



## ACCESSION NUMBER RANGES

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

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# AERONAUTICAL ENGINEERING

## A CONTINUING BIBLIOGRAPHY WITH INDEXES

(Supplement 158)

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 January 1983 in

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

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# INTRODUCTION

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

This supplement to *Aeronautical Engineering -- A Continuing Bibliography* (NASA SP-7037) lists 499 reports, journal articles, and other documents originally announced in January 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.

An annual cumulative index will be published.

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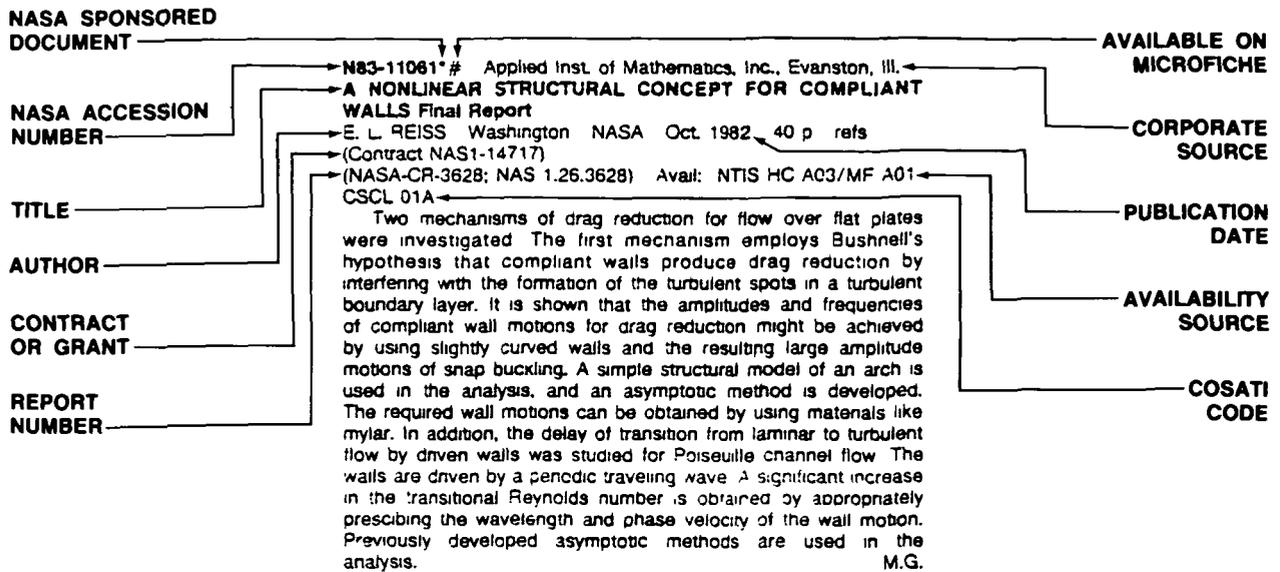
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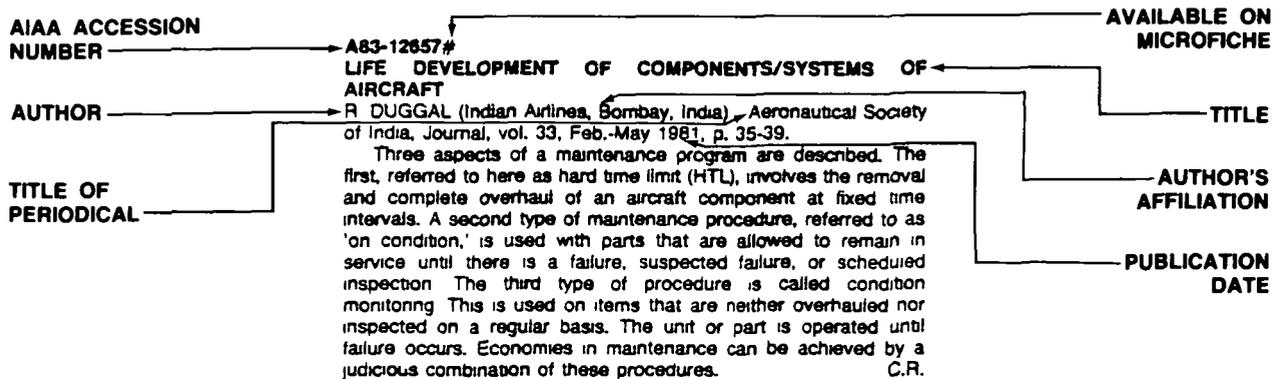
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# AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 158)

FEBRUARY 1983

01

## AERONAUTICS (GENERAL)

**A83-10750#**

### THE FIRST IMPLEMENTATION OF ATLAS FOR TESTING GAS TURBINE ENGINES

P. GOODWIN and E. QUINN (U.S. Naval Air Engineering Center, Lakehurst, NJ) In: AUTOTESTCON '81, Proceedings of the Conference, Orlando, FL, October 19-21, 1981. New York, Institute of Electrical and Electronics Engineers, Inc., 1981, p. 160-165

The first-ever implementation of the ATLAS language for testing gas turbine engines was technically managed by the Naval Air Engineering Center. The specific application was the Model WR27 auxiliary power unit, utilized in the Navy S-3A Viking aircraft. The test system is the A/E37T-26 Test Stand, in conjunction with a peculiar adapter assembly for the WR27. A brief description is given of the test system hardware and the general nature of the test procedure utilized to test/troubleshoot the WR27 in the Fleet. The software system utilized to accomplish the task is described, with specific emphasis on the ATLAS applications program software. The software development/documentation procedures are described since the WR27 program will be utilized as the basis for the generation of additional engine test programs. A minimum of six other gas turbine engines will be tested at Navy Fleet activities in the A/E37T-26 Test Stand (Author)

**A83-10778**

### DEVELOPMENT OF MAINTENANCE CONCEPTS FOR NAVY ATE

T. PACE (Grumman Aerospace Corp., Bethpage, NY) and J. LANGANKE (U.S. Naval Air Systems Command, Washington, DC) In: AUTOTESTCON '81; Proceedings of the Conference, Orlando, FL, October 19-21, 1981. New York, Institute of Electrical and Electronics Engineers, Inc., 1981, p. 376-382

The use of automatic test equipment (ATE) and a maintenance philosophy which stresses fault isolation and repair, has been shown to result in a high degree of operational readiness in U.S. Navy avionics systems. Attention is given to the trade-offs and analyses which are required in order to ensure a practical and cost-effective repair capability, as well as to the roles played within Navy ATE practice by maintenance plans, logistics and support analysis, maintenance assist modules and test program sets, and the various ILS elements needed to optimize the ATE repair system. Among the new concepts in this field which are being implemented or considered are self-certification, common equipment lists, 'stand alone' maintenance plans, building block interface control, and Common Automatic Test Equipment 'university training'. O.C

**A83-10780#**

### LESSONS LEARNED FROM MAINTENANCE APPLICATIONS OF ATE

F. LIGUORI (U.S. Naval Air Engineering Center, Lakehurst, NJ) In: AUTOTESTCON '81, Proceedings of the Conference, Orlando, FL, October 19-21, 1981. New York, Institute of Electrical and Electronics Engineers, Inc., 1981, p. 388-396 refs

Lessons learned during 12 yr of the development of automatic test equipment (ATE) are presented. An in-depth test requirements analysis is recommended before purchase of ATE, to ensure that the apparatus are satisfactory for the tasks at hand. New products should be designed with an eye to automatic testing, and pilot runs should be manufactured to validate the design functions. Attention is needed to carefully design for the human operator-in-the-loop, making sure, e.g., that proper indication is available defining the exact state of a test run. It is better to buy hardware off-the-shelf, then develop the software in-house. Strict configuration control is a necessity for accurate results, as is precise updating of software. Documentation is best when included comprehensively in the software. It is noted that it is easier to teach test engineers programming than to rely on nontechnical programmers to produce satisfactory software. M.S.K.

**A83-10785**

### ON-LINE CERTIFICATION FOR ATE SYSTEMS

H. GAVILLA, Y. CHEN, and M. GANESH (Prospective Computer Analysts, Inc., Roslyn, NY) In: AUTOTESTCON '81, Proceedings of the Conference, Orlando, FL, October 19-21, 1981. New York, Institute of Electrical and Electronics Engineers, Inc., 1981, p. 445-449 refs

The purpose of this paper is to present a systems approach pioneered by the Naval Air Systems Command (NAVAIR). This approach to Navy Automatic Test Equipment (ATE) requires on-line certification to implement the NAVAIR on-line maintenance concept. These approaches are being implemented on the Mini-VAST (MV), Tailored Mini-VAST (TMV), Hybrid Test Station (HTS), CAT-IIIID, and Radar Communications (RADCOM) ATE systems. The on-line certification techniques developed for the TMV system are presented in this paper. The importance of on-line certification requirements and their impact on the design process of the ATE system are discussed. The role of a certification module and its elements are also presented, along with detailed on-line certification techniques for two typical TMV instruments. (Author)

**A83-10786#**

### STATUS OF THE CALIBRATION SUPPORT OF THE NAVY ATE

R. DUNAWAY (U.S. Navy, Metrology Engineering Center, Pomona, CA) In: AUTOTESTCON '81, Proceedings of the Conference, Orlando, FL, October 19-21, 1981. New York, Institute of Electrical and Electronics Engineers, Inc., 1981, p. 450-454.

To assure a high degree of prime weapons systems readiness, it is essential that the calibration of supporting Automated Test Equipment (ATE) be maintained. Various means employed by the Navy to address ATE calibration support are described. Criteria and guidelines for calibration support for existing and new ATE systems are presented. (Author)

## 01 AERONAUTICS (GENERAL)

**A83-11000#**

### **DESIGNING A MINI-RPV FOR A WORLD ENDURANCE RECORD**

M. L. HILL (Johns Hopkins University, Laurel, MD) *Astronautics and Aeronautics*, vol. 20, Nov. 1982, p. 47-54. refs

A new, endurance-record setting remotely piloted vehicle is discussed. The four-stroke, 0.60 cubic inch displacement engine is described. The airframe is made of balsa wood with a bridge truss, the boxy structure is not streamlined. The fuel tank is described. The stock engine, designed for glow-plug ignition, was instead fitted with spark ignition. The solid-state magneto coil has no points to wear out and generates a milder form of radiofrequency noise than point systems or capacitance discharge systems. Problems in the valve-drive cam and the carburetor were corrected with improvisations that are described. The model was flown at about 25 mph through most of the flight and flew 1500 mpg. Its estimated FAI legal range without wind is nearly 1000 miles. The engine's fuel specific impulse is 39,000 sec, and on very calm nights the fully loaded model climbs to and cruises at a ceiling of about 2000 ft ASL with the engine at minimum throttle, 2900 rpm.

C.D.

**A83-11083**

### **NAECON 1982; PROCEEDINGS OF THE NATIONAL AEROSPACE AND ELECTRONICS CONFERENCE, DAYTON, OH, MAY 18-20, 1982. VOLUMES 1, 2 & 3**

Conference sponsored by the Institute of Electrical and Electronics Engineers. New York, Institute of Electrical and Electronics Engineers, Inc., 1982. Vol. 1, 564 p.; vol. 2, 503 p., vol. 3, 493 p. PRICE OF THREE VOLUMES, MEMBERS, \$75, NONMEMBERS, \$100

Various topics in the area of aerospace and electronics are addressed. The general subjects under discussion include: electromagnetic compatibility, navigation and communications systems, air data sensors, microcomputer technology and applications, life cycle cost management, medical technology, software algorithm technology, software quality assurance, aerospace warfare, air data computers, and speech technology applications in crew stations. Also considered are digital technology applications to advanced avionics systems, human-machine systems, environmental interactions, tactical guided weapons, software management, the practicing engineer-manager, and advanced terrain-following terrain-avoidance applications to flight control.

C.D.

**A83-11086#**

### **AEHP FOR ADVANCED TECHNOLOGY AIRCRAFT**

R. C. BEAVIN and J. R. LIPPERT (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) In: NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 19-24.

Program goals and tasks of the U.S.A.F. atmospheric electricity hazards protection advanced development program (AEHP ADP) to identify aircraft environment EM dangers, their effects on aircraft with modern electronics and composite structures, and design/criteria to deal with the hazards in new aircraft are presented. Experiments to characterize the effects of precipitation static (St. Elmo's fire) and lightning, particularly on advanced composites, are outlined. Efforts will be expended toward defining the susceptibility of CMOS, VHSIC, and fiber optics to EM interference and nuclear EMP. Effectiveness trade-offs among candidate hardened aircraft components will be studied, with attention given to requirements for helicopters, cruise missiles, and fighter aircraft. Finally, design guidelines and qualification requirements will be conveyed to aerospace manufacturers.

M.S.K.

**A83-11115**

### **ON THE CERTIFICATION OF DIGITAL COMPUTER PROGRAMS FOR FLIGHT SAFETY**

R. J. SYLVESTER (Systems Productivity and Management Corp., Dayton, OH) and J. Y. HUNG (USAF, Aeronautical Systems Div., Wright-Patterson AFB, OH) In: NAECON 1982, Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 264-269

The conceptual development of digital flight control computer programs for military aircraft, conducted by the Aeronautical Systems Division at Wright-Patterson Air Force Base, is reviewed, emphasizing the design and testing of the computer programs. It is shown that the key to the development approach is the consistent and integrated use of models and simulations. The verification of these simulations using ground and flight test information thus leads to the validation of flight control system concepts and implementation. In addition, this development approach is compared and contrasted with those used by the NASA Dryden Research Center and those proposed by the Radio Technical Commission for Aeronautics pertaining to safety in commercial aircraft.

N.B.

**A83-11116**

### **RATIONALIZING TACAIR FORCE DEVELOPMENT IN THE NEXT DECADE**

E. STELLINI (BDM Corp., Dayton, OH) In: NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 272-278

The Advanced Tactical Fighter (ATF) program is considered, in terms of capability, concept definition timing, necessary capability improvements, and design features. A mission analysis reveals the need for such capability improvements as force availability, lethality, and survivability. A threat versus capability analysis shows that a critical period can be avoided if a sufficient number of ATF's are included in the tactical air force (TACAIR). TACAIR capability needs include the ability to conduct effective combat missions regardless of environmental conditions, the ability to operate from damaged runways, and the improvement of survival probability. Applicable improvement technologies suggested include signature reductions and defense suppression. The technological proposal most capable of satisfying requirements involves the fusion of integrated avionics, STOL, and stealth.

R.K.R.

**A83-12324**

### **USAF STUDYING TECHNIQUES TO RESTORE WINDSHIELDS**

E. H. KOLCUM *Aviation Week and Space Technology*, vol. 117, Nov. 15, 1982, p. 84-86

A proprietary process is described in which aircraft windshield imperfections incurred during service are filled with an acrylic resin, allowing the transparency's restoration with much less grinding than is needed in processes by which the surface must be ground to the bottom of a fault. Attention is given to the application of this technique in the restoration of 747 airliner windshields which had been severely crazed and pitted after flying through a volcanic cloud. The two windshields were cleaned in a vacuum scrubber, which removed surface debris and moisture. The filler resin was then applied, and the surfaces were hand-polished. A total of 48 man-hours were required for the restoration of each windshield.

O.C.

**A83-12654#**

### **RELIABILITY AND MAINTAINABILITY ASPECTS OF A 'FLEET' OF PROTOTYPE HELICOPTERS**

N. S. KIRAN (Hindustan Aeronautics, Ltd., Bangalore, India) *Aeronautical Society of India, Journal*, vol. 33, Feb.-May 1981, p. 5-9.

