction. The system has proven to be useful in the preliminary design and project definition phase, giving quantitative information about tradeoffs between performance requirements, cost and geometry constraints, and pinpointing improper performance goals. (Author)

A83-16490*# Gates Learjet Corp., Wichita, Kans.
AERODYNAMIC OPTIMIZATION, COMPARISON, AND TRIM DESIGN OF CANARD AND CONVENTIONAL HIGH PERFORMANCE GENERAL AVIATION CONFIGURATIONS
M. W. KEITH (Gates Learjet Corp., Wichita, KS) and B. P. SELBERG (Missouri-Rolla, University, Rolla, MO) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 17 p. refs
(Contract NAG1-26)
(AIAA PAPER 83-0058)

A design study has been conducted to optimize trim cruise flight of high performance general aviation canard aircraft which achieve minimum drag. In order to investigate the advantages and disadvantages of canard configured aircraft, corresponding conventional tail-aft 'baseline' aircraft were designed and used for comparison. Two-dimensional predictions were obtained by coupling inviscid results from a vortex panel multi-element program to a momentum integral boundary layer analysis. Using the results of the two-dimensional vortex panel analysis, a vortex lattice method was employed to predict the finite wing results. The analysis utilized a turbulent airfoil and a natural laminar airfoil which are two NASA state-of-the-art airfoil sections. The canard aircraft designs give quantitative results of wing and canard loadings, wing-to-canard moment arm ratios, and aspect ratio effects for trim cruise flight for a wide range of wing-to-canard area ratios. Both canard and baseline aircraft achieved a 25 to 30 percent

improvement in performance over typical current technology aircraft, but high canard loading necessary for trim resulted in slightly poorer performance of the canard aircraft as compared to the baseline designs. (Author)

A83-16512*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
THRUST REVERSING EFFECTS ON HORIZONTAL TAIL EFFECTIVENESS OF TWIN-ENGINE FIGHTER AIRCRAFT
F. J. CAPONE, M. L. MASON, and G. T. CARSON, JR. (NASA, Langley Research Center, Transonic Aerodynamics Div., Hampton, VA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 11 p. refs
(AIAA PAPER 83-0086)

The Langley Research Center has conducted an experimental program to determine the interference effects of thrust reversing on horizontal tail effectiveness of a twin engine, general research fighter model at approach (Mach number 0.15) and in-flight (Mach number 0.60 and 0.90) speeds. Twin vertical tails were tested at three longitudinal locations. Two nonaxisymmetric nozzle reverser concepts were studied. The effects of thrust reversing on horizontal tail effectiveness were found to be very dependent upon vertical tail locations. At approach speeds thrust reverser operation usually resulted in large variations in horizontal tail effectiveness as either nozzle pressure ratio or model angle of attack was varied. Either increases or decreases in tail effectiveness ocurred due to reverse operation depending upon tail location. At in-flight conditions there were always decreases in tail effectiveness due to reverser operation regardless of vertical tail location. (Author)

A83-16516#
THE APPLICATION OF ENERGY SAVING CONCEPTS TO FUTURE FIGHTER/ATTACK AIRCRAFT DESIGN
S. A. POWERS, H. H. DRIGGERS, and T. E. KRIEG (Vought Corp., Dallas, TX) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 9 p. refs
(Contract N622691-81-C-0534)
(AIAA PAPER 83-0092)

A study of twenty Energy Saving Concepts as applied to an Advanced Fighter/Attack aircraft intended for an initial operational capability (IOC) of 1995 has been carried out. The results show that the use of Surface Launched Air Targeted Missiles, Advanced Engines, conformal external fuel tanks, variable sweep wings, advanced airfoils, relaxed static margin, and intelligent use of advanced structural materials can significantly reduce the fuel consumption of such an aircraft at a modest increase in Life Cycle Costs. (Author)

A83-16517#
COMPUTATIONAL WING DESIGN FOR AN ADVANCED TRAINER
M. W. GEORGE, B. W. WEDAN (Northrop Corp., Hawthorne, CA), and R. R. JOHNSON (Vought Corp., Dallas, TX) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 19 p. refs
(AIAA PAPER 83-0093)

The application of computational methods to the multipoint design of a trainer aircraft wing is described. Particular attention is given to the use of selected codes for the transonic design points, although computational methods play a critical role in other areas of the design as well. The design process is divided into three phases (methods calibration, design, and verification), and the use of computational methods within each phase is described. The design effort described shows that when computational methods are integrated properly into the design process, they can contribute significantly to the efficiency and accuracy of that process. The methods outlined allow for a timely and efficient exploration of wing twist and section shaping while taking into account manufacturing complexity and component integration requirements. C.R.

A83-16519#
SAMID, AN INTERACTIVE SYSTEM FOR THE ANALYSIS AND CONSTRAINED MINIMIZATION OF INDUCED DRAG OF AIRCRAFT CONFIGURATIONS
R. F. VAN DEN DAM (Nationaal Lucht- en Ruimtevaartlaboratorium, Amsterdam, Netherlands) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 12 p. Research supported by the Nederlands Instituut voor Vliegtuigontwikkeling en Ruimtevaart. refs
(AIAA PAPER 83-0095)

An interactive computer program system has been developed which provides induced-drag analysis, optimization and configuration-design capabilities. The program system employs subsonic far-field (Trefftz-plane) analysis, and novel mathematical formulations of the constrained optimization problems which are based on calculus of variations. The analysis and optimization technique, utilizing panel-method technology with piecewise quadratically varying bound-circulation, is fast, numerically stable and easy to use, and therefore is very suitable for interactive design purposes in which rapid configuration trade-offs have to be made. The paper presents an outline of the induced-drag analysis and optimization technique, comparisons with other theories and the interactive design capability. (Author)

A83-16567#
A METHOD FOR ESTIMATING THE PROPULSION INDUCED AERODYNAMIC CHARACTERISTICS OF STOL AIRCRAFT IN GROUND EFFECT
V. R. STEWART (Rockwell International Corp., Columbus, OH), M. M. WALTERS (U.S. Naval Material Command, Naval Air Development Center, Warminster, PA), and R. E. KUHN American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 12 p. refs
(AIAA PAPER 83-0169)

An interim empirical method has been developed which allows the rapid estimation of the longitudinal aerodynamic characteristics of various powered STOL aircraft configurations in ground effect. The method has been developed as two separate procedures; one pertaining to deflected thrust configurations with small power induced circulation lift coefficients, and the second for those configurations such as the USB and EBF which have large power induced circulation lift coefficients. The method is presented along with the approach taken during the study, the data base used, and correlations of resulting predictions with test data. In addition, the current program to expand the data base and to improve the methods to cover a broader range of configurations is discussed. (Author)

A83-16627#
OPTIMIZATION OF VARIABLE-ALTITUDE FLYBACK MANEUVERS
R. L. ALFORD (Honeywell, Inc., Hopkins, MN) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 8 p. refs
(AIAA PAPER 83-0282)

Optimal control theory is applied to two related problems in optimizing the turning performance of a bank-to-turn rocket-propelled lifting vehicle for variable-altitude flyback maneuvers. The first problem is to determine the maximum turn that can be attained with a given rocket motor and launch conditions while satisfying terminal altitude, velocity and flight path constraints. The second is to determine the minimum amount of propellant required for a specified turn. These problems are reduced to two-point boundary value problems and numerical solutions are obtained using a variation of extremals technique. Results are presented for a low-altitude munition dispenser. (Author)

A83-16628#
MAXIMUM ENDURANCE AND MAXIMUM PENETRATION TRAJECTORIES FOR HORIZONTAL GLIDING FLIGHT
C.-Y. YANG, J.-S. CHERN, and D.-M. MA (Chung Shan Institute of Science and Technology, Lungtan, Republic of China) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 6 p. refs
(AIAA PAPER 83-0283)

Attention is given to the case in which a lifting vehicle is carried by an aircraft. At a certain point, which is not too far away from a specified target, the vehicle is released for attacking the target. The vehicle approaches the target in a horizontal gliding flight. Conditions for maximizing flight time or penetration distance are investigated, taking into account the maximum endurance and maximum penetration trajectories for initial velocity yaw angles in the range from 0 to 180 deg. In the case of maximum endurance flight, true optimal trajectories are obtained through the iteration of two parameters in the optimal control problem. In the study of maximum penetration trajectories, an approximation technique is used, and the trajectory is divided into two sections corresponding to two flight phases. G.R.

A83-16674#
A DYNAMIC MODEL FOR AIRCRAFT POSTSTALL DEPARTURE
M. A. HREHA (McDonnell Douglas Corp., St. Louis, MO) and F. H. LUTZE (Virginia Polytechnic Institute and State University, Blacksburg, VA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 10 p. refs
(AIAA PAPER 83-0367)

An aerodynamic model is developed for use with a computer six degree-of-freedom vehicle motion simulator for the purpose of analyzing high angle-of-attack behavior including poststall departure. The model consists of a nonlinear lifting line theory which includes unsteady wake effects due to a discrete, nonplanar vortex system. Each lifting surface is modeled with discrete vortex segments and their associated control points. The wing, horizontal and vertical tail are treated in this manner. Application to a general aviation type vehicle indicate the effects of flight asymmetries and rate of stall penetration on poststall departure. In addition forced oscillation wind tunnel tests in roll are simulated using this aerodynamic model and are shown to agree quite well with actual tests for two different configurations. (Author)

A83-16774#
ON THE AERODYNAMICS OF OVER-THE-WING NACELLES SUPPORTED ON 'STUB-WINGS'
J. SZODRUCH and J. KOTSCHOTE (Vereinigte Flugtechnische Werke GmbH, Bremen, West Germany) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 9 p. Research supported by the Bundesministerium fuer Forschung und Technologie. refs
(AIAA PAPER 83-0538)

An advanced concept of nacelles in over-the-wing positions is experimentally investigated to study the aerodynamic performance and to gain further insight into the flow mechanism. Low speed windtunnel tests have been conducted using a typical transport aircraft semi-span model. The engine was represented by a turbo-powered simulator and supported on a canard type of wing at different vertical and longitudinal positions. The entire model was metric including the powered nacelles. Results of force and static pressure measurements on the wing display improved aerodynamic performance due to favorable interference between the engines and the wing. (Author)

A83-16818#
INVESTIGATION OF DYNAMIC CHARACTERISTICS OF AN ELASTIC WING DUE TO CORRECTION OF MASS AND STIFFNESS MATRICES
M. HASHEMI-KIA American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 7 p. refs
(AIAA PAPER 83-0653)

The effects of theoretical changes in mass and stiffness matrices on the dynamic characteristics of a model wing are considered. The NASTRAN computer code is utilized to find theoretical mass and stiffness matrices with their corresponding natural frequencies, mode shapes, and the dynamic response. Experimentally measured mode shapes and natural frequencies are used to improve the stiffness and mass matrices. The resulting improved stiffness and mass matrices are further used to calculate the dynamic response for the model. Analysis of the computational results and experimental data show that the improved theoretical model represents the experimental model better than the original theoretical model. (Author)

A83-16872
SOLAR DRONES SCAN THE EARTH
R. DEMEIS High Technology, vol. 3, Jan. 1983, p. 10, 12, 13.

NASA and Navy plans to employ long-duration, solar-powered drone aircraft for high altitude surveillance tasks are described. The NASA concept involves a glider vehicle based on principles developed for Solar Challenger. Solar cells on the wing can supply energy for driving propellers and charging fuel cells for night time power. Mylar-skinned wings with a 93 m span offer maximum lift in high altitudes for military reconnaissance or resource monitoring missions. A design contract with Lockheed is projected to lead to a flight model in 1985. The Navy's Hi-SPOT blimp is intended to be 500 ft long, 46 m in diam, and encompass 5 million cubic feet. Hovering at 13 miles altitude, the vehicle will rely on hydrogen for electric and propulsive power for the rear-mounted propeller. It is noted that the drone glider would be capable of staying aloft for nearly one-half year. M.S.K.

A83-16926#
SOME EXPERIMENTAL INVESTIGATIONS ON TRANSONIC FLUTTER CHARACTERISTICS OF THIN PLATE WING MODELS WITH SWEPTBACK AND TAPERED TIPS
E. NAKAI (National Aerospace Laboratory, Tokyo, Japan) Japan Society for Aeronautical and Space Sciences, Transactions, vol. 25, Nov. 1982, p. 129-145. refs

The present investigation utilizes a transonic blowdown wind tunnel for the study of the flutter characteristics of wing models at Mach numbers in the range from 0.8 to 1.17. It is pointed out that the speed of an advancing rotor tip in modern high-performance helicopter approaches transonic speed. Tapered and sweptback rotor tips are employed to avoid the undesirable aerodynamic effects of compressibility and to reduce the noise generated at the rotor tip. The same type of blade configuration is proposed for the propeller of prop-fan aircraft which appears to be one of the most promising types of aircraft for the future. Attention is given to the structures of wing models, the static and dynamic characteristics of wing models, and details concerning the flutter tests. G.R.

A83-16932
VIBRATION ISOLATION SYSTEM DEVELOPMENT FOR THE FB-111 TAIL POD ELECTRONICS
R. DOLBEARE (Westinghouse Electric Corp., Pittsburgh, PA) and G. P. TILLMAN (Lord Corp., Erie, PA) (Institute of Environmental Sciences, Seminar on Designing Electronic Equipment for Random Vibration Environments, Los Angeles, CA, Mar. 1982.) Journal of Environmental Sciences, vol. 25, Nov.-Dec. 1982, p. 34-40.

This paper discusses the analysis, design, and testing performed in developing the isolation system for electronics subjected to the extremely severe random vibration environment at the tip of the FB-111 aircraft vertical stabilizer. Included data shows the random

vibration response for both hard-mounted and soft-mounted configurations. (Author)

A83-17276
USAF STUDIES FIGHTERS FOR DUAL-ROLE, ALL-WEATHER OPERATIONS
C. A. ROBINSON, JR. Aviation Week and Space Technology, vol. 118, Jan. 3, 1983, p. 36, 37, 39, 40.

A comparative flight evaluation program is being conducted by the U.S. Air Force for two-seat versions of the F-15 and F-16 fighter aircraft that may be developed for night and all-weather operations in both air-to-air and ground attack/deep strike interdiction missions. A minimum of 400 of the selected aircraft will be required. The F-16 derivative under consideration employs a novel, cranked arrow wing planform which, along with a stretched fuselage, accommodates increased internal fuel capacity. Attention is given to the pilot (forward) and weapons system officer (aft) stations of the F-15 derivative, which will be equipped with multipurpose color displays that are undergoing evaluation in a flight simulator. High penetration speeds and terrain following, with full weapons load, are essential to the air-to-ground mission, as well as high resolution radar identification of targets at night and in severe weather environments. O.C.

A83-17915*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
REVIEW OF FACTORS AFFECTING AIRCRAFT WET RUNWAY PERFORMANCE
T. J. YAGER (NASA, Langley Research Center, Hampton, VA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 8 p. refs (AIAA PAPER 83-0274)

Problems associated with aircraft operations on wet runways are discussed and major factors which influence tire/runway braking and cornering traction capability are identified including runway characteristics, tire hydroplaning, brake system anomalies, and pilot inputs. Research results from investigations conducted at the Langley Aircraft Landing Loads and Traction Facility and from tests with instrumented ground vehicles and aircraft are summarized to indicate the effects of different aircraft, tire, and runway parameters. Several promising means are described for improving tire/runway water drainage capability, brake system efficiency, and pilot training to help optimize aircraft traction performance on wet runways. (Author)

A83-18068
THE EFFECT OF BACKLASH AND TRAILING-EDGE STRIPS ON THE FLUTTER SPEED OF A TWO-DIMENSIONAL MODEL OF A TAILPLANE WITH TAB
B. EMSLIE and A. GOLDMAN (Department of Defence, Aeronautical Research Laboratories, Melbourne, Australia) Aeronautical Journal, vol. 86, Nov. 1982, p. 337-340.

The effect of backlash and trailing-edge strips on the flutter speed of a two-dimensional model of a tailplane with tab has been investigated in a series of wind tunnel tests. When backlash is present, a change in preload, which is achieved by varying the incidence of the tab, can dramatically alter the flutter speed. The addition of trailing-edge strips to the tab lowered the flutter speed. (Author)

A83-18074
LONG-RANGE FALCON - FLIGHT-TEST DASSAULT FALCON 50
H. HOPKINS Flight International, vol. 123, Jan. 1, 1983, p. 12-14, 17-19.

Performance and equipment features of the Dassault Falcon 50 business jet were explored during a trial flight. The Falcon has the range of a 727, has three 3700 lb thrust jet engines, and double-swept leading edges. The mid-set tailplane has an anhedral, while the elevator is inset in the stabilizer. Weighing 32,000 lb, the Falcon is steered by pressing a palm-wheel before turning it. The start-up, climb, and air maneuver capabilities of the aircraft are described, and an overall good impression is given of the instrument display positioning. Details of the aircraft dimensions are provided, along with a maximum cargo weight of 3790 lb, range of 3400 nm, speed Mach 0.86, and top altitude of 45,000 ft. The redundancy in fuel feed pumps is noted. M.S.K.

A83-18148
XH-59A ABC AIRCRAFT FLIGHT TESTS AT FT. RUCKER, ALABAMA
A. W. LINDEN (United Technologies Corp., Sikorsky Aircraft Div., Stratford, CT), D. SIMON (U.S. Army, Applied Technology Laboratory, Fort Eustis, VA), and L. E. SCOTT (U.S. Army, Aviation Development Test Activity, Ft. Rucker, AL) Aircraft Engineering, vol. 54, Dec. 1982, p. 14-18. refs

The XH-59A aircraft is a research vehicle designed to investigate Advancing Blade Concept (ABC) flight characteristics. The ABC concept uses two rigid, counterrotating rotors, and develops the greater part of its lift in high speed forward flight on the advancing sides of the two rotor discs. Roll trim is maintained by balancing the lift between the advancing sides of the two rotors. The primary objective of the study presently reported was to conduct a quantitative and qualitative evaluation of the craft's handling qualities in nap-of-the-earth and contour flight modes typical of the attack helicopter mission. Test results are presented for the low airspeed trimmed control position in sideward, forward and rearward flight, as well as a schematic of the Cooper-Harper handling qualities rating scale used. O.C.

A83-18376
EVOLUTION OF THE APPLICATION OF COMPOSITE MATERIALS TO HELICOPTERS
R. L. FOYE (U.S. Army, Research and Technology Laboratories, Moffett Field, CA) and J. L. SHIPLEY (U.S. Army, Applied Technology Laboratory, Fort Eustis, VA) American Helicopter Society, Journal, vol. 26, Oct. 1981, p. 5-15. refs

This paper contains a brief chronology of the major US developments in the application of composite materials to helicopters. The major events of each decade from 1940 are described. Some references are made to significant accomplishments in helicopter structures, materials development and the general application of composites in order to establish a framework for the subject matter. Comments are also made on future trends and new applications. (Author)

A83-18377
COMPOSITE TECHNOLOGY IN THE UK HELICOPTER INDUSTRY
R. W. WHITE, P. S. GRAINGER, and G. R. GRIFFITHS (Westland Helicopters, Ltd., Yeovil, Somerset, England) American Helicopter Society, Journal, vol. 26, Oct. 1981, p. 24-30.

The composite materials design and manufacturing processes currently in use in British-built helicopters are illustrated by means of a detailed examination of the WG 30 helicopter vibration absorber and tail rotor blade. In both of these cases, attention is given to advantages gained over alternatives. Substantial future gains are anticipated in both rotor system and fuselage structures. In the case of the former, it is suggested that the use of aeroelastic tailoring which takes advantage of the inherently torsionally soft nature of unidirectional composites will provide both performance and noise reduction gains. In the case of the fuselage, cost and weight savings are the primary benefits to be expected. O.C.

A83-18380
ROTOR BLADE FLAP-LAG STABILITY IN TURBULENT FLOWS
J. E. PRUSSING and Y. K. LIN (Illinois, University, Urbana, IL) American Helicopter Society, Journal, vol. 27, Apr. 1982, p. 51-57. refs
(Contract DAAG29-78-G-0039)

The stability of coupled flap-lag motion of a helicopter rotor blade in the presence of turbulence is investigated. The rigid blade flap-lag equations of motion previously derived by Peters are generalized to include random turbulence in the airspeed components of the blade. By assuming white noise turbulence

and applying a special case of the stochastic averaging procedure, the equations are converted to Ito type stochastic differential equations which are then used to determine the stochastic stability of the system. Illustrated numerical results for the second moment (mean-square) stability boundaries are presented for the restricted case of a rotor blade in hover with vertical turbulence. The restriction to vertical turbulence is made because the vertical component is found to have a much larger effect on the coupled flap-lag motion than the in-plane components. The surprising result is obtained that the vertical-turbulence appears to increase the stability of the coupled flap-lag motion for realistic rms turbulence velocities. (Author)

A83-18381
HELICOPTER ICING - TESTING AND CERTIFICATION
G. W. WILSON (U.S. Army, Aviation Engineering Flight Activity, Edwards AFB, CA) American Helicopter Society, Journal, vol. 27, Apr. 1982, p. 66-72. refs

Some pertinent points gathered from the Army's eight years of icing tests are presented. The theory of ice formation is briefly discussed along with a summary of some of the more successful attempts at solving the helicopter icing problem. Basic design philosophy for electrothermal deicing systems is covered. Advantages and shortcomings of both natural and artificial testing are discussed as are the procedures for use of the Army's Helicopter Icing Spray System. A sample list of instrumentation requirements is presented along with some suggested special equipment required for icing tests. Finally, the FAA's current icing certification requirements are discussed as they apply to the rotary wing community. (Author)

A83-18382
CONCEPTS OF STOCHASTIC STABILITY IN ROTOR DYNAMICS
Y. K. LIN and J. E. PRUSSING (Illinois, University, Urbana, IL) American Helicopter Society, Journal, vol. 27, Apr. 1982, p. 73, 74. refs
(Contract DAAG29-81-K-0072)

The concepts of stochastic stability as applied to rotor blade systems for which the uncertainty is caused by atmospheric turbulence are introduced. Stochastic equations of motion are briefly discussed and definitions of stochastic stability in terms of probabilistic or statistical convergence are addressed. The use in physical systems of stability in probability, stability with probability one, and stability in the nth moment is summarized. C.D.

A83-18387
STABILITY OF TWO-BLADED AEROELASTIC ROTORS ON FLEXIBLE SUPPORTS
S. Y. CHEN (Kaman Aerospace Corp., Bloomfield, CT) American Helicopter Society, Journal, vol. 28, Jan. 1983, p. 34-41. refs
(Contract NSF GME-79-06304)

A more realistic model of a two-bladed rotor on unsymmetrical supports is formulated and its stability characteristics under the influence of aerodynamic forces and for various values of elastic parameters are examined. The mathematical model and its solution method are described, and results are found for questions such as the existence of flutter and whirl and the effect of aerodynamic damping for the following cases: two-bladed rotor on a symmetric translational ground support with and without aerodynamics; asymmetric support with translational degrees of freedom; asymmetric translational ground support with full aerodynamic force; and asymmetric support with angular degrees of freedom. C.D.

A83-18398#
HOW DECISIONS ARE MADE - MAJOR CONSIDERATIONS FOR AIRCRAFT PROGRAMS
J. E. STEINER (Boeing Co., Seattle, WA) International Council of the Aeronautical Sciences and American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Seattle, WA, Aug. 24, 1982, Paper. 37 p.

Historical accounts are presented of project management experience gained in the course of civilian and military aircraft development since the end of World War Two. Emphasis is put on the financial risks faced by aircraft manufacturers as they proceed to make decisions concerning large scale, long term aircraft development and production schedules. After assessing the performance improvement trends from the 1940's to the present in such matters as fuel consumption, noise reduction, structural weight reduction and avionics, case histories are presented for the aircraft in which such performance gains were gradually achieved. The aircraft programs include the 377 Stratocruiser, the B-52 strategic bomber, the P-3 Orion naval patrol aircraft, the 707, 727 and 747 airliners, recent wide body airliners such as the A300, 767 and 757, and the turbofan engines whose development was essential to the design of recent, fuel-efficient airliners. O.C.

A83-18402#
FATIGUE SENSITIVITY OF COMPOSITE STRUCTURE FOR FIGHTER AIRCRAFT
L. L. JEANS, G. C. GRIMES, and H. P. KAN (Northrop Corp., Aircraft Div., Hawthorne, CA) (Structures, Structural Dynamics and Materials Conference, 22nd, Atlanta, GA, April 6-8, 1981, Technical Papers. Part 1, p. 50-60.) Journal of Aircraft, vol. 20, Feb. 1983, p. 102-110. refs

(Previously cited in issue 12, p. 1933, Accession no. A81-29383)

A83-18430#
FULL SCALE TEST OF THE C22 TARGET IN THE ONERA S1MA WIND TUNNEL [ESSAI DE L'ENGIN CIBLE C22 EN VRAIE GRANDEUR A LA SOUFFLERIE S1MA DE L'ONERA]
D. FABRE (ONERA, Chatillon-sous-Bagneux, Hauts-de-Seine, France), J. FONTANEL (ONERA, Modane, Savoie, France), and M. GOUSSE (Societe Nationale Industrielle Aerospatiale, Verrieres-le-Buisson, Essonne, France) (NATO, AGARD, Symposium sur l'Aerodynamique des Missiles, Trondheim, Norway, Sept. 20-22, 1982.) ONERA, TP no. 1982-95, 1982. 16 p. In French.
(ONERA, TP NO. 1982-95)

Wind tunnel tests with the turbojet equipped C22 target drone are described, including corrections made for the wind tunnel environment and comparisons with data from flight tests. The C22 is radio remote controlled, has a maximum altitude of 12,000 m, a top speed of M 0.7-0.9, and is recoverable after flight. The S1MA wind tunnel was employed with a full scale model to test the drag effects of the positioning of the turbojet and the antennas, fittings, etc. The data were corrected for the influence of the walls, the mount for the model, and the engine presence. Strain-gage balances were employed to quantify the drag caused by the vehicle appurtenances. No interface was detected between the jet nozzle and the target airframe. Some influence on the drag was caused by the exhaust, while overall the wind tunnel tests provided drag measurements which were confirmed in flight tests. M.S.K.

A83-18435#
FLIGHT FLUTTER TESTING WITH EMPHASIS ON THE TIP VANE METHOD
H. ZIMMERMANN (Vereinigte Flugtechnische Werke GmbH, Bremen, West Germany) and R. DESTUYNDER (ONERA, Chatillon-sous-Bagneux, Hauts-de-Seine, France) (NATO, AGARD, Meeting, 61st, Cesme, Turkey, Oct. 11-15, 1982.) ONERA, TP no. 1982-109, 1982. 15 p. refs
(ONERA, TP NO. 1982-109)

The various in-flight methods used for studying aircraft flutter behavior are examined with particular attention given to the tip-vane system developed for the vibration testing of the A 310 aircraft. Existing methods of in-flight aircraft excitation are divided into those for which the measurement of input forces is difficult or inappropriate, including excitation by atmospheric turbulence, available control surfaces and bonkers, and those for which input forces may be measured, including the use of inertial shakers and vane excitation systems. The development of the tip-vane system, which utilizes a power-driven vane installed at the wing tips to produce excitations, is then discussed, with attention given

to the functional and safety requirements for the system and the system configuration. Methods used in data reduction, particularly the matching of the measured transfer function with the theoretical function, are then examined, and vibration measurements obtained in the flight testing of the A 310 aircraft are presented. A.L.W.

A83-18823#
DEVELOPMENT OF A STRUCTURAL, BIRD IMPACT RESISTANT, DE-ICED WING LEADING EDGE FOR THE DE HAVILLAND DASH 8 AIRCRAFT USING FIBRE-REINFORCED COMPOSITES
L. K. JOHN and G. A. TERWISSEN (De Havilland Aircraft of Canada, Ltd., Downsview, Ontario, Canada) (Canadian Symposium on Aerospace Structures and Materials, 1st, Toronto, Canada, June 1, 1982.) Canadian Aeronautics and Space Journal, vol. 28, Sept. 1982, p. 252-263. Research supported by the National Research Council and Department of Industry, Trade and Commerce.

The design, development, and testing of a fiber-reinforced composite leading edge for the de Havilland Dash 8 aircraft are described. Design criteria included withstanding a 4 lb bird impact at 246 kn, shape retention under aerodynamic loading, minimum drag and weight, lightning strike protection and static dissipation, mechanical fastening, a good bond between the deicing boot and the leading edge structure, and efficient production. A spar web 0.050 in. thick was chosen as suitable for impact protection and proven in testing. A Kevlar base skin with a glass fabric outer surface was selected, together with a Nomex honeycomb core. Aluminized glass on the deiced section provides lightning conduction. Peel tests showed epoxy adhesive integral bonding was effective. A two-step lay-up process was defined. Final tests are under way to establish procedures for deicing boot removal and repair. D.H.K.

A83-18925
HYDROMECHANICAL DYNAMICS OF AIRCRAFT LANDING GEAR
R. R. ALLEN (California, University, Los Angeles, CA) Fluidics Quarterly, vol. 13, Dec. 1981, p. 57-78. refs

A general method for mathematical modeling of oleopneumatic shock struts and mechanical linkages in aircraft landing gear systems is presented, using vector bond graphs to provide a versatile representation of basic shock strut hydraulics and thermodynamics. In addition, the graphs facilitate the development of such sophisticated mathematical models as those of heat transfer, the effects of gas entrainment in the oil, multiple air chambers, and active metering orifices for feedback control of damping forces. The generalization of the special case presented, to incorporate the full six degrees-of-freedom of the aircraft frame, is straightforward. An important feature of the method is the power conservation of the junction structure, which automatically produces the proper force equations once the kinematic relations are derived. O.C.

A83-19411
THE GENERAL DYNAMICS F-16 XL FIGHTER AIRCRAFT [L'AVION DE COMBAT GENERAL DYNAMICS F-16 XL]
,L'Aeronautique et l'Astronautique, no. 96, 1982, p. 17-22. In French.

Design features, flight performance, aerodynamics, and missions of the F-16 XL fighter are described. The aircraft differs from the F-16A mainly in terms of an elongated fuselage and an entirely new airfoil. The changes were introduced to conserve fuel, increase the military payload, and reduce the drag characteristics. A total of 3600 hr of test flights have been conducted on the new version. Drag reduction has reached 17 percent, lift has been augmented 66 percent, a lift/drag ratio of 8 is experienced in subsonic flight and 5.5 in supersonic flight, and nose-lifting at low speeds has been eliminated. Details of the fuselage, airfoil, empennage, landing gear, propulsion system, flight control, on-board electronics, and armament systems are provided. The F-16 XL weighs 7850 kg empty, 21,700 kg with a full load, has a top speed of Mach 2, and can accelerate at 9 g to 15,300 m altitude. A range of 4650 km can be flown, and landing and take-off require 650 m of runway. M.S.K.

A83-19450
US NAVY STOVL - WAITING IN THE WINGS
B. SWEETMAN Air International, vol. 24, Feb. 1983, p. 75-77.

An assessment is presented of the development history, present status, and prospective innovations of U.S. Navy short takeoff, vertical landing (STOVL) aircraft. Attention is given to the incompatibility of further funding for future STOVL fighter aircraft development with current plans for the expansion of the large aircraft carrier fleet and its inventory of conventional takeoff and landing aircraft. The two STOVL fighters that are presently undergoing conceptual development are the General Dynamics E-7, whose lift system employs air-entraining, thrust-augmenting ejectors similar to those of the XFV-12A, and the McDonnell Douglas 279, which incorporates the vectorable nozzle system of the highly successful Harrier aircraft. Both designs are capable of supersonic flight. O.C.

A83-19579#
PROGRESS TOWARDS A THEORY OF JET FLAP THRUST RECOVERY
P. M. BEVILAQUA, E. F. SCHUM, and C. J. WOAN (Rockwell International Corp., Columbus, OH) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 11 p. refs
(Contract F49620-78-C-0069)
(AIAA PAPER 83-0079)

A combination of analysis and testing has been utilized to develop a theory of jet flap thrust recovery at the low speeds and high deflection angles characteristic of V/STOL lift systems. The contribution of jet drag to the loss of thrust recovery has been computed with a viscid/inviscid interaction analysis. The results of this computation are compared to surface pressure and wake survey measurements made with a two-dimensional jet-flapped airfoil model. It is concluded that the jet drag causes a small loss of recovery at small values of the jet thrust coefficient and deflection angle. However, at larger values of either jet parameter, the main stream separates from the airfoil, producing a large loss of recovery. The loss increases suddenly, since it is due to bursting of the leading edge separation bubble. (Author)

A83-19594*# Dayton Univ., Ohio.
A PROPOSED SIMPLE AND SAFE AIRCRAFT TAKE-OFF OR LANDING PROCEDURE WITH WING ROUGHNESS OR PROTUBERANCES
M. A. DIETENBERGER (Dayton, University, Dayton, OH) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 47 p. refs
(Contract NAS8-33369)
(AIAA PAPER 83-0604)

A simple, safe takeoff and/or landing procedure has been developed for cases of wing roughness or proturbances. The procedure utilizes calculations of aerodynamic penalties and steady flight equations. Empirical relationships for lift, drag, and angle of attack penalties are used to construct the lift and drag coefficient versus the angle of attack. To maintain safe stall margin due to wing roughness, the lift coefficient and the angle of attack at takeoff or landing for a roughened aircraft must be less than that of a clean aircraft by the relative maximum lift loss and stall angle loss due to roughness. The procedure may be applied to many types of aircraft. S.C.S.