Reliability, availability, and maintainability (RAM) studies are undertaken on a prototype fleet of helicopters to investigate whether it is possible to complete the certification program of 1000 hours of flying in two and one-half years. It is found that

this can be accomplished and that the reliability of the test vehicle, the airborne data acquisition unit, and the tele-surveillance unit are involved. These units constitute a repairable series system with an overall reliability of 85.99%. It is also found that backup systems in all phases of the activity are necessary. The vehicle and the instrumentation make up one unit, and the telemetry reception forms another. The availability of the test vehicle, data acquisition system, and tele-surveillance system is indispensable for the conduct of the test program. If the computer is not available during on-line work, however, this will not seriously affect the flight/tele-surveillance activity. C R

**A83-12658#****WEATHER RADAR RADOMES AND THEIR MAINTENANCE**

V. K. KHANDELWAL Aeronautical Society of India, Journal, vol 33, Feb.-May 1981, p. 41-44

It is stressed that high-performance radar radomes are precisely constructed and that even a slight change in their physical characteristics (such as excessive layers of paint) can adversely affect the radar system performance. All repairs to radomes, no matter how minor, should bring the radome back to its original condition, both electrically and structurally. An improper minor repair can eventually result in an expensive major repair. After major repairs, a radome should be tested to make certain that its electrical properties are unimpaired; the most important test here is the transmission efficiency test. A pilot can be completely unaware of a radome's inefficiency, this is especially true during instrument flights. C.R

**A83-12659#****IDENTIFICATION OF THE CAUSES OF AIRCRAFT PERFORMANCE SHORTFALLS IN FLEET OPERATIONS**

S. P. G. RAJU (Indian Institute of Science, Bangalore, India) Aeronautical Society of India, Journal, vol 33, Aug.-Nov. 1981, p. 55-59.

An analytical model for aircraft performance applicable to normal twin-engine operation with the flaps undeflected is presented and utilized to interpret the shortfalls in the performance of a fleet of aircraft in scheduled operation. In the model, the differences between the drag polar, engine power, and propeller data of the aircraft are considered, leading to the ability to model the performance of a fleet aircraft for all aircraft weight and atmospheric conditions. A method of choosing the increase in zero lift drag coefficient, loss of engine power at constant turbine gas temperature, and rotation speed, and increase of fuel flow at constant power so as to model the average performance of a fleet is described. These parameters may then be identified as the causes of the performance shortfalls of the fleet by using two calculated grids of performance shortfalls onto which recorded performance is plotted. C D

**A83-12851****AERONAUTICAL RESEARCH - SOME CURRENT INFLUENCES AND TRENDS /THE SECOND SIR FREDERICK PAGE LECTURE/**

J. CHARNLEY (Ministry of Defence, London, England) Aeronautical Journal, vol. 86, Oct. 1982, p. 283-293

An attempt is made to assess major influences affecting British defence procurement with emphasis on defence-related research. It is noted that the growth of technology and consequent increasing capability for the design of increasingly potent weapons systems has led to costly and extended R & D programs. A new system costs the same to develop, however, whether hundreds of units or only one is produced. Since the number of production units that can be afforded has been falling, the proportion of defence budgets spent on R & D shows a long term tendency to increase, and currently stands at about 30% of the British defence budget. This leads to a desire on the part of governments to procure off-the-shelf items not requiring development expenditures. Attention is given to the appropriation of new RAF equipment and the retirement of obsolescent systems, as well as planning research, the influence of fuel costs, and changes in research and procurement direction and emphasis. O.C.

**A83-12852\*** National Aeronautics and Space Administration Ames Research Center, Moffett Field, Calif

**RECENT PROGRESS IN V/STOL TECHNOLOGY**

L. ROBERTS (NASA, Ames Research Center, Moffett Field; Stanford University, Stanford, CA) and W. H. DECKERT (NASA, Ames Research Center, Moffett Field, CA) Aeronautical Journal, vol 86, Oct. 1982, p. 294-305. refs

(Previously announced in STAR as N82-33334)

**A83-12968#****THE USE OF COMPOSITE PATCHES FOR REPAIR OF AIRCRAFT STRUCTURAL PARTS**

R. F. SCOTT and P. HUCULAK (National Aeronautical Establishment, Structures and Materials Laboratory, Ottawa, Canada) (Canadian Symposium on Aerospace Structures and Materials, 1st, Toronto, Canada, June 14, 1982.) Canadian Aeronautics and Space Journal, vol 28, June 1982, p. 122-134. Research sponsored by the Defence Research Establishment Pacific refs

A research program is described which undertakes the repair of metallic aircraft structures with a room-temperature, curing adhesive for bonded composite material patches. After describing the bonding technique and its preformed patches, the method is evaluated through the fatigue testing of 10 center-cracked tension specimens of 7075-T6 and 2024-T3 aluminum alloys which had been bonded with graphite patches of varying thickness, width and length. The patched specimen configurations were subjected to long term water immersion and elevated temperature and humidity conditioning. The complex variable approach to a damage tolerance analysis method reduces the cracked configuration pattern to the solution of a system of integral equations in which stress intensity factors are obtained with the usual assumptions of plane stress, small adhesive thickness, and negligible plate bending stiffness. O.C.

**N83-10003#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

**ACTA AERONAUTICA ET ASTRONAUTICA SINICA**

23 Jun 1982 159 p refs Transl. into ENGLISH of Acta Aeron. Acta Sinica (China), v 2, no 3, Sep 1981 p 1-103 (AD-A117465; FTD-ID(RS)T-0285-82) Avail: NTIS HC A08/MF A01 CSCL 01B

Aerodynamics, structural mechanics of aircraft components and aircraft construction materials, flight mechanics, aircraft propulsion systems, and computational methods are discussed

**N83-10014#** Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div

**THE SIMULATION STUDY ON A REDUNDANT FLIGHT CONTROL SYSTEM**

D. XUE *In its* Acta Aeron. Astronautica Sinica (FTD-ID(RS)T-0285-82) p 128-143 23 Jun 1982 refs Transl. into ENGLISH from Acta Aeron. Astronautica Sinica (China), v 2, no. 3, Sep 1981 16 p Original language document announced as A82-22120 Avail: NTIS HC A08/MF A01

A triple redundant flight control simulation is discussed. The effect of the redundancy on improving the reliability of automatic flight control systems is considered. The performance requirements of the selectors, the comparators, and the active standby redundant rudder mechanism are discussed and their effects on failure transients, failure coverage, and mis-disconnection are analyzed. Author

## 01 AERONAUTICS (GENERAL)

**N83-11018\*#** National Aeronautics and Space Administration  
Langley Research Center, Hampton, Va.

### **INVESTIGATION OF SOME EFFECTS OF HUMIDITY ON AERODYNAMIC CHARACTERISTICS ON A 10-PERCENT-THICK NASA SUPERCRITICAL AIRFOIL**

F. L. JORDAN, JR. Mar. 1976 69 p refs  
(NASA-TM-X-3355; L-10606; NAS 1.15:X-3355) Avail. NTIS HC  
A04/MF A01 CSCL 01B

An investigation was conducted in the Langley 8-foot transonic pressure tunnel to determine the effects of wind-tunnel humidity on the aerodynamic characteristics of a 10-percent-thick NASA supercritical airfoil. Effects of dewpoint variation from 267 K (20 F) to 294 K (70 F) were investigated. The tunnel stagnation temperature was 322 K (120 F) and the stagnation pressure was 0.1013 MN/09 m (1 atm). B.W.

**N83-11019\*#** National Aeronautics and Space Administration  
Langley Research Center, Hampton, Va.

### **WIND-TUNNEL INVESTIGATION OF EFFECTS OF UNDERWING LEADING-EDGE VORTEX GENERATORS OF A SUPERCRITICAL-WING RESEARCH AIRPLANE CONFIGURATION**

C. D. HARRIS and D. W. BARTLETT Apr. 1972 223 p refs  
(NASA-TM-X-2471; L-8049; NAS 1.15:X-2471) Avail. NTIS HC  
A10/MF A01 CSCL 01B

Effects of underwing leading-edge vortex generators on the longitudinal stability and performance characteristics and on the aerodynamic load distribution of an area-rule research airplane model with a NASA supercritical wing are presented. The fundamental flow mechanism to which the effects are related is recognized and discussed. Author

**N83-11020\*#** National Aeronautics and Space Administration  
Langley Research Center, Hampton, Va.

### **WIND-TUNNEL INVESTIGATION OF EFFECTS OF REAR UPPER SURFACE MODIFICATION ON A NASA SUPERCRITICAL AIRFOIL**

C. D. HARRIS and J. A. BLACKWELL, JR. Jan. 1972 53 p refs  
(NASA-TM-X-2454; L-7983; NAS 1.15:X-2454) Avail. NTIS HC  
A04/MF A01 CSCL 01B

Wind tunnel tests were conducted at Mach numbers from 0.60 to 0.81 to examine the effects on supercritical airfoil of modifying the rear upper surface to reduce the magnitude of an intermediate off design second velocity peak. The modification was accomplished by increasing the upper surface curvature around the 50 percent chord station and reducing the curvature over approximately the rearmost 30 percent of the airfoil while maintaining the same trailing edge thickness. S.L.

**N83-11021\*#** National Aeronautics and Space Administration  
Langley Research Center, Hampton, Va.

### **EFFECTS OF WING TRAILING-EDGE TRUNCATION ON AERODYNAMIC CHARACTERISTICS OF A NASA SUPERCRITICAL-WING RESEARCH AIRPLANE MODEL**

D. W. BARTLETT and C. D. HARRIS Aug 1974 106 p refs  
(NASA-TM-X-3024; L-9158; NAS 1.15:X-3024) Avail. NTIS HC  
A06/MF A01 CSCL 01B

The Langley 8-foot transonic pressure tunnel was used at Mach numbers from 0.80 to 1.00 to determine the effects of wing trailing-edge truncation on the aerodynamic characteristics of a 0.0625-scale model of a NASA TF-8A supercritical-wing research airplane. The effects of trailing-edge truncations of 1, 2, and 3 percent of the local streamwise chord on the longitudinal aerodynamic characteristics and the wing section characteristics are presented. A.R.H.

**N83-11022\*#** National Aeronautics and Space Administration  
Langley Research Center, Hampton, Va.

### **LOW-SPEED AERODYNAMIC CHARACTERISTICS OF A 42 DEG SWEEP HIGH-WING MODEL HAVING A DOUBLE-SLOTTED FLAP SYSTEM AND A SUPERCRITICAL AIRFOIL**

P. G. FOURNIER and K. W. GOODSON Aug 1974 108 p refs  
(NASA-TM-X-3036; L-9233; NAS 1.15:X-3036) Avail. NTIS HC  
A06/MF A01 CSCL 01B

A low-speed investigation was conducted over an angle-of-attack range from about -4 deg to 20 deg in the Langley V/STOL tunnel to determine the effects of a double-slotted flap, high-lift system on the aerodynamic characteristics of a 42 deg swept high-wing model having a supercritical airfoil. The wing had an aspect ratio of 6.78 and a taper ratio of 0.36, the double-slotted flap consisted of a 35-percent-chord flap with a 15-percent-chord vane. The model was tested with a 15-percent-chord leading-edge slat. Author

**N83-11023\*#** National Aeronautics and Space Administration  
Langley Research Center, Hampton, Va.

### **DYNAMIC STABILITY CHARACTERISTICS IN PITCH, YAW, AND ROLL OF A SUPERCRITICAL-WING RESEARCH AIRPLANE MODEL**

R. P. BOYDEN May 1974 97 p refs  
(NASA-TM-X-2900; L-9006; NAS 1.15:X-2900) Avail. NTIS HC  
A05/MF A01 CSCL 01B

The aerodynamic damping in pitch, yaw, and roll and the oscillatory stability in pitch and yaw of a supercritical-wing research airplane model were determined for Mach numbers of 0.25 to 1.20 by using the small-amplitude forced-oscillation technique. The angle-of-attack range was from -2 deg to 20 deg. The effects of the underwing leading-edge vortex generators and the contributions of the wing, vertical tail, and horizontal tail to the appropriate damping and stability were measured. Author

**N83-11024\*#** National Aeronautics and Space Administration  
Langley Research Center, Hampton, Va.

### **STABILITY AND CONTROL CHARACTERISTICS: INCLUDING AILERON HINGE MOMENTS OF A MODEL OF A SUPERCRITICAL-WING RESEARCH AIRPLANE**

R. J. RE Apr 1974 133 p refs  
(NASA-TM-X-2929; L-9196; NAS 1.15:X-2929) Avail. NTIS HC  
A07/MF A01 CSCL 01B

Tests were made in the Langley 16-foot transonic tunnel to determine the longitudinal and lateral stability and control characteristics and aileron hinge moments of a 0.087 scale model of a supercritical-wing research aircraft. Mach number was varied from 0.90 to 1.30 at a Reynolds number of approximately 2.4 million; angle of attack was varied from -8 degrees to 14 degrees; and angle of sideslip was set at about -5.5 degrees, 0 degrees, and 5.5 degrees. Aileron hinge moments were obtained at deflection angles of -15 degrees to 15 degrees. Aileron, horizontal-tail, and rudder effectiveness parameters were determined. Author

**N83-11025\*#** National Aeronautics and Space Administration  
Langley Research Center, Hampton, Va.

### **EFFECT OF WING-MOUNTED NACELLES ON A 42 DEG SWEEP SUPERCRITICAL WING CONFIGURATION AT NEAR-SONIC SPEEDS**

L. W. MCKINNEY, J. F. HERMAN (Ling-Temco-Vought Aerospace Corp.), and L. A. BODIN (Ling-Temco-Vought Aerospace Corp.)  
Mar. 1974 151 p refs  
(NASA-TM-X-2954; L-9267; NAS 1.15:X-2954) Avail. NTIS HC  
A08/MF A01 CSCL 01B

An investigation was made to assess the effect of wing-mounted nacelles on a supercritical wing configuration at near-sonic Mach numbers. The investigation was made by utilizing the Cornell Aeronautical Laboratory 8-foot transonic tunnel and covered a Mach number range from 0.90 to 0.99. Force data and pressure measurements at selected locations were obtained. The investigation with the nacelles on included the effect of spanwise

location of the nacelle (semispan locations of 35 and 70 percent) and the effect of area ruling for the nacelles located at the 35 percent semispan station. Tests were also made with the outboard nacelle extended forward so that it was directly adjacent to the inboard nacelle location. These tests provided a direct assessment of the extent of the nacelle interference flow field in a lateral direction.

Author

**N83-11026\*#** National Aeronautics and Space Administration Langley Research Center, Hampton, Va  
**AERODYNAMIC CHARACTERISTICS OF TWO 10-PERCENT-THICK NASA SUPERCRITICAL AIRFOILS WITH DIFFERENT UPPER SURFACE CURVATURE DISTRIBUTIONS**  
 C. D. HARRIS Feb. 1974 67 p refs  
 (NASA-TM-X-2977; L-8522; NAS 1.15:X-2977) Avail NTIS HC A04/MF A01 CSCL 01B

In order to assess the degree to which the characteristic region of low curvature of the supercritical airfoil can be practically extended on the upper surface, the aerodynamic characteristics of two supercritical airfoils with different upper surface curvature distributions were measured at Mach numbers from 0.60 to 0.81. Integrated section force and moment data, surface pressure distributions, and typical wake survey profiles are presented.

Author

**N83-11027\*#** National Aeronautics and Space Administration Langley Research Center, Hampton, Va  
**WIND-TUNNEL MEASUREMENTS OF THE CHORDWISE PRESSURE DISTRIBUTION AND PROFILE DRAG OF A RESEARCH AIRPLANE MODEL INCORPORATING A 17-PERCENT-THICK SUPERCRITICAL WING**  
 J. C. FERRIS Aug. 1973 271 p refs  
 (NASA-TM-X-2760; L-8730; NAS 1.15:X-2760) Avail NTIS HC A12/MF A01 CSCL 01B

The Langley 8-foot transonic pressure tunnel to determine the wing chordwise pressure distribution for a 0.09-scale model of a research airplane incorporating a 17-percent-thick supercritical wing. Airfoil profile drag was determined from wake pressure measurements at the 42-percent-semispan wing station. The investigation was conducted at Mach numbers from 0.30 to 0.80 over an angle-of-attack range sufficient to include buffet onset. The Reynolds number based on the mean geometric chord varied from  $2 \times 10^6$  to the 6th power at Mach number 0.30 to  $3.33 \times 10^6$  to the 6th power at Mach number 0.65 and was maintained at a constant value of  $3.86 \times 10^6$  to the 6th power at Mach numbers from 0.70 to 0.80. Pressure coefficients for four wing semispan stations and wing-section normal-force and pitching-moment coefficients for two semispan stations are presented in tabular form over the Mach number range from 0.30 to 0.80. Plotted chordwise pressure distributions and wake profiles are given for a selected range of section normal-force coefficients over the same Mach number range.

Author

**N83-11028\*#** National Aeronautics and Space Administration Langley Research Center, Hampton, Va.  
**A WIND-TUNNEL INVESTIGATION OF THE APPLICATION OF THE NASA SUPERCRITICAL AIRFOIL TO A VARIABLE-WING-SWEEP FIGHTER AIRPLANE**  
 T. G. AYERS Jul. 1973 269 p  
 (NASA-TM-X-2759; L-8689; NAS 1.15:X-2759) Avail NTIS HC A12/MF A01 CSCL 01B

An investigation was conducted in the Langley 8 foot transonic pressure tunnel and the Langley Unitary Plan wind tunnel to evaluate the effectiveness of three variations of the NASA supercritical airfoil as applied to a model of a variable wing sweep fighter airplane. Wing panels incorporating conventional NACA 64A series airfoil with 0.20 and 0.40 camber were used as bases of reference for this evaluation. Static force and moment measurements were obtained for wing leading edge sweep angles of 26, 33, 39, and 72.5 degrees. Fluctuating wing root bending moment data were obtained at subsonic speeds to determine buffet characteristics. Subsonic data were also obtained for determining the effects of wing transition location and spoiler deflection. Limited

lateral directional data are included for the conventional 0.20 cambered wing and the supercritical wing.

Author

**N83-11029\*#** National Aeronautics and Space Administration Langley Research Center, Hampton, Va.  
**INVESTIGATION AT NEAR-SONIC SPEED OF SOME EFFECTS OF HUMIDITY ON THE LONGITUDINAL AERODYNAMIC CHARACTERISTICS OF AN NASA SUPERCRITICAL WING RESEARCH AIRPLANE MODEL**  
 F. L. JORDAN, JR Aug. 1972 71 p refs  
 (NASA-TM-X-2618; L-8220; NAS 1.15 X-2618) Avail: NTIS HC A04/MF A01 CSCL 01B

The Langley 8-foot transonic pressure tunnel was used in an effort to determine the effects of humidity at near-sonic speed on the longitudinal aerodynamic characteristics and wing pressure distributions of an area-rule research airplane model with an NASA supercritical wing. Effects of dewpoint at the normal tunnel operating stagnation temperature of 48.9 C (120 F) and effects of stagnation temperature at a relatively high dewpoint of 15.6 C (60 F) were investigated. The test tunnel stagnation pressure was 101 325 N/sq m (1 atmosphere).

Author

**N83-11030\*#** National Aeronautics and Space Administration Langley Research Center, Hampton, Va.  
**LOW-SPEED AERODYNAMIC CHARACTERISTICS OF A MODEL HAVING A 42 DEG SWEEP LOW WING WITH A SUPERCRITICAL AIRFOIL, DOUBLE-SLOTTED FLAPS, AND A T-TAIL**  
 P. G. FOURNIER and W. C. SLEEMAN, JR Sep 1972 65 p refs  
 (NASA-TM-X-2582; L-8358; NAS 1.15.X-2582) Avail: NTIS HC A04/MF A01 CSCL 01B

A low speed wind tunnel test was conducted in the Langley V/STOL tunnel to determine the static longitudinal and lateral stability characteristics of a general research model which simulated an advance configuration for a commercial transport airplane with a T tail. The model had a 42 deg swept, aspect ratio 6.78 wing with a supercritical airfoil and a high lift system which consisted of a leading edge slat and a double slotted flap. Various slat and flap deflection combinations represented clean, take off, and landing configurations. Effects on the longitudinal and lateral aerodynamic characteristics were determined for two flow through, simulated engine nacelles located on the sides of the fuselage near the rear of the model.

Author

**N83-11031\*#** National Aeronautics and Space Administration Langley Research Center, Hampton, Va.  
**AERODYNAMIC CHARACTERISTICS OF AN IMPROVED 10-PERCENT-THICK NASA SUPERCRITICAL AIRFOIL**  
 C. D. HARRIS Feb. 1974 137 p  
 (NASA-TM-X-2978; L-9275; NAS 1.15-X-2978) Avail: NTIS HC A08/MF A01 CSCL 01B

Refinements in a 10 percent thick supercritical airfoil produced improvements in the overall drag characteristics at normal force coefficients from about 0.30 to 0.65 compared with earlier supercritical airfoils which were developed for a normal force coefficient of 0.7. The drag divergence Mach number of the improved supercritical airfoil (airfoil 26a) varied from approximately 0.82 at a normal force coefficient of 0.30, to 0.78 at a normal force coefficient of 0.80 with no drag creep evident. Integrated section force and moment data, surface pressure distributions, and typical wake survey profiles are presented.

A.R.H.

## 01 AERONAUTICS (GENERAL)

**N83-11032\*#** National Aeronautics and Space Administration Langley Research Center, Hampton, Va  
**WIND-TUNNEL DEVELOPMENT OF UNDERWING LEADING-EDGE VORTEX GENERATORS ON A NASA SUPERCRITICAL-WING RESEARCH AIRPLANE CONFIGURATION**

D. W. BARTLETT, C D HARRIS, and T. C. KELLY Nov 1973 118 p refs

(NASA-TM-X-2808; L-8495; NAS 1 15 X-2808) Avail: NTIS HC A06/MF A01 CSCL 01B

A program for the wind tunnel development of underwing leading-edge vortex generators on an NASA supercritical-wing research airplane model was conducted in the Langley 8-foot transonic pressure tunnel at Mach numbers from 0.25 to 0.99. The effects on the longitudinal aerodynamic characteristics of vortex-generator wing semispan location, distance from wing leading edge, leading-edge sweep angle, toe-in angle, and span are presented. The effects of the vortex generators on the lateral-directional aerodynamic characteristics of the model for a sideslip angle of 5 deg are included Author

**N83-11033\*#** National Aeronautics and Space Administration Langley Research Center, Hampton, Va.

**EFFECTS OF WING HEIGHT ON LOW-SPEED AERODYNAMIC CHARACTERISTICS OF A MODEL HAVING A 42 DEG SWEEP WING, A SUPERCRITICAL AIRFOIL, DOUBLE-SLOTTED FLAPS, AND A LOW TAIL**

P. G. FOURNIER and W C SLEEMAN, JR. Sep. 1973 75 p refs

(NASA-TM-X-2794; L-8832; NAS 1 15:X-2794) Avail: NTIS HC A04/MF A01 CSCL 01B

A low speed investigation was conducted in the Langley V/STOL tunnel to determine the static longitudinal lateral stability characteristics of a general research model with the wing in a high position and a low position on the fuselage. The model had a wing with a quarter chord sweep of 42 deg, an aspect ratio of 6.78, a supercritical airfoil, and a high lift system which consisted of a leading edge slat and a double slotted flap. Various slat and flap deflections represented clean, take off, and landing configurations. A 45 deg swept horizontal tail located slightly below the fuselage center line was investigated with both the low and high wing configurations. Author

**N83-11034\*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

**LOW-SPEED AERODYNAMIC CHARACTERISTICS OF A 17-PERCENT-THICK SUPERCRITICAL AIRFOIL SECTION, INCLUDING A COMPARISON BETWEEN WIND-TUNNEL AND FLIGHT DATA**

R. J. MCGHEE and G. J. BINGHAM (Army Air Mobility R & D Lab) Jul. 1972 55 p refs

(NASA-TM-X-2571; L-8290; NAS 1.15 X-2571) Avail: NTIS HC A04/MF A01 CSCL 01B

Wind-tunnel tests were conducted to determine the low speed two dimensional aerodynamic characteristics of a 17-percent-thick supercritical airfoil. The results were compared with three dimensional wind-tunnel and flight data. The tests were conducted over a Mach number range from 0.15 to 0.30 Reynolds numbers based on the airfoil chord varied from 2.0x10 to the 6th power to 15.0x10 to the 6th power Author

**N83-11035#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

**JOURNAL OF AERONAUTICS**

21 Jul. 1982 168 p refs Transl into ENGLISH of Acta Aeron et Astron. Sinica (China), v. 3, no. 1, Mar. 1982 p 1-98

(AD-A118185; FTD-ID(RS)T-0621-82) Avail: NTIS HC A08/MF A01 CSCL 20D

Aerodynamics research and development in China is discussed. Topics include elastic bodies, aircraft structures, boundary value problems, stress analysis, combustion chambers, and aerodynamic coefficients.

R J.F.

**N83-11055#** Comptroller General of the United States, Washington, D.C. Procurement Logistics and Readiness Div.

**REQUIREMENTS AND PRODUCTION CAPABILITIES ARE UNCERTAIN FOR SOME AIR FORCE, NAVY AND MARINE CORPS AIRCRAFT SPARES AND REPAIR PARTS**

22 Jul. 1982 38 p refs

(AD-A118423; GAO/PLRD-82-77) Avail: NTIS HC A03/MF A01 CSCL 05A

In fiscal year 1982, the Congress appropriated \$5.4 billion to procure spares and repair parts for Air Force, Navy and Marine Corps aircraft. This compared to \$1.9 billion provided in fiscal year 1980 and \$3.9 billion provided in fiscal year 1981. The military services testified that these increases were required to improve the operational readiness of their aircraft. However, GAO has previously reported that many aircraft operational readiness problems were caused by maintenance problems and other reasons--unexpected parts failures, late repair of parts, and modification or updating of parts--rather than a lack of sufficient funds. While approving these increases, the Congress expressed concern regarding whether the aerospace industry could produce the increased quantity of aircraft parts and whether the increased procurements would result in the increased operational readiness claimed by the services Author (GRA)

**N83-11056#** George Washington Univ., Washington, D.C. Office of Program in Logistics.

**AIRCRAFT PRODUCTION AND DEVELOPMENT SCHEDULES**

R. A. HARRISON 15 Apr. 1982 12 p refs

(Contract N00014-75-C-0729, NR PROJ. 347-020)

(AD-A118047; SERIAL-T-463) Avail: NTIS HC A02/MF A01 CSCL 01C

A model of aircraft life cycle cost is developed. This cost is estimated to be a function of the production schedule. The effect modeled is the cost variation as a function of increasing aircraft reliability achieved after the completion of a number of operating hours. An optimization problem is outlined that yields the best production schedule. A search algorithm for this difficult integer nonlinear programming problem is used to find the optimum schedule. Present practices with advanced jet aircraft are found to be suboptimal in several respects. Recommendations include a linear production buildup that continues much longer than at present and extension of the development phase of an aircraft program well beyond the current termination time. Author (GRA)

## 02

### AERODYNAMICS

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

**A83-10180#**

**LOAD DISTRIBUTION ON DEFORMED WINGS IN SUPERSONIC FLOW**

J. E. BURKHALTER (Auburn University, Auburn, AL) Journal of Aircraft, vol. 19, Nov. 1982, p. 921-927. refs

(Contract DAAG29-78-G-0036)

Arbitrary deformations which include the special cases of wing camber and twist provide unique problems to the analyst when localized loadings are to be determined. Other than twist and camber, deformations in the lifting surfaces may occur from high loadings due to severe maneuverability requirements or from aerodynamic heating or combinations thereof. Existing supersonic potential flow theories appear to be inadequate in predicting pressures under these conditions and numerical finite-difference methods have excessive computer requirements if the whole three-dimensional wing is modeled. In the present work a new method is presented which retains the simplicity of three-dimensional potential flow theories yet incorporates desirable features of finite-element techniques. The method utilizes planar

three-dimensional finite wing theory overlaid with vorticity paneling to account for perturbations due to the deformations. The solution is stable (nonoscillatory) and requires minimal computer time and storage. Results for three deformed mean lines for two separate planform geometries are presented with excellent agreement with experimental data. (Author)

A83-10185#

**COMPARISON OF COMPUTATIONAL AND EXPERIMENTAL JET EFFECTS**

J. L. JACOBS, W. L. PETERS, and F. C. GUYTON (Calspan Field Services, Inc., Arnold AFB, TN) *Journal of Aircraft*, vol. 19, Nov. 1982, p. 963-968. refs

(Previously cited in issue 24, p. 4123, Accession no. A81-49979)

A83-10440#

**WIND-TUNNEL MEASUREMENTS OF WING-BUFFET BOUNDARIES AT SUBSONIC AND TRANSONIC SPEEDS [TUNELOWE BADANIA GRANICY POZATKU BUFFETINGU SKRZYDLA W POD- I OKOLODZWIEKOWYM ZAKRESIE PREDKOSCI]**

W. KANIA *Instytut Lotnictwa, Prace*, no. 87, 1981, p. 19-33. In Polish. refs

The occurrence of buffeting on a tapered wing with a uniform profile and a slight sweep was investigated for Mach numbers in the range 0.3 to 1.1. Buffeting was detected on a single-wing model with artificial boundary layer transition by measuring the effective value of the pulsating bending stress at the root of the model wing. The buffeting boundary was determined in the form of the  $C_{zpb} = f(M)$  relationship. In addition, the characteristics of flow past the wing and boundary layer separation were investigated by visualization for the range of angles of attack at which buffeting occurs. The buffet boundary of the wing was estimated by a simplified empirical method. B. J.

A83-10573

**THE FAR FIELD OF AN AIRFOIL [DAS FERNFELD EINES TRAGFLUEGELS]**

K. OSWATITSCH (Wien, Technische Universität, Vienna, Austria) *Ingenieur-Archiv*, vol. 52, no. 5, 1982, p. 287-295. In German. refs

Two well-known solutions for the far field of an airfoil are reviewed, and a new, uniformly valid solution is derived. The traditional solutions applied to two limiting conditions of a stationary flying wing of finite width, a spatial one at great distance from the vortex sheet, and a two-dimensional one at infinite distance from the airfoil, in the so-called Trefftzplane. The new solution permits the induced drag to be calculated from the momentum in a plane parallel to the Trefftzplane, where the downwash is less than that of the Trefftzplane and where the flow is two-dimensional near the vortex sheet, but three-dimensional elsewhere. The induced resistance is also determined. C. D.

A83-10576#

**EXTENSION OF THE LIFTING BODY THEORY TO EVOLUTION ON RANDOM TRAJECTORIES AT SUBSONIC VELOCITIES [O EXTINDEREA A TEORIEI SUPRAFETEI PORTANTE LA EVOLUTII PE TRAIECTORII OARECARE CU VITEZE SUBSONICE]**

V. N. CONSTANTINESCU (Bucuresti, Institutul Politehnic, Bucharest, Rumania) and V. BUTOESCU (Institutul National pentru Creatie Stiintifica si Tehnica, Bucharest, Rumania) *Studii si Cercetari de Mecanica Aplicata*, vol. 40, Nov.-Dec. 1981, p. 791-800. In Rumanian. refs

The motion of lifting body in a perfect, infinite fluid is studied on random trajectories using the linear theory. The method takes advantage of the source and double singularities, noting the appearance of the thickness effect. The problem of the flow around the lifting body is solved by a system of integral equations, with some elements of the distribution function also used in the solution. N. D.