N83-14104# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
OPERATIONAL LOADS MEASUREMENT AND EVALUATION
Sep. 1982 23 p refs
(AGARD-R-704; ISBN-92-835-1435-0) Avail: NTIS HC A02/MF A01

Design loads and fatigue analysis, and differing approaches to one determination of operational loads and structural stresses are characterized. Author

N83-14105*# Sikorsky Aircraft, Stratford, Conn.
COUPLED ROTOR/AIRFRAME VIBRATION ANALYSIS Final Report
R. SOPHER, R. E. STUDWELL, S. CASSARINO, and S. B. R. KOTTAPALLI Washington NASA Nov. 1982 205 p refs Sponsored in part by Army Aviation Research and Development Command
(Contract NAS1-16058)
(NASA-CR-3582; NAS 1.26:3582) Avail: NTIS HC A10/MF A01 CSCL 01C

A coupled rotor/airframe vibration analysis developed as a design tool for predicting helicopter vibrations and a research tool to quantify the effects of structural properties, aerodynamic interactions, and vibration reduction devices on vehicle vibration levels is described. The analysis consists of a base program utilizing an impedance matching technique to represent the coupled rotor/airframe dynamics of the system supported by inputs from several external programs supplying sophisticated rotor and airframe aerodynamic and structural dynamic representation. The theoretical background, computer program capabilities and limited correlation results are presented in this report. Correlation results using scale model wind tunnel results show that the analysis can adequately predict trends of vibration variations with airspeed and higher harmonic control effects. Predictions of absolute values of vibration levels were found to be very sensitive to modal characteristics and results were not representative of measured values. Author

N83-14106# Aeronautical Research Labs., Melbourne (Australia).
DIGITAL FILTERING OF HELICOPTER FLIGHT DATA
N. E. GILBERT and J. A. FLEMING Jan. 1982 27 p refs
(ARL-AERO-NOTE-406; AR-002-330) Avail: NTIS HC A03/MF A01

Data obtained during flight trials on a Sea King Mk. 50 helicopter contained significant noise, especially in measurements of components of linear acceleration and angular velocity. Two digital Butterworth low pass filters were designed and their effect demonstrated. Direct representation of the transfer function as a high order filter is used, in preference to representation as a number of second order and first order subfilters. The mathematical derivation of the filter coefficients is given in direct form. Author

N83-14107*# Rockwell International Corp., Los Angeles, Calif.
A NASTRAN MODEL OF A LARGE FLEXIBLE SWING-WING BOMBER. VOLUME 1: NASTRAN MODEL PLANE Final Report
W. D. MOCK Sep. 1982 125 p refs 5 Vol.
(Contract NAS4-2308)
(NASA-CR-170392-VOL-1; NAS 1.26:170392-VOL-1;
NA-76-469-VOL-1) Avail: NTIS HC A05/MF A01 CSCL 01C

A review was conducted of B-1 aircraft no. 2 (A/C-2) internal loads models to determine the minimum model complexity necessary to fulfill all of the airloads research study objectives. Typical model sizings were tabulated at selected vehicle locations, and scale layouts were prepared of the NASTRAN structural analysis model. Author

N83-14108*# Rockwell International Corp., Los Angeles, Calif.
A NASTRAN MODEL OF A LARGE FLEXIBLE SWING-WING BOMBER. VOLUME 2: NASTRAN MODEL DEVELOPMENT-HORIZONTAL STABILZER, VERTICAL STABILIZER AND NACELLE STRUCTURES Final Report
W. D. MOCK, R. A. LATHAM, and E. D. TISHER Sep. 1982 304 p refs 5 Vol.
(Contract NAS4-2348)
(NASA-CR-170392-VOL-2; NAS 1.26:170392-VOL-2;
NA-76-469-VOL-2) Avail: NTIS HC A14/MF A01 CSCL 01C

The NASTRAN model plans for the horizontal stabilizer, vertical stabilizer, and nacelle structure were expanded in detail to generate the NASTRAN model for each of these substructures. The grid point coordinates were coded for each element. The material properties and sizing data for each element were specified. Each substructure model was thoroughly checked out for continuity, connectivity, and constraints. These substructures were processed for structural influence coefficients (SIC) point loadings and the deflections were compared to those computed for the aircraft detail models. Finally, a demonstration and validation processing of these substructures was accomplished using the NASTRAN finite element program installed at NASA/DFRC facility. Author

N83-14109*# Rockwell International Corp., Los Angeles, Calif.
A NASTRAN MODEL OF A LARGE FLEXIBLE SWING-WING BOMBER. VOLUME 3: NASTRAN MODEL DEVELOPMENT-WING STRUCTURE Final Report
W. D. MOCK and R. A. LATHAM Sep. 1982 202 p refs 5 Vol.
(Contract NAS4-2432)
(NASA-CR-170392-VOL-3; NAS 1.26:170392-VOL-3;
NA-76-469-VOL-3) Avail: NTIS HC A10/MF A01 CSCL 01C

The NASTRAN model plan for the wing structure was expanded in detail to generate the NASTRAN model for this substructure. The grid point coordinates were coded for each element. The material properties and sizing data for each element were specified. The wing substructure model was thoroughly checked out for continuity, connectivity, and constraints. This substructure was processed for structural influence coefficients (SIC) point loadings and the deflections were compared to those computed for the aircraft detail model. Finally, a demonstration and validation processing of this substructure was accomplished using the NASTRAN finite element program. The bulk data deck, stiffness matrices, and SIC output data were delivered. Author

N83-14110*# Rockwell International Corp., Los Angeles, Calif.
A NASTRAN MODEL OF A LARGE FLEXIBLE SWING-WING BOMBER. VOLUME 4: NASTRAN MODEL DEVELOPMENT-FUSELAGE STRUCTURE Final Report
W. D. MOCK and R. A. LATHAM Sep. 1982 245 p refs
(Contract NAS4-2533)
(NASA-CR-170392-VOL-4; NAS 1.26:170392-VOL-4;
NA-76-469-VOL-4) Avail: NTIS HC A11/MF A01 CSCL 01C

The NASTRAN model plan for the fuselage structure was expanded in detail to generate the NASTRAN model for this substructure. The grid point coordinates were coded for each element. The material properties and sizing data for each element were specified. The fuselage substructure model was thoroughly checked out for continuity, connectivity, and constraints. This substructure was processed for structural influence coefficients (SIC) point loadings and the deflections were compared to those computed for the aircraft detail model. Finally, a demonstration and validation processing of this substructure was accomplished using the NASTRAN finite element program. The bulk data deck, stiffness matrices, and SIC output data were delivered. Author

N83-14111*# Rockwell International Corp., Los Angeles, Calif.
A NASTRAN MODEL OF A LARGE FLEXIBLE SWING-WING BOMBER. VOLUME 5: NASTRAN MODEL DEVELOPMENT-FAIRING STRUCTURE Final Report
W. D. MOCK and R. A. LATHAM Sep. 1982 105 p refs 5 Vol.
(Contract NAS4-2614)
(NASA-CR-170392-VOL-5; NAS 1.26:170392-VOL-5;
NA-76-469-VOL-5) Avail: NTIS HC A06/MF A01 CSCL 01C

The NASTRAN model plan for the fairing structure was expanded in detail to generate the NASTRAN model of this substructure. The grid point coordinates, element definitions, material properties, and sizing data for each element were specified. The fairing model was thoroughly checked out for continuity, connectivity, and constraints. The substructure was processed for structural influence coefficients (SIC) point loadings to determine the deflection characteristics of the fairing model. Finally, a demonstration and validation processing of this substructure was accomplished using the NASTRAN finite element program. The bulk data deck, stiffness matrices, and SIC output data were delivered. Author

N83-14112# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE MANUFACTURE OF INTERIOR DECORATION WALL PLATES FOR THE YIER-86 AIRCRAFT
Q. LUZHOU 5 Aug. 1982 12 p Transl. into ENGLISH from Guoji Hangkong (China), no. 12, Dec. 1981 p 15, 40-41
(AD-A118962; FTD-ID(RS)T-0520-82) Avail: NTIS HC A02/MF A01 CSCL 01C

The fabrication of honeycomb sandwich structure interior decoration wall plates for the YIER-86 aircraft is discussed. Materials and forming techniques are discussed. R.J.F.

N83-14113# Ship Systems, Inc., San Diego, Calif.
PRELAUNCH SURVIVABILITY OF GROUND LAUNCHED CRUISE MISSILE (GLCM). VOLUME 3: SAVAGE CODE VERSION 1.0 USER'S GUIDE Final Report, 1 Jul. 1979 20 Jun. 1980
G. G. ERICKSON, G. E. JACOBSSEN, JR., K. G. HAMILTON, J. F. BROWN, and E. M. CROW 20 Jun. 1980 58 p
(Contract DNA001-79-C-0415)
(AD-A119023; SSI-80-203(S)-VOL-3; DNA-5350F-3) Avail: NTIS HC A04/MF A01 CSCL 09B

This manual represents an unclassified user handbook for the SAVAGE (Survivability and Vulnerability Assessment of GLCM Elements) deterministic computer program. The manual represents Volume 3 of a three volume set; Volume 1 details the data base that was developed to support SAVAGE, while Volume 2 addresses the architecture and modeling included in SAVAGE.
Author (GRA)

N83-14114# McDonnell Aircraft Co., St. Louis, Mo.
PICTORIAL FORMATS. VOLUME 3: LITERATURE REVIEW Final Technical Report, period ending Aug. 1981
T. J. QUINN Wright-Patterson AFB, Ohio AFWAL Mar. 1982 195 p refs
(Contract F33615-80-C-3601; AF PROJ. 2403)
(AD-A119223; MDC-A7172-VOL-3; AFWAL-TR-81-3156-VOL-3)
Avail: NTIS HC A09/MF A01 CSCL 14B

This literature review examines previously designed display concepts. These displays represent ideas developed over the last three decades. Specifics include the Army-Navy Instrumentation Program (ANIP) that commenced in the early 1950's and led into the Joint Army-Navy Aircraft Instrumentation Program (JANTR) in the 1960's. Although many of these display formats were never flown in an aircraft because of the lack of a display medium, they were compiled to serve as an excellent data base for the development of new display formats. A bibliography of over 150 sources is presented. GRA

N83-14115# McDonnell Aircraft Co., St. Louis, Mo.
PICTORIAL FORMATS. VOLUME 1: FORMAT DEVELOPMENT Final Technical Report, May 1980 - May 1981
R. A. JAUER and T. J. QUINN Wright-Patterson AFB, Ohio AFWAL Feb. 1982 129 p
(Contract F33615-80-C-3601; AF PROJ. 2403)
(AD-A119222; MDC-A7172-VOL-1; AFWAL-TR-81-3156-VOL-1)
Avail: NTIS HC A07/MF A01 CSCL 14B

The development of displays for six primary fighter crew stations functions (e.g., primary flight, tactical situation, stores management, systems status, engine status, and emergency procedures is considered with emphasis on information that the pilot really needs. Possible changes in cockpit requirements reflecting future aircraft systems and performance were examined. Pictorial formats were generated in monochrome stroke, color stroke and color raster. The color raster formats are the most aesthetically pleasing. The study indicates that pictorial formats should include limited use of alpha-numeric characters to add to the precision that certain situations/systems require. The use of color was found to enhance information transfer in situations where the pilot must distinguish between classes of stimuli. Author (GRA)

N83-14116# Logistics Management Inst., Washington, D. C.
IMPROVING ENERGY EFFICIENCY OF MAJOR WEAPON SYSTEMS Final Report
D. J. S. PETERSON and C. D. STEVENSON Jul. 1982 50 p refs
(Contract MDA903-81-C-0166)
(AD-A119563; LMI-ML111) Avail: NTIS HC A03/MF A01 CSCL 21D

The increasing cost of fuel consumed by major weapon systems is a continuing concern for the Department of Defense (DoD). Because fuel costs are growing more rapidly than other Operating and Support (O&S) costs, they are consuming a growing fraction of the O&S budget. One solution to the problem is to place greater emphasis on acquiring energy efficient weapon systems. The efficient use of energy in major systems will help assure that the DoD will get the highest level of performance for every fuel dollar spent. The major system acquisition process serves as the framework for incorporating energy efficiency into system design and development. Not all systems are energy intensive and not all would benefit from increased attention to energy. This report defines a method for determining which systems are energy intensive using an energy consumption threshold specific to the warfare area of the system under consideration. We recommend that systems designated energy intensive be subjected to a more detailed analysis of energy consumption and cost, including the sensitivity of system life cycle costs to changes in energy costs. The report provides a case study to demonstrate how the recommended analytical methods can be performed within the life cycle cost analysis required for major weapon systems.
Author (GRA)

N83-14117# Calspan Corp., Buffalo, N. Y. Flight Research Dept.
EQUIVALENT SYSTEM VERIFICATION AND EVALUATION OF AUGMENTATION EFFECTS ON FIGHTER APPROACH AND LANDING FLYING QUALITIES. VOLUME 2: PROGRAM PLAN, TEST DATA AND ANALYSIS Final Report, Jul 1978 - Jul. 1981
R. E. SMITH, J. HODGKINSON, and R. C. SNYDER Wright-Patterson AFB, Ohio AFWAL Sep. 1981 375 p refs Prepared in cooperation with McDonnell Aircraft Co., St. Louis 2 Vol.
(Contract F33615-78-C-3602; AF PROJ. 2403)
(AD-A119704; CALSPAN-6241-F-3-VOL-2;
AFWAL-TR-81-3116-VOL-2) Avail: NTIS HC A16/MF A01 CSCL 01B

An approach and landing evaluation program was performed using the AFWAL/Calspan NT-33 variable stability aircraft to test the suitability of representing aircraft with complex flight control systems by an equivalent simplified system. An evaluation of the equivalent systems includes effects of time delay, correlation with Pilot Ratings and comparison of frequency response characteristics for both high order and low order configurations. The analytical descriptions of the configurations have been plotted in Bode diagrams with the corresponding step time histories. The effects of gain parameters on the matching equivalent systems are presented. A fast Fourier Transform method has been applied to flight time histories for analysis in the frequency response mode. The resulting response characteristics also serve as a check on the predicted responses as defined by the analytical descriptions programmed in the NT-33. The equivalent systems data have been evaluated with the Neal and Smith closed-loop analysis technique. For the longitudinal evaluations, the validity of the equivalent system approach for evaluation of the flying qualities of complex aircraft was generally verified. The data for the lateral equivalent system evaluations were inconclusive. Author (GRA)

N83-14118# Naval Postgraduate School, Monterey, Calif.
HP-41CV FLIGHT PERFORMANCE ADVISORY SYSTEM (FPAS) FOR THE E-2C, E-2B AND C-2A AIRCRAFT Final Technical Report, Apr. - Jun. 1982
D. R. FERRELL Jun. 1982 153 p refs
(AD-A119580; NPS67-82-003) Avail: NTIS HC A08/MF A01 CSCL 21D

This report describes follow-on work performed under the auspices of AE 4900, Directed Studies in Aeronautical Engineering at the Naval Postgraduate School, to complement the original design of a Flight Performance Advisory System (FPAS) for the E-2C aircraft. The original design fulfilled the requirements of AE 3001, Aircraft Energy Conservation. AE 3001, offered in the Fall Quarter 1981, and conducted by Professor Allen E. Fuhs, was sponsored in part by the Naval Air Development Center (NADC). NADC desired to obtain the input of several fleet experienced aviators in order to design program code for the HP-41CV handheld, programmable calculator that would benefit pilots by providing them with fuel efficiency parameters in flight. Calculators were made available to the participants with the proviso that a completed and operable code for each aircraft be submitted by the end of the academic quarter, September 1981. Upon completion of the E-2C program, attempts were made to use the calculator in flight. One test was conducted informally in an E-2C at RVAW-110, NAS Miramar. Unfortunately, the voltage field induced in the cockpit by the main lobe of the radar passing over the cockpit caused the calculator to cease functioning. The need to devise shielding for the calculator, plus the desire to simplify and improve the existing code lead to this effort. GRA

N83-14119# Air Force Flight Test Center, Edwards AFB, Calif. Airframe Systems Div.
DEVELOPMENT OF CURVES FOR ESTIMATING AIRCRAFT ARRESTING HOOK LOADS Final Report
L. W. JONES Jul. 1982 72 p refs
(AD-A119551; AFFTC-TIM-81-3) Avail: NTIS HC A04/MF A01 CSCL 01C

This Technical Information Memorandum was written to provide AFFTC engineers with a reliable, accurate method for predicting maximum aircraft arresting hook loads based on a knowledge of aircraft weight and groundspeed at the moment of cable engagement. Possible causes of excessive data dispersion are discussed and guidelines for minimizing dispersion are provided. Families of curves relating hook load and groundspeed which fit BAK-12ER and BAK-13 arresting system test data are derived and confidence intervals are applied. The information provided in this TIM will be of interest to those involved with the design, fabrication, testing and/or operation of aircraft arresting systems. Author (GRA)

N83-14120# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.
BACKGROUND INFORMATION AND USER GUIDE FOR MIL-F8785C, MILITARY SPECIFICATION, FLYING QUALITIES OF PILOTED AIRPLANES Interim Report, May 1977 - May 1981
D. J. MOOREHOUSE and R. J. WOODCOCK Jul. 1982 255 p refs
(AD-A119421; AFWAL-TR-81-3109) Avail: NTIS HC A12/MF A01 CSCL 01C

This document is published in support of Military Specification MIL-F-8785C, Flying Qualities of Piloted Airplanes. It was compiled after an extensive literature review and meetings and discussions with personnel from concerned civilian and governmental organizations. The primary purpose is to explain the revisions from MIL-F-8785B and present substantiating data. Author (GRA)

N83-14121# Naval Air Development Center, Warminster, Pa. Aircraft and Crew Systems Technology Directorate.
A DIVE PERFORMANCE COMPUTER PROGRAM Final Report
D. B. FOBUS 24 May 1982 72 p refs
(AD-A119407; NADC-82012-60) Avail: NTIS HC A04/MF A01 CSCL 01B

A computer program has been developed which is capable of analyzing the dive performance of any general air vehicle configuration. This program can be used to determine if vehicle design critieria can be met under a dive condition. This program was written in FORTRAN VERSION 4.8 LEVEL 518 for use on a CYBER computer and uses four supporting subroutines. This report describes the analytical development and logic development for the program. In addition, it includes a user description and complete listing of the program. Author (GRA)

N83-14122# Calspan Corp., Buffalo, N. Y.
EQUIVALENT SYSTEM VERIFICATION AND EVALUATION OF AUGMENTATION EFFECTS ON FIGHTER APPROACH AND LANDING FLYING QUALITIES. VOLUME 1: SUMMARY Final Report, Jul. 1978 - Jul. 1981
J. HODGKINSON, R. C. SNYDER, and R. E. SMITH Sep. 1981 43 p
(Contract F33615-78-C-3602; AF PROJ. 2403)
(AD-A119406; C-6241-F-3-VOL-1; AFWAL-TR-81-3116-VOL-1)
Avail: NTIS HC A03/MF A01 CSCL 01B

This executive summary reports an analysis of an approach and landing evaluation program using the AFWAL/Calspan NT-33 variable stability aircraft to test the suitability of representing aircraft with complex flight control systems by an equivalent simplified system. An evaluation of the equivalent systems includes effects of time delay, correlations with Pilot Ratings and comparison of frequency response characteristics for both high-order and low-order configurations. Analytical and fast Fourier transform Bode diagrams of the configurations have been plotted with the corresponding step time histories. The effects of gain parameters on the matching of equivalent systems are presented. The resulting response characteristics also serve as a check on the predicted responses as defined by the analytical descriptions programmed in the NT-33. The equivalent systems data have been evaluated with the Neal and Smith closed-loop analysis technique. For the longitudinal evaluations, the validity of the equivalent system approach for evaluation of the flying qualities of complex aircraft was generally verified. The data for the lateral equivalent system evaluations were inconclusive. Author (GRA)

N83-15281# Federal Aviation Administration, Washington, D.C. Program Engineering and Maintenance Service.
USE OF RADAR POSITION REPORTS FOR ESTIMATING AIRCRAFT ACCELERATION Final Report
J. A. SHANNON Dec. 1982 24 p refs
(FAA-RD-82-81) Avail: NTIS HC A02/MF A01

The possibility of calculating aircraft acceleration from radar position reports using second differences of range bearing data was evaluated. The analysis shows that data provided by the monopulse radar receiver can be sufficiently accurate so that good estimates of acceleration can be calculated. Observations of a B727 aircraft maneuvering at 425 knots and observed by a present generation radar at a distance of 100 to 140 nmi were analyzed. Root mean square heading errors were calculated to be about 5 deg for nonmaneuvering flight. Nine maneuvers, ranging in extent from 9 deg to 174 deg, were observed. Calculation suggests that these can be followed using acceleration calculations with an accuracy of about 10 deg. The peak heading error for one scan is estimated to be 32 deg for a right angle turn. Although impractical for the present generation of ground based computer equipment acceleration estimates will be feasible when the next generation is in place. S.L.

N83-15282*# Kansas Univ. Center for Research, Inc., Lawrence.
ANALYSIS OF NONPLANAR WING-TIP MOUNTED LIFTING SURFACES ON LOW-SPEED AIRPLANES Final Report
C. P. VANDAM Dec. 1982 174 p refs
(Contract NSG-1633)
(NASA-CR-169738; NAS 1.26:169738; KU-FRL-427-1) Avail: NTIS HC A08/MF A01 CSCL 01C

The effects of winglets on the lateral directional stability and control of low speed general aviation and agricultural airplanes are researched. Winglet aerodynamic loading is investigated. A lifting surface method is used to conduct a parametric study of the effects of various winglet parameters on lateral directional stability deviative of general aviation type wings. An in flight investigation of winglets mounted on an agricultural airplane was conducted. The consideration involved in the design of winglets for low speed general aviation airplanes are discussed. Author

N83-15283*# Connecticut Univ., Storrs.
IDENTIFICATION AND STOCHASTIC CONTROL OF HELICOPTER DYNAMIC MODES
J. A. MOLUSIS and Y. BAR-SHALOM Jan. 1983 73 p refs
(Contract NAG2-72)
(NASA-CR-166425; NAS 1.26:166425) Avail: NTIS HC A04/MF A01 CSCL 01C

A general treatment of parameter identification and stochastic control for use on helicopter dynamic systems is presented. Rotor dynamic models, including specific applications to rotor blade flapping and the helicopter ground resonance problem are emphasized. Dynamic systems which are governed by periodic coefficients as well as constant coefficient models are addressed. The dynamic systems are modeled by linear state variable equations which are used in the identification and stochastic control formulation. The pure identification problem as well as the stochastic control problem which includes combined identification and control for dynamic systems is addressed. The stochastic control problem includes the effect of parameter uncertainty on the solution and the concept of learning and how this is affected by the control's duel effect. The identification formulation requires algorithms suitable for on line use and thus recursive identification algorithms are considered. The applications presented use the recursive extended kalman filter for parameter identification which has excellent convergence for systems without process noise.
S.L.

N83-15284# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
AIRCRAFT DYNAMIC RESPONSE TO DAMAGED AND REPAIRED RUNWAYS
London Aug. 1982 224 p refs In ENGLISH and FRENCH Meeting held in Cesme, Turkey, 5-10 Apr. 1981 and in Brussels, 4-9 Apr. 1982
(AGARD-CP-326; ISBN-92-835-0316-2; AD-A122061) Avail: NTIS HC A10/MF A01

The two purposes of the AGARD conference on aircraft dynamic response to damaged and repaired runways were to review the programs and methods for dynamic analysis and testing of taxiing aircrafts, and to encourage exchange of information on aircraft dynamic response to improve the interoperability of NATO military aircraft. Topics discussed are: (1) advanced rapid runway repair, application of semigrid pavements in rapid runway repair, repaired runway clearance environment, the have bounce program; (2) mathematical modelling of aircraft dynamic response; (3) test methods and correlation with analyses; and (4) designs and clearance.

N83-15291# Aeronautical Systems Div., Wright-Patterson AFB, Ohio.
THE HAVE BOUNCE PROGRAM
J. E. HOLPP *In* AGARD Aircraft Dyn. Response to Damaged and Repaired Runways 7 p Aug. 1982
Avail: NTIS HC A10/MF A01

The purpose of the HAVE BOUNCE program which is to define aircraft response to runway repair in a military conflict environment is discussed. Computer programs that model the dynamic and structural response of aircraft are developed and aircraft are tested over simulated repaired runways to gather data for use in validating these computer programs. The HAVE BOUNCE has two objectives: (1) a computer program which models the dynamic response of an aircraft operating over repaired bomb damaged runways; and (2) aircraft operating limitations and guidelines for operation over these repair surfaces. E.A.K.

N83-15292# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).
INFLUENCE OF MATHEMATIC MODELLING OF UNDERCARRIAGES ON THE PREDICTION OF AIRCRAFT LOADS DUE TO DAMAGED AND REPAIRED RUNWAYS
A. KRAUSS, O. BARTSCH, and G. KEMPF *In* AGARD Aircraft Dyn. Response to Damaged and Repaired Runways 20 p Aug. 1982 refs
Avail: NTIS HC A10/MF A01

The peculiarities of the response on damaged runway simulation are described and their influence on the loads assessed. The requirements of digital simulation are referred to. It is shown that simulating an oleopneumatic shock strut as a parallel combination of gas spring and hydraulic damper by far overestimates undercarriage load and hence structural response on shortwave obstacles. It is found that physically existing additional flexibility of the undercarriage in series to the oleo strut must be included in the model. E.A.K.

N83-15293# British Aerospace Aircraft Group, Weybridge (England).
DEVELOPMENT OF A COST EFFECTIVE APPROACH TO MODELLING AIRCRAFT RESPONSE TO REPAIRED RUNWAYS
B. W. PAYNE, A. E. DUDMAN, B. R. MORRIS, and M. HOCKENHULL *In* AGARD Aircraft Dyn. Response to Damaged and Repaired Runways 12 p Aug. 1982
Avail: NTIS HC A10/MF A01

The capability of an aircraft to operate from repaired runways which concerns aircraft dynamic response, which causes critical conditions involving aircraft loads and aircraft control is examined. Procedures involve mathematically modelling of the aircraft, which predict response and validate the theory with the test results. A cost effective approach to this problem, which gives results to the fully validated model for the important set of critical loads or accelerations is described. The simplified model may be used to carry out the operational analyses with the full matrix of variables at minimum cost and time, and use of the more accurate model restricted to the minimum necessary to confirm results. E.A.K.

N83-15296# National Aerospace Lab., Amsterdam (Netherlands).
PREDICTED AND MEASURED LANDING GEAR LOADS FOR THE NF-5 AIRCRAFT TAXIING OVER A BUMPY RUNWAY
H. H. OTTENS *In* AGARD Aircraft Dyn. Response to Damaged and Repaired Runways 14 p Aug. 1982 refs
Avail: NTIS HC A10/MF A01

A mathematical model of the NF-5A aircraft was developed. The model is validated using measured results. Landing gear loads are calculated for the aircraft taxiing across a repaired runway using an AM-2 mat. The results depend strongly on the heaving and pitching motion of the aircraft when it meets the repair.
E.A.K.

N83-15298# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
THE PROBLEM OF DESIGN CRITERIA FOR AIRCRAFT LOADS DUE TO ROUGH RUNWAY OPERATION
M. HACKLINGER (BWB-ML, Munich) *In its* Aircraft Dyn. Response to Damaged and Repaired Runways 13 p Aug. 1982 refs
Avail: NTIS HC A10/MF A01

Aircraft design criteria for the rough runway case with emphasis on the initial design were reviewed. The criteria are so divergent in the NATO countries that further design guidance is required to avoid excessively heavy undercarriages of new aircraft projects or shortfalls in interoperability. Nonlinearity and dynamic load cases from multiple obstacle encounter with sometimes adverse operational procedures are the two main problem areas. Groundworthiness criteria for the repaired runway which can provide a reasonable balance of normal operating and rough runway capability are proposed. E.A.K.

N83-15299# Dowty Rotol Ltd., Gloucester (England).
LANDING GEAR SHOCK ABSORBER DEVELOPMENT TO IMPROVE AIRCRAFT OPERATING PERFORMANCE ON ROUGH AND DAMAGED RUNWAYS
G. H. HAINES *In* AGARD Aircraft Dyn. Response to Damaged and Repaired Runways 19 p Aug. 1982
Avail: NTIS HC A10/MF A01

Aircraft landing gear shock absorber characteristics are almost entirely dictated by landing impact energy absorption and suitability to support ground maneuvering loads. To improve the performance of such systems when taxiing on rough or damaged surfaces requires further optimization of the damping level and spring stiffness. Higher damping and softer spring rate than generally used reduces aircraft response when taxiing on typically rough ground. Shock absorber hardware which are developed provides characteristics so modified and tests on single landing gears demonstrate significant taxiing improvements without degrading the landing energy absorption capability. E.A.K.

N83-15300# Lockheed-Georgia Co., Marietta.
ROUGHNESS CONSIDERATIONS FOR TRANSPORT AIRCRAFT
B. M. CRENSHAW *In* AGARD Aircraft Dyn. Response to Damaged and Repaired Runways 9 p Aug. 1982 refs
Avail: NTIS HC A10/MF A01

The accurate calculations of landing gear and structural loads which could occur from taxi, takeoff, and landing on repaired bomb-damaged airfields are outlined. Collection of applicable test data was accomplished for two transport aircraft. Tests of the C-141B aircraft were conducted. To date, C-5A roughness testing consists of traversing (1-cosine) shaped bumps at low speeds. Additional C-5A testing is planned for 1982 to obtain structural response near landing and takeoff speeds. Results are used to validate computer simulation predictions of loads and to assist in the development of operating techniques. E.A.K.

N83-15301# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
A FIGHTER LANDING GEAR FOR THE 1980'S
R. F. BUTTLES and R. D. RENSHAW *In its* Aircraft Dyn. Response to Damaged and Repaired Runways 13 p Aug. 1982
Avail: NTIS HC A10/MF A01

Design considerations for a landing gear incorporating soft field, damage/repaired runway, and increased sink speed capabilities over that of current USAF design in a present day fighter/attack aircraft are discussed. The establishment of the design criteria and constraints are discussed, and the resulting configuration is defined as applied to the Northrop F/A-18L aircraft. Shock strut weight and stroke comparisons various fighter landing gears illustrate trends and philosophy differences between land based and carrier based aircraft. The effects of oil loads, air loads, and friction are discussed as design parameter considerations. Shock strut internal geometry philosophy is discussed.

06

AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

A83-16772*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FIBEROPTICS TECHNOLOGY AND ITS APPLICATION TO PROPULSION CONTROL SYSTEMS
R. J. BAUMBICK (NASA, Lewis Research Center, Cleveland, OH) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 7 p. refs
(AIAA PAPER 83-0534)

Current work on optical sensors and optically controlled actuators for use in air-breathing engine control systems is reviewed with particular reference to the design and operation of several new fiber-optic devices. These include a tachometer, a rotary position encoder, a Fabry-Perot interferometer and a rare-earth sensor for measuring engine gas temperatures, a high-temperature photoswitch designed for the range -55 to 260 C, and optical cables and connectors. The advantages of optics over conventional wire systems used for sensing and actuator control are briefly discussed. V.L.

A83-16797#
ON-BOARD INSTRUMENTATION FOR TEST VEHICLES WITH VARYING ROLL RATES
V. OSKAY, W. H. MERMAGEN (U.S. Army, Ballistics Research Laboratories, Aberdeen Proving Ground, MD), and C. W. DAHLKE (U.S. Army, Missile Command, Huntsville, AL) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 10 p. refs
(AIAA PAPER 83-0570)

Although the highly nonlinear roll moments of Wrap-Around Fins (WAFs) have in the past prevented their more extensive use in compact helicopter- and aircraft-launcher rocket systems, increasing understanding of WAF aerodynamics has made possible the design of missiles with specific roll histories. A multisensor yawsonde was designed and used during the testing of the WAF-employing MK 66 MOD 1 2.75-in. and Zuni 5-in. rockets, in the former case to determine the missile's roll history and in the latter to verify theoretical predictions for several alternative WAF designs. Attention is given to yawsonde design characteristics. O.C.

A83-16876
CONCERNING THE MEASUREMENT OF AIRCRAFT ACCELERATION [PRISPEVEK K PROBLEMATICE MERENI ZRYCHLENI LETADLA]
V. FRYNTA Zpravodaj VZLU, no. 2, 1982, p. 41-54. In Czech. refs

The measurement of aircraft acceleration components by an onboard instrument is discussed. Detailed consideration is given to a system of sensors that measures only the component in the direction of the motion of the sensor mass which reacts to the acceleration. An analysis of the motion of the reacting mass shows that the instrument actually measures only the aircraft load factors. Formulas are derived which make it possible to calibrate the instrument and to correct its readings for the dynamic characteristics. Particular attention is given to the determination of the instrument coordinate system and to the elimination of misalignment error. B.J.

A83-16880
AN INSTRUMENT FOR RECORDING THE EXCEEDING OF SPECIFIED LEVELS OF AN OPERATIONAL PARAMETER OF AN AIRCRAFT [HLADINOVY ZAPISOVAC PROVOZNICH PARAMETRU LETADEL]
J. BAR and V. KAHANEK Zpravodaj VZLU, no. 4, 1982, p. 121-126. In Czech.

The measurement of the analog record of the operational parameter of an aircraft is considered. A method is described for processing the cumulative rate of the exceeding of specified values of this parameter. For measuring stress in the control rod, an instrument was constructed that counts the number of times four levels of loading are exceeded. This instrument is described, and its possible application is discussed. B.J.

A83-17302#
MULTIFUNCTION DISPLAY SIMULATION FACILITY
T. G. SHARPE (Rockwell International Corp., Collins Avionics Flight Simulation Center, Schaumburg, IL) In: Radio Technical Commission for Aeronautics, Technical Symposium and Annual Assembly Meeting, Washington, DC, November 18-20, 1981, Proceedings. Washington, DC, Radio Technical Commission for Aeronautics, 1982, p. 19-27.

It is pointed out that electronic or CRT instruments are finding increasing use in new generation aircraft cockpits. In connection with the inherent flexibility of the CRT instruments, there exists the need for some form of assistance to the designer in evaluating and trading off various options. A flexible design tool is required. It should permit the easy generation and modification of candidate displays, the saving and recalling of promising results, and the dynamic evaluation of candidate displays. A description is provided of a facility which has been developed by a U.S. aerospace company to support the design and evaluation of multifunction displays. This facility provides the functions needed for the effective design of aircraft CRT displays. The required capability was developed around a commercially available interactive graphics system. The system provides a stroke written color graphics display with common user interaction devices. G.R.

A83-19177
OPTIMAL PROCESSING OF THE CORRECTION DATA OF AN AIRCRAFT FUEL-MEASUREMENT SYSTEM [OPTIMAL'NAIA OBRABOTKA DANNYKH KORREKTSII AVIATSIONNOI TOPLIVOIZMERITEL'NOI SISTEMY]
A. L. ALIMOV and A. E. SHCHADILOV (Leningradskii Institut Aviatsionnogo Priborostroeniia, Leningrad, USSR) Priborostroenie, vol. 25, Dec. 1982, p. 6-10. In Russian.

The paper proposes an algorithm for the piecewise-linear approximation of the correction curves of an aircraft fuel-measurement system employing level sensors. The algorithm makes it possible to achieve a maximum compression of the correction data. It is shown that, depending on the size of the fuel tank and the complexity of its configuration, it is possible to achieve a 5-to-12-fold reduction in the correction data. This should make it possible to utilize a onboard digital computer for the correction of the fuel-measurement system. B.J.

N83-14123*# Ideal Research, Inc., Rockville, Md.
DEVELOPMENT AND TEST OF A MICROWAVE ICE ACCRETION MEASUREMENT INSTRUMENT (MIAMI) Final Report
B. MAGENHEIM and J. K. ROCKS Washington NASA Nov. 1982 85 p refs
(Contract NAS3-22765)
(NASA-CR-3598; NAS 1.26:3598; BATT-92880) Avail: NTIS HC A05/MF A01 CSCL 01D

The development of an ice accretion measurement instrument that is a highly sensitive, accurate, rugged and reliable microprocessor controlled device using low level microwave energy for non-instrusive real time measurement and recording of ice growth history, including ice thickness and accretion rate is discussed. Data is displayed and recorded digitally. New experimental data is presented, obtained with the instrument, which demonstrates its ability to measure ice growth on a two-dimensional airfoil. The device is suitable for aircraft icing protection. It may be mounted flush, non-intrusively, on any part of an aircraft skin including rotor blades and engine inlets. R.J.F.

N83-14124# Naval Training Equipment Center, Orlando, Fla. Advanced Simulation Concepts Lab.
HELMET MOUNTED DISPLAY FEASIBILITY MODEL: OPTICAL DESIGN Final Report, Aug. 1979 - May 1982
E. D. MALDONATO Jul. 1982 26 p refs
(AD-A119191; NAVTRAEQUIPC-IH-340) Avail: NTIS HC A03/MF A01 CSCL 14B

This report describes the optical design of a Feasibility Model Laser Projector Helmet Mounted Display for visual simulation in flight training. The feasibility model was designed to evaluate the Laser Projection Concept and serve as a test bed to determine required performance parameters for an advanced system. Author (GRA)

N83-14125# National Aerospace Lab., Amsterdam (Netherlands). Flight Div.
CALIBRATION FACILITIES FOR FLIGHT TEST EQUIPMENT
A. W. B. KALSHOVEN May 1981 28 p refs Presented at 4th AGARD Special Course on Flight Test Instrumentation, Delft, May 1981
(NLR-MP-81029-U) Avail: NTIS HC A03/MF A01

The basic considerations which should be followed in the design of a calibration system are given. The treatment and propagation of measurement errors are considered. A case study of an automatic pressure calibration system is given. Author (ESA)

N83-15302*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FIBEROPTICS TECHNOLOGY AND ITS APPLICATION TO PROPULSION CONTROL SYSTEMS
R. J. BAUMBICK 1983 12 p refs Presented at the 21st Aerospace Sci. Conf., Reno, Nevada, 10-13 Jan. 1983; sponsored by the American Inst. of Aeronautics and Astronautics
(NASA-TM-83009; E-1444; NAS 1.15:83009) Avail: NTIS HC A02/MF A01 CSCL 01D

Electro-optical systems have many advantages over conventional electrical systems. Among these are optics' insensitivity to electro-magnetic interference, good electrical isolation and the ability to make measurements in highly explosive areas without risk. These advantages promise to help improve the reliability of future aircraft engine control systems which will be entirely electronic digital. To improve the reliability of these systems, especially against lightning strikes, passive, optical, sensors and fiberoptic transmission lines are being considered for use in future engine systems. Also under consideration are actuators which receive their command signals over fiber optic cables. This paper reviews concepts used for optical instrumentation and actuation systems and discusses work being done by NASA Lewis Research Center in this area. Author

N83-15303# RAND Corp., Santa Monica, Calif.
AVIONICS SOFTWARE: WHERE ARE WE?
W. H. WARE Sep. 1982 17 p Presented at the AGARD AVP Symp. Software for Avionics, The Hague, 6-10 Sep. 1982
(RAND/P-6786) Avail: NTIS HC A02/MF A01

The issues of surrounding the implementation and management of avionics software resources are discussed. Many positive actions under way are discussed. A direction in which the future may well move is proposed. It is concluded that software will continue to be troublesome; progress will come slowly. R.J.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.

A83-16456*# Purdue Univ., Lafayette, Ind.
AXIAL-COMPRESSOR FLOW DISTORTION WITH WATER INGESTION
T. TSUCHIYA and S. N. B. MURTHY (Purdue University, West Lafayette, IN) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 9 p. refs
(Contract F33615-78-C-2401; NAG3-63; NAG3-204)
(AIAA PAPER 83-0004)

The objective of the investigation is as follows: to establish relations between the steady state mean flow distortion generated during water ingestion into an axial-flow compressor and (a) characteristic length and time scales pertaining to (1) the centrifugal action and (2) the heat and mass transfer processes and (b) aerodynamic parameters based on blade geometry, aspect ratio and blade loading. Analytical and experimental results are presented for a small compressor to illustrate the extent of the distortion introduced as a function of (1) the operating speed and (2) the mass-based water content in the ingested mixture. Methods of scaling the effects in compressors of different sizes are discussed. (Author)

A83-16458#
NUMERICAL PREDICTION OF CHOKING FLUTTER OF AXIAL COMPRESSOR BLADES
Z. M. TANG and S. ZHOU (Beijing Institute of Aeronautics and Astronautics, Beijing, People's Republic of China) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 11 p. refs
(AIAA PAPER 83-0006)

It has been found that the most dangerous type of choking flutters in some practical operations of the middle and rear stages of multistage axial compressor is the bending mode, not the torsional mode. By using a finite-difference method developed recently, the onset of the choking flutter with the bending mode at subsonic inlet Mach numbers and low negative incidence has been predicted. The effects of some geometric and aerodynamic parameters on the aeroelastic stability of the bending oscillation of a cascade were investigated. The preliminary numerical results show that the existence of shock waves has a significant effect on the stability of the choking flutter, and that might be considered as the main cause of the onset of choking flutter with the bending mode. (Author)

A83-16491#
EFFICIENCY IMPROVED TURBOPROP
W. S. GEARHART (Pennsylvania State University, State College, PA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 7 p. Navy-supported research. refs
(AIAA PAPER 83-0059)

Among the NASA studies conducted in pursuit of more fuel-efficient aircraft designs have been tests on turboprop rotor systems whose disk loadings are as much as four times greater than those of current turboprop aircraft. The high disk loadings result in greater slipstream swirl and higher energy losses, where the radial distribution of energy losses across the slipstream, due to tangential and axial velocities, is of primary importance. An analysis is presented which defines tangential and axial kinetic energy losses, as well as losses from pressure drag due to swirl, and a propeller configuration incorporating short span, swirl-counteracting stator vanes is proposed to recuperate slipstream swirl energy and reduce noise. O.C.

A83-16559#
PREDICTION OF LIQUID FUEL SPRAY CAPTURE BY V-GUTTER DOWNSTREAM OF PLAIN ORIFICE INJECTOR UNDER UNIFORM CROSS AIR-FLOW
J.-S. CHIN and M.-H. CAO (Beijing Institute of Aeronautics and Astronautics, Beijing, People's Republic of China) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 10 p. refs
(AIAA PAPER 83-0153)

Chin et al. (1981) and Cao et al. (1982) have proposed a 'flat fan spray' model for the prediction of liquid fuel distribution downstream of a plain orifice injector under uniform cross air flow. Attention is given to details regarding the 'flat-fan spray' model, vertical injection into cross flow, the initial droplet velocity, a liquid fuel stray capture model, a calculation method concerning liquid fuel spray capture, and the results obtained in a calculation regarding the liquid fuel spray capture by the v-gutter. It is found that the liquid fuel spray capture analysis provides a simple approach for analyzing the effects of a number of parameters on the fuel spray capture by the v-gutter downstream of a plain orifice injector under uniform cross air flow conditions. G.R.

A83-16572*# Cincinnati Univ., Ohio.
A METHOD OF PREDICTING THE PERFORMANCE DETERIORATION OF A COMPRESSOR CASCADE DUE TO SAND EROSION
C. BALAN and W. TABAKOFF (Cincinnati, University, Cincinnati, OH) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 13 p. refs
(Contract DAAG29-82-K-0029; NSG-3218)
(AIAA PAPER 83-0178)

Performance deterioration due to sand erosion is a well known phenomena for aircraft engines operating in particulate flow environments. A method for predicting this performance deterioration is developed and applied to a two dimensional compressor cascade. The locations of the particles impacts are computed by analyzing the trajectories of the individual particles. From this analysis, the material removed, the changes in the airfoil shape, and the roughness development over the surface are estimated as a function of time. The resulting airfoil profiles are analyzed for predicting performance by using an inviscid-viscous interaction technique. The analytical solution is compared with experimental results. (Author)

A83-16608#
GASEOUS EMISSIONS OF GAS TURBINE COMBUSTORS
N. G. RUGGIERI (Northern Research and Engineering Corp., Woburn, MA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 7 p.
(AIAA PAPER 83-0242)

This paper describes a general and efficient calculation procedure which uses well known mathematical models to detail the turbulent, chemically reacting flows which are an integral part of gas turbine combustors. The number of empirical correlations used has been kept to a minimum. In this way, it may be used to model a large number of combustor configurations free from the rigid constraints imposed by heavily empirical models. The predictions are of exhaust plane chemical species and temperature profiles. It is believed that the combination of all of these process models into a single numerical algorithm will be a definite aid to the designer. (Author)

A83-16662#
TRAJECTORY WITH DIFFUSION METHOD FOR PREDICTING THE FUEL DISTRIBUTION IN A TRANSVERSE STREAM
M. L. YANG, S. J. GU, G. E. LIU, and X. Y. LI (Beijing Institute of Aeronautics and Astronautics, Beijing, People's Republic of China) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 9 p. refs
(AIAA PAPER 83-0336)

A semiempirical method is described for predicting the liquid-fuel distribution in a target plane downstream of a plain orifice injector in a transverse flow. A normalized version of the drop-size distribution function and a modified drag coefficient for the fuel droplets are used to calculate the normal trajectory of each group of drops in the spray. An equivalent diffusion coefficient selected on the basis of the standard deviation of the Gaussian fuel-concentration distribution curve is employed to determine the diffusion from an imaginary equivalent point source. The calculated fuel-concentration profile is shown to be in good agreement with experimental results. F.G.M.

A83-16663*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SMALL GAS TURBINE COMBUSTOR STUDY - COMBUSTOR LINER EVALUATION
C. T. NORGREN and S. M. RIDDLEBAUGH (NASA, Lewis Research Center, Cleveland, OH) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 12 p. refs
(AIAA PAPER 83-0337)

A reverse flow combustor liner constructed of Lamilloy (a multilaminate transpiration type material) is compared both analytically and experimentally with a conventional splash film-cooled design with the same combustor configuration. Comparison of selected critical combustor panels indicated that it was possible to maintain the liner temperature similar between the two configurations using 50 percent less coolant for the Lamilloy as compared with the reference film-cooled combustor. Additional benefits indicated improvement in outlet temperature distribution and NOx emission level. (Author)

A83-16702#
TRANSVERSE JET BREAK-UP AND ATOMIZATION WITH RAPID VAPORIZATION ALONG THE TRAJECTORY
P. W. HEWITT and J. A. SCHETZ (Virginia Polytechnic Institute and State University, Blacksburg, VA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 11 p. USAF-supported research. refs
(AIAA PAPER 83-0419)

A simulation approach is developed to study hot flow subsonic cross-stream fuel injection problems, where ambient temperature fuel is injected into a heated airstream. A typical ramjet combustion chamber fuel injection problem is outlined, and the effects of evaporation and heating of the injectant (kerosene) along the plume by the airflow, as well as the effect on droplet sizes, penetration, and jet structure, are investigated. Experiments for the simulated case were conducted using chilled Freon-12 injected into a 23 x 23 cm blow-down wind tunnel at a freestream Mach number of 0.44. The visualization of the resulting spray plume showed a clear picture of the mechanisms of jet decomposition in the presence of rapid vaporization. It was found that immediately after injection a vapor cloud was formed in the jet plume, which dissipated downstream leaving droplets on the order of 8-10 microns in diameter for the conditions examined. It is concluded that the introduction of evaporation and heating considerations over a baseline case of water injection can result in a decrease in average droplet size by over 70%, while keeping the basic jet structure and break-up mechanisms the same. N.B.

A83-16705*# Massachusetts Inst. of Tech., Cambridge.
A ONE-DIMENSIONAL UNSTEADY MODEL OF DUAL MODE SCRAMJET OPERATION
T. R. A. BUSSING and E. M. MURMAN (MIT, Cambridge, MA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 12 p. refs (Contract NAG1-229)
(AIAA PAPER 83-0422)

A one-dimensional unsteady model and code have been developed which can handle internal flows involving area change, heat release, transients and coupled inviscid core-boundary layer flows. The model has been shown to work well in diverging channels with a supersonic entrance Mach number and unseparated boundary layers. Transient flows have also been studied. The model needs no prior knowledge of shock (or shocks) location and can be extended to two or three dimensions. The results show that the one-dimensional unsteady model developed here can be used for analysis of internal flows as occur in scramjet combustors. (Author)

A83-16773#
EFFECTIVENESS OF TURBINE ENGINE DIAGNOSTIC SYSTEMS
C. E. CHAMBLEE and A. E. BURWELL (Arnold Engineering Development Center, Arnold Air Force Station, TN) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 12 p. refs
(AIAA PAPER 83-0535)

The variation in the high-pressure compressor inlet temperature during the ingestion of gun gas is measured with four high-response thermocouples approximately 90 deg apart at the high-pressure compressor inlet. An analysis of the data from the flight tests suggest that the high-pressure compressor was subjected to average temperature ramps between 400 and 9000 deg per sec during gun firings. It is also found that a radial temperature exists, ranging from 10 to 30%, with the hottest gas in the hub area. Using a three-dimensional time-dependent mathematical model of the compressor, the effects of pressure distortion, temperature distortion, and rapid inlet temperature ramps on the operation of the compressor are investigated. C.R.

A83-16776*# General Electric Co., Cincinnati, Ohio.
SCALE MODEL PERFORMANCE TEST INVESTIGATION OF MIXED FLOW EXHAUST SYSTEMS FOR AN ENERGY EFFICIENT ENGINE /E3/ PROPULSION SYSTEM
A. P. KUCHAR (General Electric Co., Cincinnati, OH) and R. CHAMBERLIN (NASA, Lewis Research Center, Cleveland, OH) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 13 p.
(AIAA PAPER 83-0541)

As part of the NASA Energy Efficient Engine program, scale-model performance tests of a mixed flow exhaust system were conducted. The tests were used to evaluate the performance of exhaust system mixers for high-bypass, mixed-flow turbofan engines. The tests indicated that: (1) mixer penetration has the most significant affect on both mixing effectiveness and mixer pressure loss; (2) mixing/tailpipe length improves mixing effectiveness; (3) gap reduction between the mixer and centerbody increases high mixing effectiveness; (4) mixer cross-sectional shape influences mixing effectiveness; (5) lobe number affects mixing degree; and (6) mixer aerodynamic pressure losses are a function of secondary flows inherent to the lobed mixer concept. S.C.S.

A83-16878
THE MODULE CONCEPT IN A MATHEMATICAL MODEL OF A TURBOPROP ENGINE [MODULOVA KONCEPCE MATEMATICKEHO MODELU TURBOVRTULOVEHO POHONU]
B. RIHA Zpravodaj VZLU, no. 3, 1982, p. 81-95. In Czech. refs

The formulation and characteristics of a mathematical model of a turboprop engine for passenger aircraft that is based on the module concept are discussed. Constructed from unified subgroups, the model can be used in solving problems of automatic take-off

and landing. Emphasis is given to problems bearing directly on practical applications of the model. Numerical data from a unit comprising the M 601 engine and the B 508 propeller are presented. C.R.

A83-16953
THE ENTROPY EFFICIENCY OF BLADE MACHINES [ENTROPIINYI KPD LOPATOCHNYKH MASHIN]
V. I. BABARIN and V. M. MIKIRTICHAN (Tsentral'nyi Nauchno-Issledovatel'skii Institut Aviatsionnogo Motorostroeniia, Moscow, USSR) Promyshlennaia Teplotekhnika, vol. 4, Nov.-Dec. 1982, p. 76-84. In Russian.

A new efficiency characteristic for compressors and turbines is derived from a combined law of thermodynamics. The new characteristic, entropy efficiency, is determined by the useful and the total (available) increments of the specific isobaric entropy. The principal properties of the new kind of efficiency are identified. A procedure for determining the entropy efficiency of a compressor is illustrated by examples. V.L.

A83-17125
AIRCRAFT ELECTRICAL EQUIPMENT [ELEKTROOBORUDOVANIE LETATEL'NYKH APPARATOV]
G. N. KLEIMENOV, I. S. KURBATOV, and N. V. MAKSIMOV Moscow, Izdatel'stvo Transport, 1982. 280 p. In Russian. refs

The book is divided into three parts: the theory underlying electric drive in aircraft, electrical control systems in aircraft, and electric lights for illumination and signaling. In discussing theory, attention is given to the mechanical characteristics and operating cycles of dc electric motors and to the characteristics of ac electric motors and electromagnets. The parametric regulation of the angular velocity of electric drives is discussed, along with the generator regulation of the angular velocity of dc electric motors. C.R.

A83-17236
NEW THRUSTS IN ENGINE DESIGN
J. NELSON (USAF, Aeronautical Systems Div., Wright-Patterson AFB, OH) Air Force Magazine, vol. 66, Jan. 1983, p. 54-57.

The history of aircraft engine development is considered, taking into account the twelve-horsepower engine of the Wright brothers in 1903, advantages of improved thermodynamic efficiencies in connection with higher operating temperatures, and fuel efficiency. The significant engine improvements and applications of the 1970s are examined, giving attention to the application of high bypass turbofans to transports, and substantial increases in turbine rotor inlet temperatures. Improvements of modern turbofan technology in connection with the Energy Efficient Engine program are considered along with the potential of the propfan, the Air Force Advanced Turbine Engine Gas Generator, the application to fighter and bomber designs of augmented turbofans with high thrust-to-weight and low bypass ratios. Attention is given to the Advanced Tactical Fighter for the 1990s, the Advanced Turbine Engine Studies, STOL and Supercruise designs, and the Engine Structural Integrity Program. G.R.

A83-18147
POWERPLANTS. II
T. FORD Aircraft Engineering, vol. 54, Dec. 1982, p. 2-5.

A comparative discussion is presented concerning civilian and military turbofan engines currently under development in Britain, France, the U.S. and Canada. The largest of the civilian engines is the 56,000-62,000 lb thrust CF6-80C, which is scheduled for certification by June, 1985. This powerplant is being proposed for the A300-600, 747-300, DC 10-30 and 767 airliners. Another engine under consideration for aircraft of this class is the JT9D-7R4, which has already received certification and is rated at 50,000-56,000 lb thrust. The military turbofans considered include the PW 1130 augmented turbofan, of 24,000-30,000 lb thrust rating, which has been designed in light of requirements for advanced versions of the F-14, F-15 and F-16 aircraft, and the M 53-5, which is to be fitted to both the Mirage 2000 and Super Mirage 4000 fighter aircraft. O.C.

A83-18213#
APPLICATION OF OPTIMIZATION TO AIRCRAFT ENGINE DISK SYNTHESIS
J. O. SONG and R. E. LEE (United Technologies Corp., Pratt and Whitney Aircraft Group, West Palm Beach, FL) In: International Symposium on Optimum Structural Design and ONR Naval Structural Mechanics Symposium, 11th, Tucson, AZ, October 19-22, 1981. Tucson, AZ, University of Arizona, 1982, p. 5-15 to 5-22. refs

An automated optimum disk synthesis technique for aircraft gas turbine engines is developed using a mathematical programming method. The optimum synthesis program constructs a minimum-weight disk while meeting burst speed, stress and geometric constraints. A general purpose optimization program is used in synthesizing piece-wise hyperbolically shaped disks in which thermal gradient effects in the radial direction are taken into account. For conceptual design purposes, the disk analysis is simplified based on elastic plane stress assumption. The feasibility of this approach is demonstrated through example problems of a typical disk from the preliminary design phase. (Author)

A83-18406*# United Technologies Corp., West Palm Beach, Fla.
DIGITAL ELECTRONIC ENGINE CONTROL SYSTEM - F-15 FLIGHT TEST
W. J. BARRETT, J. P. REMBOLD (United Technologies Corp., Pratt and Whitney Aircraft Group, West Palm Beach, FL), F. W. BURCHAM, JR., and L. P. MYERS (NASA, Flight Research Center, Edwards, CA) Journal of Aircraft, vol. 20, Feb. 1983, p. 134-141.

(Previously cited in issue 19, p. 3268, Accession no. A81-40912)

A83-18821#
THE PRATT & WHITNEY PW100 - EVOLUTION OF THE DESIGN CONCEPT
R. E. MORRIS (Pratt and Whitney Aircraft of Canada, Ltd., Longueil, Quebec, Canada) Canadian Aeronautics and Space Journal, vol. 28, Sept. 1982, p. 211-221.

The design criteria and applications constraints for the PW100 turboprop/turboshaft aircraft engine are discussed. A commuter and executive market was defined to exist as a consequence of rising fuel costs and airline deregulation, which led to major airlines leaving the short route service. The PW100 features 2000 shp, and is intended for use with larger commuter aircraft operating over 2000 hr/yr. Fuel consumption was identified as the most significant factor, with other considerations being high reliability and low maintenance costs. The cruise pressure ratio is set for 15:1 at a temperature of 2000 F. An optimal altitude of 25,000 ft at a cruise speed of 350 mph was set as a design goal. The engine has a two-spool, two-stage centrifugal compressor, a reverse flow combustor, cooling on the first stage blades only, and a separate, offset gearbox. Certification of the engine is expected in 1983. D.H.K.

A83-18948
MILITARY PROPULSION TECHNOLOGY. I - FIGHTER POWER - THE NEED FOR TOMORROW
J. MOXON and G. WARWICK Flight International, vol. 123, Jan. 15, 1983, p. 141, 142.

The development of fighter-aircraft engines for the 1990s is discussed in terms of efficiency, reliability, and performance. High 'g' flight at Mach numbers up to 1.6, low by-pass ratios of engines, supersonic long-range flights are the objectives to be attained. Therefore engines with fewer components, a by-pass ratio of 0.1-0.25:1, and an overall pressure ratio of 22 have to be designed. The 2D nozzle, which is capable of reducing the heat signature and increasing the runway performance of aircraft, is discussed. In this category is the F404, which has half the weight of the J99 and one-third fewer parts. Finally, the possible contribution of full-authority digital engine-control relative to reliability, reduced weight and cost efficiency are discussed. The RB.199 Mk103 is

equipped with this system, and a similarly equipped F-15 is being tested. M.I.I.

A83-18949
MILITARY PROPULSION TECHNOLOGY. II - SUPERSONIC V/STOL TECHNOLOGY SHAPES UP
,Flight International, vol. 123, Jan. 15, 1983, p. 143-145.

The development of supersonic V/STOL fighter/attack aircraft is discussed, with emphasis on ejector development. Ram drag and duct stowage are examined along with the tandem fan concept. Remote augmented lift systems which have the capability of improving supersonic acceleration and specific excess power are also discussed. M.I.I.

A83-19025
A COMPARISON BETWEEN THE CRAIG-COX AND THE KACKER-OKAPUU METHODS OF TURBINE PERFORMANCE PREDICTION
G. LOZZA (Milano, Politecnico, Milan, Italy) Meccanica, vol. 17, Dec. 1982, p. 211-221. refs

Two complete comprehensive loss correlations for estimating the efficiency of axial flow turbines are considered, namely the Craig-Cox (1971) method and the Ainley-Mathieson (1951) method as developed by Kacker and Okapuu (1981). A comparison is made by evaluating the losses in a number of representative cascades having various solidities, aspect ratios, and Reynolds and Mach numbers. It is shown that whereas the two methods are in good agreement for subsonic cascades having high flow coefficients, significant differences are found in high deflection blades, especially for the secondary losses. Attention is then given to the way in which the choice of correlation affects the design of a turbine. A design procedure carried out automatically by a computer program is applied to a number of cases. The differences between the two solutions to the same design problem obtained using the two correlations are discussed. C.R.

A83-19385
DESIGN OF ERROR-ACTUATED CONTROLLERS FOR MULTIVARIABLE PLANTS WITH UNKNOWN DYNAMICS AND UNMEASURABLE OUTPUTS
B. PORTER and A. BRADSHAW (Salford, University, Salford, Lancs., England) International Journal of Control, vol. 37, Jan. 1983, p. 1-16. refs
(Contract F49620-81-C-0026)

It is shown that, for a large class of multivariable plants, the design of error-actuated controllers which ensure that excellent set-point tracking occurs simultaneously with disturbance rejection can be readily effected even though the detailed dynamical properties of the processes involved are unknown and the controlled outputs are unmeasurable. The theory is illustrated by the design of analogue and digital controllers for a modern gas-turbine engine. (Author)

A83-19593*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
FLIGHT EVALUATION OF MODIFICATIONS TO A DIGITAL ELECTRONIC ENGINE CONTROL SYSTEM IN AN F-15 AIRPLANE
F. W. BURCHAM, JR., L. P. MYERS (NASA, Flight Research Center, Edwards, CA), and J. R. ZELLER (NASA, Lewis Research Center, Cleveland, OH) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 10 p.
(AIAA PAPER 83-0537)

The third phase of a flight evaluation of a digital electronic engine control system in an F-15 has recently been completed. It was found that digital electronic engine control software logic changes and augmentor hardware improvements resulted in significant improvements in engine operation. For intermediate to maximum power throttle transients, an increase in altitude capability of up to 8000 ft was found, and for idle to maximum transients, an increase of up to 4000 ft was found. A nozzle instability noted in earlier flight testing was investigated on a test engine at NASA Lewis Research Center, a digital electronic engine control software logic change was developed and evaluated, and no instability occurred in the Phase 3 flight evaluation. The backup control airstart modification was evaluated, and gave an improvement of airstart capability by reducing the minimum airspeed for successful airstarts by 50 to 75 knots. (Author)

A83-19595*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A REMOTE AUGMENTOR LIFT SYSTEM WITH A TURBINE BYPASS ENGINE
L. H. FISHBACH and L. C. FRANCISCUS (NASA, Lewis Research Center, Cleveland, OH) International Council of Aeronautical Sciences, Congress, 13th, and American Institute of Aeronautics and Astronautics Aircraft Systems and Technology Meeting, Seattle, WA, Aug. 22-27, 1982, Paper. 10 p. refs
(Previously announced in STAR as N83-12087)

N83-14126*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
UNIFORM ENGINE TESTING PROGRAM. PHASE 1: NASA LEWIS RESEARCH CENTER PARTICIPATION
T. BLESIADNY, L. BURKARDT, and W. BRAITHWAITE Oct. 1982 63 p refs
(NASA-TM-82978; E-1407; NAS 1.15:82978) Avail: NTIS HC A04/MF A01 CSCL 21E

Two jet engines were tested under identical conditions in a variety of altitude and ground level facilities as a means to correlating these facilities. Two J57-19W turbojet engines were tested in an altitude test facility. The test results are summarized. S.L.

N83-14127*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ANALYTICAL CALCULATION OF A SINGLE JET IN CROSSFLOW AND COMPARISON WWITH EXPERIMENT
R. W. CLAUSS 1982 15 p refs Proposed for presentation at the 21th Aerospace Sci. Conf., Reno, Nev., 10-13 1983; sponsored by AIAA
(NASA-TM-83027; E-1462; NAS 1.15:83027) Avail: NTIS HC A02/MF A02 CSCL 21E

A series of calculations of a jet in crossflow using a three-dimensional finite difference model of the Navier-Stokes equations were made on a series of progressively finer grids. With a reasonable number of grid point (40x30x20), calculated jet penetration and mixing characteristics were found to compare favorably with the experimental measurements of Crabb, Durao and Whitelaw. The calculated results were grid dependent (i.e., numerical or false diffusion was present in the result). A finer grid calculation indicated that turbulence model deficiencies may become more noticeable in the calculated results as the magnitude of numerical diffusion is reduced. Author

N83-14128*# United Technologies Corp., East Hartford, Conn. Commercial Products Div.
ROTOR REDESIGN FOR A HIGHLY LOADED 1800 FT/SEC TIP SPEED FAN. 3: LASER DOPPLER VELOCIMETER REPORT Final Report
W. B. HARVEY, D. E. HOBBS, D. LEE, M. C. WILLIAMS, and K. F. WILLIAMS Apr. 1982 258 p refs
(Contract NAS3-20591)
(NASA-CR-167954; NAS 1.26:167954; PWA-5523-122) Avail: NTIS HC A12/MF A01 CSCL 21E

Laser Doppler velocimeter (LDV) techniques were employed for testing a highly loaded, 550 m/sec (1800 ft/sec) tip speed, test fan stage, the objective to provide detailed mapping of the upstream, intrablade, and downstream flowfields of the rotor. Intrablade LDV measurements of velocity and flow angle were obtained along four streamlines passing through the leading edge at 45%, 69%, 85%, and 95% span measured from hub to tip, at 100% of design speed, peak efficiency; 100% speed, near surge; and 95% speed, peak efficiency. At the design point, most passages appeared to have a strong leading edge shock, which

moved forward with increasing strength near surge and at part speeds. The flow behind the shock was of a complex mixed subsonic and supersonic form. The intrablade flowfields were found to be significantly nonperiodic at 100% design speed, peak efficiency. Author

N83-14129*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TIP CAP FOR A ROTOR BLADE Patent Application
W. K. KOFFEL (GE, Cincinnati, Ohio), E. N. TULEY (GE, Cincinnati, Ohio), C. H. GAY, JR. (GE, Cincinnati, Ohio), R. E. TROEGER (GE, Cincinnati, Ohio), and A. P. STERMAN, inventors (to NASA) (GE, Cincinnati, Ohio) 20 Mar. 1981 19 p Sponsored by NASA
(NASA-CASE-LEW-13654-1; US-PATENT-APPL-SN-245571)
Avail: NTIS HC A02/MF A01 CSCL 21E

A replaceable tip cap for a rotor blade is disclosed. The tip cap is comprised of a plurality of walls for defining a compartment. The tip cap is attachable to the radially outer end of the rotor blade and may be divided into a plurality of subcompartments. A flow of cooling fluid is introduced through inlet holes in the radially inner wall of the tip cap. The fluid exists through outlet holes in a sidewall. The tip cap design provides for reduced overheating and increased tip cap life as well as increased wear resistance to reduce the rate of engine efficiency loss. NASA

N83-14130*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
APPARATUS AND METHOD FOR IMPROVING THE FUEL EFFICIENCY OF A GAS TURBINE ENGINE Patent Application
G. A. COFFINBERRY, inventor (to NASA) (General Electric Co., Cincinnati, Ohio) 20 Mar. 1980 15 p Sponsored by NASA
(NASA-CASE-LEW-13142-1; US-PATENT-APPL-SN-132364)
Avail: NTIS HC A02/MF A01 CSCL 21E

An energy recovery system is provided for an aircraft gas turbine engine of the type in which some of the pneumatic energy developed by the engine is made available to support systems such as an environmental control system. In one such energy recovery system, some of the pneumatic energy made available to but not utilized by the support system is utilized to heat the engine fuel immediately prior to the consumption of the fuel by the engine. Some of the recovered energy may also be utilized to heat the fuel in the fuel tanks. Provision is made for multiengine applications wherein energy recovered from one engine may be utilized by another one of the engines or systems associated therewith. NASA

N83-14131# Minnesota Univ., Minneapolis. Dept. of Mechanical Engineering.
CURVATURE EFFECTS ON THE HEAT TRANSFER PERFORMANCE OF THREE-DIMENSIONAL FILM COOLING OF GAS TURBINE BLADES Final Report, 25 Jun. 1979 - 24 Jun. 1982
E. R. G. ECKERT and R. J. GOLDSTEIN Aug. 1982 65 p refs
(Contract DAAG29-79-C-0117)
(AD-A119729; ARO-16595.6-EG) Avail: NTIS HC A04/MF A01 CSCL 21E

Film cooling is used extensively for the blades of high-performance, high-temperature gas turbines, especially for aircraft turbines. In this method, a film of coolant is injected into the boundary layer covering the skin of the blades and creating a cool layer which separates the blade surface from the hot gas stream and, in this way, reduces the blade temperature. For best performance the coolant should be injected through a slot or a strip of porous material. This, however, is not possible for turbine blades because of strength considerations, and the coolant is injected through one or several rows of holes. For aircraft gas turbines, air is used as a coolant. The present investigation, therefore, is concerned with the cooling performance of film cooling when cooling air is injected into the boundary through one or two rows of holes. A standard configuration of the coolant holes is used because it has been used in previous investigations and because configurations in actual turbine blades are close to it. The cooling holes are arranged at a distance apart equal to three times the hole diameter. For injection through two rows of holes, the two rows are staggered and the centers of the holes are on the corners of equilateral triangles. The channels which end at the blade skin in the cooling holes are inclined by an angle of 35 deg against the skin surface in the downstream direction. GRA

N83-14132# Elektroschmelzwerk Kenpten G.m.b.H., Munich (West Germany).
DEVELOPMENT AND FABRICATION OF REFRACTORY BODIES FOR GAS TURBINE ENGINES Final Report, Nov. 1980
K. HUNOLD, W. GRELLNER, J. KRIEGESMANN, A. LIPP, and K. REINMUTH Bonn Bundesministerium fuer Forschung und Technologie Jul. 1982 50 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-82-138; ISSN-0340-7608) Avail: NTIS HC A03/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 10,50

Two hot pressed silicon carbides materials were developed. One (HP-T) is characterized by a constant strength from room temperature up to high temperatures. Silicon carbide powders for hot pressing can be produced in large quantities. The parameters for hot isostatic pressing (HIP) of silicon carbide powders were evolved. A technique for capsulation was developed. Pressureless sintered and hot pressed parts were post-densified by HIP. Properties of the different silicon carbide materials are evaluated and their potential for the production of gas turbine parts are discussed. Author (ESA)

N83-14133# Keramische Betriebe G.m.b.H., Roedental (West Germany). Geschaeftsbereich Ceranox.
DEVELOPMENT OF HIGH STRENGTH SILICON CARBIDE MATERIALS FOR GAS TURBINE APPLICATIONS, PHASE 2 Final Report, Jul. 1980
E. GUGEL and G. LEIMER Bonn Bundesministerium fuer Forschung und Technologie Jul. 1982 43 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung une Technologie
(BMFT-FB-T-82-140; ISSN-0340-7608) Avail: NTIS HC A03/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 9

Pressureless sintered and silicon containing silicon carbides were selected for application in gas turbines. The materials were developed in order to improve mechanical properties, and shaping, and to produce prototype components. Development projects are presented, microstructure and properties are shown, as well as mistakes and further improvements. Nose cones and stators that showed good results as stationary gas leading components were introduced. For the shaping of these parts a special slip casting procedure was developed. Author (ESA)

N83-15255# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STUDY ON TIME BETWEEN OVERHAULS (TBO) OF AIRCRAFT TURBOJET AND ITS RELIABILITY
Z. YIMIN (Shanghai Aviation Industry Corp.) *In its* Acta Aeron. et Astron. Sinica (FTD-ID(RS)T-0518-82) p 90-107 28 Jul. 1982 Transl. into ENGLISH from Acta Aeron. et Astron. Sinica (China), v. 2, no. 4, Dec. 1981
Avail: NTIS HC A10/MF A01

Statistical methods (frequency histogram, probability paper, linear regression, and chi-square tests) are applied to analyzing time between overhauls (TBO) of aircraft engines. The calculated results of three types of aeroengines showed that the normal distribution is an appropriate model for TBO of aircraft engines. Therefore, along with them given value of TBO, it is reasonable to indicate the probability of the actual operating time of aircraft engines exceeding the given TBO. It is suggested to express the TBO by H(R sub K percent). Thus many unnecessary overhauls can be avoided which is of significant economical importance. R.J.F.