A83-10579#

**SUPERSONIC FLOW AROUND A CONICAL FUSELAGE OF ARBITRARY SECTION ISOLATED OR EQUIPPED WITH A DELTA WING WITH SUBSONIC LEADING EDGES [CURGEREA SUPERSONICA IN JURUL UNUI FUZELAJ CONIC DE SECTIUNE OARECARE IZOLAT SAU PREVAZUT CU O ARIPIA DELTA CU BORDURILE SUBSONICE]**

D. MATEESCU and R. SELESCU (Institutul National pentru Creatie Stiintifica si Tehnica, Bucharest, Rumania) *Studii si Cercetari de Mecanica Aplicata*, vol. 40, Nov.-Dec. 1981, p. 819-836. In Rumanian. refs

The supersonic flow for a lifting body is studied by determining the turbulent axial velocity and pressure coefficient on the wing and fuselage, and the lifting coefficient for the total lifting system. The solution for the isolated cone of arbitrary section is obtained from the delta wing-fuselage system. The work is done in the frame of the general theory of conical motions (Carafoli, 1969) and the theoretical results are favorably compared with Jorgensen's (1958) experimental ones. N. D.

A83-10580#

**OPTIMAL ADAPTION OF THE AIRCRAFT PROPELLER [ASUPRA ADAPTARII OPTIME A ELICEI LA AVION]**

S. GALETUSE (Bucuresti, Institutul Politehnic, Bucharest, Rumania) *Studii si Cercetari de Mecanica Aplicata*, vol. 40, Nov.-Dec. 1981, p. 837-846. In Rumanian.

Improved computation methods for the induced velocities around the propeller and for the maximum efficiency condition are presented. The nondimensional thrust, nondimensional moment and the efficiency are determined as function of the blade path geometry, and the induced efficiency. The results are presented also in graphs and are useful in the design of propellers for light aircraft. N. D.

A83-10581#

**APPLICATION OF THE CARAFOLI METHOD TO THE SUPERSONIC FLOW AROUND A CRUCIFORM WING [O APLICATIE A METODEI CARAFOLI LA STUDIUL MISCARII SUPERSONICE IN JURUL UNEI ARIPI CRUCIFORME]**

S. STAIU (Bucuresti, Institutul Politehnic, Bucharest, Rumania) *Studii si Cercetari de Mecanica Aplicata*, vol. 40, Nov.-Dec. 1981, p. 847-853. In Rumanian.

The supersonic flow around a thin asymmetric, cruciform wing is analyzed in order to obtain finite velocities at the subsonic leading edges of the vertical plane. The boundary layer separation is neglected so that the flow remains conical. Finally, the equations for the transverse cross section are determined, together with the pressure distribution. N. D.

A83-10669

**THE FUNDAMENTAL GEOMETRICAL AND AERODYNAMIC CHARACTERISTICS OF AIRCRAFT AND ROCKETS [OSNOVNYE GEOMETRICHESKIE I AERODINAMICHESKIE KHARAKTERISTIKI SAMOLETOV I RAKET]**

V. G. MIKELADZE and V. M. TITOV (Moscow, Izdatel'stvo Mashinostroenie, 1982, 150 p. In Russian. refs

The characteristics are defined in accordance with government standards on the geometrical characteristics of aircraft and the dynamics of flight in the atmosphere and with the new system of symbols for flight mechanics elaborated by the International Standardization Organization. Definitions and designations used in the USSR are compared with those adopted by Britain, France, West Germany, and the international organization. Recent concepts of aircraft aerodynamics are discussed. C. R.

A83-11772

**THE EFFECTS OF FIRING A WEAPON ON THE AIR INTAKE IN A SUBSONIC FLOW [EFFETS DU TIR D'UNE ARME SUR UNE PRISE D'AIR EN SUBSONIQUE]**

J. P. FLODROPS (Lille I, Université, Villeneuve-d'Ascq, Nord, France) Association Aeronautique et Astronautique de France, Colloque d'Aérodynamique Appliquée, 18th, Poitiers, France, Nov, 18-20, 1981, 37 p. In French. Research supported by the Direction des Recherches, Etudes et Techniques. refs (AAAF PAPER NT 81-11)

The results of experimental trials involving the interaction between the firing of an aircraft cannon and the flow in the engine air intake ducts are presented. Two experimental set-ups were used. One involved both the intake and cannon muzzle at zero angle of attack, wherein the analysis took into account the position of the armament and the Mach number of the oncoming flow. The angle of attack was raised to 20 deg for studies of Mach 0.35 flows. High speed photography was used in both cases, synchronized with the firing of the gun. Measurements were made of the unsteady pressure to characterize and trace the disturbances produced in the air duct by firing the gun. It was found that burning gases may enter the duct and cause oxygen shortages in the combustion chamber, leading to engine shutdown. Flow disturbances were also noted from the shock wave of the projectile and from the emptying of the armament tube. M.S.K.

A83-11773

**A HALF-WING NEAR A WALL AT HIGH ANGLES OF ATTACK IN A PULSED FLOW [DEMI-AILE EN PAROI A FORTE INCIDENCE EN ECOULEMENT PULSE]**

J. REBONT, D. FAVIER, and C. MARESCA (Aix-Marseille I, Université, Marseille, France) Association Aeronautique et Astronautique de France, Colloque d'Aérodynamique Appliquée, 18th, Poitiers, France, Nov 18-20, 1981, 37 p. In French. Service Technique des Programmes Aeronautiques refs (Contract STPA-79-98-012) (AAAF PAPER NT 81-12)

The effects of cyclic variations of the velocity on the aerodynamic twist of a half-wing were examined and compared to the results from two-dimensional studies of the same phenomenon. Varying angles of attack were exposed to the flow. The frequency of variations were kept within amplitudes between 0.64-0.48, and the turbulence shed by the wing was monitored. Attention was focused on the stall angle of 6 deg observed in the two-dimensional studies, and the stall angle of 20 deg, which is significantly affected by a pulsed flow. The results are considered useful for modeling the turbulence created at the extremities of rotor blades. M.S.K.

A83-11775

**X-WIRE SOUNDING IN AN AIR INLET AT HIGH ANGLE OF ATTACK [SONDAGES AU FIL CHAUD CROISE DANS UNE ENTREE D'AIR EN INCIDENCE]**

J. VERRIERE and J. M. BOURGEOIS (Toulouse, Centre d'Essais Aeronautique, Toulouse, France) Association Aeronautique et Astronautique de France, Colloque d'Aérodynamique Appliquée, 18th, Poitiers, France, Nov. 18-20, 1981, 29 p. In French (AAAF PAPER NT 81-15)

The results of two experimental trials using X-wire anemometers to examine the local fluctuations at the intake of a compressor at high angles of attack are reported. Two intakes were tested, one a cylinder at high angles of attack, and the other an intake with the upper edge extended outward enough to form a 30 deg angle with the vertical plane of the lower lip. Air velocities were kept at 40 m/sec, while the angle of attack was varied between 0-40 deg. Internal Mach numbers of 0.12-0.18 were generated at a Reynolds number of 630,000. The tube with the beveled edge was tried only in a Mach 0.9 flow. The X-wire technique was found to be suitable for industrial applications of measuring fluctuations at different angles of attack and for measuring the intake air velocity. M.S.K.

A83-11778

**HELICOPTER BLADE TIPS [LES EXTREMITES DE PALES D'HELICOPTERES]**

R. LYOTHIER (Société Nationale Industrielle Aérospatiale, Marignane, Bouches-du-Rhône, France) Association Aeronautique et Astronautique de France, Colloque d'Aérodynamique Appliquée, 18th, Poitiers, France, Nov 18-20, 1981, 23 p. In French. refs (AAAF PAPER NT 81-19)

Methods of improving helicopter performance and vibration level by proper shaping of helicopter blade tips are considered. The principle involved consists of reducing the extent of the supersonic zone above the advancing tip and of the turbulent interaction. For stationary and advancing flight, the influence of the rotor and the problems posed by blade tips are reviewed. The theoretical methods of dealing with the two types of flight are briefly stated, and the experimental apparatus is described, including model triple and quadruple rotors. Different blade tip shapes are shown and briefly discussed. The theoretical results include an advancing speed of 309 km/h and a blade tip rotational speed of 215 m/s. The experimental values are advancing speed of 302 km/h and blade tip Mach number 0.86 for both types of rotor. C.D.

A83-13023

**PRESSURE DISTRIBUTION ON A SIMPLE DELTA WING**

F. WALKDEN, P. CAINE (Salford, University, Salford, Lancs., England), and G. MORETTI (New York, Polytechnic Institute, Farmingdale, NY) Computers and Fluids, vol. 10, no. 4, 1982, p. 295-305. refs

Some theoretical results are compared with experimental measurements of pressure on a given delta wing. An investigation of the differences between two sets of theoretical results obtained by different computational procedures has been carried out. Explanations of the causes of the differences are given and it is shown that theoretical results which are in close agreement with each other can be produced by the different methods. It is argued that the theoretical pressure distribution resulting from applying the use of inviscid theory, has been calculated now with reasonable accuracy, and that remaining differences between theory and experiment are probably due to viscous boundary layer effects. (Author)

A83-13077#

**DEVELOPMENT OF ANALYTICAL AND EXPERIMENTAL TECHNIQUES FOR DETERMINING STORE AIRLOAD DISTRIBUTIONS**

C. H. MORGRET, R. E. DIX (Calspan Field Services, Inc., Arnold Air Force Station, TN), and L. E. LIJEWSKI (USAF, Armament Laboratory, Eglin AFB, FL) Journal of Spacecraft and Rockets, vol. 19, Nov.-Dec 1982, p. 489-495 refs

(Previously cited in issue 21, p. 3613, Accession no. A81-44584)

N83-10004# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div

**AERODYNAMIC CHARACTERISTICS OF MANEUVERING FLAPS**

B. FANG, H. WANG, and Y. ZHANG *In its* Acta Aeron. Astronautica Sinica (FTD-ID(RS)T-0285-82) p 1-20 23 Jun. 1982. Transl. into ENGLISH from Acta Aeron. Astronautica Sinica (China), v. 2, no. 3, Sep. 1981 20 p. Original language document announced as A82-22110

Avail: NTIS HC A08/MF A01

The use of maneuvering flaps to improve the air combat capability of fighter aircraft was investigated. Data from wind tunnel tests was used to examine the capability and effect of maneuvering flaps in drag reduction, the effect of flap chord and flap span, the problem of matching the leading and trailing edge, the effect of the shapes of wing strake and wing plane on drag reduction, and the improvement of flight quality at large angles of attack through use of maneuvering flaps. It was determined that the use of maneuvering flaps is effective in improving combat capability through control of flow separation and decrease of drag at large angles of attack, and through expansion of the buffet boundary

and reduction of the buffet intensity. The best combined effects are obtained through considering the effects of maneuvering flap parameters on the aircraft structure and system. Author

**N83-10005#** Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.  
**NUMERICAL CALCULATION OF LIFT, MOMENT COEFFICIENT AND DYNAMIC STABILITY DERIVATIVE ON SIDESLIPPING WINGS IN UNSTEADY SUPERSONIC FLOWS**

G. ZHANG *In its* Acta Aeron. Astronautica Sinica (FTD-ID(RS)T-0285-82) p 21-33 23 Jun. 1982 refs Transl. into ENGLISH from Acta Aeron. Astronautica Sinica (China), v 2, no. 3, Sep 1981 13 p Original language document announced as A82-22111

Avail: NTIS HC A08/MF A01

A numerical solution of unsteady supersonic flows of sideslipping wings utilizing the characteristic lines network method of unsteady supersonic forces distributed on the wing plane is presented. The oscillating mode of undulatory, pitching, and rolling harmonic oscillations of sideslipping wings and the methods for calculation of lift, moment coefficient, and dynamic stability derivatives (including cross coupling derivatives) are demonstrated. The dynamic stability derivatives of a typical wing without sideslipping calculated using the numerical method of nonstationary theory are compared with results obtained using the more common analytical formula of quasistationary theory. Author

**N83-10006#** Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.  
**NUMERICAL COMPUTATION OF UNSTEADY SUBSONIC AERODYNAMIC FORCES ON WING-BODY-TAIL EXPOSED TO TRAVELING GUST**

G. WEN and Z. SUN *In its* Acta Aeron. Astronautica Sinica (FTD-ID(RS)T-0285-82) p 34-44 23 Jun. 1982 refs Transl. into ENGLISH from Acta Aeron. Astronautica Sinica (China), v. 2, no. 3, Sep. 1981 11 p Original language document announced as A82-22112

Avail: NTIS HC A08/MF A01

The unsteady aerodynamic characteristics of complex subsonic wing-body-tail configurations undergoing traveling gust induced by shock waves. The finite element method was employed to compute unsteady aerodynamic forces for various blast orientations, elevation angles, and complex plane forms. The results were found to be in good agreement with experimental data. Author

**N83-10016\*#** National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.  
**AN EXPERIMENTAL AND THEORETICAL INVESTIGATION OF THICK WINGS AT VARIOUS SWEEP ANGLES IN AND OUT OF GROUND EFFECT**

J. W. PAULSON, JR. and S. O. KJELGAARD Oct. 1982 165 p refs (NASA-TP-2068; L-15314; NAS 1 60 2068) Avail: NTIS HC A08/MF A01 CSCL 01A

The effects of sweep and aspect ratio on the longitudinal aerodynamics of a wing in and out of ground effect are analyzed. Experimental data were obtained in the Langley 4 by 7 Meter Tunnel for a wing with various sweep angles, aspect ratios, and flap deflections both in and out of ground effect. Theoretical predictions of the out of ground effect lift coefficients and flap effectiveness and the in ground effect lift coefficients are compared with the experimental results. As expected, the lift curve slope and flap effectiveness are reduced when the aspect ratio is reduced or the sweep angle is increased both in and out of ground effect. In ground effect, the lift and flap effectiveness are increased above a wing height to span ratio of 0.15. However, with flap deflections less than or equal to 10 deg and an angle of attack near 0 deg lift is markedly decreased at very low heights above the ground plane. This trend is not predicted by planar theoretical models but is predicted by a surface panel method where thickness effects are included. Author

**N83-10017\*#** National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.  
**COMPARISON OF ANALYTICAL AND EXPERIMENTAL SUBSONIC STEADY AND UNSTEADY PRESSURE DISTRIBUTIONS FOR A HIGH-ASPECT-RATIO-SUPERCritical WING MODEL WITH OSCILLATING CONTROL SURFACES**  
W. E. MCCAIN Aug. 1982 53 p refs (NASA-TM-84490; NAS 1.15-84490) Avail: NTIS HC A04/MF A01 CSCL 01A

The results of a comparative study using the unsteady aerodynamic lifting surface theory, known as the Doublet Lattice method, and experimental subsonic steady- and unsteady-pressure measurements, are presented for a high-aspect-ratio supercritical wing model. Comparisons of pressure distributions due to wing angle of attack and control-surface deflections were made. In general, good correlation existed between experimental and theoretical data over most of the wing planform. The more significant deviations found between experimental and theoretical data were in the vicinity of control surfaces for both static and oscillatory control-surface deflections. Author

**N83-10018\*#** United Technologies Research Center, East Hartford, Conn.  
**ANALYSIS OF AIRFOIL LEADING EDGE SEPARATION BUBBLES Interim Report, 1 Apr. 1981 - 15 Jun. 1982**

J. E. CARTER and V. N. VATSA Hampton, Va. NASA, Langley Research Center May 1982 52 p refs (Contract NAS1-16585) (NASA-CR-165935; NAS 1.26.165935; R82-915622-8) Avail: NTIS HC A04/MF A01 CSCL 01A

A local inviscid-viscous interaction technique was developed for the analysis of low speed airfoil leading edge transitional separation bubbles. In this analysis an inverse boundary layer finite difference analysis is solved iteratively with a Cauchy integral representation of the inviscid flow which is assumed to be a linear perturbation to a known global viscous airfoil analysis. Favorable comparisons with data indicate the overall validity of the present localized interaction approach. In addition numerical tests were performed to test the sensitivity of the computed results to the mesh size, limits on the Cauchy integral, and the location of the transition region. M.G.