N83-15256# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

EXPERIMENTAL RESEARCH ON PERFORATED ACOUSTIC LINERS IN TURBOJET ENGINE AFTERBURNERS

O. XUEBIN (Shenyang Liming Machinery Co.) and N. GUOXIONG *In its* Acta Aeron. et Astron. Sinica (FTD-ID(RS)T-0518-82) p 108-120 28 Jul. 1982 refs Transl. into ENGLISH from Acta Aeron. et Astron. Sinica (China), v. 2, no. 4, Dec. 1981

Avail: NTIS HC A10/MF A01

The reasonable choice of construction parameters for perforated acoustic liners in turbojet engine afterburners was investigated from the engineer's point of view. The perforated acoustic liner should have as much as possible high oscillation absorptivity in a quite wide frequency range by increasing the volume of acoustic resonant space and the perforated area ratio of the shield. The smooth geometry of the liner can make the secondary flow uniform around the outer chamber shell and, therefore, avoid high temperature stripes proceeding from the gas separated-flow vortex at the wave valley on the perforated acoustic liner. Consequently, the circular temperature difference and the thermal stresses of the shell can be decreased, and the wall temperature of the afterburner shell can be kept down below the allowable temperature of its material. As a result, the afterburner can operate reliability for a long time. Author

N83-15260# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

A COMPUTATIONAL GEOMETRY METHOD FOR BLADE SPACE GEOMETRIC DESIGN

L. DINGYAN (Fundan Univ.), Z. YUGI (Nanhua Powerplant Research Inst.), Z. TINGXIONG (Nanhua Powerplant Research Inst.), and X. HONGEN (Nanhua Powerplant Research Inst.) *In its* Acta Aeron. et Astron. Sinica (FTD-ID(RS)T-0518-82) p 181-197 28 Jul. 1982 refs Transl. into ENGLISH from Acta Aeron. et Astron. Sinica (China), v. 2, no. 4, Dec. 1981

Avail: NTIS HC A10/MF A01

A new method of computer aided blade geometric design is given which combines several typical methods of computational geometry developed recently (including Bezier patches, B-spline patches and Bezier B-spline mixed patches, etc.) with the space shaping for aerojet blades. An integral mathematical model for a blade configuration is obtained and the curved blade is jointed by a set of 3 times 2 order mixed surface patches. Thus, it is advantageous to the computational analysis of the blade's three dimensional flow field performance and limited strength as well as to the combination with numerical control processing. Actual cases show that this method is simple, has a small number of computations and is effective for the design of blades with large curvatures. R.J.F.

N83-15261# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

OVERSPEED AND OVERTEMPERATURE TESTS AND DISSECTION EXAMINATION OF THE TURBINE DISCS MADE OF A IRON-NICKEL BASE SUPERALLOY

G. JIANTING (Academia Sinica) and Z. JINAN (Academia Sinica) *In its* Acta Aeron. et Astron. Sinica (FTD-ID(RS)T-0518-82) p 198-204 28 Jul. 1982 Transl. into ENGLISH from Acta Aeron. et Astron. Sinica (China), v. 2, no. 4, Dec. 1981

Avail: NTIS HC A10/MF A01

A 35 Ni-15 Cr type iron-nickel base superalloy engine turbine disc material is discussed. It possesses outstanding comprehensive properties and microstructure stability. Therefore, it can meet the requirements of the turbine discs of aeroengines for long time use below 650 to 700 C. For a new type of material to be formally used in an engine it is necessary to go through long time test runs and test flights. However, these types of tests are expensive and long, and so to examine the turbine disc's body and tenon it is reasonable to first conduct overspeed and overtemperature tests on the finished disc. These tests were conducted on Chinese made vertical testers. Six thermoelectric couples are installed on different positions of the turbine disc to measure the temperature field. A photoelectric velocity measurement apparatus and gear velocity measurement apparatus are used simultaneously to measure rotation. R.J.F.

N83-15304*# Pratt and Whitney Aircraft Group, East Hartford, Conn. Energy Efficient Engine Component Development and Integration Program.

ENERGY EFFICIENT HIGH-PRESSURE TURBINE LEAKAGE TECHNOLOGY REPORT

W. B. GARDNER Dec. 1980 82 p refs

(Contract NAS3-20646)

(NASA-CR-165202; NAS 1.26:165202; PWA-5594-106) Avail: NTIS HC A05/MF A01 CSCL 21E

The leakage test program was one of such supporting technology programs structured to provide guidance to the Energy Efficient Engine High Pressure Turbine Component Design Effort. Leakage reduction techniques were identified and evaluated. Test models were used to simulate component leak paths and to evaluate leakage reduction techniques. These models simulated the blade/disk attachment, the vane inner platform attachment, and the vane outer platform attachment combined with the blade outer airseal. Disk blade attachment testing indicated that leakage in this area could be reduced to very low levels by paying careful attention to the tolerances along the contact surface between the blade vibration damper and the blade platform contact surface. The aim of feather seal testing was to achieve a goal for an effective leakage gap of one mil (.001 inch) per inch of feather seal length. Results indicated that effective gaps even below the goal level were achievable by (1) maintaining close tolerances between feather seals and their slots to minimize end gaps and limit seal rotation, (2) avoiding feather seal overlap, and (3) minimizing feather seal intersections. W seals were shown to be effective leakage control devices. Wire rope, in its present state of development, was shown not to be an effective sealing concept for application to the component design. Author

N83-15305*# Pratt and Whitney Aircraft Group, East Hartford, Conn. Commercial Engineering.

JT9D CERAMIC OUTER AIR SEAL SYSTEM REFINEMENT PROGRAM, PHASE 2

L. T. SHIEMBOB Nov. 1982 48 p refs

(Contract NAS3-20630)

(NASA-CR-167962; NAS 1.26:167962; PWA-5515-175) Avail: NTIS HC A03/MF A01 CSCL 21E

The sprayed ceramic gas turbine outer air seal system was tested in two JT9D engines to substantiate the abradability and durability of the seals. Of particular significance was that one of the tests, a 150 hour 1000 cycle endurance program at nominal JT9D operating conditions, was completed with minimal effect on the seals and received Federal Aviation Administration cognizance with respect to potential field service use by the airlines. The other engine test completed 1825 endurance cycles at severe operating conditions and no burn through or other serious defects in the structural integrity of a seal segment was observed. These test results combined with other Pratt and Whitney Aircraft engine tests substantiate the potential of the ceramic outer air seal system to attain the durability goal of 50000 hour engine operating capability. Both engine tests subjected the seals to intentional blade rubs and demonstrated good abradability with volume wear ratios greater than 100, far exceeding the design goal of 10. The improved volume wear ratio will allow the turbine tip clearance to be reduced, thereby resulting in an estimated thrust specific fuel consumption improvement of 0.3 percent. Author

N83-15306*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF STEADY-STATE PRESSURE DISTORTION ON INLET FLOW TO A HIGH-BYPASS-RATIO TURBOFAN ENGINE
R. H. SOEDER and G. A. BOBULA Oct. 1982 31 p refs Prepared in cooperation with Army Aviation Research and Development Command, Cleveland
(NASA-TM-82964; E-1383; NAS 1.15:82964; AVRADCOM-TR-81-C-27) Avail: NTIS HC A03/MF A01 CSCL 21E

Static pressure and total pressure distributions were measured in the inlet duct upstream of the engine inlet and within the fan and compressor of a YTF34 turbofan engine. In addition, the free stream flow angle was measured between the distortion generator and the engine inlet. Distortions were generated using three screen configurations with extents of 90 deg or 180 deg. The screens were mounted on a rotatable screen assembly. Reynolds number index upstream of the distortion device was maintained at 0.5 or 0.2, and engine fan speed corrected to station 2 temperature was maintained at 80 or 90 percent of rated condition (7005 rpm). Flow angle was nearly constant near the distortion device and increased as flow approached the engine inlet. The largest flow angle occurred in the hub region of the engine inlet. Static pressure distortion along the inlet duct increased exponentially as the flow approached the engine. Both static pressure and total pressure distortions were attenuated between engine inlet and compressor exit. Author

N83-15307*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FEASIBILITY OF WATER INJECTION INTO THE TURBINE COOLANT TO PERMIT GAS TURBINE CONTINGENCY POWER FOR HELICOPTER APPLICATION
G. J. VANFOSSEN 1983 16 p refs Proposed for presentation at the 28th Ann. Intern. Gas Turbine Conf., Phoenix, Ariz., 27-31 Mar. 1983; sponsored by the American Society of Mechanical Engineers
(NASA-TM-83043; E-1490; NAS 1.15:83043) Avail: NTIS HC A02/MF A01 CSCL 21E

A system which would allow a substantially increased output from a turboshaft engine for brief periods in emergency situations with little or no loss of turbine stress rupture life is proposed and studied analytically. The increased engine output is obtained by overtemperaturing the turbine; however, the temperature of the compressor bleed air used for hot section cooling is lowered by injecting and evaporating water. This decrease in cooling air temperature can offset the effect of increased gas temperature and increased shaft speed and thus keep turbine blade stress rupture life constant. The analysis utilized the NASA-Navy-Engine-Program or NNEP computer code to model the turboshaft engine in both design and off-design modes. This report is concerned with the effect of the proposed method of power augmentation on the engine cycle and turbine components. A simple cycle turboshaft engine with a 16:1 pressure ratio and a 1533 K (2760 R) turbine inlet temperature operating at sea level static conditions was studied to determine the possible power increase and the effect on turbine stress rupture life that could be expected using the proposed emergency cooling scheme. The analysis showed a 54 percent increse in output power can be achieved with no loss in gas generator turbine stress rupture life. A 231 K (415 F) rise in turbine inlet temperature is required for this level of augmentation. The required water flow rate was found to be .0109 kg water per kg of engine air flow. B.W.

N83-15308*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Business Group.
MATERIALS FOR ADVANCED TURBINE ENGINES. VOLUME 1: ADVANCED BLADE TIP SEAL SYSTEM Final Report
J. W. ZELAHY and N. P. FAIRBANKS Jul. 1982 99 p
(Contract NAS3-20074)
(NASA-CR-167851; NAS 1.26:167851; R82AEB403-VOL-1)
Avail: NTIS HC A05/MF A01 CSCL 21E

Project 3, the subject of this technical report, was structured toward the successful engine demonstration of an improved-efficiency, long-life, tip-seal system for turbine blades. The advanced tip-seal system was designed to maintain close operating clearances between turbine blade tips and turbine shrouds and, at the same time, be resistant to environmental effects including high-temperature oxidation, hot corrosion, and thermal cycling. The turbine blade tip comprised an environmentally resistant, activated-diffussion-bonded, monocrystal superalloy combined with a thin layer of aluminium oxide abrasive particles entrapped in an electroplated NiCr matrix. The project established the tip design and joint location, characterized the single-crystal tip alloy and abrasive tip treatment, and established the manufacturing and quality-control plans required to fully process the blades. A total of 171 blades were fully manufactured, and 100 were endurance and performance engine-tested. Author

N83-15309*# Michigan Univ., Ann Arbor. Coll. of Engineering.
IGNITION AND COMBUSTION: LOW COMPRESSION RATIO, HIGH OUTPUT DIESEL Final Report, Sep. 1979 - 30 Apr. 1979
Jul. 1981 43 p refs
(Contract NSG-3161)
(NASA-CR-169742; NAS 1.26:169742) Avail: NTIS HC A03/MF A01

The feasibility of converting a spark ignition aircraft engine GTSI0-520 to compression ignition without increasing the peak combustion pressure of 1100 lbs/sq.in. was determined. The final contemplated utilized intake air heating at idle and light load and a compression ratio of about 10:1 with a small amount of fumigation (the addition of about 15% fuel into the combustion air before the cylinder). The engine used was a modification of a Continental-Teledyne gasoline engine cylinder from the GTSI0-520 supercharged aircraft engine. S.L.

N83-15310# General Electric Co., Cincinnati, Ohio. Aircraft Engine Business Group.
RESPONSE SENSITIVITY OF TYPICAL AIRCRAFT JET ENGINE FAN BLADE-LIKE STRUCTURES TO BIRD IMPACTS Final Report, 1 Oct. 1977 - 30 Jan. 1979
D. P. BAUER and R. S. BERTKE Wright-Patterson AFB, Ohio AFWAL May 1982 49 p refs
(Contract F33615-77-C-5221; AF PROJ. 3066)
(AD-A119974; AFWAL-TR-82-2045) Avail: NTIS HC A03/MF A01 CSCL 21E

The response sensitivity of jet engine fan blade-like structures to the details of impact loading were studied. In particular, impacts of birds and ice on jet engines are difficult to model analytically. This report provides guidance in determining the spacial and temporal loading parameters that must be most accurately modeled in a coupled load-response analysis. A finite element model of a cantilever plate was subjected to various spatial and temporal loading details to determine important parameters. The cantilever plate was 7.62 cm (3 inches) by 24.46 cm (9.63 inches) by 3.81 mm to a 85 g (3 ounce) bird impacting at 244 m/sec (800 ft/sec). The plate response was monitored by observing deflected shapes at several increments of time during and after impact. The results show that the cantilever plate and presumably a jet engine fan blade are very sensitive to the level of momentum transfer. The detailed spatial and temporal loads that most affect momentum transfer were found to be of particular importance to the structure response. GRA

N83-15311# Systems Control Technology, Inc., Palo Alto, Calif.
TURBINE ENGINE FAULT DETECTION AND ISOLATION PROGRAM. VOLUME 1: TURBINE ENGINE PERFORMANCE ESTIMATION METHODS Final Report, 15 Aug. 1979 - 30 Nov. 1981
C. SMITH, M. BROADIE, and R. DEHOFF Wright-Patterson AFB, Ohio AFWAL Aug. 1982 252 p refs 2 Vol.
(Contract F33615-78-C-2062; AF PROJ. 3066)
(AD-A119998; AFWAL-TR-82-2058-VOL-1) Avail: NTIS HC A12/MF A01 CSCL 21E

This report documents work done for the Turbine Engine Fault Detection and Isolation Program. A gas path performance algorithm has been developed which can be used to trend engine module health. The Maintenance Information Management System was developed for the integration of data into the maintenance framework of the services. These tools have been applied to test data from the F100/EDS, TF34/TEMS and TF41/IECMS data acquisition systems. Author (GRA)

N83-15312# Systems Control Technology, Inc., Palo Alto, Calif.
TURBINE ENGINE FAULT DETECTION AND ISOLATION PROGRAM. VOLUME 2: MAINTENANCE MODEL DEVELOPMENT Final Report, 15 Aug. 1979 - 30 Nov. 1981
R. FLEMING and R. DEHOFF Wright-Patterson AFB, Ohio AFWAL Aug. 1982 82 p refs 2 Vol.
(Contract F33615-78-C-2062; AF PROJ. 3066)
(AD-A119999; AFWAL-TR-82-2058-VOL-2) Avail: NTIS HC A05/MF A01 CSCL 21E

Maintenance decision analysis models for evaluation of the TF34 maintenance process, both with and without the Turbine Engine Monitoring System (TEMS), are formulated. These models form the foundation for the U.S. Air Force to establish techniques for determining optimal policy for troubleshooting and maintenance on its aircraft engines using decision analysis methods. Technical background is provided and models presented. Model structure and parameters, as well as input and output, are treated. A preliminary plan for model evaluation is given, including methods for data collection, model evaluation criteria, as well as solution techniques and algorithms for the actual model evaluation. Conclusions are drawn and directions for future activity are suggested. GRA

N83-15313# Naval Postgraduate School, Monterey, Calif. Dept. of Aeronautics.
EXPERIMENTAL INVESTIGATION OF THRUST AUGMENTING EJECTORS USING VANE EXCITED PRIMARY JETS M.S. Thesis
T. R. MCCLELLAN Mar. 1982 143 p refs
(AD-A120424) Avail: NTIS HC A07/MF A01 CSCL 21E

An experimental investigation has been conducted to evaluate the entrainment characteristics of a thrust augmenting ejector, with a small, oscillating airfoil inserted in the potential core of the primary jet. Velocity distributions were measured across the width of the jet, at downstream distances of 20 and 40 nozzle widths, with the jet exhausting into still air and with the jet exhausting into an instrumented ejector shroud for the following range of parameters: Pressure ratio 1.137 and 1.268, amplitude of oscillation 2.6 deg and 6.9 deg zero-to-peak frequency of oscillation 0, 20, 40 and 60 Hz. Static pressure distributions were measured within the shroud when the jector was installed. The results amplify previously conducted studies. Jet spreading and entrainment appear to increase with increasing amplitude and frequency of oscillation and to decrease with increasing nozzle pressure ratio. *Author (GRA)*

N83-15314# Naval Air Development Center, Warminster, Pa. Aircraft and Crew Systems Technology Directorate.
COMPUTER PROGRAM FOR CALCULATION OF TURBOJET SYSTEM PERFORMANCE Final Report
J. J. FRANZ 15 Jun. 1982 125 p refs
(AD-A120665; NADC-77022-30) Avail: NTIS HC A06/MF A01 CSCL 21E

A computer program has been written which calculates combined turbojet engine, air induction and exhaust system characteristics to produce integrated propulsion system performance. GRA

N83-15511# Motoren- und Turbinen-Union Muenchen G.m.b.H. (West Germany).
THE OIL/AIR SYSTEM OF A MODERN FIGHTER AIRCRAFT ENGINE
J. SCHMIDT, W. K. HANK, A. KLEIN, and K. MAIER *In* AGARD Probl. in Bearings and Lubrication 19 p Aug. 1982 refs
Avail: NTIS HC A20/MF A01

The specification requirements of the oil/air system of modern fighter aircraft engine are defined and interpreted. Taking a three-spool engine as an example, the basic features of the design and functioning of the oil/air system are explained. The importance of the sealing air system and of its reliable computation is demonstrated. The advantages and disadvantages of interconnected and separated bearing chambers are pointed out. Attention is drawn to the vent system and to some special conditions of the turbine bearing chamber. Problems of highly loaded bearings are dealt with in some detail in view of a long bearing life, in particular the optimization of the oil supply and the bearing behavor in the event of an oil supply interruption. Finally, the reasons and consequences of a possible bearing chamber overheating are described as well as means to avoid such overheating. Author

08

AIRCRAFT STABILITY AND CONTROL

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

A83-16492*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
QUALIFICATION OF THE FLIGHT-CRITICAL AFTI/F-16 DIGITAL FLIGHT CONTROL SYSTEM
D. A. MACKALL, S. D. ISHMAEL (NASA, Flight Research Center, Edwards, CA), and V. A. REGENIE (Systems Control Technology, Inc., Edwards, CA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 17 p.
(AIAA PAPER 83-0060)

Qualification considerations for assuring the safety of a life-critical digital flight control system include four major areas: systems interactions, verification, validation, and configuration control. The AFTI/F-16 design, development, and qualification illustrate these considerations. In this paper, qualification concepts, procedures, and methodologies are discussed and illustrated through specific examples. *(Author)*

A83-16493*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
DEVELOPMENT OF A FLIGHT TEST MANEUVER AUTOPILOT FOR A HIGHLY MANEUVERABLE AIRCRAFT
E. L. DUKE (NASA, Flight Research Center, Edwards CA), F. P. JONES, and R. B. RONCOLI American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 21 p. refs
(AIAA PAPER 83-0061)

This paper details the development of a flight test maneuver autopilot for a highly maneuverable aircraft. This newly developed flight test technique is being applied at the Dryden Flight Research Facility of the NASA Ames Research Center. The flight test maneuver autopilot (FTMAP) is designed to increase the quantity and quality of the data obtained in flight test. The vehicle with which it is being used is the highly maneuverable aircraft technology (HiMAT) vehicle. This paper describes the HiMAT vehicle systems, maneuver requirements, FTMAP development process, and flight results. (Author)

A83-16496#
NONLINEAR CONTROLLER FOR THE PITCH-UP REGION
H. M. YOUSSEF and W. J. DAVIS (Lockheed-California Co., Burbank, CA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 9 p.
(AIAA PAPER 83-0064)

An advanced pitch active control system (PACS) was developed under the NASA Aircraft Energy Efficiency (ACEE) program, using normal acceleration, pitch rate, and pitch attitude feedback signals to control the short period and phugoid motion. The feedback gains were scheduled as functions of stabilizer trim position and dynamic pressure. Two different approaches to the synthesis of a nonlinear controller will be discussed using different sensor signals and shaping filters. One approach is based on adjusting the stabilizer trim position signal used in the feedback gain schedule as a function of Mach number and angle of attack. The other approach is a direct stabilizer command as a function of stabilizer position. Mach number, normal acceleration, and washed-out pitch rate. Simulation results in the time domain will show the effectiveness of different designs and some practical aspects that should be considered. (Author)

A83-16497*# Systems Technology, Inc., Mountain View, Calif.
EFFECTS OF CONTROL SATURATION ON THE COMMAND RESPONSE OF STATICALLY UNSTABLE AIRCRAFT
G. D. HANSON (Systems Technology, Inc., Mountain View, CA) and R. F. STENGEL (Princeton University, Princeton, NJ) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 12 p. refs
(Contract NSG-1587)
(AIAA PAPER 83-0065)

Hanson and Stengel (1981) have described the effects of saturating controls on the initial-condition response of statically unstable aircraft. In an analysis of the stability augmentation system, consideration was given to maximizing the region of stable response. The present investigation is concerned with an extension of the control saturation analysis to the problem of command response, taking into account the main problem of control design for satisfactory flying qualities (as perceived by the pilot). A model for examining the effects of control saturation on longitudinal stability and command response is developed and applied to an aircraft with a static instability. Three parameters prescribing longitudinal flying qualities are examined with respect to their ability to identify proper flying qualities in the presence of control saturation. The presented analysis provides also satisfactory guidelines for establishing command saturation/stability boundaries. G.R.

A83-16550#
ASSESSMENT OF ADVANCED FIGHTER POWERED APPROACH SIMULATIONS
W. W. HARRINGTON, B. W. VAN VLIET, and F. E. UNFRIED (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 17 p. refs
(AIAA PAPER 83-0141)

Recent flight experience has indicated that aircraft incorporating highly augmented digital flight control systems may exhibit handling difficulties during powered landing approach. Since the Advanced Fighter Technology Integrator/F-16 employs a highly augmented digital control system, its landing approach behavior was simulated by a proprietary simulation system as well as the U.S. Air Force's LAMARS simulator and NT-33 in-flight simulator. Attention is given to simulation methods and results, as well as an analysis of the latter based on Cooper-Harper pilot ratings, pilot-induced oscillation ratings, pilot commentaries, equivalent systems analysis, equivalent time delays, and gust sensitivity. Simulation results led to changes in the configuration that was to be ultimately flight tested. O.C.

A83-16566*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
TRIMMING HIGH LIFT FOR STOL FIGHTERS
J. W. PAULSON, JR., P. F. QUINTO, D. W. BANKS (NASA, Langley Research Center, Hampton, VA), and G. M. GATLIN American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 8 p. refs
(AIAA PAPER 83-0168)

The results of investigations of three different approaches to obtaining longitudinal trim for advanced fighter configurations with STOL performance are presented. The first, a differential thrust vectoring/reverser nozzle on an F-15 model, was very effective with an increment in pitching moment generated by the 90 deg/50 deg nozzle at military power equal to that which would be produced by a change in horizontal tail deflection of 20 deg. This trim pitching moment was accompanied by a modest loss in lift. The second method involved a nose jet on a supersonic cruise fighter configuration which, when combined with some canard deflection and longitudinal instability, provided trim capability for the configuration with military power setting and main nozzles deflected 43 degrees. Finally, a blown-high-lift canard on an advanced fighter configuration indicated that trim could be obtained across the complete angle-of-attack range tested with thrust set at military power and the main nozzles deflected 40 degrees. There was no loss in configuration lift and a slight increase in longitudinal stability. C.D.

A83-16624#
ACTIVE CONTROL OF A RELAXED-STATIC-STABILITY AIRPLANE USING A DISCRETE MODEL FOLLOWING TECHNIQUE
B. L. NAGABHUSHAN (Goodyear Aerospace Corp., Defense Systems Div., Akron, OH) and F. H. LUTZE (Virginia Polytechnic Institute and State University, Blacksburg, VA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 9 p. Research supported by Virginia Polytechnic Institute and State University. refs
(AIAA PAPER 83-0279)

A discretized, real model following scheme is used to construct an active controller which augments the stability of a Relaxed-Static-Stability (RSS) airplane, by closely following its desired model. An optimization procedure which minimizes the error between the model and follower system dynamics is used to design the corresponding control law. The resulting stability and control characteristics of the actively controlled RSS airplane have been found to be more favorable than that of the unaugmented airplane designed conventionally. (Author)

A83-16673#
ESTIMATING ROLL COUPLING INSTABILITY FOR HIGHLY AUGMENTED AIRCRAFT
R. H. KOGLER (USAF, Aeronautical Systems Div., Wright-Patterson AFB, OH) and D. L. QUAM (Dayton, University, Dayton, OH) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 8 p.
(AIAA PAPER 83-0366)

An easy to use method is presented to estimate roll coupling instability for highly augmented aircraft. Although this relatively simple method may sometimes only approximately predict specific instability roll rates, it is a valuable design and evaluation tool for estimating the incremental effects of various airframe or control system changes to an aircraft configuration. The method is used to determine the effect of horizontal tail size variations on the roll coupling instability of the F-16. Increasing the horizontal tail area of the F-16 results in increased roll coupling stability, except at low angles of attack. (Author)

A83-16927#
PILOTING TECHNIQUES ON THE BACKSIDE
N. GOTO, N. MORIZUMI (Kyushu University, Fukuoka, Japan), and S. HASHIGUCHI (Mitsubishi Electric Corp., Kamakura Works, Kamakura, Kanagawa, Japan) Japan Society for Aeronautical and Space Sciences, Transactions, vol. 25, Nov. 1982, p. 146-159. refs

Longitudinal control problems regarding flight path and height arise in connection with flight operation on the backside of the drag curve. Kato and Sato (1978) and Kato et al. (1979) have investigated the gust response of various aircraft analytically as a stochastic regulator problem, using quadratic criteria. However, there appear to remain questions regarding the response of the optimal controller to outside disturbances. In connection with aspects of the pilot's manual control, it may be desirable to know a deterministic control law for a deterministic command input. The present investigation is concerned with the utilization of Wiener's approach for an analysis of optimal piloting techniques to control flight-path angle and height for a deterministic step command. The analytical results with respect to the piloting techniques proposed so far are discussed. G.R.

A83-17922*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AN EVALUATION OF AERODYNAMICS MODELING OF SPINNING LIGHT AIRPLANES
B. N. PAMADI and L. W. TAYLOR, JR. (NASA, Langley Research Center, Hampton, VA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 12 p. refs
(AIAA PAPER 83-0368)

This paper extends the application of the modified strip theory for wing body combination of a spinning light airplane reported earlier. In addition, to account for the contribution of the tail plane, the shielding effect on vertical tail under steady state spin condition is modeled from basic aerodynamic considerations. The results of this combined analysis, presented for some light airplane configurations, are shown to be in good agreement with spin tunnel rotary balance test data. (Author)

A83-18379* Tokyo Univ. (Japan).
STUDY OF ROTOR GUST RESPONSE BY MEANS OF THE LOCAL MOMENTUM THEORY
A. AZUMA (Tokyo, University, Tokyo, Japan) and S. SAITO (NASA, Ames Research Center, Moffett Field, CA) American Helicopter Society, Journal, vol. 27, Jan. 1982, p. 58-72. refs

The vertical gust response of the helicopter rotor in cruising flight is studied analytically by means of the local momentum theory (LMT) and experimentally in a wind tunnel utilizing a gust generator. By introducing the unsteady aerodynamic effects into the LMT and by considering the elastic deformation of the rotor blade, the vibratory characteristics of flapping blades and of the rotor forces can be obtained. Since the LMT makes it possible to calculate the instantaneous load distribution along the rotor blade in desired azimuthal or timewise intervals, the effects of gradual penetration of the rotor into the gust can be studied and the Fourier analysis or power spectrum analysis of the rotor response applied to any kind of gust input. Some results obtained analytically are verified by the experimental tests performed in the wind tunnel which generates step, sinusoidal and random vertical gusts by the motion of a series of cascaded vanes upstream of the rotor. (Author)

A83-18385
WIND TUNNEL RESULTS SHOWING ROTOR VIBRATORY LOADS REDUCTION USING HIGHER HARMONIC BLADE PITCH
C. E. HAMMOND (U.S. Army, Applied Technology Laboratory, Fort Eustis, VA) (Structures, Structural Dynamics, and Materials Conference, 21st, Seattle, WA, May 12-14, 1980, Technical Papers.) American Helicopter Society, Journal, vol. 28, Jan. 1983, p. 10-15. refs

(Previously cited in issue 14, p. 2499, Accession no. A80-35107)

A83-18401*# Bihrle Applied Research, Inc., Jericho, N. Y.
SPIN PREDICTION TECHNIQUES
W. BIHRLE, JR. and B. BARNHART (Bihrle Applied Research, Inc., Jericho, NY) Journal of Aircraft, vol. 20, Feb. 1983, p. 97-101. refs
(Contract NAS1-14849; NAS1-16205)

(Previously cited in issue 20, p. 3663, Accession no. A80-45863)

A83-19031
IMPLICIT ADAPTIVE CONTROL FOR A CLASS OF MIMO SYSTEMS
K. SOBEL (Lockheed California Co., Burbank, CA), H. KAUFMAN (Rensselaer Polytechnic Institute, Troy, NY), and L. MABIUS (Analytic Sciences Corp., Reading, MA) IEEE Transactions on Aerospace and Electronic Systems, vol. AES-18, Sept. 1982, p. 576-590. refs

Two implicit model reference adaptive control algorithms for multi-input multi-output systems are developed. These algorithms do not require either satisfaction of the perfect model following conditions or explicit parameter identification. The first algorithm ensures asymptotic stability of the output error provided that thyoutput stabilized plant transfer matrix is strictly positive real. The second algorithm guarantees a bounded error under less restrictive conditions. The algorithms are applied to the lateral axis of an F-8 aircraft. (Author)

A83-19622#
NONLINEAR OBSERVERS FOR EVALUATING THE STATE VARIABLES OF THE LONGITUDINAL MOTION OF AN AIRCRAFT [NICHTLINEARE BEOBACHTER ZUR SCHAETZUNG VON ZUSTANDSGROESSEN DER LAENGSBEWEGUNG EINES FLUGZEUGES]
H. SEIDEL Braunschweig, Technische Universitaet, Fakultaet fuer Maschinenbau und Elektrotechnik, Dr.-Ing. Dissertation, 1981. 198 p. In German. refs

A calculative observer system is used to measure the input and output values and obtain the state variables of an aircraft. The theory of linear and nonlinear observers is explained, and the practical design of a nonlinear observer is addressed using linearized expressions for estimation error. The evaluation of the state variables of a longitudinally moving aircraft is considered, showing that a nonlinear observer can be used to obtain the angles of pitch, incidence, and position given certain assumptions. The simulations indicate that the nonlinear observer is useful in a large flight range. The behavior during disturbances is especially studied, examining the relationship between observer design and the measured values of exit variables. C.D.

N83-14134# Aeronautical Research Labs., Melbourne (Australia). Structures Dept.
FLUTTER SUBSTANTIATION TESTS ON A TRANSAVIA PL-12/T-300 AIRTRUK
A. GOLDMAN Jun. 1982 74 p refs
(AD-A118895; ARL/STRU-TM-341; AR-002-890) Avail: NTIS HC A04/MF A01 CSCL 01C

A resonance test and subsequent flight tests have been conducted on a Transavia Airtruk. The natural modes and frequencies of vibration were measured in the ground tests, and attempts made to induce flutter during flight tests. The results of these tests are presented. GRA

N83-14135# Bendix Corp., Teterboro, N. J. Flight Systems Div.
ADVANCED VERIFICATION TESTING OF A DUAL MODE ELECTRO/PNEUMATIC ACTUATOR FOR THE T-2C AIRCRAFT Final Report, Sep. 1978 - Apr. 1981
W. KINEYKO Apr. 1982 56 p
(Contract N62269-78-C-0247)
(AD-A119003; NADC-82047-60) Avail: NTIS HC A04/MF A01 CSCL 01C

This is a report of the fabrication and design verification testing of a Dual Mode Electro/Pneumatic Actuator. Pneumatic mode open loop operation and control verified. Torque/Speed performance less than design goal due to excessive gear separation force. GRA

N83-14136# Bendix Corp., Teterboro, N. J. Flight Systems Div.
ADVANCED FLIGHT CONTROL ACTUATION SYSTEM (AFCAS -E/P). FABRICATION AND DESIGN VERIFICATION TESTING OF A DUAL MODE ELECTRO/PNEUMATIC ACTUATOR FOR THE T-2C AIRCRAFT Final Report, Sep. 1978 - Apr. 1981
W. KINEYKO Warminster, Pa. NADC Apr. 1982 55 p
(Contract N62269-78-C-0247)
(AD-A119627; NADC-82047-60) Avail: NTIS HC A04/MF A01 CSCL 01C

Report of the fabrication and design verification testing of a Dual Mode Electro/Pneumatic Actuator. Pneumatic model open loop operation and control verified. Torque/Speed performance less than design goal due to excessive gear separation force. Author (GRA)

N83-14137# Naval Postgraduate School, Monterey, Calif.
DYNAMIC STABILITY OF FLIGHT VEHICLES M.S. Thesis
D. P. POULIEZOS Jun. 1982 257 p refs
(AD-A119637) Avail: NTIS HC A12/MF A01 CSCL 20D

The thesis presents an analytical treatment of the dynamics of the flight vehicle and might be used as a textbook for a Dynamic Stability and Control advanced class. Concentration is given to derivation of equations of motion, investigation of particular modes of motion, stability derivatives, aerodynamic transfer functions and digital computer solutions. Author (GRA)

N83-15315*# Lockheed-Georgia Co., Marietta.
DIGITAL FLIGHT CONTROL SYSTEM VALIDATION TECHNOLOGY ASSESSMENT Final Report
D. B. MULCARE, W. G. NESS, and R. M. DAVIS Moffett Field, Calif. NASA. Ames Research Center Jul. 1982 134 p refs Sponsored in cooperation with FAA
(Contract NAS2-10270)
(NASA-CR-166374; NAS 1.26:166374; FAA-CT-82-140) Avail: NTIS HC A07/MF A01 CSCL 01C

This report presents a description and critique of digital flight control system technology with emphasis on real time simulation. This includes methods to define test cases as well as those to apply them. Particular attention is also directed toward the significance of embedded software, implementation variations, documentation methods, and vital issues in validation technology research. Author

N83-15316*# Bendix Corp., Teterboro, N. J.
ADVANCED FLIGHT CONTROL SYSTEM STUDY Final Contractor Report
J. C. MCGOUGH, K. MOSES, and J. F. KLAFIN (Grumman Aerospace Corp., Bethpage, N.Y.) Nov. 1982 374 p refs
(Contract NAS4-2877)
(NASA-CR-163120; NAS 1.26:163120; B-82SRC5) Avail: NTIS HC A16/MF A01 CSCL 01C

The architecture, requirements, and system elements of an ultrareliable, advanced flight control system are described. The basic criteria are functional reliability of 10 to the minus 10 power/hour of flight and only 6 month scheduled maintenance. A distributed system architecture is described, including a multiplexed communication system, reliable bus controller, the use of skewed sensor arrays, and actuator interfaces. Test bed and flight evaluation program are proposed. E.A.K.