**N83-10019\*#** National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio  
**WIND TUNNEL TESTS OF A ZERO LENGTH, SLOTTED-LIP ENGINE AIR INLET FOR A FIXED NACELLE V/STOL AIRCRAFT**

R. R. WOOLLETT, W. E. BECK, JR. (Lockheed-California Co., Burbank), and E. R. GLASGOW (Lockheed-California Co., Burbank) Aug. 1982 117 p refs (NASA-TM-82939; E-1338; NAS 1 15:82939) Avail: NTIS HC A06/MF A01 CSCL 01A

Zero length, slotted lip inlet performance and associated fan blade stresses were determined during model tests using a 20 inch diameter fan simulator in the NASA-LeRC 9 by 15 foot low speed wind tunnel. The model configuration variables consisted of inlet contraction ratio, slot width, circumferential extent of slot fillers, and length of a constant area section between the inlet throat and fan face. The inlet performance was dependent on slot gap width and relatively independent of inlet throat/fan face spacer length and slot flow blockage created by 90 degree slot fillers. Optimum performance was obtained at a slot gap width of 0.36 inch. The zero length, slotted lip inlet satisfied all critical low speed inlet operating requirements for fixed horizontal nacelles subsonic V/STOL aircraft. Author

## 02 AERODYNAMICS

**N83-10020#** Cambridge Univ (England). Dept. of Physics and Chemistry of Solids

### **REDUCTION OF AERODYNAMIC DRAG: TORSION DISC VISCOMETRY Interim Report, May - Dec. 1981**

W A WILBY and J E FIELD Jan. 1982 37 p refs  
(Contract AF-AFOSR-0057-79; AF PROJ. 2307)  
(AD-A117859; AFOSR-82-0619TR) Avail. NTIS HC A03/MF A01 CSCL 20D

This report describes the design, construction and evaluation of a working torsion disc viscometer. Initial tests at gas pressures between 91 mbar and 1000 mbar show that the theory of the instrument is adequate and that the viscometer is capable of detecting small changes in gas viscosity. A thorough investigation of the effect of radioactive irradiation on gas viscosity will be made shortly, following the work of Kestin and Shah. An analysis of their approach is given here, viewed in the light of our preliminary work, and suggests the most likely ways of achieving a change in gas viscosity.  
Author (GRA)

**N83-10021#** Messerschmitt-Boelkow-Blohm G m b.H., Ottobrunn (West Germany). Unternehmensbereich Drehfluegler.

### **CALCULATION OF THREE DIMENSIONAL UNSTEADY TRANSONIC FLOW AROUND ROTOR BLADES**

H STAHL 19 Mar 1982 16 p refs Presented at AGARD Fluid Dyn. Panel Specialists Meeting on Prediction of Aerodyn Loads on Rotorcraft, London, 17-18 May 1982  
(MBB-UD-353) Avail: Issuing Activity

The application and adaptation of classical wing methods to the special requirements of rotor blade tip flow are described. The problem is split up into two principal parts: (1) the three dimensional steady flow and (2) the two dimensional unsteady case. The unsteady calculation is carried out by a finite difference method for the two dimensional case, considering both the angle of attack and the Mach number variation. The three dimensional calculation is based on a finite element model for fixed wings which is adapted for the rotor blade application by a linearly varying velocity distribution over the blade radius. Only the outer 25% of the radius is taken into account. Several parameters, such as tip Mach number and angle of attack, were investigated. A model is suggested that determines the final lift and moment distributions on the blade by superposition of three dimensional steady and two dimensional unsteady results.  
Author (ESA)

**N83-11036#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div

### **CALCULATION OF THE LIFT DISTRIBUTION AND AERODYNAMIC DERIVATIVES OF QUASI-STATIC ELASTIC AIRCRAFT**

L. QIANGANG, W. CHANGLIN, and J. ZHENG *In its* J of Aeron (FTD-ID(RS)T-0621-82) p 1-19 21 Jul. 1982 refs Transl. into ENGLISH from Acta Aeron. et Astron Sinica (China), v 3, no. 1, Mar. 1982  
Avail: NTIS HC A08/MF A01 CSCL 01A

A numerical method is presented for predicting the aerodynamic characteristics of elastic aircraft under quasi-static approximation. This method can be used to evaluate the lift distribution and 11 main longitudinal aerodynamic derivatives of elastic aircraft at subsonic speeds. The aerodynamic calculations are based on the Green's function method. The structure deformation is evaluated by the free structure influence coefficient method. The combination of these methods can provide an efficient, general and flexible aerodynamic tool for design of elastic aircraft. Several numerical examples are given and some dynamical problems of elastic aircraft are also discussed. The derivatives evaluated can be directly adopted in analysis of stability and control of elastic aircraft.  
Author

**N83-11044#** Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

### **AERODYNAMIC COEFFICIENT IDENTIFICATION OF TIME-VARYING AIRCRAFT SYSTEM AND ITS APPLICATION**

W TONG *In its* J of Aeron. (FTD-ID(RS)T-0621-82) p 109-123 21 Jul 1982 refs Transl. into ENGLISH from Acta Aeron. et Astron Sinica (China), v 3, no. 1, Mar. 1982  
Avail: NTIS HC A08/MF A01 CSCL 01A

Aerodynamic coefficient identification for time-varying aircraft system was studied. On the basis of practical measurement in flight tests and by analyzing trend of the coefficients in aircraft time-varying differential equations, it is possible to transform the individual time-varying coefficient into a known function multiplied by an unknown constant. These unknown constants are referred to as undefined coefficients. With the aid of the Newton-Raphson method extended to the time-varying coefficient differential equations, the undefined coefficients can be evaluated by iteration calculation. In this way the complicated time-varying aircraft identification can be carried out. In order to verify this calculation, the aerodynamic coefficients of an aircraft were evaluated by the data taken from unsteady flight, and the reliability of aerodynamic coefficients obtained from this identification was discussed. The calculation results matched very well the test data and made a contribution to the improvement of aircraft flight tests.  
R.J.F.

**N83-11057#** Aeronautical Research Labs., Melbourne (Australia)

### **AN INTERFEROMETRIC INVESTIGATION OF THE NEAR DESIGN POINT FLOW OVER SUPERCRITICAL AEROFOIL BGK-1**

N POLLOCK Jan 1982 40 p refs  
(ARL-AERO-NOTE-405; AR-002-328, AD-A118894) Avail: NTIS HC A03/MF A01

The upper surface flow over a supercritical aerofoil BGK-1 near its design condition was studied using a laser interferometer. The tests were carried out at a chord Reynolds number of 1.65 million with transition free and artificially fixed at various chordwise locations. The interferograms were analysed to produce 'instantaneous' surface pressure distributions for comparison with conventional time averaged distributions obtained from surface tappings. The results show that the upper surface flow is unsteady with both fixed and free transition. They also indicate that artificially fixing transition in low Reynolds number tests does not produce an accurate simulation of the high Reynolds number flow for conditions near the design point.  
S.L.

**N83-11058\*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

### **PERFORMANCE OF A TANDEM-ROTOR/TANDEM-STATOR CONICAL-FLOW COMPRESSOR DESIGNED FOR A PRESSURE RATIO OF 3**

J R WOOD, A. K. OWEN (Army Aviation Research and Development Command, Cleveland, Ohio), and L. F. SCHUMANN (Army Aviation Research and Development Command, Cleveland, Ohio) Oct. 1982 38 p refs  
(NASA-TP-2034; E-369, NAS 1.60.2034, AVRADCOM-TR-81-C-5)  
Avail: NTIS HC A03/MF A01 CSCL 01A

A conical-flow compressor stage with a large radius change through the rotor was tested at three values of rotor tip clearance. The stage had a tandem rotor and a tandem stator. Peak efficiency at design speed was 0.774 at a pressure ratio of 2.613. The rotor was tested without the stator, and detailed survey data were obtained for each rotor blade row. Overall peak rotor efficiency was 0.871 at a pressure ratio of 2.952.  
Author

**N83-11059\*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.  
**INVESTIGATION OF INSTALLATION EFFECTS OF SINGLE-ENGINE CONVERGENT-DIVERGENT NOZZLES**  
 J. R. BURLEY, II and B. L. BERRIER Nov. 1982 234 p refs  
 (NASA-TP-2078, L-15343, NAS 1.60:2078) Avail: NTIS HC A11/MF A01 CSCL 01A

An investigation was conducted in the Langley 16-Foot Transonic Tunnel to determine installation effects on single-engine convergent-divergent nozzles applicable to reduced-power supersonic cruise aircraft. Tests were conducted at Mach numbers from 0.50 to 1.20, at angles of attack from -3 degrees to 9 degrees, and at nozzle pressure ratios from 1.0 (jet off) to 8.0. The effects of empennage arrangement, nozzle length, a cusp fairing, and afterbody closure on total aft-end drag coefficient and component drag coefficients were investigated. Basic lift- and drag-coefficient data and external static-pressure distributions on the nozzle and afterbody are presented and discussed  
 Author

**N83-11061\*#** Applied Inst. of Mathematics, Inc., Evanston, Ill.  
**A NONLINEAR STRUCTURAL CONCEPT FOR COMPLIANT WALLS Final Report**  
 E. L. REISS Washington NASA Oct 1982 40 p refs  
 (Contract NAS1-14717)  
 (NASA-CR-3628, NAS 1.26:3628) Avail: NTIS HC A03/MF A01 CSCL 01A

Two mechanisms of drag reduction for flow over flat plates were investigated. The first mechanism employs Bushnell's hypothesis that compliant walls produce drag reduction by interfering with the formation of the turbulent spots in a turbulent boundary layer. It is shown that the amplitudes and frequencies of compliant wall motions for drag reduction might be achieved by using slightly curved walls and the resulting large amplitude motions of snap buckling. A simple structural model of an arch is used in the analysis, and an asymptotic method is developed. The required wall motions can be obtained by using materials like mylar. In addition, the delay of transition from laminar to turbulent flow by driven walls was studied for Poiseuille channel flow. The walls are driven by a periodic traveling wave. A significant increase in the transitional Reynolds number is obtained by appropriately prescribing the wavelength and phase velocity of the wall motion. Previously developed asymptotic methods are used in the analysis  
 M G

**N83-11062\*#** Systems Technology, Inc., Hawthorne, Calif  
**STABILITY AND CONTROL OF THE GOSSAMER HUMAN POWERED AIRCRAFT BY ANALYSIS AND FLIGHT TEST Final Report**  
 H. R. JEX and D. G. MITCHELL Washington NASA Oct. 1982 83 p refs Revised  
 (Contract NAS4-2705)  
 (NASA-CR-3627; NAS 1.26:3627; STI-TR-2109-1; AV-R-82/520)  
 Avail: NTIS HC A05/MF A01 CSCL 01A

The slow flight speed, very light wing loading, and neutral stability of the Gossamer Condor and the Gossamer Albatross emphasized apparent-mass aerodynamic effects and unusual modes of motion response. These are analyzed, approximated, and discussed, and the resulting transfer functions and dynamic properties are summarized and compared. To verify these analytical models, flight tests were conducted with and electrically powered Gossamer Albatross II. Sensors were installed and their outputs were telemetered to records on the ground. Frequency sweeps of the various controls were made and the data were reduced to frequency domain measures. Results are given for the response of: pitch rate, airspeed and normal acceleration from canard-elevator deflection; roll rate and yaw rate from canard-rudder tilt; and roll rate and yaw rate from wing warp. The reliable data are compared with the analytical predictions  
 A.R.H.

**N83-11069\*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.  
**TABULATED PRESSURE MEASUREMENTS ON AN EXECUTIVE-TYPE JET TRANSPORT MODEL WITH A SUPERCRITICAL WING**  
 D. W. BARTLETT Sep. 1975 467 p refs  
 (NASA-TM-X-72701; NAS 1.15:X-72701) Avail: NTIS HC A20/MF A01 CSCL 01A

A 1/9 scale model of an existing executive type jet transport refitted with a supercritical wing was tested on in the 8 foot transonic pressure tunnel. The supercritical wing had the same sweep as the original airplane wing but had maximum thickness chord ratios 33 percent larger at the mean geometric chord and almost 50 percent larger at the wing-fuselage juncture. Wing pressure distributions and fuselage pressure distributions in the vicinity of the left nacelle were measured at Mach numbers from 0.25 to 0.90 at angles of attack that generally varied from -2 deg to 10 deg. Results are presented in tabular form without analysis  
 S L

**N83-11070\*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.  
**WIND-TUNNEL INVESTIGATION OF SEVERAL HIGH ASPECT-RATIO SUPERCRITICAL WING CONFIGURATIONS ON A WIDE-BODY-TYPE FUSELAGE**  
 D. W. BARTLETT Jul 1977 407 p refs  
 (NASA-TM-X-71996; NAS 1.15 X-71996) Avail: NTIS HC A18/MF A01 CSCL 01A

An investigation was conducted in the Langley 8-foot transonic pressure tunnel on two aspect-ratio 11.95 supercritical wings that were tested in combination with a representative wide-body-type fuselage. The two supercritical wings have identical planforms for equal sweep angles and differ only in thickness. Each wing was tested at quarter-chord sweep angles of 27 deg and 30 deg. At the higher sweep angle, the aspect ratio is reduced to 11.36. At 27 deg of quarter-chord sweep, the thicker supercritical wing (SCW-1) has maximum streamwise thickness-to-chord ratios of 0.16 at the wing-fuselage juncture, 0.14 at the planform break station, and 0.12 at the tip. The thinner wing (SCW-2) has maximum streamwise thickness-to-chord ratios of 0.144, 0.12, and 0.10 at the same stations respectively. Tests were also conducted on the thinner supercritical wing at the 27 deg sweep angle with a 15.24 cm (6.0 in) shorter span which results in an aspect ratio of 10.25. For comparison, data were obtained on a current wide-body transport wing (AR=7) that was tested on the same fuselage used with the supercritical wings.  
 Author

**N83-11071\*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.  
**THE NASA SUPERCRITICAL-WING TECHNOLOGY**  
 D. W. BARTLETT and J. C. PATTERSON, JR. Jul. 1978 23 p refs  
 Presented at the CTOL Transport Technol Conf., Hampton, Va., 28 Feb. - 3 Mar. 1978  
 (NASA-TM-78731, L-12341, NAS 1.15:78731) Avail: NTIS HC A02/MF A01 CSCL 01A

A number of high aspect ratio supercritical wings in combination with a representative wide body type fuselage were tested in the Langley 8 foot transonic pressure tunnel. The wing parameters investigated include aspect ratio, sweep, thickness to chord ratio, and camber. Subsequent to these initial series of tests, a particular wing configuration was selected for further study and development. Tests on the selected wing involved the incorporation of a larger inboard trailing edge extension, an inboard leading edge extension, and flow through nacelles. Range factors for the various supercritical wing configurations are compared with those for a reference wide body transport configuration  
 M.G.