N83-15317*# Analytical Mechanics Associates, Inc., Hampton, Va.
ANALYTICAL PROCEDURES FOR FLUTTER MODEL DEVELOPMENT AND CHECKOUT IN PREPARATION FOR WIND TUNNEL TESTING OF THE DAST ARW-1 WING
S. PINES Dec. 1982 87 p refs
(Contract NAS1-15593)
(NASA-CR-166023; NAS 1.26:166023; AMA82-35) Avail: NTIS HC A05/MF A01 CSCL 01C

A study to develop analytical procedures to be used in the checkout and calibration of a flutter wind tunnel model of the DAST ARW-1 wing equipped with a flutter suppression device is reported. The methods used to obtain a realistic simulation of the structural inertial and aerodynamic properties of the wing, the hydro-electro-servo actuator used for flutter suppression, a prediction of the open loop flutter speed at a fixed Mach number (.897), a procedure for checkout and calibration using the method frequency response of a wing mounted accelerometer, and an analytical representation of a reduced state approximation of the overall system are described. Author

N83-15318*# Pratt and Whitney Aircraft Group, West Palm Beach, Fla. Government Products Div.
INTEGRATED RESEARCH AIRCRAFT CONTROL TECHNOLOGY WITH FULL AUTHORITY DIGITAL ELECTRONIC CONTROL
Apr. 1980 118 p refs Sponsored in part by the Navy and the Air Force
(Contract NAS4-2556)
(NASA-CR-163100; FR-11792; NAS 1.26:163100) Avail: NTIS HC A06/MF A01 CSCL 01C

Baseline definitions for three major areas of the Integrated Research Aircraft Control Technology (INTERACT) program are provided. Author

N83-15319*# George Washington Univ., Hampton, Va. Joint Inst. for the Advancement of Flight Sciences.
THE USE OF LATERALLY VECTORED THRUST TO COUNTER THRUST ASYMMETRY IN A TACTICAL JET AIRCRAFT Final Report, Oct. 1980 - Oct. 1982
Jan. 1983 95 p refs
(Contract NCC1-29)
(NASA-CR-166047; NAS 1.26:166047) Avail: NTIS HC A05/MF A01 CSCL 01C

A nonlinear, six degree-of-freedom flight simulator for a twin engine tactical jet was built on a hybrid computer to investigate lateral vectoring of the remaining thrust component for the case of a single engine failure at low dynamic pressures. Aircraft control was provided by an automatic controller rather than a pilot, and thrust vector control was provided by an open-loop controller that deflected a vane (located on the periphery of each exhaust jet and normally streamlined for noninterference with the flow). Lateral thrust vectoring decreased peak values of lateral control deflections, eliminated the requirement for steady-state lateral aerodynamic control deflections, and decreased the amount of altitude lost for a single engine failure. Author

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RESEARCH AND SUPPORT FACILITIES (AIR)

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

A83-16482*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
FREE STREAM NOISE AND TRANSITION MEASUREMENTS IN A MACH 3.5 PILOT QUIET TUNNEL
I. E. BECKWITH, T. R. CREEL, JR., F.-J. CHEN (NASA, Langley Research Center, Hampton, VA), and J. M. KENDALL (NASA, Langley Research Center, Hampton, VA; California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 25 p. refs
(Contract NAS1-16096)
(AIAA PAPER 83-0042)

Free stream fluctuating pressures are determined from hot-wire measurements in a Mach 3.5 pilot quiet nozzle over a unit Reynolds number range from 10-60 million per meter. Further, the transition Reynolds numbers on a sharp tip 5 degree half-angle cone at zero angle of attack are obtained over the same range of unit Reynolds numbers from equilibrium temperature measurements on the cone. Results show that the nozzle provides noise levels in the upstream regions of the test rhombus that are substantially lower than in conventional nozzles. The normalized rms levels of the fluctuating static pressures are found to vary from extremely low values of less than 0.03% up to about 0.8% depending on the unit Reynolds number, the axial location in the test rhombus, and the bleed slot flow. By opening the boundary-layer bleed flow, the wall boundary layers over upstream regions of the nozzle become laminar and the absence of high frequency radiated noise then results in cone transition Reynolds numbers that are in the range of free-flight data. As the unit Reynolds numbers are increased, the nozzle wall boundary layers become transitional and turbulent, and the noise increases to peak levels of about 0.5% with significant energy up to 150 KHz. The cone transition Reynolds numbers then decrease to values that are in the range of those measured in conventional wind tunnels. N.B.

A83-16547#
IMPROVING THE DATA BASE GENERATION PROCESS FOR FLIGHT SIMULATOR DATA BASES
M. R. NICOL (USAF, Aeronautical Systems Div., Wright-Patterson AFB, OH) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 7 p.
(AIAA PAPER 83-0138)

The problems involved in the automatic generation of large real-world environmental data bases for use in full mission training simulators are examined. A specific example of a data base, the US Air Force C-130 Visual System Data Base, is presented to illustrate several of the problems encountered in the data base generation process, such as intersections in the definitions of linear and areal features. The solutions employed to overcome these problems are presented. The application of a software package for detecting certain anomalies in the Digital Feature Analysis Data which may cause problems for the simulators is discussed. In addition, a proposed effort for the standardization of the data base and the transformation program is examined. N.B.

A83-16548#
'A TOTAL G-FORCE ENVIRONMENT DYNAMIC FLIGHT SIMULATOR' - A NEW DIMENSION IN FLIGHT SIMULATION
R. J. CROSBIE and J. EYTH, JR. (U.S. Naval Material Command, Naval Air Development Center, Warminster, PA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 8 p.
(AIAA PAPER 83-0139)

The Naval Air Development Center is developing the world's first full system, total G-force environment, Dynamic Flight Simulator (DFS). Using the Center's unique human centrifuge as a motion and force base, the DFS is capable of reproducing, under pilot control, the total multidirectional G-force environment associated with controlled or uncontrolled flight of modern high performance military aircraft. The DFS will have particular application in man-machine interface programs where the G environment of the simulated aircraft may hamper or prevent the pilot from performing his required mission related tasks. A description of the DFS is presented including the features which enable it to be converted from one aircraft to another. The control concepts involved in using the centrifuge as a force/motion base for flight simulation studies are also explained. (Author)

A83-16551#
THE NORTHROP F-20 AVIONICS MISSION SIMULATOR
R. A. WEEKS, R. A. KURIHARA, and L. B. BARRAZA (Northrop Corp., Aircraft Group, Hawthorne, CA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 9 p.
(AIAA PAPER 83-0142)

This paper presents the real time man-in-the loop systems simulation status of the Northrop F-20 Tigershark (formerly called the F-5G Tigershark) aircraft and its avionics/flight control systems which has been designated the 'F-20 Avionics Mission Simulator.' The primary objective of the F-20 Avionics Mission Simulator is to develop, implement and verify the integration of the F-20 crew station in a realistic visual environment for Air-to-Air and Air-to-Ground mission profiles. (Author)

A83-16552#
A GLIMPSE INTO THE FUTURE OF AIR COMBAT
H. PASSMORE and J. GREEN (McDonnell Aircraft Co., St. Louis, MO) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 9 p.
(AIAA PAPER 83-0143)

A proprietary flight simulator facility devoted to the simulation of air combat has recently been expanded in order to provide up to 12 piloted aircraft simultaneously, including current and advanced versions of aircraft in friendly and potential adversary forces, as well as more than 30 missiles of various types in simultaneous flight. Assumed by the simulator program are a variety of current and advanced avionics systems, including radars, armament control, electronic warning, beyond-visual-range identification, communication/navigation system, gunsights, and head-up and head-down cockpit displays. Special attention is given to the simulation of anticipated communications jamming and electronic countermeasures, as well as surface-to-air threats and weather effects. Overall facility and simulator cockpit design features are described. O.C.

A83-16554#
ACOUSTIC CAPABILITIES OF THE GERMAN-DUTCH WIND TUNNEL DNW
J. C. A. VAN DITSHUIZEN, G. D. COURAGE (Duits-Nederlandse Windtunnel, Noordoostpolder, Netherlands), R. ROSS (Duits-Nederlandse Windtunnel, Noordoostpolder; National Lucht- en Ruimtevaartlaboratorium, Amsterdam, Netherlands), and K.-J. SCHULTZ (Duits-Nederlandse Windtunnel, Noordoostpolder, Netherlands; Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne, West Germany) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 12 p. refs
(AIAA PAPER 83-0146)

The DNW (Duits-Nederlandse Windtunnel) is a subsonic atmospheric wind tunnel of the closed return type with three interchangeable, closed test section configurations and one open jet configuration. The three components of the interchangeable part include the contraction, the test section, and the diffusor transition. The closed test sections have cross-sectional sizes of 9.5 m x 9.5 m, 8 m x 6 m, and 6 m x 6 m, and maximum velocities of 62, 116, and 152 m/s, respectively. The DNW is equipped with two distributed computer network systems. Acoustic design considerations are discussed, taking into account Mach number range, model size, background noise floor, the side-line angle range, and the frequency domain of interest. Attention is given to the aero-acoustic configuration, and the calibration tests. It is found that the DNW is suited for the conduction of aero-acoustic measurements on both jet models and rotor models. G.R.

A83-16556*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
REMOTELY DRIVEN MODEL CONTROL SURFACES FOR EFFICIENT WIND-TUNNEL OPERATIONS
G. M. WARE, B. SPENCER, JR., and L. R. GENTRY (NASA, Langley Research Center, Hampton, VA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 8 p.
(AIAA PAPER 83-0148)

A remote control system for wind-tunnel model control surfaces was developed during the Space Shuttle program to make more efficient use of wind-tunnel occupancy time and to aid in gathering the large force test data base necessary for the definition of the Shuttle aerodynamic characteristics. This paper presents a history of the development of the remote system, details of the system and associated equipment, and results from wind-tunnel tests showing the effect of system improvements on experimental data. Wind-tunnel test rate and cost comparisons are made between conventional models with bracketed control surfaces and remote models. (Author)

A83-16557#
THE ROLE OF CFD IN AEROPROPULSION GROUND TESTING
J. M. BARTON (Sverdrup Technology, Inc., Arnold Air Force Station, TN) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 8 p. refs
(AIAA PAPER 83-0149)

Increasing costs regarding wind tunnel tests in conjunction with rapidly decreasing computational costs provide a strong impetus for the utilization of Computational Fluid Dynamics (CFD) in aerospace-related development projects. The present investigation is concerned with the role CFD plays in a test organization, giving particular attention to the operation of the Engine Test Facility at the Arnold Engineering Development Center. A secondary objective is to list generic problem areas which must be addressed to provide continued growth in the problem-solving capability of CFD. Four applications of CFD to testing are considered, taking into account forebody simulator evaluation for subsonic and supersonic flow, inlet duct flow quality, and unsteady cascade flow. The presented examples demonstrate that CFD is already manifesting a positive influence in the operation of a propulsion test facility, and that its future potential is great. G.R.

A83-16687*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SUPPORT-STING INTERFERENCE ON BOATTAIL PRESSURE DRAG FOR REYNOLDS NUMBERS UP TO 70 X 10 TO THE 6TH
B. B. GLOSS and W. G. SEWALL (NASA, Langley Research Center, Hampton, VA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 11 p. refs
(AIAA PAPER 83-0387)

A model was tested in the Langley 0.3-Meter Transonic Cryogenic Tunnel to investigate the effects of Reynolds number on boattail pressure drag for a variety of sting shapes. The boattail pressure drag for constant Mach number increased linearly with Reynolds number over the Reynolds number range tested. The data indicated that, as the disturbance produced by the sting on the boattail increased, the boattail pressure drag became less sensitive to Reynolds number change. Also, it was found that the model base pressure versus Reynolds number curve reached a plateau within the Reynolds number range examined. (Author)

A83-16821#
WATER TUNNEL CONSTRUCTION FOR CONTINUOUS MODE FLOW VISUALIZATION
G. L. VOGT (Utah, University, Salt Lake City, UT) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 11 p. refs
(AIAA PAPER 83-0657)

Continuous laminar flow in a gravity fed water tunnel is obtained using experimental procedures on an existing water tunnel at the Von Karman Institute for Fluid Dynamics, Belgium. This water tunnel previously produced turbulent free flow only in a 'blow-down' mode after an extended settling period. The procedure for each phase of the study is discussed, as well as the calibration results of the final configuration. Lastly, the operation of the water tunnel in a continuous mode is compared to results previously obtained using the 'blow-down' mode. (Author)

A83-16931
THE MCDONNELL AIRCRAFT ENVIRONMENTAL TEST LABORATORY
C. O. HILGARTH and J. E. QUIST (McDonnell Douglas Corp., St. Louis, MO) Journal of Environmental Sciences, vol. 25, Nov.-Dec. 1982, p. 20-24, 29-31.

The laboratory comprises a mechanical and electrical equipment room, a combined environment test chamber room, a control room, and a vibration test facility. In the combined environment test chamber, three variable-speed blowers are used to circulate the air within the chamber to accomplish the convective heat transfer necessary to produce the high transient temperature rates. A shaker chamber compatibility test conducted as part of the acceptance tests of the combined environment test chamber is described. A microprocessor-based digital control programmer-controller is used for controlling the temperature, altitude, and humidity conditions of each chamber through one or more cycles. C.R.

A83-18270
BOEING GAINS REAL-TIME FLIGHT DATA
B. M. ELSON Aviation Week and Space Technology, vol. 118, Jan. 17, 1983, p. 45-47, 49, 51.

The cost savings and development period reductions that can be realized through the use of real time simulation has led to the tenfold increase of engineering utilization at the Boeing Company's Renton, Washington flight simulation facility since 1976. Simulation is estimated to offer a 100:1 cost advantage in areas where it can be used in lieu of flight tests, and technological advancements have resulted in increasingly accurate and complex modeling of aircraft and flight environments. The Boeing facility is used by staff and project engineers for the assessment of stability, control and flying qualities, as well as the development of automatic flight controls, flight deck designs and instrument displays. Simulators are also used in system and subsystem failure studies, crew workload evaluation, and system certification criteria development.

Attention is given to the use of the facility in 757 and 767 airliner development programs. O.C.

A83-18271
ROCKWELL B-1B DESIGN TO BE STUDIED IN NEW CAB
,Aviation Week and Space Technology, vol. 118, Jan. 17, 1983, p. 52-54.

An upgrading of computer capability has been undertaken at Rockwell International's engineering flight simulation facility in preparation for development tasks aimed at improving the crew ride, flight, and handling characteristics of the B-1B strategic bomber. Motion cues are especially important for B-1 man-in-the-loop simulations because of the turbulence encountered during operations in the terrain-following penetration mode. The simulator undergoing modifications has been used to support the development of the B-1 vertical situation display and work stations, including CRT symbology, symbology drive logic and scaling factors, and the impact of those factors on display clarity. Additional simulation work has been done in the area of force-feel system development, as well as the training of test pilots and the development of mission plans. O.C.

A83-18272
REAL-TIME SCENARIOS AID MCDONNELL WEAPONS WORK
,Aviation Week and Space Technology, vol. 118, Jan. 17, 1983, p. 57, 59, 61, 62.

The McDonnell Aircraft Company's simulation laboratory facilities are designed for the evaluation of airframe/weapons system concepts early in the development cycle, offering performance observation in realistic, real time scenarios. The laboratory's manned air combat simulator cockpits are installed in domes that allow tactical pilots to fly either against each other or against opposing aircraft that are digitally driven by computer logic. The five domes currently in use incorporate real time image projection systems which provide both terrain imagery and multiple air-to-air targets. To date, these simulators have supported design development efforts on behalf of the F-15, F/A18A, and AV-8B aircraft. O.C.

A83-18273
AMES EXPANDS ROTORCRAFT CAPABILITY
,Aviation Week and Space Technology, vol. 118, Jan. 17, 1983, p. 65, 68, 69, 71.

The NASA Ames Research Center's ability to develop novel rotorcraft technology and vehicles, and conduct research in the man-vehicle systems area, will be expanded through the addition of a rotorcraft systems integration simulator that can support all phases of the development of such new U.S. Army aircraft as a new family of light helicopters. This man-vehicle systems research facility is scheduled for completion in early 1984, an;will provide an opportunity for scientists to study psychological factors in the complex relationships among pilots, crew members and current and advanced aircraft. Attention is given to the planned configuration of the center's vertical motion simulator, which will have an integrated rotorcraft simulator motion generator and an interchangeable simulator cab and visual system. O.C.

A83-18274
COMPUTER MODELS CUT USAF TEST COSTS
K. J. STEIN Aviation Week and Space Technology, vol. 118, Jan. 17, 1983, p. 77-79.

The Air Force's Flight Dynamics Laboratory is using man-in-the-loop engineering simulation as an analytical tool in the development of advanced aircraft designs, novel instrumentation, and new or improved weapons systems, at costs considerably below those of conventional engineering methods. Costs of one-tenth the $20,000-30,000/hour figure typical of flight testing for such current fighter aircraft as the F-15 have been achieved. The Laboratory uses the Large Amplitude Multimode Aerospace Research Simulator (LAMARS) as a primary tool in aerodynamics research to bridge analytical and flight test efforts. LAMARS carries a single-place generic fighter cockpit, with full visual system, at the end of a 30-ft beam. The system is driven by a large hybrid computer complex. O.C.

A83-18373
THE DEVELOPMENT AND APPLICATION OF A FULL-SCALE WIDE-BODY TEST ARTICLE TO STUDY THE BEHAVIOR OF INTERIOR MATERIALS DURING A POST CRASH FUEL FIRE
C. P. SARKOS, R. G. HILL, and W. D. HOWELL and W. D. Howell (FAA, Technical Center, Atlantic City, NJ). Journal of Fire and Flammability, vol. 13, July 1982, p. 172-202. refs

A full-scale wide-body test article has been constructed from a surplus C-133 aircraft for studying the characteristics of transport cabin fires created by a postcrash external fuel fire. The development, design, and application of the test article are discussed with particular reference to the capabilities and instrumentation, derivation of fuel fire test conditions based on physical modeling and large-scale fire tests, and characterization of cabin fire hazards arising from an external fuel fire and from the exposure of interior materials to the fire. The effectiveness of urethane seat cushion fire-blocking layers and improved cushioning materials is evaluated over a range of test conditions. V.L.

A83-18407#
NAPC GYROSCOPIC MOMENT TEST FACILITY
H. C. SCOTT (U.S. Naval Air Propulsion Test Center, Propulsion Technology and Projects Engineering Div., Trenton, NJ) Journal of Aircraft, vol. 20, Feb. 1983, p. 142-145.

(Previously cited in issue 19, p. 3272, Accession no. A81-40900)

A83-18427#
THERMAL BEHAVIOR AND INSULATION OF A CRYOGENIC WIND TUNNEL
G. FRANCOIS (ONERA, Chatillon-sous-Bagneux, Hauts-de-Seine, France) (Reunion sur la Technologie Cryogenique, Amsterdam, Netherlands, Sept. 15, 1982.) ONERA, TP no. 1982-89, 1982. 19 p. refs
(ONERA, TP NO. 1982-89)

The thermal behavior of the structural elements of a cryogenic wind tunnel is examined along with the effects of thermal insulation on this behavior for the example of the planned European Transonic Wind Tunnel continuous-flow device. Time constants for responses to stepwise variations in gas temperature are calculated for elements located in the gas flow itself (filters and corner turning vanes), walls exposed to the gas flow on a single face, and elements only indirectly subjected to gas flow temperature variations (external walls and chamber supports). The wide range of time constants obtained is noted, and consequences for the thermal stresses of the structure are assessed. The attenuation of structural temperature variations by various types of internal insulation of the walls, which also allows more rapid changes in flow temperature and the reduction of energy consumption, is then considered. Possibilities for the thermal design of elements in the gas flow, the sting holder, test section walls and wind tunnel walls are presented. A.L.W.

A83-18429#
THE IMPACT OF DATA PROCESSING ON WIND TUNNEL TESTING [IMPACT DE L'INFORMATIQUE SUR LES ESSAIS EN SOUFFLERIE]
J. P. CHEVALLIER (ONERA, Division de l'Aerodynamique Experimentale, Chatillon-sous-Bagneux, Hauts-de-Seine, France) ONERA, TP no. 1982-92, 1982. 15 p. In French.
(ONERA, TP NO. 1982-92)

An examination of the effects that modern data processing has on the field of wind tunnel testing is presented. The activities during testing involve measurements on the model, control of the positions and types of sensors around the model, signal processing, and the analysis and formatting of results. Automatic data processing has allowed a significant increase in the quantity of data points available for study, has permitted real time examination in controlled conditions, and has caused fundamental changes in the operating mode of wind tunnel testing due to the presence of

powerful computers which increase the fidelity relative to actual flight tests. It is noted that only cost is an inhibiting factor in the implementation of sensors for recording increasing numbers of simultaneous data points. Examples of data handling capabilities at the ONERA Modane wind tunnels for wake measurements are described. M.S.K.

A83-18434#
PROGRESS IN WIND TUNNEL TEST TECHNIQUES AND IN THE CORRECTIONS AND ANALYSIS OF THE RESULTS
T. W. BINION, JR. (Calspan Field Services, Inc., Arnold Air Force Station, TN), X. VAUCHERET, and X. BOUIS (ONERA, Chatillon-sous-Bagneux, Hauts-de-Seine, France) (NATO, AGARD, Meeting, 61st, Cesme, Turkey, Oct. 11-14, 1982.) ONERA, TP no. 1982-108, 1982. 32 p. refs
(ONERA, TP NO. 1982-108)

The paper presents a general overview of some of the innovations devised for the improvement of the effectiveness of wind tunnel testing. Efforts have centered around three approaches: (1) increasing the amount of information, as opposed to data, that can be obtained in ground test facilities; (2) reducing test costs per data unit; and (3) improving data quality. Areas in which innovations have been realized include propulsion system simulations aimed at reducing drag in transport aircraft, and engine-airframe integration in combat aircraft. Cost reduction may be achieved by computer-controlled constant parameter testing and parameter optimization, stereophotographic techniques and computerized store trajectory generation in the captive trajectory system. Improvements in instrumentation have concerned store alignment, the application of an electro-optical interferometer, and airflow intake transducers. Developments in micro- and minicomputers have lead to automated test control, data acquisition and measurement device checking. Finally, advances have been made in the long-term repeatability of test data, corrections for sting and wall interference, and the comparison of test data obtained at different installations. A.L.W.

A83-19414
SOON 30 YEARS OF TESTING AT MODANE - RESEARCH CONTINUES WITH PRECISION AND EFFICACITY [BIENTOT 30 ANS D'ESSAIS A MODANE - RECHERCHE CONTINUE DE PRECISION ET D'EFFICACITE]
X. BOUIS (ONERA, Centre d'Essais de Modane, Modane, Savoie, France) L'Aeronautique et l'Astronautique, no. 96, 1982, p. 53-67. In French. refs

A review of the evolution of equipment and effectiveness of aerodynamic testing at the ONERA Modane wind tunnel installation is presented. The center increased from 215 to 230 personnel during 1972-82, i.e., 7 percent, while actual test rates have climbed 15 percent. Productivity increases have been witnessed in terms of real time monitoring links, automation of the data gathering, new equipment for the test channels, improvements in test preparation procedures, and overall improvements in methods, organization, and test design. Details of the improvements in the accuracy of the instrumentation, the lowering of noise in the data channels, and the 10 kHz sampling rate equipment are provided. M.S.K.

N83-14138*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ADAPTIVE WALL WIND TUNNELS, A SELECTED, ANNOTATED BIBLIOGRAPHY
M. H. TUTTLE (Kentron International Inc.) and E. B. PLENTOVICH Nov. 1982 38 p
(NASA-TM-84526; L-15497; NAS 1.15:84526) Avail: NTIS HC A03/MF A01 CSCL 14B

This bibliography, with abstracts, consists of 134 citations arranged in chronological order by dates of publication or dates of presentation. Selection of the citations was made for their relevance to the problems involved in reducing wind tunnel wall interference by the use of adaptive walls. Author

N83-14139*# Shaker Research Corp., Ballston Lake, N. Y.
DIGITAL SYSTEM FOR STRUCTURAL DYNAMICS SIMULATION Final Report
A. I. KRAUTER, L. J. LAGACE, M. K. WOJNAR, and C. GLOR Nov. 1982 125 p
(Contract NAS3-22546)
(NASA-CR-168019; NAS 1.26:168019; MTI-83TR12) Avail: NTIS HC A06/MF A01 CSCL 14B

State-of-the-art digital hardware and software for the simulation of complex structural dynamic interactions, such as those which occur in rotating structures (engine systems). System were incorporated in a designed to use an array of processors in which the computation for each physical subelement or functional subsystem would be assigned to a single specific processor in the simulator. These node processors are microprogrammed bit-slice microcomputers which function autonomously and can communicate with each other and a central control minicomputer over parallel digital lines. Inter-processor nearest neighbor communications busses pass the constants which represent physical constraints and boundary conditions. The node processors are connected to the six nearest neighbor node processors to simulate the actual physical interface of real substructures. Computer generated finite element mesh and force models can be developed with the aid of the central control minicomputer. The control computer also oversees the animation of a graphics display system, disk-based mass storage along with the individual processing elements. A.R.H.

N83-14140*# Applied Cryogenics and Materials Consultants, New Castle, Del.
POSSIBLE SAFETY HAZARDS ASSOCIATED WITH THE OPERATION OF THE 0.3-M TRANSONIC CRYOGENIC TUNNEL AT THE NASA LANGLEY RESEARCH CENTER
T. J. WEBSTER Oct. 1982 12 p
(Contract NASA ORDER L-44921-B)
(NASA-CR-166026; NAS 1.26:166026) Avail: NTIS HC A02/MF A01 CSCL 14B

The 0.3 m Transonic Cryogenic Tunnel (TCT) at the NASA Langley Research Center was built in 1973 as a facility intended to be used for no more than 60 hours in order to verify the validity of the cryogenic wind tunnel concept at transonic speeds. The role of the 0.3 m TCT has gradually changed until now, after over 3000 hours of operation, it is classified as a major NASA research facility and, under the administration of the Experimental Techniques Branch, it is used extensively for the testing of airfoils at high Reynolds numbers and for the development of various technologies related to the efficient operation and use of cryogenic wind tunnels. The purpose of this report is to document the results of a recent safety analysis of the 0.3 m TCT facility. This analysis was made as part of an on going program with the Experimental Techniques Branch designed to ensure that the existing equipment and current operating procedures of the 0.3 m TCT facility are acceptable in terms of today's standards of safety for cryogenic systems. Author

N83-14141# Naval Facilities Engineering Command, Alexandria, Va.
AIRFIELD LIGHTING, DESIGN MANUAL 23.1 Final Report
Jul. 1981 42 p
(AD-A119525; NAVFC-DM-23.1) Avail: NTIS HC A03/MF A01 CSCL 13A

Design criteria for presented for Category Code 136 and are intended for use by experienced architects and engineers. The contents include approach lighting, runway lighting, taxiway lighting; and helipad lightings. Author (GRA)

N83-14142# Naval Facilities Engineering Command, Alexandria, Va.
HELIUM PLANTS AND STORAGE, DESIGN MANUAL 24.2 Final Report
Jun. 1980 25 p
(AD-A119517; NAVFAC-DM-24.2) Avail: NTIS HC A02/MF A01 CSCL 13H

Basic design guidance for helium storage, repurification, and distribution facilities, Category Code 142, is presented for use by experienced architects and engineers. The contents include helium characteristics, storage data, handling techniques, receiving facilities, working pressures, pipe sizing and strengths, valving, and cleaning and condensing techniques. Author (GRA)

N83-14143# Aeronautical Research Labs., Melbourne (Australia). Aerodynamics Div.
A SET OF FLIGHT DYNAMIC EQUATIONS FOR AIRCRAFT SIMULATION
P. H. HALL Jun. 1982 26 p refs
(AD-A119543; ARL/AERO-TM-339; AR-002-888) Avail: NTIS HC A03/MF A01 CSCL 01C

The six degrees of freedom dynamic equations of aircraft motion are documented for use in aircraft simulations at ARL. Earth axes are chosen for the integration of the force equations, and body axes for the integration of the moment equations. The use of quaternions to calculate aircraft attitude and associated direction cosines is described. A brief description of an atmospheric data subroutine for use in aircraft simulation is also included. Author (GRA)

N83-14144# Aeronautical Research Labs., Melbourne (Australia). Aero Dept.
DESIGN OF A NEW CONTRACTION, WIDE ANGLE DIFFUSER AND FLOW MANIPULATORS FOR THE LOW SPEED WIND TUNNEL
J. B. WILLIS and I. A. HUNT Jun. 1982 27 p refs
(AD-A119544; ARL/AERO-TM-340; AR-002-894) Avail: NTIS HC A03/MF A01 CSCL 14B

It is over forty years since the A.R.L. low speed wind tunnel was built, and the quality of the flow in the test section is inadequate by today's standards. This memorandum describes the design of a new contraction, wide angle diffuser and flow manipulators, to improve the flow in this tunnel. These modifications should substantially improve the velocity distribution and reduce turbulence levels with only a small reduction in top speed of the tunnel. A useful increase in the length of the test section has also been obtained. Author (GRA)

N83-15285# Air Force Engineering and Services Center, Tyndall AFB, Fla.
MINIMUM OPERATING STRIP SELECTION PROCEDURE
W. S. STRICKLAND and L. R. CALDWELL *In* AGARD Aircraft Dyn. Response to Damaged and Repaired Runways 23 p Aug. 1982
Avail: NTIS HC A10/MF A01

Minimum operating strip (MOS) selection procedures for use in postattack launch and recovery operations are reported. The procedures are based on interim surface roughness guidance and are provided pending development of finalized procedures under the rapid runway repair (RRR) program. The general procedures can be applied to MOS selection for any aircraft at any particular airfield. The MOS selection criteria are to minimize the time required to repair a MOS, prevent damage to the aircraft, and optimize the flexibility in selection of a MOS. Five levels of repair quality, for AM-2 mat and crushed stone repairs, together with a repair spacing criteria for the F-4 aircraft. E.A.K.

N83-15286# Air Force Engineering and Services Center, Tyndall AFB, Fla.
PROPOSED SPECIFICATIONS FOR INTERNATIONAL INTEROPERABILITY ON REPAIRED BOMB DAMAGED RUNWAYS
L. R. CALDWELL and A. G. GERARDI *In* AGARD Aircraft Dyn. Response to Damaged and Repaired Runways 20 p Aug. 1982 refs Original document was announced as N79-19325
Avail: NTIS HC A10/MF A01

Definitions for data, data formats, and National responsibilities for development of war emergency airfield pavement repair specifications was suggested. The specifications are used to make repairs after an enemy attack. Minimum Operating Strip size, repair quality, repair spacing, and other parameters are specified. Exchange of the specifications between the nation operating an aircraft and the nation managing an airfield could enhance NATO interoperability. E.A.K.

N83-15287# United States Air Forces in Europe, APO New York 09012. Force Development Div.
ADVANCED RAPID RUNWAY REPAIR. A STABLE AND FLUSH REPAIRED RUNWAY SURFACE
R. J. BERGHOLZ *In* AGARD Aircraft Dyn. Response to Damaged and Repaired Runways 8 p Aug. 1982
Avail: NTIS HC A10/MF A01

The nature of damage to aircraft launch surfaces that may reasonably be expected to occur during a conflict was examined. The need to develop rapid large area and deep trenched runway repair is suggested, new civil engineering methods to deal with rapid repair of that damage are proposed and effects on aircraft landing gear shock absorbers are postulated. Currently ongoing field investigative efforts to adapt commercially available materials and equipment to provide flush repaired runway surfaces for this expected damage, lessening vertical and horizontal shock forces on aircraft landing gear systems are described. E.A.K.

N83-15288# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).
EVALUATION OF THE PILOT PAPERS FROM THE SPRING 1981 SMP MEETING
A. KRAUSS *In* AGARD Aircraft Dyn. Response to Damaged and Repaired Runways 7 p Aug. 1982 refs
Avail: NTIS HC A10/MF A01

Two different types of runway damage, regular craters and scabs and penetrated craters are outlined. Minimum operating strip (MOS) selection procedures for use in postattack launch and recovery operations are presented. Examples are given for an F-4 aircraft, yet the general procedures can be applied to MOS selection for any aircraft at any particular airfield. The ground roughness data are supplemented and the scope to the problems to be solved in an environment where a nation managing an airfield is to accommodate other nations operating a variety of aircraft types are expanded. Data on manpower and equipment for rapid runway repair and two runway repair procedures developed and tested in Germany are described. E.A.K.

N83-15289# Centro de Mecanica e Engenharia Estruturais, Lisbon (Portugal). Thermomechanics Section.
APPLICATION OF SEMI-RIGID PAVEMENTS IN RAPID RUNWAY REPAIR
A. F. T. DELEMOS *In* AGARD Aircraft Dyn. Response to Damaged and Repaired Runways 4 p Aug. 1982 refs
Avail: NTIS HC A10/MF A01

The semirigid pavements are described and compared with the traditional types: the rigid pavements made of cement concrete and flexible pavements made of bituminous concrete. The design and process of application for aeronautic pavements are presented. Experience on the application of semirigid pavements in Europe and in Africa is described. It is emphasized that normally in Portugal this type of pavement is used in new runways, chiefly thresholds, but it is also used for pavement repairs, which are not due to bombs. The merits and disadvantages of the semirigid type pavements as opposed to traditional ones are discussed. E.A.K.

N83-15290# Aeroplane and Armament Experimental Establishment, Boscombe Down (England).
THE REPAIRED RUNWAY CLEARANCE ENVIRONMENT
C. BRAIN *In* AGARD Aircraft Dyn. Response to Damaged and Repaired Runways 10 p Aug. 1982
Avail: NTIS HC A10/MF A01

Aspects of the repaired runway operational environment which influence considerations of aircraft dynamic response are examined. These aspects include: the roughness of repaired and unrepaired operating surfaces and operational factors which cause variability of aircraft response and pilot techniques which influence the loads on undercarriages. How aircrafts are cleared to operate from repaired runways; the safety margins required for this type of operation and the need to transfer data between NATO nations on the roughness tolerance of individual aircraft types if there is to be genuine interoperability are investigated. E.A.K.

N83-15295# Avions Marcel Dassault, Saint-Cloud (France).
A METHOD FOR THE NUMERICAL SIMULATION OF AN *AIRCRAFT UNDERCARRIAGE SYSTEM [METHODE DE* SIMULATION NUMERIQUE DU SYSTEME AVION ATTERRISSEUR]
C. PETTAU and A. CELIER *In* AGARD Aircraft Dyn. Response to Damaged and Repaired Runways 18 p Aug. 1982 In FRENCH; ENGLISH summary
Avail: NTIS HC A10/MF A01

A simulation method, being developed for the dynamic calculation of landing, roll-off, taxiing, takeoff and catapulting impacts, provides the landing-gear loads and the overall structural stresses as functions of time. The calculation takes account of the dynamic response of the structure and the non-linearities of the problem: large rotations, non-linear elasticity of tyres and shock absorbers, oil shearing, dry friction, etc. The implicit integration algorithm proceeds by elimination at different levels, of the freedom degrees of both the linear and linearized parts, leading, at each time step, to the solution of a non-linear equation system relative to the degrees of freedom associated with oil film shearing and dry friction. Shock absorber sticking due to friction can be considered. As the simulation cost is very low, statistical studies can be carried out, especially as regards the simulation of taxiing and takeoff. Author

N83-15320*# Virginia Univ., Charlottesville. Dept. of Mechanical and Aerospace Engineering.
DEVELOPMENT OF THE DESIGN CONCEPTS FOR A MEDIUM-SCALE WIND TUNNEL MAGNETIC SUSPENSION SYSTEM Final Report, Feb. 1977 - Sep. 1982
R. R. HUMPHRIS and R. N. ZAPATA Dec. 1982 37 p refs
(Contract NSG-1010)
(NASA-CR-166042; NAS 1.26:166042; UVA/643078-MAE82-111)
Avail: NTIS HC A03/MF A01 CSCL 14B

The magnitude of AC losses from a superconducting coil strongly indicates that the predicted scaling lawa are valid. The stainless steel bands around the test coil were the source of additional helium boiloff due to a transformer action and, hence, caused erroneously high AC loss measurements in the first run. However, removal of these bands for the second run produced data which are consistent with previous results on small scale multifilamentary superconducting coils. S.L.

N83-15321# Los Alamos Scientific Lab., N. Mex.
DESIGN OF THE CTX DIAGNOSTICS SCREEN ROOM
G. I. CHANDLER, II 1981 5 p refs Presented at the 9th Symp. on Eng. Problems of Fusion Res., Chicago, 26-29 Oct. 1981
(Contract W-7405-ENG-36)
(DE82-002320; LA-UR-81-3150; CONF-811040-57) Avail: NTIS HC A02/MF A01

The design of a shielded enclosure (or screen room) to house data acquisition equipment in an area in which substantial, time varying magnetic fields are present and capable of producing significant interference is described. The experiment, including power supplies, energy storage, control and other equipment covers several thousand square feet. The components are arranged electrically along the legs of a star ground system. Diagnostics apparatus located near the plasma vessels are connected to the screen room primarily with RG223 coaxial cables. DOE

N83-15322# Atomic Energy Research Establishment, Harwell (England). Computer Science and Systems Div.
AN EFFICIENT FULLY IMPLICIT SIMULATOR
B. A. FOSTER, P. F. NACCACHE, M. O. NICHOLAS, R. K. POLLARD, D. K. PONTING, J. RAE, D. BANKS (British National Oil Corp., Glasgow), and S. K. WALSH (AEE Winfrith) May 1982 39 p refs
(CSS-126) Avail: NTIS HC A03/MF A01

An efficient general purpose black oil simulator, PORES, now in production use for modelling North Sea fields is described. The fully implicit finite diifference equations are solved for each time step using a Newton-Raphson procedure. The resulting large sets of linear equations are usually solved simulataneously by a powerful iterative method which uses a preconditioned conjugate gradient algorithm with an enforced column sum condition to accelerate convergence. A sequential solution option is available and direct matrix inversion methods are also provided. Gas condensate problems are handled by a variable switching technique. Four examples are presented to illustrate the power and efficiency of the program. S.L.

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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.

A83-16655#
MEASUREMENT OF THE FREQUENCY RESPONSE OF A DIGITAL AUTOPILOT
R. L. STAPLEFORD (Space Applications Corp., Santa Ana, CA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 6 p. USAF-supported research.
(AIAA PAPER 83-0326)

This paper describes the application of frequency response measurement to the verification of the software for a digital autopilot. The testing involved an Interpretive Computer Simulation, ICS, which executed the actual autopilot code. The ICS provided a bit-for-bit match of the results of each machine instruction. Synthetic autopilot inputs were provided by another program, FRACOS, Frequency Response Analysis of COmputer Software. FRACOS also analyzed the autopilot responses and computed the frequency response (output/input relative amplitude and phase). The measured frequency responses were compared with expected values computed from autopilot design documentation. Examples of these comparisons are presented. (Author)

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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.

A83-17254
AN EVALUATION OF FRETTING AT SMALL SLIP AMPLITUDES
P. KENNEDY, L. STALLINGS (U.S. Naval Material Command, Naval Air Development Center, Warminster, PA), and M. B. PETERSON (Wear Science Corp., Arnold, MD) In: Materials evaluation under fretting conditions; Proceedings of the Symposium, Warminster, PA, June 3, 1981. Philadelphia, PA, American Society for Testing and Materials, 1982, p. 30-48. refs

Fretting wear, produced by the twisting motion of a flat steel specimen against a fixed 12.7-mm steel ball, has been investigated in the limited microslip region ranging from 0.05 to 5.0 micrometers. The construction of the test rig and the type of fretting wear associated with this particular specimen configuration and motion are discussed. This discussion is exemplified by data obtained either with SAE 52100 steel or Hastelloy B alloy ball specimens in combination with SAE 1018 steel flat specimens. The first indication of metal oxidation normally associated with the onset of fretting occurred at a slip amplitude of about 0.075 micrometer. Severe damage was noted at 2.5 micrometers. (Author)

A83-18950
MILITARY PROPULSION TECHNOLOGY. III - MATERIALS ARE THE KEY
G. WARWICK Flight International, vol. 123, Jan. 15, 1983, p. 146, 147.

The demand for future fighter engines built to withstand the limiting combustor temperatures of about 2000 C for sustained periods of supersonic operation, and for light and inexpensive aircraft, calls for the reduction in engine components like compressors and turbines, and this reduction results in an increase in loading, rotational speeds and operating temperatures. The necessity of developing new construction techniques and materials that can withstand these operating conditions are discussed. Solidification of polycrystalline blade materials, which are reinforced with low-melting point strengthening elements such as boron, carbon, hafnium, and zirconium, and hybrid blades cooled by effusion and which can stand up to 1730 C are favored. The T76 turbo gas turbine equipped with ceramic blades has been test-run and a maximum inlet temperature of 1200 C was achieved. Other manufacturing techniques discussed include the rapid-solidification-rate and the rapid-solidification plasma deposition techniques, and the dual-property and integrally bladed disks. M.I.I.

A83-19102
FABRICATION AND HEAT TREATMENT OF A NI-BASE SUPERALLOY INTEGRALLY BLADED ROTOR FOR SMALL GAS TURBINE ENGINE APPLICATIONS
S. E. HUGHES, R. E. ANDERSON, and R. L. ATHEY (United Technologies Corp., Government Products Div., West Palm Beach, FL) In: Modern developments in powder metallurgy. Volume 14. Princeton, NJ, Metal Powder Industries Federation, 1981, p. 131-144. refs

N83-14169*# Textron Bell Helicopter, Fort Worth, Tex.
FLIGHT SERVICE EVALUATION OF COMPOSITE COMPONENTS ON THE BELL HELICOPTER MODEL 206L: DESIGN, FABRICATION AND TESTING
H. ZINBERG Nov. 1982 75 p refs
(Contract NAS1-15279)
(NASA-CR-166002; NAS 1.26:166002) Avail: NTIS HC A04/MF A01 CSCL 11D

The design, fabrication, and testing phases of a program to obtain long term flight service experience on representative helicopter airframe structural components operating in typical commercial environments are described. The aircraft chosen is the Bell Helicopter Model 206L. The structural components are the forward fairing, litter door, baggage door, and vertical fin. The advanced composite components were designed to replace the production parts in the field and were certified by the FAA to be operable through the full flight envelope of the 206L. A description of the fabrication process that was used for each of the components is given. Static failing load tests on all components were done. In addition fatigue tests were run on four specimens that simulated the attachment of the vertical fin to the helicopter's tail boom. R.J.F.

N83-14170*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
EFFECTS OF SIMULATED LIGHTNING ON COMPOSITE AND METALLIC JOINTS
W. E. HOWELL and J. A. PLUMER (Lightning Technologies, Inc., Pittsfield, Mass.) Oct. 1982 29 p refs Presented at the *Army Symp. on Solid Mech., Cape Cod, Mass., 21-23 Sep. 1982*
(NASA-TM-84554; NAS 1.15:84554) Avail: NTIS HC A03/MF A01 CSCL 11D

The effects of simulated lightning strikes and currents on aircraft bonded joints and access/inspection panels were investigated. Both metallic and composite specimens were tested. Tests on metal fuel feed through elbows in graphite/epoxy structures were evaluated. Sparking threshold and residual strength of single lap bonded joints and sparking threshold of access/inspection panels and metal fuel feed through elbows are reported. E.A.K.

N83-14173# Aeronautical Research Labs., Melbourne (Australia). Materials Div.
PROCEDURE FOR APPLICATION OF BORON-FIBRE REINFORCED PLASTIC PATCH TO THE MIRAGE LOWER WING SKIN FUEL DECANT REGION
M. J. DAVIS and J. D. ROBERTS Aug. 1981 38 p
(AD-A119545; ARL/MAT-TM-373; AR-001-803) Avail: NTIS HC A03/MF A01 CSCL 01C

Aeronautical Research Laboratories have developed a new procedure for the repair of metallic aircraft components suffering from cracking due to fatigue or stress-corrosion; the procedure is based on the use of patches made from Boron-Fiber Reinforced Plastic which are adhesively bonded over the crack region. Crack patching using this technique has been successfully used in a number of repair applications on RAAF aircraft since 1975, and has been shown to be highly cost effective and also to have many other advantages over standard repair procedures. More recently, a 'crack patching' procedure was developed by ARL to repair fatigue cracks which have developed in the lower wing skins of some RAAF Mirage aircraft. Since this was a much more critical and complex application than any previously undertaken, involving the use of specially developed ground support equipment, a detailed specification was written as a guide for RAAF personnel, who were trained to implement the repair; this specification is presented in this Memorandum. Author (GRA)

N83-14287# Naval Surface Weapons Center, White Oak, Md.
POLYURETHANE FOAMS FOR AIRCRAFT SHOCK MOUNTS. 4: OTHER POLYOLS Final Report, Jul. 1980 - Sep. 1981
J. V. DUFFY Jun. 1982 29 p
(AD-A119399; AD-F400070; NSWC/TR-82-176) Avail: NTIS HC A03/MF A01 CSCL 01C

A number of polyether polyurethane flexible foams are being developed as shock mitagators for electronic equipment aboard Navy aircraft. These foams are based on polyol mixtures derived from poly(oxytetramethylene) glycol and poly(oxypropylene)polyol. This report describes the effect that changes in the basic polyol composition has on the foam's vibration damping and mechanical properties. GRA

N83-14291# Federal Aviation Administration, Washington, D.C.
THE IMPACT OF PETROLEUM, SYNTHETIC AND CRYOGENIC FUELS ON CIVIL AVIATION Final Report
C. L. BLAKE Jun. 1982 210 p
(FAA-EM-82-29) Avail: NTIS HC A10/MF A01

Various concerns with regard to aviation fuels are discussed, including price, the effects of supply and demand, the various sources and forms of supply, alternatives, and conservation measures which reduce demand. The likelihood, the nature, and the effects of disruption in foreign crude oil deliveries to the United States are discussed. R.J.F.

N83-14294# Naval Research Lab., Washington, D. C.
THE EFFECT OF ADDITIVES ON THE AEROSOLIZATION OF JP-5 JET FUEL Final Report
R. C. LITTLE, R. PRATT, and J. B. ROMANS 25 Aug. 1982 33 p refs
(AD-A119324; NRL-MR-4694) Avail: NTIS HC A03/MF A01 CSCL 21D

The May spinning top aerosol generator was used to generate aerosols from neat Navy jet fuel and selected dispersions of three types of polymer additives in the jet fuel. The additives selected were Oppanol B-200, a Vistanex Series, and a proprietary antimisting additive designated as FM-9. The mass median diameter (MMD) of the droplets produced was studied as a function of additive concentration and spinning top velocity for each additive. In the case of each additive the MMD significantly increased with concentration at constant RPS. The effect of the Oppanol B-200 was comparable to that of FM-9 with respect to its influence on the MMD. GRA

N83-15361*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
STRESS ANALYSIS OF ADVANCED ATTACK HELICOPTER COMPOSITE MAIN ROTOR BLADE ROOT END LUG
D. J. BAKER (Army Aviation Research and Development Command, Hampton, Va.) Dec. 1982 25 p refs
(NASA-TM-84578; NAS 1.15:84578) Avail: NTIS HC A02/MF A01 CSCL 11D

Stress analysis of the Advanced Attack Helicopter (AAH) composite main rotor blade root end lug is described. The stress concentration factor determined from a finite element analysis is compared to an empirical value used in the lug design. The analysis and test data indicate that the stress concentration is primarily a function of configuration and independent of the range of material properties typical of Kevlar-49/epoxy and glass epoxy. S.L.

N83-15364*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PMR POLYIMIDE COMPOSITES FOR AEROSPACE APPLICATIONS
T. T. SERAFINI 1982 22 p refs Presented at the 1st Tech. Conf. on Polyimides, Ellenville, N.Y., 10-12 Nov. 1982; sponsored by the Society of Plastics Engineers, Inc.
(NASA-TM-83047; E-1494; NAS 1.15:83047) Avail: NTIS HC A02/MF A01 CSCL 11D

Fiber reinforced PMR polyimides are finding increased acceptance as engineering materials for high performance structural applications. Prepreg materials based on this novel class of highly processable, high temperature resistant polyimides, are commercially available and the PMR concept was incorporated in several industrial applications. The status of PMR polyimides is reviewed. Emphasis is given to the chemistry, processing, and applications of the first generation PMR polyimides known as PMR-15. S.L.

N83-15412*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Business Group.
POWDER METALLURGY RENE 95 ROTATING TURBINE ENGINE PARTS, VOLUME 2 Final Report
L. G. WILBERS and T. K. REDDEN Jan. 1981 30 p refs
(Contract NAS3-20074)
(NASA-CR-165142; NAS 1.26:165141; R80AEG664-VOL-2)
Avail: NTIS HC A03/MF A01 CSCL 11F

A Rene 95 alloy as-HIP high pressure turbine aft shaft in the CF6-50 engine and a HIP plus forged Rene 95 compressor disk in the CFM56 engine were tested. The CF6-50 engine test was conducted for 1000 C cycles and the CFM56 test for 2000 C cycles. Post test evaluation and analysis of the CF6-50 shaft and the CFM56 compressor disk included visual, fluorescent penetrant, and dimensional inspections. No defects or otherwise discrepant conditions were found. These parts were judged to have performed satisfactorily. S.L.

N83-15429# British Aerospace Aircraft Group, Kingston-upon-Thames (England).
ADVANCED CASTINGS IN THE DESIGN OF MILITARY AIRCRAFT
D. J. DUCKWORTH and R. M. SHAW *In* AGARD Advan. Casting Technol. 10 p Aug. 1982 refs
Avail: NTIS HC A15/MF A01

The use of castings and the developments which took place from the user point of view, over a period of years, were reviewed. It is suggested that in any new design the final shape used is always a compromise. Factors as cost, structural efficiency, mechanical properties and quality must be considered. Interaction of these factors and the more important areas where development is required are shown. More extensive use of castings in modern airframes in the future is anticipated. E.A.K.

N83-15438# Titan-Aluminum-Feinguss G.m.b.H., Bestwig (West Germany).
NEW DEVELOPMENTS IN ALUMINUM AND TITANIUM INVESTMENT CASTINGS
G. WEDEKING *In* AGARD Advan. Casting Technol. 8 p Aug. 1982
Avail: NTIS HC A15/MF A01

Aluminum and Titanium are most important basic materials in modern aircraft construction. The contribution of aluminum investment castings for manufacturing of aircraft units is discussed. Integral construction is one of the features of modern aircraft construction. This involves limiting the expensive assembly of individual parts to a minimum. Investment casting has proved to be an especially efficient moulding process as it combines considerable cost savings in material, assembly and machining with the unsurpassed degree of freedom it gives to the designer of the individual casting. The investment casting process has to compete with other moulding processes for the technological aspects of a component. Tolerances, achievable dimensions and wall thicknesses of a component and, the strength of the material are essential. E.A.K.

N83-15439# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany). Helicopter and Transport Div.
AN EVALUATION OF VACUUM CENTRIFUGED TITANIUM CASTINGS FOR HELICOPTER COMPONENTS
L. J. MAIDMENT and H. PAWELETZ *In* AGARD Advan. Casting Technol. 7 p Aug. 1982 refs Document also announced as A81-41516
Avail: NTIS HC A15/MF A01

The applicability of centrifugally cast Titanium (Ti6Al4V) for a critical helicopter component, a rotor head, was investigated. The

economic aspects were considered. The results of the investigation are summarized as follows: the endurance limit of cast Titanium is approximately 63% that of the wrought alloy, a 15% reduction in the machining costs was achieved. Improvements in the centrifugal casting technique leading to enhanced microstructural and mechanical material properties play a decisive role in extending the application of cast Titanium in the Aerospace industry.
E.A.K.

N83-15446# Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Evry Cedex (France).
THE QUALITY AND CONTROL OF PRECISION CASTINGS FOR TURBOMACHINES [QUALITE ET CONTROLE DES PIECES DE FONDERIE DE PRECISION POUR TURBOMACHINES]
J. THIERY and J. VOELTZEL *In* AGARD Advan. Casting Technol. 11 p Aug. 1982 In FRENCH
Avail: NTIS HC A15/MF A01

The high temperature characteristics of nickel and cobalt base alloys require a perfect matrix for castng so that the potential qualities of the metals are preserved. The principal aircraft turbine components made by precision casting are discussed as well as the problems encountered in their fabrication. The quality of these castings must be considered during these stages: (1) selection of the base material; (2) selection of waxes and shells, mold design, and casting; (3) dissecting, adjusting, and conducting nondestructive tests of the components; and (4) overseeing the manufacture to determine the total range of quality and ascertain the deviations. Future techniques are needed to lessen the sensibility to microporosity by modifying the alloys or by isostatic pressing. Some method is needed to maintain control of quality when making hollow vanes. A.R.H.

N83-15483*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EVALUATION OF ULTRAVIOLET SPECTROPHOTOMETRY FOR SIMULTANEOUS ANALYSIS OF ALKYLBENZENES, ALKYLNAPHTHALENES, ENES AND TOTAL AROMATICS IN MID-DISTILLATE FUELS
W. S. KIM and G. T. SENG Nov. 1982 47 p refs
(NASA-TM-83032; E-1470; NAS 1.15:83032) Avail: NTIS HC A03/MF A01 CSCL 21D

A rapid ultraviolet spectrophotometric method for the simultaneous determination of aromatics in middistillate fuels was developed and evaluated. In this method, alkylbenzenes, alkylnaphthalenes, alkylanthracenes/phenanthracenes and total aromatics were determined from ultraviolet spectra of the fuels. The accuracy and precision were determined using simulated standard fuels with known compositions. The total aromatics fraction accuracy was 5% for a Jet A type fuel and 0.6% for a broadened properties jet turbine type fuel. Precision, expressed as relative standard deviations, ranged from 2.9% for the alkylanthracenes/phenanthrenes to 15.3% for the alkylbenzenes. The accuracy, however, was less for actual fuel samples when compared to the results obtained by a mass spectrometric method. In addition, the ASTM D-1840 method for naphthalenes by ultraviolet spectroscopy was evaluated. S.L.

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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.

A83-16477*# 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) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 25 p. refs
(AIAA PAPER 83-0037)

The present effectiveness and future promise of computational fluid dynamics (CFD) are discussed. The CFD ideal of computer-designed flight vehicles and the progress that has been made toward its achievement, expressed in terms of primary and secondary pacing items, are also addressed. The primary pacing items listed by Chapman - grid generation, turbulence modeling, solution methodology development, and mainframe computer methods and architecture - are modified and reviewed. Important secondary pacing items in CFD development are also examined: algorithm development, complex geometry definition, and predata and postata processing. In addition, user requirements placed on CFD computer codes are defined and some problems associated with the dissemination of CFD technology are identified. (Author)

A83-16664#
DESIGN OF A LOW EMISSION COMBUSTOR FOR AN AUTOMOTIVE GAS TURBINE
J. W. SANBORN, H. C. MONGIA, and J. R. KIDWELL (Garrett Turbine Engine Co., Phoenix, AZ) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 9 p.
(AIAA PAPER 83-0338)

The design of a lean-burn low-emission combustor for a regenerative automotive gas turbine engine, including detailed analysis and element testing to improve premixing of fuel and air to minimize NOx emissions is described. The measured emission levels for the various configurations tested are presented along with a brief description of the resulting full-scale combustion system. (Author)

A83-16688*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
LASER HOLOGRAPHIC INTERFEROMETRY FOR AN UNSTEADY AIRFOIL IN DYNAMIC STALL
G. LEE, D. A. BUELL, J. P. LICURSI (NASA, Ames Research Center, Moffett Field, CA), and J. E. CRAIG (Spectron Development Laboratory, Costa Mesa, CA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 15 p. refs
(AIAA PAPER 83-0388)

Laser holographic interferometry was used to study a two-dimensional NACA 0012 airfoil undergoing dynamic stall. The airfoil, fabricated from graphite fiber and epoxy, was tested at Mach numbers of 0.3 to 0.6, at Reynolds numbers of 500,000-2,000,000, at reduced frequencies of 0.015 to 0.15, and at mean angles of attack of 0-10 deg with amplitudes of 10 deg. Density and pressure fields were obtained from dual-plate interferograms. Double-pulse interferograms, which seemed to show the wake boundaries better, were also taken. Comparisons of pressures with orifice pressures were good for the attached flow cases. For the separated flow cases, which had a vortex enbedded in the flow, the comparisons were poor. Vortices, wake

structures, and the dynamic stall process can be seen by holographic interferometry. (Author)

A83-16816*# General Dynamics/Convair, San Diego, Calif.
THE DESIGN OF A HUMAN-POWERED VEHICLE
J. V. WIEDERHOLT (General Dynamics Corp., Convair Div., San Diego, CA) and J. W. PAHLE (NASA, Flight Research Center, Edwards, CA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 11 p.
(AIAA PAPER 83-0649)

Human power applied through a bicycle is perhaps the most efficient means of transport available today. Aerodynamic drag, however, limits the speed possible from the man/bicycle combination. An aerodynamically efficient body enclosing the system can reduce the drag and permit increased speeds. A study was conducted to determine an efficient body design for a high-speed bicycle. Wind tunnel and potential flow studies were conducted to evaluate the drag and lift characteristics of proposed shell designs. A proposed bicycle/shell design is presented. (Author)

A83-16897
INVESTIGATION OF UNSTEADY FLOW PROBLEMS [ERFORSCHUNG INSTATIONAERER STROEMUNGSPROBLEME]
P. BUBLITZ (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Institut fuer Aeroelastik, Goettingen, West Germany) DFVLR-Nachrichten, vol. 37, Nov. 1982, p. 24-29. In German.

A historical review is provided regarding the most important developments in the area of unsteady fluid mechanics, giving particular attention to fundamental discoveries in fluid flow physics. Problems related to flow separation are considered along with unsteady phenomena induced by motion. It is found that unsteady processes in fluid mechanics are related to the occurrence of layers of separation or vortex sheets. The development of separation layers and vortex sheets can be understood, in principle, on the basis of the theory conceived by Prandtl for the boundary layer and separation phenomena. However, intensive investigations are needed to clarify many details related to separated flow. G.R.

A83-16898
THE DEVELOPMENT OF RADIO ENGINEERING [ZUR ENTWICKLUNG DER FLUGFUNKTECHNIK]
F. TRENKLE (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Institut fuer Physik der Atmosphaere, Oberpfaffenhofen, West Germany) DFVLR-Nachrichten, vol. 37, Nov. 1982, p. 51-59. In German. refs

A review is provided of the development of radio engineering in Germany during the time period from 1897 to 1969, when sections of the German Experimental Institute for Aviation were incorporated into the 'German Research and Experimental Institute for Aeronautics and Astronautics. Techniques for radiotelephony communication between airships, aircraft, and ground stations were established during the period from 1897 to 1918. Developments occurring during the time from 1919 to 1937 are related to fundamental investigations regarding the behavior of electromagnetic waves, methods for the remote control of vehicles, position finding techniques, and approaches for making the landing of airships under conditions of poor visibility possible. Navigation methods and long-range radio communication were developed during the time from 1927 to 1945. G.R.

A83-17282#
THE INTRICATE PATTERNS OF STRESS
H. J. MACKE and T. D. SANT (General Electric Co., Aircraft Engine Business Group, Evendale, OH) Mechanical Engineering, vol. 104, Dec. 1982, p. 19-23. refs

The current uses of photoelastic analysis in the aerospace industry for the optimization of designs, for superposition studies, and for the analysis of complex three-dimensional stress concentrations and stress distributions are briefly reviewed. Consideration is given to the basic principles underlying photoelastic analysis, and specific photoelastic techniques are discussed with emphasis on two-dimensional transmission and three-dimensional stress freezing. The basic mathematics of photoelastic analysis is also presented. Analytical results obtained routinely from photoelastic analysis of three-dimensional stress-frozen models include interacting holes or other concentrations, sharp-edged holes versus radiused or chamfered holes, stress distributions across apparently two-dimensional concentrations, and two-dimensional versus three-dimensional (circular) concentrations of similar form. V.L.

A83-17316#
AEROELASTICITY OF HELICOPTER ROTORS IN FORWARD FLIGHT
C. T. TRAN, D. PETOT (ONERA, Chatillon-sous-Bagneux, Hauts-de-Seine, France), and D. FALCHERO (Societe Nationale Industrielle Aerospatiale, Marignane, Bouches-du-Rhone, France) La Recherche Aerospatiale, (English Edition), no. 4, 1982, p. 11-25. refs

The case of a prototype high speed propeller blade in forward flight is considered in light of the ONERA semiempirical model for dynamic stall unsteady aerodynamics in airfoils, as well as quasi-steady aerodynamics. Either of these aerodynamic methods is coupled with a method of structural modal representation. The aeroelastic equations thus derived are in the form of differential equations having periodic coefficients, which are then solved by the use of Floquet's theorem O.C.

A83-17532
TREATMENT OF LATE TIME INSTABILITIES IN FINITE-DIFFERENCE EMP SCATTERING CODES
L. T. SIMPSON, R. HOLLAND, and S. ARMAN (Mission Research Corp., Albuquerque, NM) (IEEE, DOD, NASA, and DOE, Annual Conference on Nuclear and Space Radiation Effects, 19th, Las Vegas, NV, July 20-22, 1982.) IEEE Transactions on Nuclear Science, vol. NS-29, Dec. 1982, p. 1943-1948. refs
(Contract N60921-81-C-0134)

Constraints applicable to a finite difference mesh for solution of Maxwell's equations are defined. The equations are applied in the time domain for computing electromagnetic coupling to complex structures, e.g., rectangular, cylindrical, or spherical. In a spatially varying grid, the amplitude growth of high frequency waves becomes exponential through multiple reflections from the outer boundary in cases of late-time solution. The exponential growth of the numerical noise exceeds the value of the real signal. The correction technique employs an absorbing surface and a radiating boundary, along with tailored selection of the grid mesh size. High frequency noise is removed through use of a low-pass digital filter, a linear least squares fit is made to thy low frequency filtered response, and the original, filtered, and fitted data are merged to preserve the high frequency early-time response. M.S.K.

A83-17724
ON THE POSSIBILITY OF BALANCING ROTATING FLEXIBLE SHAFTS
R. E. D. BISHOP (Brunel University, Uxbridge, England) Journal of Mechanical Engineering Science, vol. 24, Dec. 1982, p. 215-220. refs

The balancing of a flexible multidisc rotor supported on two bearings and employing two motorized balancing heads is discussed from a theoretical standpoint that differs significantly from that of Van de Vegte (1981), which modal analysis shows to be unnecessarily complicated. If certain bearing requirements are met, only one motorized balancing head becomes necessary, and neither the reference to discs nor the restriction to two bearings may be needed. It is necessary that the balancing head have provisions for antagonizing the balancing masses, and for rotating them continuously through equal and opposite angles. O.C.

A83-18383* Rensselaer Polytechnic Inst., Troy, N. Y.
NATURAL FREQUENCY OF ROTATING BEAMS USING NON-ROTATING MODES
R. G. LOEWY (Rensselaer Polytechnic Institute, Troy, NY) and N. KHADER American Helicopter Society, Journal, vol. 27, Apr. 1982, p. 75-78. refs
(Contract NAG3-37)

A Lagrangian approach is formulated for predicting the rotating natural frequencies of a beam from the nonrotating modes and frequencies. Using the first two nonrotating mode shapes in one case and the first four such modes in the other case the frequencies of the rotating modes are calculated for a short tapered beam and a typical helicopter blade, respectively. In each case the beam is represented by lumped parameters. The number of mass points representing the beam and the accuracy of the calculated slopes of the nonrotating mode shapes at those points are both shown to affect the accuracy of the resulting frequencies, but the number of stations is shown to be more important. (Author)

A83-18386* Maryland Univ., College Park.
DYNAMIC ANALYSIS OF CONSTANT-LIFT AND FREE-TIP ROTORS
I. CHOPRA (Maryland, University, College Park, MD) (Structures, Structural Dynamics and Materials Conference, 22nd, Atlanta, GA, April 6-8, 1981, and AIAA Dynamics Specialists Conference, Atlanta, GA, April 9, 10, 1981, Technical Papers. Part 2, p. 471-489.) American Helicopter Society, Journal, vol. 28, Jan. 1983, p. 24-33.
(Contract NCC2-13)
(Previously cited in issue 12, p. 2022, Accession no. A81-29479)

A83-18428#
MODEL ATTITUDE AND DEFORMATION MEASUREMENT IN WIND TUNNEL
J. SURGET (ONERA, Chatillon-sous-Bagneux, Hauts-de-Seine, France) (Reunion sur la Technologie Cryogenique, Amsterdam, Netherlands, Sept. 15, 1982.) ONERA, TP no. 1982-91, 1982. 16 p.
(ONERA, TP NO. 1982-91)

The use of a torsiometer and an optical transducer in ONERA wind tunnel research to quantify the wing deformations, and attitude changes of a model under test conditions, and probe positions, is described. The torsiometer measures the pitch or yaw angle of the model by application of penumbra photoelectric polarimetry. A target 100 mm in diam and 0.4 mm thick is placed on the model and laser light scattered from the target surface provides backscattering data, particularly rectilinear polarization which is directly related to surface movement of the model. Sensitivity of 1/1000 deg and accuracy to 1/100th deg has been demonstrated in tests. Angular and transverse displacement oscillations have been mapped. The optical position transducer functions by ascertaining the position of the pressure probes which are marked by optical fibers. A resolution of 0.1 mm has been shown in tests. M.S.K.

A83-18596
THE ANALYSIS OF OPERATIONAL STRESSES [ANALYSE DES SOLLICITATIONS DE SERVICE]
R. GREGOIRE (Centre d'Etude Technique des Industries Metallurgiques, Senlis, Oise, France) (Societe Francaise de Metallurgie, Journees de Printemps sur les Sollicitations en Service: Analyse et Simulation, Paris, France, May 11, 12, 1982.) Memoires et Etudes Scientifiques de la Revue de Metallurgie, vol. 79, Nov. 1982, p. 581-598. In French. refs

An analysis of the operational stresses encountered by aircraft during flight is presented in order to identify and quantify the statistical parameters which depict these stresses. The currently most utilized methods for computing operational stresses are examined, including methods for calculating the extremities, the number of overshoots of a given level, the extension-average pairs, and the extensions by cascade. The capacities of these methods for calculating the diverse parameters involved in operational stresses are determined. In addition, techniques for sampling and analog-digital conversion are analyzed. N.B.

A83-18643
A NOVEL PRECISE METHOD OF MEASURING THE EFFICIENCY OF ARBITRARY LOW-GAIN ANTENNAS
R. J. CHIGNELL, G. Y. PHILIPPOU, and R. BUSTAMANTE (ERA Technology, Ltd., Leatherhead, Surrey, England) In: International Conference on Antennas and Propagation, 2nd, York, England, April 13-16, 1981, Proceedings. Part 1. London, Institution of Electrical Engineers, 1981, p. 237-240. Research supported by the Ministry of Defence (Procurement Executive). refs

A precise method is developed for measuring the efficiency of arbitrary low-gain antennas. The multipole expansion coefficients of the antenna are first derived from Spherical Near Field Scanning measurements and are then employed to generate an accurate but general network model of the antenna's mutual impedance properties. The antenna is totally characterized and the efficiency is determined by means of an additional set of measurements employing a reflecting screen. The measurement results for a lossy aircraft blade antenna are presented. It is found that the theoretical and measured results for this aircraft blade antenna, having an efficiency of 42%, do not precisely agree at all points, although the maximum spread in results corresponds to a variation in efficiency from 38% to 46%. N.B.

A83-18679
SYNTHESIS OF CONFORMAL HF AND VHF DIRECTIONAL ARRAYS ON SPHERICAL BODIES USING SURFACE RESONATOR TECHNIQUES
W. L. JONES (Marconi Space and Defence Systems, Ltd., Stanmore, Middx., England) and J. R. JAMES (Royal Military College of Science, Shrivenham, Wilts., England) In: International Conference on Antennas and Propagation, 2nd, York, England, April 13-16, 1981, Proceedings. Part 1. London, Institution of Electrical Engineers, 1981, p. 433-437. Research supported by the Ministry of Defence (Procurement Executive). refs

A new technique involving the use of low-profile surface resonators that are similar to microstrip patch antennas and are conformal with the body surface is investigated. It is shown that the proposed technique offers good control over radiation patterns and takes full advantage of the directivity available from a body of a given size, while avoiding either significant interference with the interior of the body or large protrusions. The technique is expected to find application in narrow band systems on vehicles where a low-profile system is desirable, e.g., for spacecraft telemetry and remotely piloted vehicles. V.L.