## 02 AERODYNAMICS

**N83-11072\*#** National Aeronautics and Space Administration Langley Research Center, Hampton, Va

**RECENT EXPERIENCES WITH THREE-DIMENSIONAL TRANSONIC POTENTIAL FLOW CALCULATIONS**

D. A. CAUGHEY (Cornell Univ.), P. A. NEWMAN (New York Univ.), and A. JAMESON Jul. 1978 25 p Presented at the CTOL Transport Technol. Conf., Hampton, Va, 28 Feb. - 3 Mar 1978 (Contract NGR-33-016-167; NGR-33-016-201; N00014-77-C-0033, N00014-77-C-0032)

(NASA-TM-78733; L-12359; NAS 1.15:78733) Avail NTIS HC A02/MF A01 CSCL 01A

Some recent experiences with computer programs capable of solving finite-difference approximations to the full potential equation for the transonic flow past three dimensional swept wings and simple wing-fuselage combinations are discussed. The programs used are a nonconservative program for swept wings, a quasi-conservative finite-volume program capable of treating swept wings mounted on fuselages of slowly varying circular cross section, and a fully conservative finite volume scheme capable of treating swept wings and wing-cylinder combinations. The present capabilities of these codes are reviewed. The relative merits of the conservative and nonconservative formulations are discussed, and the results of calculations including corrections for the boundary-layer displacement effect are presented. RJF

**N83-11073\*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va

**EFFECTS OF DIFFERENTIAL AND SYMMETRICAL AILERON DEFLECTION ON THE AERODYNAMIC CHARACTERISTICS OF AN NASA SUPERCRITICAL-WING RESEARCH AIRPLANE MODEL**

D. W. BARTLETT Oct. 1975 66 p refs (NASA-TM-X-3231, L-10220, NAS 1 15-X-3231) Avail NTIS HC A04/MF A01 CSCL 01A

An investigation has been conducted in the Langley 8 foot transonic pressure tunnel to determine the effects of differential and symmetrical aileron deflection on the longitudinal and lateral directional aerodynamic characteristics of an 0.087 scale model of an NASA supercritical wing research airplane (TF-8A). Tests were conducted at Mach numbers from 0.25 to 0.99 in order to determine the effects of differential aileron deflection and at Mach numbers of 0.25 and 0.50 to determine the effects of symmetrical aileron (flap) deflection. The angle of attack range for all tests varied from approximately -12 deg to 20 deg. Author

**N83-11074\*#** National Aeronautics and Space Administration Langley Research Center, Hampton, Va.

**STATIC AERODYNAMIC CHARACTERISTICS OF A MODEL WITH A 17 PERCENT THICK SUPERCRITICAL WING**

J. C. FERRIS May 1972 143 p refs (NASA-TM-X-2551, L-8081; NAS 1.15:X-2551) Avail: NTIS HC A07/MF A01 CSCL 01A

The static stability and control characteristics and air loads on the wing and aileron of a 0.09 scale model of an airplane with a 17 percent thick supercritical wing were investigated. The longitudinal aerodynamic characteristics were determined over a lift coefficient range sufficiently high to induce buffet onset at Mach numbers from 0.30 to 0.80. In addition, the lateral aerodynamic characteristics were determined as a function of sideslip angle and angle of attack at selected Mach numbers. M.G.

**N83-11075\*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

**AERODYNAMIC CHARACTERISTICS OF THE 10-PERCENT-THICK NASA SUPERCRITICAL AIRFOIL 33 DESIGNED FOR A NORMAL-FORCE COEFFICIENT OF 0.7**

C. D. HARRIS 1975 105 p refs (NASA-TM-X-72711; NAS 1.15:X-72711) Avail: NTIS HC A06/MF A01 CSCL 01A

A 10-percent-thick supercritical airfoil based on an off-design sonic-pressure plateau criterion was developed and experimental aerodynamic characteristics measured. The airfoil had a design

normal-force coefficient of 0.7 and was identified as supercritical airfoil 33. Results show the airfoil to have good drag rise characteristics over a wide range of normal-force coefficients with no measurable shock losses up to the Mach numbers at which drag divergence occurred for normal-force coefficients up to 0.7. Comparisons of experimental and theoretical characteristics were made and composite drag rise characteristics were derived for normal-force coefficients of 0.5 and 0.7 and a Reynolds number of 40 million. Author

**N83-11076\*#** National Aeronautics and Space Administration Langley Research Center, Hampton, Va.

**COMPARISON OF THE EXPERIMENTAL AERODYNAMIC CHARACTERISTICS OF THEORETICALLY AND EXPERIMENTALLY DESIGNED SUPERCRITICAL AIRFOILS**

C. D. HARRIS Jul. 1974 136 p refs (NASA-TM-X-3082; L-9548; NAS 1.15:X-3082) Avail. NTIS HC A07/MF A01 CSCL 01A

A lifting airfoil theoretically designed for shockless supercritical flow utilizing a complex hodograph method has been evaluated in the Langley 8-foot transonic pressure tunnel at design and off-design conditions. The experimental results are presented and compared with those of an experimentally designed supercritical airfoil which were obtained in the same tunnel. Author

**N83-11077\*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

**AERODYNAMIC CHARACTERISTICS OF A 14-PERCENT-THICK NASA SUPERCRITICAL AIRFOIL DESIGNED FOR A NORMAL-FORCE COEFFICIENT OF 0.7**

C. D. HARRIS Jul. 1975 101 p refs (NASA-TM-X-72712; NAS 1.15:X-72712) Avail. NTIS HC A05/MF A01 CSCL 01A

This report documents the experimental aerodynamic characteristics of a 14 percent thick supercritical airfoil based on an off design sonic pressure plateau criterion. The design normal force coefficient was 0.7. The results are compared with those of the family related 10 percent thick supercritical airfoil 33. Comparisons are also made between experimental and theoretical characteristics and composite drag rise characteristics derived for a full scale Reynolds number of 40 million. Author

**N83-11078\*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

**AERODYNAMIC CHARACTERISTICS OF 10 PERCENT THICK NASA SUPERCRITICAL AIRFOILS WITH DIFFERENT AFT CAMBER**

C. D. HARRIS Feb. 1975 192 p refs (NASA-TM-X-72007; NAS 1.15:X-72007) Avail: NTIS HC A09/MF A01 CSCL 01A

The aerodynamic characteristics of several supercritical airfoils interim to the improved 10-percent thick NASA supercritical airfoil 26a are discussed. The airfoils have related slope and curvature distributions over the rear which result in different aft camber. For identification, the airfoils are designated supercritical airfoils 12, 13, 21, 22, and 24. Data is presented without analysis. Author

**N83-11079\*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

**DEVELOPMENT OF TWO SUPERCRITICAL AIRFOILS WITH A THICKNESS-TO-CHORD RATIO OF 0.20 AND DESIGN LIFT COEFFICIENTS OF 0.3 AND 0.4**

L. S. JERNELL 1 Sep. 1976 30 p refs (NASA-TM-X-73948, NAS 1 15:X-73948) Avail: NTIS HC A03/MF A01 CSCL 01A

Two supercritical airfoils were developed specifically for application to span distributed loading cargo aircraft. These airfoils have a thickness-to-chord ratio of 0.20 and design lift coefficients of 0.3 and 0.4, and were derived by modifying a recently developed supercritical airfoil having a thickness-to-chord ratio of 0.18 and a design lift coefficient of 0.5. The aerodynamic characteristics were calculated using a theoretical method which computes the flow

field about an airfoil having supercritical surface velocities.

Author

**N83-11080\*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va. COMPARISON OF EXPERIMENTAL AND THEORETICAL DRAG CHARACTERISTICS FOR A 10-PERCENT-THICK SUPERCRITICAL AIRFOIL USING A NEW VERSION OF AN ANALYSIS CODE**

C. D. HARRIS and D. O. ALLISON Jun 1977 49 p refs (NASA-TM-X-74041, NAS 1 15:X-74041) Avail: NTIS HC A03/MF A01 CSCL 01A

Comparisons of experimental and theoretical drag characteristics for a 10-percent-thick supercritical airfoil using a new version of an advanced analysis code. Comparisons are made at near-design normal-force coefficients for Reynolds numbers from 2 to 11 million. Comments are made concerning various input parameters to the code R.J.F.

**N83-11081\*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va. STATIC LONGITUDINAL AERODYNAMIC CHARACTERISTICS OF A MODEL WITH A MODIFIED 17 PERCENT THICK SUPERCRITICAL WING**

J. C. FERRIS May 1975 40 p refs (NASA-TM-X-3211, L-9960; NAS 1.15:X-3211) Avail: NTIS HC A03/MF A01 CSCL 01A

The static longitudinal stability characteristics of a 0.09 scale model of an airplane with a modified 17 percent thick supercritical wing were investigated. Modifications were made to the wing to reduce a gradual buildup of boundary layer shock loss preceding drag divergence (drag creep) noted in an earlier investigation. The longitudinal aerodynamic characteristics were determined over a Mach number range from 0.30 to 0.76 at angles of attack that generally provided a lift coefficient range from 0 to buffet onset. Results indicate that the modifications to the airfoil essentially eliminated the drag creep associated with the airfoil that occurs between the critical Mach number and the drag divergence Mach number. M.G.

**N83-11082\*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va. APPLICATION OF A SUPERCRITICAL WING TO AN EXECUTIVE-TYPE JET TRANSPORT MODEL**

D. W. BARTLETT Oct. 1975 257 p refs (NASA-TM-X-3251, L-9939; NAS 1 15:X-3251) Avail: NTIS HC A12/MF A01 CSCL 01A

An investigation was conducted in the Langley 8-foot transonic pressure tunnel of a 1/9-scale model of an existing executive-type jet transport refitted with a supercritical wing. The supercritical wing had the same sweep as the original airplane wing but had maximum thickness-chord ratios 33 percent larger at the mean geometric chord and almost 50 percent larger at the wing-fuselage juncture. Force and moment data are presented at Mach numbers from 0.25 to 0.90 at angles of attack that generally vary from -2 to 10 deg. Wing and fuselage pressure distributions are also presented for conditions near the cruise lift coefficient M.G.

**N83-11083\*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va. TRANSONIC AERODYNAMIC CHARACTERISTICS OF THE 10-PERCENT-THICK NASA SUPERCRITICAL AIRFOIL 31**

C. D. HARRIS Mar. 1975 138 p refs (NASA-TM-X-3203, L-9841, NAS 1.15:X-3203) Avail: NTIS HC A07/MF A01 CSCL 01A

Refinements in a 10 percent thick supercritical airfoil (airfoil 31) have produced significant improvements in the drag characteristics compared with those for an earlier supercritical airfoil (airfoil 12) designed for the same normal force coefficient of 0.7. Drag creep was practically eliminated at normal force coefficients between about 0.4 and 0.7 and was greatly reduced at other normal force coefficients. Substantial reductions in the drag levels preceding drag divergence were also achieved at all normal force

coefficients. The Mach numbers at which drag diverges were delayed for airfoil 31 at normal force coefficients up to about 0.6 (by approximately 0.01 and 0.02 at normal force coefficients of 0.4 and 0.6, respectively) but drag divergence occurred at slightly lower Mach numbers at higher normal force coefficients. Author

**N83-11084\*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va. AERODYNAMIC CHARACTERISTICS OF AN 11-PERCENT-THICK SYMMETRICAL SUPERCRITICAL AIRFOIL AT MACH NUMBERS BETWEEN 0.30 AND 0.85**

J. A. BLACKWELL, JR. Jul 1969 42 p refs (NASA-TM-X-1831; NAS 1.15 X-1831) Avail: NTIS HC A03/MF A01 CSCL 01A

The aerodynamic characteristics of an 11 percent thick symmetrical supercritical airfoil were determined in an 8 foot transonic pressure tunnel over a Mach number range of 0.30 to 0.85. The Reynolds number of the tests, based on the airfoil chord, varied with Mach number over a range of 360 million to 774 million. The geometric angle of attack varied from -0.5 to 10.5 deg. The abrupt drag rise for the supercritical airfoil at zero normal force conditions occurs at a Mach number just above 0.82. The corresponding drag rise Mach number for a conventional NACA 0012 airfoil is approximately 0.70. At zero normal force conditions, the level of supersonic flow over the supercritical airfoil is considerably reduced from that for the NACA 0012 airfoil. Also, the shock wave for the supercritical airfoil is substantially weaker than that for the NACA 0012 airfoil. For a Mach number of 0.82 and zero normal force, the flow over the present airfoil is supercritical; however, there is no discernible shock wave in the flow, indicating near isentropic recompression. S.L.

**N83-11085\*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va. EFFECTS OF LANDING GEAR, SPEED BRAKE AND PROTUBERANCES ON THE LONGITUDINAL AERODYNAMIC CHARACTERISTICS OF AN NASA SUPERCRITICAL-WING RESEARCH AIRPLANE MODEL**

D. W. BARTLETT and G. SANGIORGIO Jul. 1975 55 p refs (NASA-TM-X-72684; NAS 1.15:X-72684) Avail: NTIS HC A04/MF A01 CSCL 01A

An investigation was conducted in the Langley Research Center 8-foot transonic pressure tunnel to determine the effects of the landing gear, speed brake and the major airplane protuberances on the longitudinal aerodynamic characteristics of an 0.087-scale model of the TF-8A supercritical-wing research airplane. For the effects of the landing gear and speed brake, tests were conducted at Mach numbers of 0.25 and 0.35 with a flap deflection of 20 degrees and a horizontal-tail angle of -10 degrees. These conditions simulated those required for take-off and landing. The effects of the protuberances were determined with the model configured for cruise (i.e., horizontal-tail angle of -2.5 degrees and no other control deflection), and these tests were conducted at Mach numbers from 0.50 to 1.00. The angle-of-attack range for all tests varied from about -5 degrees to 12 degrees. Author

**N83-11086\*# Iowa Inst. of Hydraulic Research, Iowa City. MEASUREMENTS IN THE WAKE OF AN INFINITE SWEEP AIRFOIL**

C. J. NOVAK and B. R. RAMAPRIAN Apr. 1982 150 p refs (Contract NSG-1200; NAG2-110) (NASA-CR-169464; NAS 1.26:169464; PB82-212499; IHR-240) Avail: NTIS HC A07/MF A01 CSCL 01A

This is a report of the measurements in the trailing edge region as well as in the report of the developing wake behind a swept NACA 0012 airfoil at zero incidence and a sweep angle of 30 degrees. The measurements include both the mean and turbulent flow properties. The mean flow velocities, flow inclination and static pressure are measured using a calibrated three-hole yaw probe. The measurements of all the relevant Reynolds stress components in the wake are made using a tri-axial hot-wire probe and a digital data processing technique developed by the authors. The development of the three dimensional near-wake into a nearly

two dimensional far-wake is discussed in the light of the experimental data. A complete set of wake data along with the data on the initial boundary layer in the trailing edge region of the airfoil are tabulated in an appendix to the report. Author (GRA)

**N83-11089#** Air Force Flight Test Center, Edwards AFB, Calif.  
**AERODYNAMIC CHARACTERISTICS OF THE AFFTC NOSEBOOM INSTRUMENTATION UNIT, VOLUME 1 Final Report**

K. RAWLINGS, III and M. T. KORSMO Mar. 1982 107 p refs 2 Vol.  
 (AD-A118315; AFFTC-TIM-81-2-VOL-1) Avail: NTIS HC A06/MF A01 CSCL 01C

This technical information memorandum presents the results and data from wind tunnel calibration of the flow-angle sensing portion of the Air Force Flight Test Center noseboom instrumentation unit. Analysis of the data from the NASA/Ames Research Center 11- by 11-foot and 9- by 7-foot wind tunnels is presented along with fairings resulting from the analysis. The data fairings, which present error in sensed angle of attack and sensed angle of sideslip as a function of Mach number, angle of attack, and angle of sideslip, are summarized and compared extensively with the data. Computer software incorporating the data fairings in a concise form for data reduction routines and the software documentation are included Volume 1 of this memorandum includes discussion of the analysis, data fairings, fairing-to-data comparisons, software and software documentation Volume 2 is a run schedule and complete listing of the NASA/ARC original wind tunnel data Author (GRA)

**N83-11091#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany) Inst fuer Aeroelastik.

**THE INFLUENCE OF BLADE TIP GEOMETRY ON THE UNSTEADY PRESSURE DISTRIBUTION OF A ROTOR BLADE. PART 1: RECTANGULAR TIP**

K KIENAPPEL Mar. 1982 72 p refs In GERMAN; ENGLISH summary  
 (DFVLR-FB-82-11) Avail: NTIS HC A04/MF A01; DFVLR, Cologne DM 26,50

The influence of various blade tip geometries on the tip vortex of a harmonically oscillating helicopter was investigated experimentally. The basic shape is a common rectangular tip. An introduction to the problem is given as well as a description of the experimental test setup and the measurement technique. The experimental results of the basic configuration are discussed. Parameters are angle of attack, oscillating frequency, amplitude, and Reynolds number. The cases of leading edge separation and dynamic stall are included The results show that the maximum unsteady pressure coefficients occur at fully or partially separated flow Author (ESA)

**N83-11092#** Technische Hogeschool, Delft (Netherlands). Dept. of Aerospace Engineering.

**NUMERICAL AND EXPERIMENTAL INVESTIGATION OF THE AERODYNAMICS OF DOUBLE MEMBRANE SAILWING AIRFOIL SECTIONS**

R. G. DENBOER Feb. 1982 64 p refs  
 (VTH-LR-345) Avail: NTIS HC A04/MF A01

A simple numerical method which can estimate the performance of both slightly and highly cambered double membrane sailwing profiles is presented. Elasticity is taken into account A parameter study was performed and the numerical results were verified. Wind tunnel tests on a two dimensional model were carried out. The lift coefficient,  $C_{sub L}$ , was determined from static pressures at the wind tunnel side walls. The drag coefficient was found with a wake rake. For each test, the shape of the airfoil was photographed and the pressure inside the profile was measured. Besides proving the numerical method, results show that the maximum value of the lift to drag ratio is 88.6, occurring at  $C_{sub L} = 1.88$ , which is much higher than the values for all the other sailwings in the literature. Author (ESA)

## AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents

**A83-12224**

**C-141 OPERATIONS IN BRIGHT STAR 82**

R. E. BROOKS (USAF, Charleston AFB, SC) Navigation, vol. 29, Fall 1982, p 189-194.

A journalistic account is given of a major element on the Operation Bright Star 82 exercise of the Rapid Deployment Force, which involved the flight of six C-141 aircraft from Pope AFB in North Carolina to Cairo West, Egypt, for the dropping of 600 paratroopers before flying on to Rhein-Main air base in West Germany. This nonstop flight lasted more than 19 hours, and required three inflight refuelings Attention is given to the refueling procedures, along with problems associated with conducting such operations in formation. Also covered are the force rendezvous of 18 C-141 and six C-130 aircraft and the mass airdrop at Cairo West O.C.

**A83-13011**

**OBSERVATIONS REGARDING THE MNPS IN THE NORTH ATLANTIC AND CONSIDERATIONS CONCERNING THEIR APPLICABILITY IN THE EUROPEAN AIR SPACE. I [ERFAHRUNGEN MIT MNPS IM NORDATLANTIK UND UEBERLEGUNGEN ZU IHRER ANWENDBARKEIT IM EUROPAEISCHEN LUFTRAUM. I]**

K. E. KARWATH Ortung und Navigation, no. 2, 1982, p 182-184, 186-192 In German refs

In view of the positive results obtained in connection with the application of the Minimum Navigation Performance Specifications (MNPS) in the North Atlantic, an investigation is being conducted to determine whether the introduction of similar specifications for the European air space could contribute to a significant improvement of the air traffic control system For a better understanding of the involved issues and as a basis for a discussion regarding a possible introduction of similar specifications for the European air space, a description is provided of the concept and the application of the MNPS in the North Atlantic. It is pointed out that the employment of the MNPS made it possible to enhance the capacity of the air traffic control system in the North Atlantic air space. The conditions could be provided for permitting a greater number of air space users to cross the North Atlantic by means of a route involving minimum time and minimum fuel consumption. G.R.

**A83-13012**

**COLLISION RISK MODELS [KOLLISIONSRISIKO-MODELLE]**

W. SCHROER (Braunschweig, Technische Universitaet, Brunswick, West Germany) Ortung und Navigation, no. 2, 1982, p. 193-214. In German. refs

The present investigation is concerned with questions regarding the development of model concepts for predicting the probability of a collision in air traffic. It is pointed out that the application of a model for making such predictions requires the definition of a measurement unit for the collision risk Such units are considered along with questions regarding an acceptable risk. The structure of risk models is examined, and the risk model developed by Reich (1964, 1966) is discussed. Attention is given to the application of the Reich model in the European air space, the employment of the Reich model in the case of air traffic under radar surveillance, terminal models, and risk models for the development and evaluation of aircraft collision avoidance systems. G.R.

**N83-10022#** National Transportation Safety Board, Washington, D C.

**AIRCRAFT ACCIDENT REPORT. AIR FLORIDA, INC. BOEING 737-222, N62AF COLLISION WITH 14TH STREET BRIDGE, NEAR WASHINGTON NATIONAL AIRPORT, WASHINGTON, D.C., JANUARY 13, 1982**

10 Aug 1982 142 p  
(PB82-916408; NTSB-AAR-82-8) Avail. NTIS HC A07/MF A01 CSCL 01C

On January 13, 1982, Air Florida Flight 90, a Boeing 737-222 (N62AF), was a scheduled flight to Fort Lauderdale, Florida, from Washington National Airport, Washington, D.C. There were 74 passengers, including 3 infants, and 5 crewmembers on board. The flight's scheduled departure time was delayed about 1 hour 45 minutes due to a moderate to heavy snowfall which necessitated the temporary closing of the airport. Following takeoff from runway 36, which was made with snow and/or ice adhering to the aircraft, the aircraft at 1601 e.s.t. crashed into the barrier wall of the northbound span of the 14th Street Bridge, which connects the District of Columbia with Arlington County, Virginia, and plunged into the ice covered Potomac River. It came to rest on the west side of the bridge 0.75 nmi from the departure end of runway 36. Four passengers and one crewmember survived the crash. When the aircraft hit the bridge, it struck seven occupied vehicles and then tore away a section of the bridge barrier wall and bridge railing. Four persons in the vehicles were killed; four were injured.

Author

**N83-10023\*#** Texas Technological Univ., Lubbock Dept of Electrical Engineering.

**LABORATORY MODELING AND ANALYSIS OF AIRCRAFT-LIGHTNING INTERACTIONS**

C D TURNER and T. F. TROST Aug 1982 168 p refs  
(Contract NAG1-28)  
(NASA-CR-169455; NAS 1.26 169455) Avail. NTIS HC A08/MF A01 CSCL 01C

Modeling studies of the interaction of a delta wing aircraft with direct lightning strikes were carried out using an approximate scale model of an F-106B. The model, which is three feet in length, is subjected to direct injection of fast current pulses supplied by wires, which simulate the lightning channel and are attached at various locations on the model. Measurements are made of the resulting transient electromagnetic fields using time derivative sensors. The sensor outputs are sampled and digitized by computer. The noise level is reduced by averaging the sensor output from ten input pulses at each sample time. Computer analysis of the measured fields includes Fourier transformation and the computation of transfer functions for the model. Prony analysis is also used to determine the natural frequencies of the model. Comparisons of model natural frequencies extracted by Prony analysis with those for in flight direct strike data usually show lower damping in the in flight case. This is indicative of either a lightning channel with a higher impedance than the wires on the model, only one attachment point, or short streamers instead of a long channel.

Author

**N83-10024\*#** National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.

**LOW-ALTITUDE WIND MEASUREMENTS FROM WIDE-BODY JET TRANSPORTS**

R E. DUNHAM, JR. Oct. 1982 45 p refs  
(NASA-TM-84538; L-15321; NAS 1.15.84538) Avail. NTIS HC A03/MF A01 CSCL 01C

For a 2-week period in the spring of 1977, data were collected onboard wide-body jet transports for the determination of winds and wind shear during landings and take-offs. The data represent about 640 take-offs or landings at 14 airports in Europe and the United States. Analysis of the wind-shear data indicates that shears of a given value are equally likely to occur at any altitude in the lower 1400-ft section of the atmosphere. Analysis of the data indicates that low shears (plus or minus 0.33 knot/per ft) have a 67-percent chance of occurrence during a landing or take-off, while higher values (plus or minus 0.15 knot/per ft) have a 0.5-percent

chance of occurrence. A determination of the duration of a given shear was not made. Author

**N83-10025#** McDonnell-Douglas Corp., Long Beach, Calif  
**A COMBINED HAZARD INDEX FIRE TEST METHODOLOGY FOR AIRCRAFT CABIN MATERIALS, VOLUME 1 Final Report, Sep. 1977 - Nov. 1981**

H H SPIETH, J G. GAUME, R E LUOTO, and D. M KLINCK  
Apr 1982 168 p refs 2 Vol  
(Contract DOT-FA77WA-4019)  
(AD-A117448, DOT/FAA/CT-82/36-1) Avail. NTIS HC A08/MF A01 CSCL 01C

This report describes a laboratory test method and the modeling of the resultant data to produce a means of ranking aircraft cabin materials for the combined hazards produced in a survivable post-crash fire. Ranking is based on reducing each hazard accumulating in a cabin during a 5-minute crash fire scenario to the common denominator of a passenger escape time. Combined Hazards Index (CHI) is expressed as the number of seconds of scenario burn time at which the sum of the fractional hazards doses reaches an escape limit. All data was obtained using a computer-augmented Ohio State University Calorimeter modified to measure the major combustion gases in addition to heat and smoke as a material burns. A computerized fire analysis model was developed to predict cabin environmental hazards from the laboratory data. A human survival model relating short term hazard dose to incapacitation time was incorporated in this program. The changing cabin environment was compared continuously with the human survival model limits to calculate the unaided escape time ranking for each material. GRA

**N83-10026#** McDonnell-Douglas Corp., Long Beach, Calif.

**A COMBINED HAZARD INDEX FIRE TEST METHODOLOGY FOR AIRCRAFT CABIN MATERIALS, VOLUME 2 Final Report**

H H. SPIETH, J G. GAUME, R E LUOTO, and D. M KLINCK  
Apr. 1982 217 p refs 2 Vol  
(Contract DOT-FA77WA-4019)  
(AD-A117449; DOT/FAA/CT-82/36-2) Avail. NTIS HC A10/MF A01 CSCL 01C

This report supplements the description of the methodology developed for ranking cabin materials for combined hazards generated in a survivable crash fire presented in Part 1 of the report. More comprehensive procedures are presented for the calibration and operation of the computer-augmented Ohio State University Calorimeter modified to derive the new materials fire hazards testing apparatus known as the Combined Hazards Analysis System (CHAS). Definitive derivations of the human survival models for temperature, smoke, and toxic gases used in the hazards analysis and a thorough presentation of the mathematics used in the FORTRAN Fire Analysis Computer Program are presented. A full description of the full-scale fire testing method used during the development and demonstration phases of the program is presented to give a better understanding of the capability of the laboratory methodology to rate materials on the basis of the relative passenger escape time potential from a cabin section. Part 2 is, essentially a working manual which will assist greatly those committed to duplicating and successfully operating the CHAS. The CHAS methodology is useful for development of new fire resistant materials. Author (GRA)

**N83-11093#** Committee on Government Operations (U. S. House).

**AIRCRAFT CABIN SAFETY STAFFING STANDARDS**

Washington GPO 1981 32 p refs Presented by the Comm. of the Whole House on the State of the Union, 97th Congr., 1st Sess., 11 Dec. 1981  
(H-REPT-97-394, GPO-87-604) Avail. US Capital, House Document Room

The many emergency conditions handled by flight attendants are listed and that portion of one company's manual showing flight attendants' assignments for evacuating a Boeing 727 aircraft is presented. The background for current FAA regulations pertaining to the number of flight attendants required aboard

### 03 AIR TRANSPORTATION AND SAFETY

passenger-carrying aircraft is given and the implications of a proposed amendment to base the number of required staff on the number of passengers rather than on the seating capacity of the aircraft are examined. Issues discussed include: (1) passenger location and evacuation; (2) the possibility of concurrent exemptions; (3) substitution of rule making for current exemption process; and (4) the economic justification for the proposal. The committee found no empirical evidence to support the FAA's claim that safety would not be affected, and recommended that the proposed amendment to 14 CFR 121.391 be withdrawn.

A.R.H.

**N83-11094#** Committee on Government Operations (U. S. House).

#### **AIRCRAFT CABIN SAFETY STAFFING STANDARDS**

Washington GPO 1981 546 p Hearing before a Subcomm. of the Comm. on Govt. Operations, 97th Congr., 1st Sess., 6 Apr. 1981

(GPO-77-969) Avail: Committee on Government Operations

Potential adverse effects of changes to regulations that would permit airlines to reduce the normally required number of cabin safety personnel by changing the cabin configuration for seating per purposes in certain instances are examined. Flight service handbooks and emergency procedures for commercial aircraft are included as well as statements and letters submitted by flight attendants, and representatives of the FAA, the Air Transport Association of America, the National Transportation Safety Board, and the International Association of Fire Fighters.

A.R.H.

**N83-11095\*#** Lockheed-California Co., Burbank  
**ASSESSMENT OF CRASH FIRE HAZARD OF LH SUB 2 FUELED AIRCRAFT Final Report, Aug. 1980 - Sep. 1981**

G. D. BREWER, G. WITTLIN, E. F. VERSAW, R. PARMLEY, R. CIMA, and E. G. WALTHER Dec 1981 199 p refs Sponsored in part by Lockheed Missiles and Space Co., Inc. and The John Muir Inst., Nevada Univ.

(Contract NAS3-2483)

(NASA-CR-165525; NAS 1.26:165525, LR-30060) Avail: NTIS HC A09/MF A01 CSCL 01C

The relative safety of passengers in LH2 - fueled aircraft, as well as the safety of people in areas surrounding a crash scene, has been evaluated in an analytical study. Four representative circumstances were postulated involving a transport aircraft in which varying degrees of severity of damage were sustained. Potential hazard to the passengers and to the surroundings posed by the spilled fuel was evaluated for each circumstance. Corresponding aircraft fueled with liquid methane, Jet A, and JP-4 were also studied in order to make comparisons of the relative safety. The four scenarios which were used to provide a basis for the evaluation included: (1) a small fuel leak internal to the aircraft, (2) a survivable crash in which a significant quantity of fuel is spilled in a radial pattern as a result of impact with a stationary object while taxiing at fairly low speed, (3) a survivable crash in which a significant quantity of fuel is spilled in an axial pattern as a result of impact during landing, and (4) a non-survivable crash in which a massive fuel spill occurs instantaneously.