A83-18692
RADIATION CHARACTERISTICS OF RADIAL WAVEGUIDE FED SLOT ARRAYS OF VARIOUS SHAPES
F. RAHMAN, L. SHAFAI, and E. BRIDGES (Manitoba, University, Winnipeg, Canada) In: International Conference on Antennas and Propagation, 2nd, York, England, April 13-16, 1981, Proceedings. Part 1. London, Institution of Electrical Engineers, 1981, p. 501-503. refs

It is demonstrated that the slot shapes could be made a parameter in order to achieve a desired radiation pattern. Results are presented showing an alternate form of a radial waveguide fed array producing radiation in the axial direction. With photo etching techniques, arrays of crescents (or any shape) can easily be formed. Owing to the simplified feed, an array of crescents will be simple and less expensive to operate in comparison with an array of uniform thickness with TM(01) excitation. C.R.

A83-18725
MULTIPLE DIFFRACTION EFFECTS IN VHF PROPAGATION
M. L. MEEKS and R. W. REED (MIT, Cambridge, MA) In: International Conference on Antennas and Propagation, 2nd, York, England, April 13-16, 1981, Proceedings. Part 2. London, Institution of Electrical Engineers, 1981, p. 154-157. DARPA-sponsored research.

VHF Omnidirectional Range (VOR) signal strength was investigated as a function of height using a helicopter, and the resulting measurements are used to evaluate computer-based propagation models that predict the signal strength over specified terrain profiles. Propagation measurements were made in the vicinity of the VOR station at Gardner, MA, about 80 km west of Boston. Terrain profiles for the six propagation paths are shown. The signal power propagated over each path was measured during the vertical descent of the helicopter over each end point. Single and multiple knife-edge propagation models, which account for diffraction effects by Fresnel theory and a generalized Deygout (1966) method, are presented. Comparisons of measurements and model predictions are made, showing the propagation paths and the deviations between measurements and the predicted curves for both models, as well as received power measurements and model predictions. C.D.

A83-19312
THE EFFECT OF AERODYNAMIC COUPLING BETWEEN THE BLADES OF A CASCADE ON THE AERODYNAMIC DAMPING OF BLADE VIBRATIONS AND THE ONSET OF BLADING FLUTTER [VLIIANIE AERODINAMICHESKOI SVIAZNOSTI MEZHDU LOPATKAMI RESHETKI NA AERODEMPFIROVANIE IKH KOLEBANII I VOZNIKNOVENIE RESHETOCHNOGO FLATTERA]
A. A. KAMINER and A. L. STELMAKH (Akademiia Nauk Ukrainskoi SSR, Institut Problem Prochnosti, Kiev, Ukrainian SSR) Problemy Prochnosti, Dec. 1982, p. 74-77. In Russian.

A systematic analysis of experimental data on aerodynamic damping and flexural vibration generation in the blading as a function of phase shifts between the adjacent blades shows that the aeroelastic phenomena in a vibrating cascade are largely determined by the aerodynamic coupling of the blades. Particular attention is given to the aerodynamic coupling of the blades in nonseparated and separated flows with the Strouhal number tending to zero. As the Strouhal number decreases or the angle of attack increases, the aerodynamic coupling of the blades is shown to increase, leading, under certain combinations of the above parameters, to blading flutter. V.L.

A83-19313
PREVENTING THE STRENGTH FAILURE OF MACHINES BY VIBRODIAGNOSTIC TECHNIQUES. I [PREDUPREZHDENIE PROCHNOSTNYKH OTKAZOV MASHIN VIBRODIAGNOSTICHESKIMI METODAMI. I]
V. A. KARASEV and A. B. ROITMAN Problemy Prochnosti, Dec. 1982, p. 78-81. In Russian. refs

The existing vibrodiagnostic methods are reviewed with particular reference to failure prevention during the operation of large parks of complex machinery (e.g., gas-turbine engines or aircraft). A general approach to the problem of failure prevention is developed whereby simplified mathematical models of vibrations in dynamic systems are used in conjunction with detailed experimental data for individual pieces of machinery to derive information on the early indications of a possible failure and evaluate the conditions of the entire park. On the other hand, failure statistics for the park as a whole and diagnostic results are used in a feedback mode for the correction of the models used. V.L.

A83-19314
PREVENTING THE STRENGTH FAILURE OF MACHINES BY VIBRODIAGNOSTIC METHODS. II - THE USE OF VIBRODIAGNOSTICS FOR PREVENTING THE FAILURE OF CERTAIN PARTS AND ASSEMBLIES OF GAS-TURBINE ENGINES [PREDUPREZHDENIE PROCHNOSTNYKH OTKAZOV MASHIN VIBRODIAGNOSTICHESKIMI METODAMI. II - ISPOL'ZOVANIE VIBRODIAGNOSTIKI DLIA PREDOTVRASHCHENIIA RAZRUSHENIIA NEKOTORYKH DETALEI I UZLOV GAZOTURBINNYKH DVIGATELEI]
V. A. KARASEV, I. D. KOSTIN, and A. B. ROITMAN Problemy Prochnosti, Dec. 1982, p. 81-86. In Russian.

The use of vibrodiagnostic techniques for preventing the failure of complex machinery is demonstrated by two examples where vibrodiagnostic techniques are used to evaluate the condition of the conical gears of a reducer and to determine the dynamic loading of a gas-turbine engine due to the effect of a planetary reduction gear. It is shown that the use of vibrodiagnostic techniques makes it possible to accurately establish the origin of a defect, to determine the relative contribution of the analyzed factors to the development of the defect, to eliminate the defect or increase the average number of hours of operation before the defect (failure) develops, to reduce the severity of the defect (failure) during operation under heavy-duty conditions, and to select the most efficient way of eliminating the defect. V.L.

A83-19620#
BENDING VIBRATIONAL BEHAVIOR OF LAMINATED ROTORS [DAS BIEGESCHWINGUNGSVERHALTEN VON ROTOREN, DIE MIT BLECHPAKETEN BESETZT SIND]
G. SIEGL Berlin, Technische Universitaet, Fachbereich Physikalische Ingenieurwissenschaft, Dr.-Ing. Dissertation, 1981. 200 p. 41 refs. In German.

A generally valid material law is obtained for a loaded laminated rotor. The elasticity and damping characteristics of the lamination packet are experimentally obtained and the material law is derived, studying the deformation mechanism of the packet, developing its elastic line, and introducing nonlinear and linear material models. This involves the use of partial models and full multiple-element models. Rotor models and equations of motion are examined, including the determination of the Laval wave, the restoring and damping forces, the restoring vector and frictive cutting load vector, and the normalization of the equations of motion. The equations of motion of the Laval wave and of the continuous rotor in the materials model are treated. The behavior of the Laval wave for a nonlinear material law is analytically and numerically investigated for a nonrotating wave without weight influence and for a rorating wave with and without weight influence and eccentricity. Finally, the behavior of the Laval wave and a continual rotor for a linear material law is similarly examined. C.D.

N83-14369# Army Aviation Research and Development Command, St. Louis, Mo.
IMPROVED AIRBORNE HF RECEIVE ANTENNA: AN ILIR REPORT Fiscal Year, 1981
J. F. BRUNE and J. G. GRATALO Jul. 1982 46 p refs (AD-A118861; USAAVRADCOM-TR-81-3) Avail: NTIS HC A03/MF A01 CSCL 09E

An investigation of improvement of signal-to-noise ratio in an Airborne High Frequency Single Sideband (HF SSB) system by use of an 'active', dedicated, receive antenna function, in addition to a combination transmit/receive mode now commonly provided (shorted-loop). The approach described is an optional receive mode of the shorted-loop antenna, where electronic tuning, a stage of RF gain and a stage of matching is provided in lieu of passive tuned function normally provided by the HF SSB amp/coupler. The results obtained in this study show a possible improvement of 5 to 10 dB in the signal-to-noise ratio over the passively tuned antenna. This translates in raising an intelligibility reading of a 2 to 5. It is anticipated that this improved sensitivity can provide a doubling of the width of the 'window' in some cases. A second advantage is to permit very rapid scanning over a broad range of frequencies within a portion of the 2-30 MHz HF Band while using

a 'High Q' device. The present shorted-loop design is passively tuned by cumbersome mechanically driven capacitors, thus preventing a rapid receive scan mode. Author (GRA)

N83-14387# Army Avionics Research and Development Activity, Fort Monmouth, N. J.
ELECTRONIC VOICE COMMUNICATIONS IMPROVEMENTS FOR ARMY AIRCRAFT
M. S. MAYER Aug. 1982 21 p refs
(AD-A119427; USAAVRADCOM-TR-81-E-1) Avail: NTIS HC A02/MF A01 CSCL 17B

The communications systems on all Army aircraft flying today are based on design concepts that are over 50-years old. We have designed a totally modern, state-of-the-art communications system for Army aircraft, and have published two new specifications which contain many of the modern test procedures required to accurately test and evaluate the various components of the communication system. As a first step in the development of new test procedures, we evaluated both ASA and ANSI standards and found them lacking. The components of the new state-of-the-art communications system will include, as a minimum: high impedance DC powered noise canceling microphones (using piezoelectric ceramic, electret, or PVF2 diaphragms); earphone elements designed and tested to have flat frequency response when inside the circumaural earcup of the hearing protective device; and intercoms which replace positive peak-clipping with fast-acting AGC circuits and expander/compander circuits for maximum output signal without distortion, even under conditions of extremes stress. In the future, audio signals in the microphone will be converted into the digital mode or directly into the optical spectrum for high efficiency, and secure communications inside the aircraft. The savings in weight and security improvements will be considerable. GRA

N83-14388# Naval Postgraduate School, Monterey, Calif.
ATMOSPHERIC EFFECTS ON ULTRA HIGH FREQUENCY RADIO PROPAGATION M.S. Thesis
J. C. BOUDREAUX, III Jun. 1982 88 p refs
(AD-A119581) Avail: NTIS HC A05/MF A01 CSCL 20N

The dependence of received power on range within and below atmospheric ducts was measured in conditions of elevated, nonhomogeneous, multilayered ducts. An aircraft with UHF transmitter covered the range 0 to 150 nm. from a shore based receiver. Range dependent maxima and minima in received power were detected at the surface in elevated duct conditions. The results were compared to predictions from ray, waveguide multi-mode, and single mode theories. Ray and single mode theories were inadequate to predict power patterns over the horizon. Multi-mode theory yielded qualitative agreement for conditions of deep, low elevated ducts. Agreement for higher, thinner, ducts was poor. Multilayered duct systems were observed and produced interference patterns without recognizable period with range. Author (GRA)

N83-14430*# Arizona State Univ., Tempe. College of Engineering and Applied Sciences.
WAKES FROM ARRAYS OF BUILDINGS Final Report
E. LOGAN, JR. and S. H. LIN Nov. 1982 127 p refs
(Contract NAS8-34318)
(NASA-CR-170666; NAS 1.26:170666) Avail: NTIS HC A07/MF A01 CSCL 20D

Experiments were carried out in a small wind tunnel in which atmospheric flow around buildings was simulated. Arrays of one, two, three, and four model buildings were tested, and wake profiles of velocity and turbulence were measured. The data indicate the effect of the buildings on the wind environment encountered by aircraft during landing or takeoff operations. It was possible to use the results to locate the boundaries of the air regions affected by the obstacles and to recommend preferred arrangements of buildings to maximize light safety. Author

N83-14432*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MEASURED AND CALCULATED WALL TEMPERATURES ON AIR-COOLED TURBINE VANES WITH BOUNDARY LAYER TRANSITION
C. H. LIEBERT, R. E. GAUGLER, and H. J. GLADDEN 1982 12 p refs Proposed for presentation at the 28th Ann. Intern. Gas Turbine Conf., Phoenix, Ariz., 27-31 Mar. 1983; sponsored by ASME
(NASA-TM-83030; E-1466; NAS 1.15:83030) Avail: NTIS HC A02/MF A01 CSCL 20D

Convection cooled turbine vane metal wall temperatures experimentally obtained in a hot cascade for one vane design were compared with wall temperatures calculated with TACT1 and STAN5 computer codes which incorporated various models for predicting laminar-to-turbulent boundary layer transition. Favorable comparisons on both vane surface were obtained at high Reynolds number with only one of these transition models. When other models were used, temperature differences between calculated and experimental data obtained at the high Reynolds number were as much as 14 percent in the separation bubble region of the pressure surface. On the suction surface and at lower Reynolds number, predictions and data unsatisfactorily differed by as much as 22 percent. Temperature differences of this magnitude can represent orders of magnitude error in blade life prediction. Author

N83-14521*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
CORRELATION AND ASSESSMENT OF STRUCTRURAL AIRPLANE CRASH DATA WITH FLIGHT PARAMETERS AT IMPACT
H. D. CARDEN Nov. 1982 44 p refs
(NASA-TP-2083; L-15431; NAS 1.60:2083) Avail: NTIS HC A03/MF A01 CSCL 20K

Crash deceleration pulse data from a crash dynamics program on general aviation airplanes and from transport crash data were analyzed. Structural airplane crash data and flight parameters at impact were correlated. Uncoupled equations for the normal and longitudinal floor impulses in the cabin area of the airplane were derived, and analytical expressions for structural crushing during impact and horizontal slide out were also determined. Agreement was found between experimental and analytical data for general aviation and transport airplanes over a relatively wide range of impact parameter. Two possible applications of the impulse data are presented: a postcrash evaluation of crash test parameters and an assumed crash scenario. E.A.K.

N83-14523*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MEASUREMENTS OF SELF-EXCITED ROTOR-BLADE VIBRATIONS USING OPTICAL DISPACEMENTS
A. P. KURKOV 1982 13 p refs Proposed for presentation at the 28th Ann. Intern. Gas Turbine Conf., Phoenix, Ariz., 27-31 Mar. 1983
(NASA-TM-82953; E-1368; NAS 1.15:82953) Avail: NTIS HC A02/MF A01 CSCL 20K

The characteristics of optical displacement spectra and their role of monitoring rotor blade vibrations are discussed. During the operation of a turbofan engine at part speed, near stall, and elevated inlet pressure and temperature, several vibratory instabilities were excited simultaneously on the first fan rotor. The torsional and bending contributions to the main flutter mode were resolved by using casing-mounted optical displacement sensors. Other instabilities in the blade deflection spectra were identified. E.A.K.

N83-14530# Rockwell International Corp., El Segundo, Calif. Aircraft Div.

A USERS MANUAL FOR A DETAILED LEVEL FATIGUE CRACK GROWTH ANALYSIS COMPUTER CODE. VOLUME 1: THE CRKGRO PROGRAM Final Report, 16 Jan. 1979 - 30 Nov. 1981

J. B. CHANG, M. SZAMOSSI, and K. W. LIU Wright-Patterson AFB, Ohio AFWAL Nov. 1981 149 p refs 2 Vol.
(Contract F33615-77-C-3121; AF PROJ. 2401)
(AD-A118968; NA-81-148; AFWAL-TR-81-3093-VOL-1) Avail: NTIS HC A07/MF A01 CSCL 09B

This report presents the description of a computer program which was developed to perform detailed fatigue crack-growth analysis on a cycle-by-cycle basis. This program is a two-dimensional crack-growth computer routine. An improved load interaction model which accounts for both the retardation and acceleration effects of the spectrum loading was implemented in the program. This program contains a crack library which consists of 10 subroutines, each containing a specific stress intensity factor solution for a specific crack geometry. The program provides the option for counting the cycles for spectrum loadings through the range-pair counting routine built into the program. It also provides the option to perform parametric studies. Author (GRA)

N83-14531# Rockwell International Corp., El Segundo, Calif. Aircraft Div.

A USER'S MANUAL FOR A COMPUTER PROGRAM TO PREDICT FATIGUE CRACK GROWTH ON FLIGHT-BY-FLIGHT BASIS (FLTGRO) Final Report, Jan. 1979 - Nov. 1981

J. B. CHANG, M. SZAMOSSI, and K. W. LIU Wright-Patterson AFB, Ohio AFWAL Nov. 1981 104 p refs
(Contract F33615-77-C-3121; AF PROJ. 2401)
(AD-A118965; REPT-NA-81-258; AFWAL-TR-81-3094) Avail: NTIS HC A06/MF A01 CSCL 09B

This report presents the description of a computer code which uses the spectrum characterization method to first convert the random flight spectrum into the equivalent constant-amplitude loading, either one-cycle-per-flight or multisegment-per-flight, and then perform damage accumulation using the linear approximation method. A large saving on computer cost can be achieved by using this program. GRA

N83-14532# Rockwell International Corp., El Segundo, Calif. Aircraft Div.

REVISED STRUCTURAL TECHNOLOGY EVALUATION PROGRAM (STEP) USER'S MANUAL FOR STRUCTURAL SYNTHESIS Final Report, Jan. 1979 - Nov. 1981

J. B. CHANG and R. HIYAMA Wright-Patterson AFB, Ohio AFWAL Nov. 1981 171 p refs
(Contract F33615-77-C-3121; AF PROJ. 2401)
(AD-A118964; AFWAL-TR-81-3095) Avail: NTIS HC A08/MF A01 CSCL 01C

This report presents the description of a structural synthesis program used within the Structural Technology Evaluation Program (STEP). This program is the revised version of APAS III (Automated Pre-Design of Aircraft Structure). The reversion includes implementation of a fatigue crack-growth analysis methodology which realistically accounts for the spectrum load interaction effects to crack growth. Additional work was to add to the program the capability of producing fighter aircraft load spectra.
Author (GRA)

N83-14543# Dayton Univ., Ohio.

A MODEL FOR PREDICTION BIRD AND ICE IMPACT LOADS ON STRUCTURES Interim Report, 1 Oct. 1977 - 31 Nov. 1979

L. I. BOEHMAN and A. CHALLITA Wright-Patterson AFB, Ohio AFWAL May 1982 96 p refs
(Contract F33615-77-C-5221; AF PROJ. 3066)
(AD-A119408; UDR-TR-79-54; AFWAL-TR-82-2046) Avail: NTIS HC A05/MF A01 CSCL 20D

This report describes a loading model for computation of the pressure distribution exerted on surfaces during bird and ice impacts. Bird and ice impacts are considered as fluid dynamic in nature and are modeled as fluid jets impinging on arbitrarily shaped three dimensional deformable surfaces. A quasi-steady, potential flow analysis is applied to the jet impact problem thereby reducing the impact problem to the problem of solving Laplace's equation. The surface singularity technique is used to solve Laplace's equation. A computer program for computing pressure distributions on both rotating and non-rotating turbine engine components is described. A model for treating slicing of birds and ice by rotating blades is incorporated into this computer program. The loading model computer program is specifically developed to be interfaced with finite-element structural analysis computer programs. Given the instantaneous impacted surface shape and displacement velocity the loading model computer program computes the pressure distribution existing on the impacted surface. The shape of the impact surface is fed to the loading model in the form of finite element surface nodal point coordinates. From this information, the loading model computer program constructs a system of quadrilateral elements covering the impacted surface.
GRA

N83-15506# Defence Research Establishment Pacific, Victoria (British Columbia).

DETECTION AND DIAGNOSIS OF BEARING DETERIORATION IN AIRCRAFT PROPULSION SYSTEMS BY WEAR DEBRIS ANALYSIS

C. A. WAGGONER *In* AGARD Probl. in Bearings and Lubrication 13 p Aug. 1982 refs
Avail: NTIS HC A20/MF A01

Aspects of wear revealed by advanced analytical methods, and the manner in which these methods are being successfully applied to detect and diagnose bearing deterioration in aircraft propulsion machinery are reviewed. Author

N83-15507# Pratt and Whitney Aircraft, East Hartford, Conn. Commercial Products Div.

INCREASING THE WEAR LIFE OF GAS TURBINE ENGINE ROLLER BEARINGS

P. F. BROWN, L. J. DOBEK, M. J. CARRANO, R. A. VALORI (Naval Air Propulsion Center, Trenton), and R. D. DAYTON (AFWAL) *In* AGARD Probl. in Bearings and Lubrication 14 p Aug. 1982 refs
Avail: NTIS HC A20/MF A01

Life limiting roller end wear of the eccentric type, which ultimately results in cage failure, was demonstrated in high speed rig tests to levels of 3.0 MDN. Seventeen parameters having the potential for influencing the skew action of the roller and its end wear were selected for experimental evaluation on a series of 124 mm experimental roller bearings. The corresponding statistical test plan is described and the essentials of a mathematical model are covered that ultimately defines the motion of the roller and its interaction with other parts of the bearing. The test results showed roller corner radius runout as having the most influence on wear with roller length to diameter ratio and end clearance demonstrating modest effects. Author

N83-15510# SKF Engineering and Research Centre, Nieuwegein (Netherlands). Material Development Dept.

LIGHTWEIGHT MATERIALS FOR ROLLING ELEMENTS IN AIRCRAFT BEARINGS

R. T. CUNDILL and F. GIORDANO (RIV-SKF Industrie S.p.A.) *In* AGARD Probl. in Bearings and Lubrication 10 p Aug. 1982 refs
Avail: NTIS HC A20/MF A01

Using in-house experience with powder metallurgy, two approaches in the development of lightweight rolling elements were followed. Balls were made from both silicon nitride and proprietary composite material using process routes based on hot isostatic compaction. The composite material consisted of titanium carbide in a superalloy matrix and the finished balls had densities of 5.4 to 5.75 g/cc with hardness values above 1500 Hv. The performance of silicon nitide balls was compared with that of T1 tool steel balls in a test in which two mainshaft bearings were run at progressively increasing loads and speeds. Inspection after testing

showed that there was much less distortion of raceway profiles in the bearing with silicon nitride balls indicating better kinematic behavior. As a consequence, the silicon nitride balls showed little change in physical form, whereas there was marked deterioration of the tool steel balls for the bearing design and test conditions considered. Author

N83-15523*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LUBRICANT EFFECTS ON EFFICIENCY OF A HELICOPTER TRANSMISSION
A. M. MITCHELL and J. J. COY (AVRADCOM) *In* AGARD Probl. in Bearings and Lubrication 14 p Aug. 1982 refs
Avail: NTIS HC A20/MF A01 CSCL 11H

Efficiency tests were conducted using eleven different lubricants in the NASA Lewis Research Center's 500 hp torque regenerative helicopter transmission test stand. The test transmission was the OH58A helicopter main transmission. The mechanical power input to the test transmission was 224 kW (300 hp) at 6060 rpm. Tests were run at oil-in temperatures of 355 K (180 F) and 372 K (210 F). The efficiency was calculated from a heat balance on the water running through an oil-to-water heat exchanger while the transmission was heavily insulated. The following results were obtained: (1) Among the eleven different lubricants, the efficiency ranged from 98.3 to 98.8 percent, which is a 50 percent variation relative to the losses associated with the maximum efficiency measured; (2) For a given lubricant, the efficiency increased as temperature increased and thus a viscosity decreased. There were two exceptions which could not be explained on the basis of available data; (3) Between lubricants, efficiency was not correlated with viscosity. There were relatively large variations in efficiency with the different lubricants whose viscosity generally fell in the 5 to 7 centistoke range; and (4) The lubricants had no significant effect on the vibration signature of the transmission. Author

N83-15529# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Stuttgart (West Germany). Inst. fuer Technische Physik.
BEHAVIOR OF AIRCRAFT ENGINE OILS AT HIGH TEMPERATURE
E. JANTZEN *In* AGARD Probl. in Bearings and Lubrication 11 p Aug. 1982 refs
Avail: NTIS HC A20/MF A01

Higher temperatures in current and future aircraft engines which lead to a stronger thermal and oxydative attack of the engine oils were examined. The reversible and irreversible change of the engine oil is reported and the influence of hot surfaces on aircraft engine oils is shown. Different types of deposits, their properties, and the current knowledge about the influencing parameters are reported. Possibilities to avoid deposit formation are shown.
E.A.K.

N83-15530*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL AND ANALYTICAL DETERMINATION OF GEAR TOOTH TEMPERATURES WITH OIL JET LUBRICATION
D. P. TOWNSEND and L. S. AKIN (Western Gear Corp.) *In* AGARD Probl. in Bearings and Lubrication 14 p Aug. 1982 refs Presented at the ASME 3rd Intern. Power Transmission and Gearing Conf., San Francisco, 18-22 Aug. 1980
Avail: NTIS HC A20/MF A01

Gear tooth average and instantaneous surface temperatures were measured with a fast response infrared radiometric microscope, while operating at arious speeds, loads and oil jet pressures. Increased oil jet pressure had a significant effect on both average and peak surface temperatures at all test conditions, increasing the speed at constant load and increasing the load at constant speed causes a significant rise in average and peak surface temperatures of gear teeth. A gear tooth temperature analysis was conducted by a finite element method combined with a calculated heat input and oil jet impingment depth with estimated heat transfer coefficients based on the experimental data. It is concluded that oil jet pressures required for adequate cooling at high load and speed conditions must be high enough to get full penetration depth of the teeth. E.A.K.

N83-15533# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Dept. Chemin.
THE ACTIDYNE ACTIVE MAGNETIC BEARING [LE PALIER MAGNETIQUE ACTIF ACTIDYNE]
H. HABERMANN *In its* Probl. in Bearings and Lubrication 9 p Aug. 1982 refs In FRENCH
Avail: NTIS HC A20/MF A01

The active magnetic bearing which is based on the utilization of a force developed by a magnetic field, to maintain a rotor by magnetic lifting without mechanical contact between the fixed and the moving parts is discussed. It is necessary to have two electromagnets which only work by gravitation to control a degree of freedom. Controls obtained by application of tension makes fast separation unnecessary. E.A.K.

N83-15537# Karlsruhe Univ. (West Germany). Inst. fuer Maschinenkonstruktionslehre.
AERODYNAMIC COMPLIANT BEARINGS FOR SMALL TURBO-ENGINES
M. EHINGER, J. GLIENICKE, and H. HUNGER *In* AGARD Probl. in Bearings and Lubrication 13 p Aug. 1982 refs Sponsored in part by Bundesministerium fuer Wirtschaft
Avail: NTIS HC A20/MF A01

Aerodynamic spring bearings, the elastic bearing bushing structure of which can stand thermal deformations without any inadmissably large changes in the bearing clearance were investigated. The spring bearings be suitable for the mounting of small turbo machines under extreme operating conditions. A method to determine the static and dynamic spring bearing characteristic curves was developed and applied to the tilting pad, 'Garrett' and multiwedged spring bearing. In the static and dynamic bearing characteristic curves determined in this way the parameters of the resilient bearing bushing structure are dominant over wide ranges. The applicability of these hearings to extreme circumferential speeds. The reliability of the calculated bearing characteristic values is shown. E.A.K.

N83-15538# Garrett Turbine Engine Co., Phoenix, Ariz.
HIGH-TEMPERATURE (649 DEG C/1200 DEG F) COATINGS FOR GAS-LUBRICATED FOIL BEARINGS OF THE NAVY'S ADVANCED AUXILIARY POWER UNIT CONCEPTS
F. J. SURIANO, R. J. KEISER, F. G. WOESSNER (Naval Air Propulsion Center, Trenton), and R. VALORI (Naval Air Propulsion Center, Trenton) *In* AGARD Probl. in Bearings and Lubrication 17 p Aug. 1982 refs
Avail: NTIS HC A20/MF A01

The materials development task and the identified coatings for high temperatures are described. In a high temperature foil bearing development effort a separate materials task was directed at identifying and developing coatings and coatings combinations for use in a turbine end journal foil bearing of an advanced design auxiliary power unit. The coatings are required to operate in thermal environments up to 649 C. E.A.K.

N83-15540# Pisa Univ. (Italy). Ist. di Macchine.
APPLICATION OF DYNAMIC GAS BEARINGS TO CRYOGENIC COMPRESSORS AND TURBINES
G. NARDI *In* AGARD Probl. in Bearings and Lubrication 7 p Aug. 1982 refs
Avail: NTIS HC A20/MF A01

A design of dynamic gas bearing containing tilting pads, for cryogenic compressor and turbine applications, is discussed. The bearing system has no gas input during normal operation to prevent entirely the exchange of hot and cold gas. A pressure increase is generated in the wedge shaped gas film between the shaft and the pad. A portion of the gas stream flowing through the wedge is introduced through the pad into the gas between the pad and the pad housing. In this manner, the pressure in the gap is a factor of the pressure in the wedge. The pad is completely surrounded by a gas film. It adjusts itself automatically in

accordance with the equilibrium of the forces. The angle of incidence of the pads is determined by the equilibrium of torques relative to the axis of rotation of the pad. It is shown that the gas bearing offer the advantage of improved reliability because no control system is necessary. E.A.K.

N83-15558# Lowell Univ., Mass. Center for Atmospheric Research.
MEASURING THE ANTENNA PATTERN OF THE HF HEATER ANTENNA IN PUERTO RICO
B. W. REINISCH, R. W. GOWELL, J. G. MOORE, J. B. WAARAMAA, and R. R. GAMACHE Hanscom AFB, Mass. AFGL Mar. 1982 43 p refs
(Contract F19628-80-C-0064; AF PROJ. 4643)
(AD-A119963; ULRF-419/CAR; SR-3; AFGL-TR-82-0123) Avail: NTIS HC A03/MF A01 CSCL 09E

The radiation pattern of the 4 x 8 element array of the Arecibo HF heater antenna was measured with a Digisonde onboard AFGL's KC 135 airplane. With seven flight tracks over the antenna array at an altitude of 8840 m it was verified that the radiation pattern of the heater antenna is in good agreement with the calculations. The measurements were conducted at 5.1 MHz. Author (GRA)

N83-15570# Ohio State Univ., Columbus. Electroscience Lab.
AN ALGORITHM TO SELECT ELEMENT LOCATIONS OF AN ADAPTIVE ARRAY Interim Report, Sep. 1980 - Sep. 1981
I. J. GUPTA and W. D. BURNSIDE Griffiss AFB, N.Y. RADC Jun. 1982 47 p refs
(Contract F30602-79-C-0068; AF PROJ. 4519)
(AD-A120486; ESL-711679-7; RADC-TR-82-184) Avail: NTIS HC A03/MF A01 CSCL 20N

An algorithm is presented which provides the appropriate element placement of an adaptive array such that the output signal-to-interference-plus-noise ratio (SINR) of the array is above a given threshold for all desired and interference signal directions. The algorithm is used to find interelement spacings of a linear as well as a conformal array. It is shown that the structure (scattered field) affects the performance of an adaptive array mounted on a complex structure such as an aircraft fuselage. A method to take care of these effects is presented. GRA

N83-15627*# Detroit Diesel Allison, Indianapolis, Ind.
ADVANCED GAS TURBINE (AGT) POWER-TRAIN SYSTEM DEVELOPMENT Semiannual Report, 1 Jul. - 31 Dec. 1981
H. E. HELMS, R. A. JOHNSON, and R. K. GIBSON Feb. 1982 65 p refs Sponsored in cooperation with DOE
(Contract DEN3-168)
(NASA-CR-167875; DOE/NASA/0168-82/4; DDA-EDR-10977; NAS 1.26:167875; SAR-4) Avail: NTIS HC A04/MF A01 CSCL 13I

Technical work on the design and component testing of a 74.5 kW (100 hp) advanced automotive gas turbine is described. Selected component ceramic component design, and procurement were tested. Compressor tests of a modified rotor showed high speed performance improvement over previous rotor designs; efficiency improved by 2.5%, corrected flow by 4.6%, and pressure ratio by 11.6% at 100% speed. The aerodynamic design is completed for both the gasifier and power turbines. Ceramic (silicon carbide) gasifier rotors were spin tested to failure. Improving strengths is indicated by burst speeds and the group of five rotors failed at speeds between 104% and 116% of engine rated speed. The emission results from combustor testing showed NOx levels to be nearly one order of magnitude lower than with previous designs. A one piece ceramic exhaust duct/regenerator seal platform is designed with acceptable low stress levels. E.A.K.

N83-15629*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ROTORDYNAMIC INSTABILITY PROBLEMS IN HIGH-PERFORMANCE TURBOMACHINERY
Washington Dec. 1982 460 p refs Workshop held in College Station, Tex., 10-12 May 1982; sponsored by Texas A and M Univ. and the Army Research Office
(NASA-CP-2250; E-1287; NAS 1.55:2250) Avail: NTIS HC A20/MF A01 CSCL 13I

Rotor dynamic instability problems in high performance turbomachinery are reviewed. Mechanical instability mechanisms are discussed. Seal forces and working fluid forces in turbomachinery are discussed. Control of rotor instability is also investigated.

N83-15630*# Southwest Research Inst., San Antonio, Tex.
ROTORDYNAMIC INSTABILITY FIELD PROBLEMS
J. C. WACHEL *In* NASA. Lewis Research Center Rotordyn. Instability Probl. in High-Performance Turbomachinery p 1-19 Dec. 1982 refs
Avail: NTIS HC A20/MF A01 CSCL 13I

Vibration data obtained during several rotor instability investigations is presented to illustrate the effect of changes in system parameters on overall rotor stability. The data includes the effects of bearing and seal changes as well as those due to variations in speed and pressure ratio. Field Problems indicate that the stability of rotors is often highly sensitive to fairly minor variations in bearing and seal parameters. Measured field data is valuable in normalizing analytical computer models so that effective solutions can be obtained. Author

N83-15631*# Radian Corp., Austin, Tex.
FIELD EXPERIENCES WITH RUB INDUCED INSTABILITIES IN TURBOMACHINERY
D. G. GOGGIN *In* NASA. Lewis Research Center Rotordyn. Instability Probl. in High-Performance Turbomachinery p 20-32 Dec. 1982 refs Sponsored by Hartford Steam Boiler Inspection and Insurance Co.
Avail: NTIS HC A20/MF A01 CSCL 13I

Rotordynamic instability problems are not uncommon in high speed industrial turbomachinery. One type of the many destabilizing forces that can occur is caused by a rub between the stationary and rotating parts. Descriptions are given of several cases of rub induced instabilities. Included in the descriptions are the conditions at onset, the whirl frequency and direction, and the steps taken to eliminate the problem. Author

N83-15632*# Failure Analysis Associates, Palo Alto, Calif.
ANALYSIS OF A TURBINE ROTOR CONTAINING A TRANSVERSE CRACK AT OAK CREEK UNIT 17
G. W. ROGERS, C. A. RAU, JR., J. J. KOTTKE (Wisconsin Electric Power Co., Milwaukee), and R. H. MENNING (Wisconsin Electric Power Co., Milwaukee) *In* NASA. Lewis Research Center Rotordyn. Instability Probl. in High-Performance Turbomachinery p 33-44 Dec. 1982 refs
Avail: NTIS HC A20/MF A01 CSCL 13I

Transient increases in one, two and three per revolution vibration characteristics of a low pressure steam turbine were observed during steam temperature reduction operations. Vibration and fracture mechanics analyses suggested the presence of a transverse shaft crack which was eventually identified by ultrasonic inspection and confirmed by destructive sectioning. Signature analyses of vibration data recorded over a two-year period prior to crack identification are correlated with fatigue crack growth, which occurred intermittently during transient temperature decreases. The apparent increased response of the rotor to vibration is due to asymmetric stiffness changes introduced by the growing transverse crack. The vibration response is predicted to increase with increasing crack depths in excess of 10% of the shaft diameter. Fracture mechanics analyses predict that fatigue crack growth occurred during periods of steam temperature decrease, when high surface tensile stresses are present. These same transient thermal stresses are shown to have retarded and

prevented subsequent fatigue crack growth during steady operation. Author

N83-15634*# Ingersoll-Rand Co., Phillipsburg, N. J.
INSTABILITIES OF GEARED COUPLINGS: THEORY AND PRACTICE
R. G. KIRK, R. E. MONDY, and R. C. MURPHY *In* NASA. Lewis Research Center Rotordyn. Instability Probl. in High-Performance Turbomachinery p 58-80 Dec. 1982 refs
Avail: NTIS HC A20/MF A01 CSCL 13I

The use of couplings for high speed turbocompressors or pumps is essential to transmit power from the driver. Typical couplings are either of the lubricated gear or dry diaphragm type design. Gear couplings have been the standard design for many years and recent advances in power and speed requirements have pushed the standard design criteria to the limit. Recent test stand and field data on continuous lube gear type couplings have forced a closer examination of design tolerances and concepts to avoid operational instabilities. Two types of mechanical instabilities are reviewed in this paper: (1) entrapped fluid, and (2) gear mesh instability resulting in spacer throw-out onset. Test stand results of these types of instabilities and other directly related problems are presented together with criteria for proper coupling design to avoid these conditions. An additional test case discussed shows the importance of proper material selection and processing and what can happen to an otherwise good design. Author

N83-15635*# Technische Universitaet, Hanover (West Germany). Ist. fuer Mechanik.
SHAFT VIBRATIONS IN TURBOMACHINERY EXCITED BY CRACKS
B. GRABOWSKI *In* NASA. Lewis Research Center Rotordyn. Instability Probl. in High-Performance Turbomachinery p 81-97 Dec. 1982 refs
Avail: NTIS HC A20/MF A01 CSCL 13I

During the past years the dynamic behavior of rotors with cracks has been investigated mainly theoretically. This paper deals with the comparison of analytical and experimental results of the dynamics of a rotor with an artificial crack. The experimental results verify the crack model used in the analysis. They show the general possibility to determine a crack by extended vibration control. Author

N83-15637*# Hitachi Ltd., Tsuchiura (Japan). Mechanical Engineering Research Lab.
ROTOR VIBRATION CAUSED BY EXTERNAL EXCITATION AND RUB
O. MATSUSHITA, M. TAKAGI, K. KIKUCHI, and M. KAGA *In* NASA. Lewis Research Center Rotordyn. Instability Probl. in High-Performance Turbomachinery p 105-129 Dec. 1982 refs
Avail: NTIS HC A20/MF A01 CSCL 13I

For turbomachinery with low natural frequencies, considerations have been recently required for rotor vibrations caused by external forces except unbalance one, such as foundation motion, seismic wave, rub and so forth. Such a forced vibration is investigated analytically and experimentally in the present paper. Vibrations in a rotor-bearing system under a harmonic excitation are analyzed by the modal technique in the case of a linear system including gyroscopic effect. For a nonlinear system a new and powerful quasi-modal technique is developed and applied to the vibration caused by rub. Author

N83-15642*# Allis-Chalmers Mfg. Co., Milwaukee, Wis. Compressor and Custom Pump Div.
VIBRATION AND DESTABILIZING EFFECTS OF FLOATING RING SEALS IN COMPRESSORS
M. F. EMERICK *In* NASA. Lewis Research Center Rotordyn. Instability Probl. in High-Performance Turbomachinery p 187-204 Dec. 1982 refs
Avail: NTIS HC A20/MF A01 CSCL 13I

Operating experience on a compressor commissioned 12 years ago has presented an interesting history of sporadic increases in shaft vibration. Initial operation was satisfactory with low levels of vibration. However, after some time the shaft vibration level increased to several mils. Initially this was believed to be due to rotor unbalance from deposits formed in the passages due to process upsets. After cleaning up the rotor, operation was again increased. It was then found that the rotor vibration was primarily subsynchronous. Further investigation revealed that the original seal design was subject to wear and was no longer properly pressure balanced. A modified seal design was installed and it has operated successfully for the past six years. Author

N83-15648*# Kaiserslautern Univ. (West Germany). Dept. of Mechanical Engineering.
INFLUENCE OF PARAMETER CHANGES TO STABILITY BEHAVIOR OF ROTORS
C. P. FRITZEN and R. NORDMANN *In* NASA. Lewis Research Center Rotordyn. Instability Probl. in High-Performance Turbomachinery p 284-306 Dec. 1982 refs
Avail: NTIS HC A20/MF A01 CSCL 13I

The occurrence of unstable vibrations in rotating machinery requires corrective measures for improvement of the stability behavior. A simple approximate method is represented to find out the influence of parameter changes to the stability behavior. The method is based on an expansion of the eigenvalues in terms of system parameters. Influence coefficients show the effect of structural modifications. The method first of all was applied to simple nonconservative rotor models. It was approved for an unsymmetric rotor of a test rig. Author

N83-15656*# Virginia Univ., Charlottesville. Dept. of Mechanical and Aerospace Engineering.
VIBRATION LIMITING OF ROTORS BY FEEDBACK CONTROL
D. W. LEWIS, J. W. MOORE, P. L. BRADLEY, and P. E. ALLAIRE *In* NASA. Lewis Research Center Rotordyn. Instability Probl. in High-Performance Turbomachinery p 434-439 Dec. 1982 refs
Avail: NTIS HC A20/MF A01 CSCL 13I

Experimental findings of a three mass rotor with four channels of feedback control are reported. The channels are independently controllable with force being proportional to the velocity and/or instantaneous displacement from equilibrium of the shaft at the noncontacting probe locations (arranged in the vertical and horizontal attitudes near the support bearings). The findings suggest that automatic feedback control of rotors is feasible for limiting certain vibration levels. Control of one end of a rotor does afford some predictable vibration limiting of the rotor at the other end. Author

N83-15676# Pisa Univ. (Italy). Inst. of Aeronautics.
THE FATIGUE CRACK GROWTH UNDER VARIABLE AMPLITUDE LOADING IN BUILT-UP STRUCTURES Final Technical Report, Sep. 1978 - Feb. 1982
A. SALVETTI, G. CAVALLINI, and L. IAZZERI Apr. 1982 124 p refs
(Contract DA-ERO-78-G-107; DA PROJ. 1T1-61102-BH-57)
(AD-A119764) Avail: NTIS HC A06/MF A01 CSCL 01E

Seventy-four specimens, made of 2024-T3 aluminum alloy, were tested both at constant and variable amplitude loading. The specimens were both simple sheets and riveted stiffened panels. The constant amplitude tests on simple sheet specimens were conducted in order to obtain the average K-rate relationship and the relevant scatter of the batch of sheets. The constant amplitude tests of stiffened panels aimed at obtaining information on the overall junction flexibility. Variable amplitude tests were performed utilizing three standard fatigue spectra, like FALSTAFF, MINITWIST, and Gaussian random. The data from sheet specimens was used to assess the reliability of prediction methods such as those devised by Wheeler and Willenborg, and the stiffened panels test data to evaluate how these methods work in the case of built-up structures. Some general conclusions on the reliability of the crack growth prediction methods have been obtained treating on statistical basis the data collected in the current year, as well as in the previous year's research activity. To this end, data from variable amplitude tests, irrespective of the type of spectrum and of the material, has been collected and analyzed in order to evaluate in this respect

the methods proposed by Willenborg and by Wheeler. The results are quite interesting, because they allow to evaluate the scatter associated with most of the parameters involved in crack growth predictions. GRA

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GEOSCIENCES

Includes geosciences (general); earth resources; energy production and conversion; environment pollution; geophysics; meteorology and climatology; and oceanography.

A83-16526*# Tennessee Univ., Tullahoma.
INFLUENCE OF MULTIDROPLET SIZE DISTRIBUTION ON ICING COLLECTION EFFICIENCY
H.-P. CHANG, K. R. KIMBLE (Tennessee, University, Tullahoma, TN), W. FROST (FWG Associates, Inc.; Tennessee, University, Tullahoma, TN), and R. J. SHAW (NASA, Lewis Research Center, Cleveland, OH) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 6 p. refs
(AIAA PAPER 83-0110)

Calculation of collection efficiencies of two-dimensional airfoils for a monodispersed droplet icing cloud and a multidispersed droplet is carried out. Comparison is made with the experimental results reported in the NACA Technical Note series. The results of the study show considerably improved agreement with experiment when multidroplet size distributions are employed. The study then investigates the effect of collection efficiency on airborne particle droplet size sampling instruments. The biased effect introduced due to sampling from different collection volumes is predicted. (Author)

A83-16527#
AIRCRAFT ICING ROUGHNESS FEATURES AND ITS EFFECT ON THE ICING PROCESS
R. D. KIRCHNER (Institute for Hypersonic Studies, Inc., Richmond, VA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 7 p. refs
(AIAA PAPER 83-0111)

This paper describes an effort to establish the surface roughness of accreting ices and its effect on the icing process in both rime and glaze icing conditions. The effort involves the use of a time-dependent icing model that simulates icing on a 2.54 cm in. diameter circular cylinder at temperatures of -5 C and -15 C, with velocities varying from 30.5 m/sec to 122 m/sec and liquid water contents varying from 0.4 g/cu cm to 1.2 g/cu cm. Leading edge roughness effects are included in the ice accretion model, and values of leading edge roughness are varied until optimum correlations can be achieved with experimental results. These optimum roughness values are then used to produce an icing roughness model in terms of the free stream velocity, temperature, and liquid water content that conforms to expected exponential trends and provides roughness values that are consistent with the values used by others. (Author)

A83-16583*# National Center for Atmospheric Research, Boulder, Colo.
APPLICATIONS OF DOPPLER RADAR TO AVIATION OPERATIONS - JAWS EXPERIENCES
J. MCCARTHY and J. W. WILSON (National Center for Atmospheric Research, Boulder, CO) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 4 p. U.S. Department of Transportation
(Contract DOT-FA01-82-Y-10513; NSF ATM-81-09828; NSF ATM-82-05776 ; NASA ORDER H-59314-B)
(AIAA PAPER 83-0205)

The field phase of the Joint Airport Weather Studies (JAWS) Project was conducted in the vicinity of Denver's Stapleton International Airport from 15 May to 13 August 1982. The primary collection systems were three Doppler radars, a 27-station, closely spaced (4 km) network of surface stations, and five research aircraft. The program was specifically planned to observe wind shear phenomena with high time and space resolution that would be dangerous to aircraft operations. The program was successful in observing a large number of such events. Preliminary conclusions are presented on the effectiveness of several wind shear detection systems to warn of wind shear events critical to aviation safety. (Author)

A83-16714#
ARCTIC HAZE AND THE ARCTIC GAS AND AEROSOL SAMPLING PROGRAM /AGASP/
R. C. SCHNELL (Cooperative Institute for Research in Environmental Sciences, Boulder, CO) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 7 p. NOAA-Navy-Army-supported research. refs
(AIAA PAPER 83-0439)

The spring atmosphere in the Arctic has been observed to have anthropogenic pollution levels (Arctic haze) equivalent to those in cities such as Denver and Los Angeles. These high carbon content aerosols (efficient energy absorbers) have a probable Eurasian source. Model studies suggest that aerosol-induced heating has the potential of reducing the Arctic ice cap. A multi-agency group is undertaking an airborne study of the phenomenon using the long range NOAA WP-3D research aircraft. This research will characterize the physical and chemical aspects of the haze constituents and determine their distribution and trajectories. In situ radiative effects will also be measured. Together, these measurements will allow for closing the loop on theory and modeling of the effects of Arctic haze. Aerosol data will be used to determine the applicability of using the proposed NOAA-Air Force-NASA Wind Satellite (WINDSAT) for the measurement of tropospheric wind in the Arctic. (Author)

A83-18413#
ICING ANALYSIS OF AN UNPROTECTED AIRCRAFT RADOME
J. STONE and R. ROSS (Ross Aviation Associates, Sedgwick, KS) Journal of Aircraft, vol. 20, Feb. 1983, p. 174-177.
(Previously cited in issue 06, p. 921, Accession no. A82-17874)

A83-18996
FIRST RESULTS OF BOUNDARY LAYER RESEARCH FLIGHTS WITH THREE POWERED GLIDERS DURING THE FIELD EXPERIMENT PUKK
J. M. HACKER Beitraege zur Physik der Atmosphaere, vol. 55, Nov. 1982, p. 383-402. refs

During the field experiment PUKK at the coast of the German Bight three instrumented powered gliders were used to investigate the planetary boundary layer over sea and land. First evaluations of the aircraft data give a comprehensive picture of the influence of the coast on the turbulence, temperature and humidity pattern. For selected cases the horizontal wind vector could be determined and showed good agreement with independent measurements. The temporal and spatial variations of the vertical energy fluxes are presented for the coastal region and an area over the flat

countryside 80 km inland. For the inland area the mean horizontal wind divergence could be estimated. (Author)

N83-14769# General Accounting Office, Washington, D. C.
FRESH LOOK IS NEEDED AT SOUTH FLORIDA JETPORT
15 Jun. 1982 68 p refs
(GAO/CED-82-54; B-204739) Avail: NTIS HC A04/MF A01; SOD HC $3.25

The need to renegotiate the Jetport Pact is discussed (an agreement between the United States, the State of Florida, and Dade County, Florida) in light of changed conditions and the need to resolve certain operational questions concerning the suitability of the site selected for a new jetport in south Florida. Because the Federal Aviation Administration's intent is to seek 100 percent Federal funding to carry out the terms of the Pact, the Congress will ultimately have to decide whether to appropriate funding. This review was made to assist the Congress in evaluating the Jetport Pact and in determining what action to take if and when funding to carry out the Pact is requested. Author

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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.

A83-17314#
SOFTWARE ASPECTS IN CERTIFICATION OF NEW EUROPEAN CIVIL TRANSPORT AIRCRAFT
P. TOULOUSE (Societe Nationale Industrielle Aerospatiale, Paris, France) In: Radio Technical Commission for Aeronautics, Technical Symposium and Annual Assembly Meeting, Washington, DC, November 18-20, 1981, Proceedings. Washington, DC, Radio Technical Commission for Aeronautics, 1982, p. 195-202.

It is pointed out that each new generation aircraft, such as the Airbus A.310 will fly with near to 100 digital components on board. Approaches for meeting certification requirements are considered, taking into account principles, the early design stage, software criticality, and questions of software development and the certification plane. Two examples are employed to illustrate the fault/error-tolerant concept. It is concluded that the use of a disciplined approach for software development is necessary to reach an acceptable level of quality compatible with the criticality of this software. The demonstration effort of this quality for most critical software may be very great. Alternatively, by taking advantage of architectural arrangements at an early design stage it may be possible to obtain a reduction in software criticality and the associated certification demonstration effort. G.R.

A83-19033
VARIABLE DIMENSION FILTER FOR MANEUVERING TARGET TRACKING
Y. BAR-SHALOM and K. BIRMIWAL (Connecticut, University, Storrs, CT) IEEE Transactions on Aerospace and Electronic Systems, vol. AES-18, Sept. 1982, p. 621-629. refs
(Contract N00014-78-C-0529)

A novel approach to tracking a maneuvering target is developed. This approach does not rely on a statistical description of the maneuver as a random process. Instead, the state model for the target is changed by introducing extra state components when a maneuver is detected. The maneuver, modeled as an acceleration, is estimated recursively. The performance of this estimator is shown to be superior to a recent algorithm presented by Chan et al. that handles the maneuver by estimating it as an unknown input. A significant departure from the current practice of comparison of algorithms is made: a recently introduced rigorous statistical methodology is used in the comparison of these estimators. (Author)

N83-14929*# Raytheon Co., Sudbury, Mass.
CARE 3 PHASE 2 REPORT - MATHEMATICAL DESCRIPTION
J. J. STIFFLER and L. A. BRYANT Washington NASA Nov. 1982 61 p refs
(Contract NAS1-15072)
(NASA-CR-3566; NAS 1.26:3566) Avail: NTIS HC A04/MF A01 CSCL 14D

CARE III (Computer-Aided Reliability Estimation, version three) a computer program designed to help estimate the reliability of complex, redundant systems is described. Although the program can model a wide variety of redundant structures, it was developed specifically for fault tolerant avionics systems. CARE III generalizes the class of system structures that can be modeled and greatly expands the coverage model to take into account such effects as intermittent and transient faults, latent faults, and error propagation. R.J.F.

N83-14954# Naval Research Lab., Washington, D. C.
INTERFACE SPECIFICATIONS FOR THE A-7E SHARED SERVICES MODULE
P. C. CLEMENTS 8 Sep. 1982 107 p refs
(AD-A118897; NRL-MR-4863) Avail: NTIS HC A06/MF A01 CSCL 09B

This document describes the programmer interface to one of the modules in the Naval Research Laboratory's Software Cost Reduction (SCR) project, which is demonstrating the feasibility of applying advanced software engineering techniques to complex real-time systems in order to simplify maintenance. To illustrate the principles, the onboard software for the Navy's A-7E aircraft will be redesigned and rewritten. The Shared Services module provides those values and services that are used in the computation or derivation of output affecting more than one peripheral device in the system. The purpose of the Shared Services module is to allow the remainder of the software to remain unchanged when the requirements-based rules for these values and services change. This report describes the modular structure of the Shared Services module, and contains the abstract interface specifications for all of the facilities provided to users. It serves as development and maintenance documentation for the SCR software design, and is also intended as a model for other people interested in applying the abstract interface approach on other software projects. Author (GRA)

N83-14973# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.
SOFTWARE OPTIMIZATION FOR ARRAY PROCESSORS. AN AP-120B KALMAN FILTER Final Report, 1 Apr. 1981 - 28 May 1982
E. C. DUDZINSKI 1 Jun. 1982 120 p refs
(Contract AF PROJ. 6095)
(AD-A119221; AFWAL-TR-82-1100) Avail: NTIS HC A06/MF A01 CSCL 12A

The fusion of navigation sensor data to arrive at an accurate position determination is done by a programmed algorithm, a Kalman filter. Achieving the necessary processing speed for next generation navigation filters requires the use of innovative machine architectures. One of the most promising configurations, given the computational nature of the Kalman filter, is the array processor. To explore the software issues and demonstrate the potential speedup made possible by an array architecture, an in house research project was undertaken to install a Kalman filter on a vector machine and maximize its execution speed. To assess software optimization techniques, processing times for a simulated scenario were measured initially with the AP-120B programmed to function as if it were a strictly serial processor, and then again after the software had been optimized to exploit the machine's parallel architecture. Algorithm restructuring, expression tree height reduction, maximization of loop parallelism, and other techniques were applied to the Kalman filter algorithm chosen for this project. 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.

A83-16929#
ON THE RADIALLY NON-COMPACT SOURCE MODEL FOR SUBSONIC JET NOISE
F. SAKAO (Hiroshima University, Hiroshima, Japan) Japan Society for Aeronautical and Space Sciences, Transactions, vol. 25, Nov. 1982, p. 174-185. refs

The present investigation is concerned with a scheme for the numerical calculation of the efficiency of sound radiation for several representative modes of velocity fluctuations assumed to be present in a jet. Representative results are provided for a range of Strouhal and Mach numbers. The results are evaluated with respect to their significance in determining the jet noise spectrum. Attention is given to the basic equation for the sound pressure in a far field, a model for jet turbulence, the circumferential node, the axial compactness of the source, the procedure of calculation, and the range of parameters. Questions regarding the change in spectral emissivity with the Mach number are explored, and the spatial distribution of source intensities is investigated. G.R.

A83-18393
NON-LINEAR EFFECT IN HIGH SPEED ROTOR NOISE
J. D. MORGAN (Dundee, University, Dundee, Scotland) Journal of Sound and Vibration, vol. 85, Dec. 22, 1982, p. 501-511. Ministry of Defence refs
(Contract MOD-A12/1510)

The noise radiated by a high speed rotor is strongly influenced by non-linear air flows near the tip. These non-linearities are made susceptible to analysis by first approximating the full equation by one in which the most significant non-linear term is retained. A certain change of variables then transforms this into the linear acoustic equation with all the simplification this implies. (Author)

A83-18397* United Technologies Research Center, East Hartford, Conn.
NOISE OF A MODEL HELICOPTER ROTOR DUE TO INGESTION OF ISOTROPIC TURBULENCE
R. W. PATERSON and R. K. AMIET (United Technologies Research Center, East Hartford, CT) Journal of Sound and Vibration, vol. 85, Dec. 22, 1982, p. 551-577. refs
(Contract NAS1-15094)
(Previously announced in STAR as N80-11067)

A83-18414#
STRUT OR GUIDE VANE SECONDARY FLOWS AND THEIR EFFECT ON TURBOMACHINERY NOISE
B. LAKSHMINARAYANA, D. E. THOMPSON, and R. TRUNZO (Pennsylvania State University, University Park, PA) Journal of Aircraft, vol. 20, Feb. 1983, p. 178-186. Navy-supported research. refs
(Previously cited in issue 06, p. 941, Accession no. A82-17797)

N83-14513# Minnesota Univ., Minneapolis.
COHERENT STRUCTURE AND JET NOISE
R. E. A. ARNDT and D. F. LONG *In* Shock and Vibration Information Center The Shock and Vibration Digest, Vol. 14, No. 10 p 3-10 Oct. 1982 refs
Avail: SVIC, Code 5804, Naval Research Lab., Washington, D.C. 20375

Aeroacoustics research into the existence of coherent structures in turbulent flow and their possible influence in the radiation of sound is reviewed. Methods that might lead to meaningful understanding of the physics of turbulence are discussed. J.D.

N83-15042*# Southwest Research Inst., San Antonio, Tex.
DESIGN AND TEST OF AIRCRAFT ENGINE ISOLATORS FOR REDUCED INTERIOR NOISE Final Report
J. F. UNRUH and D. C. SCHEIDT Dec. 1982 118 p refs
(Contract NAS1-14861)
(NASA-CR-166021; NAS 1.26:166021; SRI-06-4860) Avail: NTIS HC A06/MF A01 CSCL 20A

Improved engine vibration isolation was proposed to be the most weight and cost efficient retrofit structure-borne noise control measure for single engine general aviation aircraft. A study was carried out the objectives: (1) to develop an engine isolator design specification for reduced interior noise transmission, (2) select/design candidate isolators to meet a 15 dB noise reduction design goal, and (3) carry out a proof of concept evaluation test. Analytical model of the engine, vibration isolators and engine mount structure were coupled to an empirical model of the fuselage for noise transmission evaluation. The model was used to develop engine isolator dynamic properties design specification for reduced noise transmission. Candidate isolators ere chosen from available product literature and retrofit to a test aircraft. A laboratory based test procedure was then developed to simulate engine induced noise transmission in the aircraft for a proof of concept evaluation test. Three candidate isolator configurations were evaluated for reduced structure-borne noise transmission relative to the original equipment isolators. Author

N83-15043*# Kansas Univ. Center for Research, Inc., Lawrence. Flight Research Lab.
STUDY OF THE DAMPING CHARACTERISTICS OF GENERAL AVIATION AIRCRAFT PANELS AND DEVELOPMENT OF COMPUTER PROGRAMS TO CALCULATE THE EFFECTIVENESS OF INTERIOR NOISE CONTROL TREATMENT, PART 1 Progress Report
R. NAVANNETHAN, J. HUNT, and B. QUAYLE Dec. 1982 103 p refs
(Contract NCC1-6)
(NASA-CR-169534; NAS 1.26:169534; KU-FRL-417-19) Avail: NTIS HC A06/MF A01 CSCL 20A

Tests were carried out on 20 inch x 20 inch panels at different test conditions using free-free panels, clamped panels, and panels as installed in the KU-FRL acoustic test facility. Tests with free-free panels verified the basic equipment set-up and test procedure. They also provided a basis for comparison. The results indicate that the effect of installed panels is to increase the damping ratio at the same frequency. However, a direct comparison is not possible, as the fundamental frequency of a free-free panel differs from the resonance frequency of the panel when installed. The damping values of panels installed in the test facility are closer to the damping values obtained with fixed-fixed panels. Effects of damping tape, stiffeners, and bonded and riveted edged conditions were also investigated. Progress in the development of a simple interior noise level control program is reported. A.R.H.

N83-16150*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AIRCRAFT NOISE PREDICTION PROGRAM USER'S MANUAL
R. E. GILLIAN 1982 323 p refs
(NASA-TM-84486; L-15064; NAS 1.15:84486) Avail: NTIS HC A14/MF A01 CSCL 20A

The Aircraft Noise Prediction Program (ANOPP) predicts aircraft noise with the best methods available. This manual is designed to give the user an understanding of the capabilities of ANOPP and to show how to formulate problems and obtain solutions by using these capabilities. Sections within the manual document basic ANOPP concepts, ANOPP usage, ANOPP functional modules, ANOPP control statement procedure library, and ANOPP permanent data base. appendixes to the manual include information on preparing job decks for the operating systems in use, error diagnostics and recovery techniques, and a glossary of ANOPP terms. S.L.

N83-16151*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
REDUCTION OF HIGH-SPEED IMPULSIVE NOISE BY BLADE PLANFORM MODIFICATION OF A MODEL HELICOPTER ROTOR
D. A. CONNER and D. R. HOAD Dec. 1982 61 p refs Prepared in cooperation with Army Aviation Research and Development Command, Hampton, Va.
(Contract DA PROJ. 1L1-61102-AH-45)
(NASA-TM-84553; L-15511; NAS 1.15:84553; AVRADCOM-TR-82-B-6) Avail: NTIS HC A04/MF A01 CSCL 20A

The reduction of high speed impulsive noise for the UH-1H helicopter was investigated by using an advanced main rotor system. The advanced rotor system had a tapered blade planform compared with the rectangular planform of the standard rotor system. Models of both the advanced main rotor system and the UH-1H standard main rotor system were tested at 1/4 scale in the 4 by 7 Meter Tunnel. In plane acoustic measurements of the high speed impulsive noise demonstrated that the advanced rotor system on the UH-1H helicopter reduced the high speed impulsive noise by up to 20 dB, with a reduction in overall sound pressure level of up to 5 dB. S.L.

N83-16152*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTS ON HIGH BYPASS INTERNAL MIXER NOZZLE JET NOISE
J. H. GOODYKOONTZ Dec. 1982 23 p refs
(NASA-TM-83020; E-1456; NAS 1.15:83020) Avail: NTIS HC A02/MF A01 CSCL 20A

Model scale jet noise data are presented for a variety of internal lobed mixer nozzle configurations for take off power settings in a static environment. The results are presented for a 17.5 cm diameter fan nozzle to show the effect on noise levels caused by changes in geometric shape of the internal, or core flow, nozzle. The geometric variables include the lobe discharge angle, the number of lobes, spacing between the center plug and lobe valley, lobe side wall shape and axial contour of the lobes. An annular plug core flow nozzle was also tested and is used as a baseline for comparative purposes. Comparison of data from the internal lobed configurations showed that for comparative effect, in terms of the effect on full scale perceived noise levels, was caused by a change in the lobe discharge angle. The results showed that increasing the discharge angle caused an increase as large as 7 dB in sound pressure levels in the high frequency portion of the spectra. Changes in the other geometric variables cause negligible effects. Author

N83-16154# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio. Biodynamic Environment Branch.
USAF BIOENVIRONMENTAL NOISE DATA HANDBOOK. VOLUME 155. CH-3 IN-FLIGHT CREW NOISE
H. K. HILLE Sep. 1982 18 p refs 55 Vol.
(Contract AF PROJ. 7231)
(AD-A120791; AMRL-TR-75-50-VOL-155) Avail: NTIS HC A02/MF A01 CSCL 01B

The CH-3 is a USAF tactical combat transport helicopter. This report provides measured data defining the bioacoustic environments at flight crew/passenger locations inside this helicopter during normal flight operations. Data are reported for nine locations in a wide variety of physical and psychoacoustic measures: overall and band sound pressure levels, C weighted and A weighted sound levels, preferred speech interference level, perceived noise levels and limiting times for total daily exposure of personnel with and without standard Air Force ear protectors. Refer to Volume 1 of this handbook, USAF Bioenvironmental Noise Data handbook, Vol. 1: Organization, Content and Application, AMRL-TR-75-50(1) 1975, for discussion of the objective and design of the handbook, the types of data presented, measurement procedures, instrumentation, data processing, definitions of quantities, symbols, equations, applications, limitations, etc. GRA

N83-16156# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
USAF BIOENVIRONMENTAL NOISE DATA HANDBOOK. VOLUME 157: KC-10A IN-FLIGHT CREW NOISE
H. K. HILLE Sep. 1982 18 p
(Contract AF PROJ. 7231)
(AD-A120507; AMRL-TR-75-60-VOL-157) Avail: NTIS HC A02/MF A01 CSCL 01B

The KC-10A is a standard USAF tanker-transport aircraft with high-speed, high altitude refueling and long range transport capability. This report provides measured data defining the bioacoustic environments at flight crew/passenger locations inside this helicopter during normal flight operations. Data are reported for 24 locations in a wide variety of physical and psychoacoustic measures: overall and band sound pressure levels, C-weighted and A-weighted sound levels, preferred speech interference level, perceived noise level, and limiting times for total daily exposure of personnel with and without standard Air Force ear protectors. Refer to Volume 1 of this handbook, USAF Bioenvironmental Noise Data Handbook, Vol. 1: Organization, Content and Application, AMRL-TR-75-50(1) 1975, for discussion of the objective and design of the handbook, the types of data presented, measurement procedures, instrumentation, data processing, definitions of quantities, symbols, equations, applications, limitations, etc. GRA

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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.

N83-15169*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
RESEARCH AND TECHNOLOGY, LEWIS RESEARCH CENTER Annual Report, 1982
1982 47 p refs
(NASA-TM-83038; NAS 1.15:83038) Avail: NTIS HC A03/MF A01 CSCL 05B

Aeronautics, space, and terrestrial energy research is covered. Energy conversion processes and systems for propulsion in the atmosphere, in space, and on the ground are reviewed. Electric energy generation and storage for both terrestrial and space applications and materials and structures for such systems are also reviewed. N.W.

N83-16253# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio. Directorate of Management Services.
AFWAL FY81 TECHNICAL ACCOMPLISHMENTS Final Technical Report
R. S. HOFF, JR. Apr. 1982 76 p
(AD-A120682; AFWAL-TR-82-0001) Avail: NTIS HC A05/MF A01 CSCL 01C

This report contains highlights of significant technical achievements made during FY 81. The document exemplifies the broad range of R/D activities being undertaken within AFWAL and the significance of the technological contributions being made to enhance Air Force operational capabilities. The accomplishments have been grouped by Laboratory to assist the reader in understanding the technologies covered. Points of contact have been identified for each accomplishment, if additional information on the subject is desired. GRA

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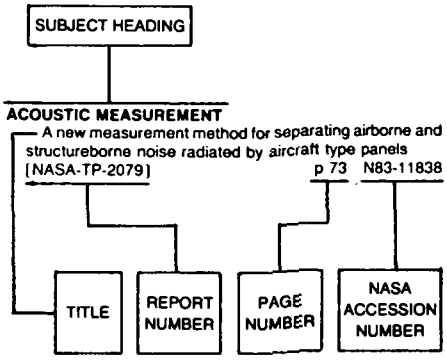
GENERAL

N83-16273*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
RESEARCH AND TECHNOLOGY ANNUAL REPORT, 1982
Nov. 1982 77 p
(NASA-TM-84312; A-9136; NAS 1.15:84312) Avail: NTIS HC A05/MF A01 CSCL 05A

Various research and technology activities are described. Highlights of these accomplishments indicate varied and highly productive reseach efforts. S.L.

Typical Subject Index Listing



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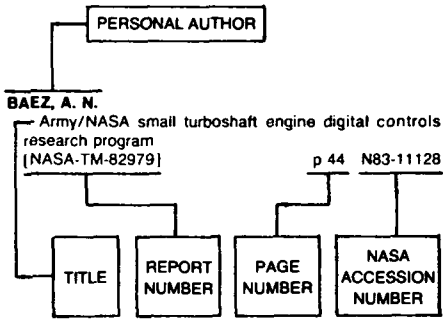

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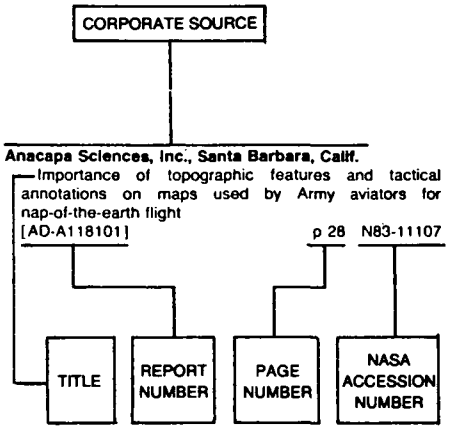

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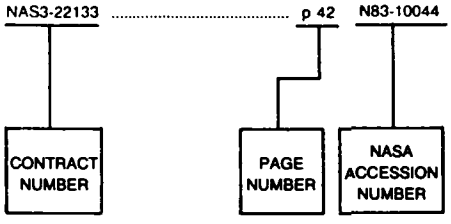

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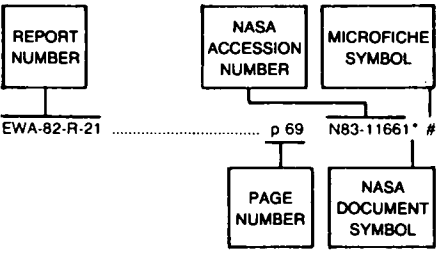

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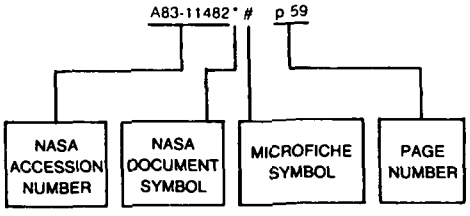

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1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
NASA SP-7037(160)		April 1983

4. Title and Subtitle	5. Report Date
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7. Author(s)	8. Performing Organization Report No.
9. Performing Organization Name and Address National Aeronautics and Space Administration Washington, D.C. 20546	10. Work Unit No. 11. Contract or Grant No.
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15. Supplementary Notes

16. Abstract

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