Author

**N83-11097\*#** Douglas Aircraft Co., Inc., Long Beach, Calif.  
**THE OPTIMIZATION OF AIRCRAFT SEAT CUSHION FIRE-BLOCKING LAYERS. FULL SCALE: TEST DESCRIPTION AND RESULTS Final Report, Sep. 1981 - Sep. 1982**

K. J. SCHUTTER and F. E. DUSKIN May 1982 233 p refs (Contract NAS2-11095)

(NASA-CR-166418; NAS 1.26:166418; MDC-J2525) Avail: NTIS HC A11/MF A01 CSCL 01C

Full-scale burn tests were conducted on thirteen different seat cushion configurations in a cabin fire simulator. The fire source used was a quartz lamp radiant energy panel with a propane pilot flame. During each test, data were recorded for cushion temperatures, radiant heat flux, rate of weight loss of test specimens, and cabin temperatures. When compared to existing passenger aircraft seat cushions, the test specimens incorporating a fire barrier and those fabricated from advance materials, using

improved construction methods, exhibited significantly greater fire resistance.

A.R.H.

**N83-11098\*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

#### **AVOIDANCE MANEUVERS SELECTED WHILE VIEWING COCKPIT TRAFFIC DISPLAYS**

J. D. SMITH, S. R. ELLIS, and E. LEE Oct. 1982 37 p refs (NASA-TM-84269; A-8992; NAS 1 15:84269) Avail: NTIS HC A03/MF A01 CSCL 01C

Ten airline pilots rates the collision danger of air traffic presented on cockpit displays of traffic information while they monitored simulated departures from Denver. They selected avoidance maneuvers when necessary for separation. Most evasive maneuvers were turns rather than vertical maneuvers. Evasive maneuvers chosen for encounters with low or moderate collision danger were generally toward the intruding aircraft. This tendency lessened as the perceived threat level increased. In the highest threat situations pilots turned toward the intruder only at chance levels. Intruders coming from positions in front of the pilot's own ship were more frequently avoided by turns toward than when intruders approached laterally or from behind. Some of the implications of the pilots' turning-toward tendencies are discussed with respect to automatic collision avoidance systems and coordination of avoidance maneuvers of conflicting aircraft.

Author

**N83-11099#** Dayton Univ., Ohio.

**DAYTON AIRCRAFT CABIN FIRE MODEL, VERSION 3. VOLUME 2: PROGRAM USER'S GUIDE AND APPENDICES Final Report, 1 Apr. 1980 - 31 Mar. 1981**

C. D. MACARTHUR Atlantic City, N.J. FAA Jun. 1982 207 p refs 2 Vol.

(Contract DOT-FA74WA-3532)

(AD-A118390, FAA-CT-81-69-VOL-2; UDRI-TR-81-160-VOL-2)

Avail: NTIS HC A10/MF A01 CSCL 01B

This third version of the Dayton Aircraft Cabin Fire Model (DACFIR) is refinement and generalization of earlier mathematical models for the computer simulation of fire growth in the cabin of a commercial transport airplane. The model uses data from laboratory tests on the cabin furnishing materials and a zone (control volume) representation for the cabin atmosphere to predict the accumulation of heat, smoke, and gases resulting from arbitrary ignition sources specified in the program input. The major improvements are a revised cabin atmosphere model which allows for multiple compartments and the prescribed entry of exterior fire gases, and an implicit numerical integration technique for the atmosphere equations. A user's guide and listing of the computer code are presented.

GRA

**N83-11100#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

#### **DIRECT LIGHTNING STRIKES TO AIRCRAFT M.S. Thesis**

J. S. SCHOWALTER Jun. 1982 122 p refs

(AD-A118075, AFIT/GE/EE/82J-12) Avail: NTIS HC A06/MF A01 CSCL 01B

Two direct lightning strikes to a NOAA WC-130 aircraft equipped with eleven electromagnetic field sensors were recorded in South Florida during the summer of 1981. In both cases, the aircraft was flying in precipitation at an altitude of about 4 km and a few kilometers away from active thunderstorm regions. An analysis of the data shows that both strikes exhibit a train of discrete pulses which can be correlated in most of the eleven sensors. The flashes lasted 295 and 460 msec and were characterized by an initial active period of about 40 msec with a pulse repetition rate of ten pulses per millisecond. In both flashes the most of the current flow was along the fuselage with peak currents estimated at 3 KA in one flash and 600 A in the other flash. A continuing current of an estimated 50 A was evident in only one strike. The electric field sensors recorded a maximum change of 200,000 V/M. In one flash the leader appears to propagate from the cloud to the aircraft with a duration of 350 microsecond which implies a distance of about 175 m to the cloud charge center.

GRA

04

**AIRCRAFT COMMUNICATIONS AND NAVIGATION**

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

**A83-10259****TACTICAL THREE-DIMENSIONAL AIR SURVEILLANCE RADAR**

G. PFISTER (ITT Gilfillan, Van Nuys, CA) Electrical Communication, vol. 57, no. 1, 1982, p. 51-61

The Series 320 mobile air surveillance radar gives reliable three-dimensional target information on aircraft in a tactical environment even under adverse conditions. The radar equipment consists of the antenna, transmitter group, liquid coolant and air pressurizer, air conditioner, receiver and signal processor group, and display console. With the optional addition of identification, tracking, and communication functions, the scope of the radar can be expanded to furnish an on-site operational capability (aircraft control) while providing target identification and velocity vector information to remote operations centers C.R.

**A83-10668****FUNDAMENTALS OF RADIO NAVIGATION [OSNOVY RADIONAVIGATSII]**

L. S. BELIAEVSKII, V. S. NOVIKOV, and P. V. OLIANIUK Moscow, Izdatel'stvo Transport, 1982. 288 p. In Russian. refs

The general theory of radio navigation is briefly reviewed, and techniques used for determining the principal radio navigation parameters are examined. In particular, attention is given to goniometry, range finding, and radial and angular velocimetry. The discussion also covers the effect of radio wave properties and propagation conditions on the accuracy of radio measurements, the architectures of radio navigation complexes, the use of radiotechnical means for solving navigational problems, and radio navigation satellites. V.L.

**A83-10707****ON MISSILES MODELLING, SIMULATION AND EVALUATION IN PRESENCE OF NOISE AND MULTI-SOURCE ENVIRONMENT**

N. A. KHEIR (Alabama, University, Huntsville, AL) and D. SUTHERLIN (U.S. Army, Aeroballistics Directorate, Redstone Arsenal, AL) Applied Mathematical Modelling, vol. 6, Oct. 1982, p. 343-346. refs  
(Contract DAAG29-76-C-0100)

The development of a numerical model for noise elimination for processing telemetry data during monitoring of missile flights in a noisy, multi-source environment is reported. The missile data is employed for the ARMSIM computer code for simulating missile behavior. Digitized data recorded on tape revealed that different energy sources produced spikes on recordings of missile attitude and behavior. Autocorrelation and partial autocorrelation functions revealed a seasonal, unstationary character to the signals. Box-Jenkins time series techniques were employed to fit the observed spikes and generate forecasts. A correlation of 89.98 was established between forecast and actual spikes. A time difference method was used to forecast future values of the observed time series. Theil's Inequality Coefficient served for matching the modeled and field data M.S.K.

**A83-10738****ANTENNA COUPLERS - THE AIRCRAFT INTERFACE**

R. G. QUIST and R. R. BURNS (Tech Resources, Inc., Amherst, NH) In: AUTOTESTCON '81, Proceedings of the Conference, Orlando, FL, October 19-21, 1981. New York, Institute of Electrical and Electronics Engineers, Inc., 1981, p. 79-83

It is noted that the Organizational Level ('O' Level) of maintenance in support of complex RF avionics typically requires a support program that combines and utilizes the testing capability of both Avionics Built-In-Test (BIT) and External Test Equipment

(ETE). ATE with test program sets that include unique antenna couplers is the ETE chosen by the Navy to meet the complex 'O' Level support requirements of multiple TACAIR Aircraft and Electronic Warfare (EW) Integrated Suites. Owing to the dynamic support requirements of the TACAIR 'O' Level Electronic Warfare Support Program, the Navy has established an in-house capability to effectively develop and produce the many types of 'O' Level EW Suites Test Program Sets required in the use of a common ATE mainframe. The Navy is regarded as a leader with ATE at 'O' Level. C.R.

**A83-10803****OPTIMAL COMPLEXING OF MEASURING INSTRUMENTS IN SHORT-RANGE NAVIGATION SYSTEMS [OPTIMAL'NOE KOMPLEKSIPOVANIE IZMERITELEI V RADIOTEKHNICHESKIKH SISTEMAKH BLIZHNEI NAVIGATSII]**

M. S. IARLYKOV and V. S. ARTEMENKOV Radiotekhnika, Sept. 1982, p. 22-32. In Russian. refs

A method for the optimal complexing of measuring instruments in short-range navigation systems is developed on the basis of the Markov theory of nonlinear filtering. In contrast to methods based on Kalman filtering, the present approach can be used for the synthesis of complex automatic systems with primary data processing. B.J.

**A83-10805****OPTIMALITY OF THE MEASUREMENT OF NAVIGATION PARAMETERS ON THE BASIS OF SIGNALS OF DIFFERENCE-RANGEFINDING SYSTEMS [OB OPTIMAL'NOSTI IZMERENIYA NAVIGATSIONNYKH PARAMETROV PO SIGNALAM RAZNOSTNO-DAL'NOMERNYKH SISTEM]**

A. L. RIABTSOV and V. A. BOLDIN Radiotekhnika, Sept. 1982, p. 38-42. In Russian.

Optimal algorithms of reception and processing utilize a priori information about input signals and, in particular, are determined by the specified vector of the estimated parameters. In this paper, two variants of the specification of this vector are considered for the case of the synthesis of the receiving device on the basis of the Markov theory of nonlinear filtering and the processing of signals of difference-rangefinding (hyperbolic) navigation systems. Results of synthesis for these cases are compared B.J.

**A83-11090****GRAVITY MODELING FOR AIRBORNE APPLICATIONS**

J. A. LOWREY, III and G. Y. OAK (Rockwell International Corp., Pittsburgh, PA) In NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 46-55. USAF-sponsored research. refs

A statistical gravity model in the horizontal direction is presented and an upward continuation is derived based on this model. Parameters for this model are selected based on actual data and then this model is used in the development of an algorithm for compensating an inertial navigation system of a cruise missile carrier aircraft for gravity disturbances. A residual statistical gravity model is generated and covariance analysis techniques are employed over a typical carrier aircraft and cruise missile trajectory in the evaluation of gravity disturbance errors before and after compensation. It is shown that only one altitude level of gravity disturbance data need be carried and that mid and low frequency errors in the gravity data are the dominant contributors to the inertial navigation errors for a typical aircraft/missile mission. (Author)

## 04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

**A83-11092**

### **EFFECTS OF THERMAL NOISE AND INTERFERENCE DUE TO SCATTERERS ON VOR SYSTEM ACCURACY**

G FEDELE, L. IZZO, and L. PAURA (Napoli, Universita, Naples, Italy) In: NAECON 1982, Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982 Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 64-68. refs

The bearing accuracy of a split-channel receiver VOR in the presence of obstacle-reradiated interference is analyzed. The receiver employs two separate detectors for the signals carrying azimuth information and reference-phase information to reduce cross modulation. Analytic formulations are developed for the error levels in each channel. A statistical evaluation reveals that error in the reference-phase data is irrelevant. Conditions which produce increases in the signal-to-noise ratio in the bearing segment are defined. M.S.K.

**A83-11094**

### **THE DEVELOPMENT OF JTIDS DISTRIBUTED TDMA /DTDMA/ ADVANCED DEVELOPMENT MODEL /ADM/ TERMINALS**

J. RUBIN (ITT, ITT Avionics Div, Nutley, NJ) In: NAECON 1982, Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 1 New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 75-83

(Contract N62269-76-C-0105)

An overview of the joint tactical information distribution system (JTIDS)/distributed TDMA (DTDMA) architecture development program and hardware is presented. The DTDMA operates at 960-1215 MHz, providing combined spread spectrum multiple access command and control functions and TACAN navigation. Pseudo-random distribution in the time-frequency-code domain distinguishes the system from normal TDMA operations. Systems features such as modular channelization, a basic event concept associated with an event code, and basic, meta-, and function channels to meet C3 requirements are discussed. Functional characteristics of JTIDS/DTDMA terminals are outlined, as are a tactical fighter terminal and a JTIDS environment simulator. Test results are reported, showing that the terminal performance has been better than required, operational environments have been successfully explored, and full scale implementation of the DTDMA system is under way. M.S.K.

**A83-11095**

### **INTEGRATED CNI - A NEW TESTING CHALLENGE**

J. W. ARNOLD (USAF, Avionics Laboratory, Wright-Patterson AFB, OH), D. G. HALDEMAN, and R. B. MARCUM (TRW Defense Systems Group, Dayton, OH) In: NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 1 New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 84-92.

Requirement techniques and simulator equipment for testing and evaluation of integrated communication, navigation, and identification avionics (ICNIA) systems for military applications are reviewed. System architectures capable of integrating normal CNI system in the 2 MHz-2GHz spectrum are discussed. The testing procedures are required to model the physical environment encountered between friendly aircraft in a hostile environment, the EM environmental interference density, and error sources. Test necessities include multiple/universal RF signal capability, multiple/universal RF environmental and threat simulations, transmission path effects, real world error models and failure modes, avionics functional simulations, and real-time, flight dynamics, scenario-driven synthesis of all the factors in combinations. Software processing for the tests is noted to involve 100 kbytes and 3,000,000 instructions/sec for implementation. M.S.K.

M.S.K.

**A83-11096#**

### **ICNIA - LESSONS LEARNED ON SENSOR INTEGRATION**

D. L. HAMME (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) In: NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982 Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 93-97

Integration, at several levels, appears to be a fruitful concept for addressing avionics problems at both macroscopic and microscopic levels. This paper addresses some of the necessary attributes of system integration efforts and associated problems in winning acceptance of integration concepts from a management viewpoint. It is illustrated by reference to the Integrated Communication Navigation Identification Avionics (ICNIA) program which is traced from its initial concept through approval to become one of the first Air Force programs with the primary objective of functionally integrating a subset of sensor avionics. The discussion covers lessons learned from proposing and defending the philosophy of integration which ultimately resulted in this major advanced development program within the Avionics Laboratory. It offers an insight into system and technology challenges for the coming decade. (Author)

**A83-11099**

### **AIR DATA SYSTEMS FOR AIRPLANES OF THE 1990'S**

J. MANDLE (Crouzet, Division Aerospatial et Systemes, Valence, Drome, France) In: NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 1 New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 113-119. refs

The results of a study to define the requirements of avionics architecture for fly-by-wire systems in modern aircraft are presented. Air data systems were found to be constrained by the necessity of inhibiting any loss of air data which could cause either mission abortion or catastrophe, and having a response time commensurate with the maneuverability of modern aircraft. Triple redundancy was determined to be necessary for flight control system and aircraft attitude data, and double redundancy for weapons system and engine and air inlet control information. The distribution of probes to characterize the aircraft condition is outlined, together with software validation problems inherent in in-place systems. A second architecture with dedicated organization of the system circuitry is offered as a means of satisfying security requirements. M.S.K.

**A83-11102**

### **TECHNOLOGY UPGRADE TO ALR-46 AND ALR-69 RADAR WARNING RECEIVERS**

J. L. LANSFORD, T. M. STRIKE, and T. E. TIBBITTS (Georgia Institute of Technology, Atlanta, GA) In: NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 139-145

(Contract F09603-78-G-4368-0014)

System features and functions of the ALR-46 and -49 breadboard systems to introduce electrically reprogramming a breadboard systems for radar warning receivers on the flight line are outlined. The ALRs were required to be reprogrammable in less than 30 min, have 32 K words of memory, need no airframe rewiring, and reduce the system power consumption. The Intel 2816 2 K x 8 bit chip was selected due to density, physical size, and access speed. The system chosen was a single-card processor featuring a single CPU with 32 K of memory and a DMA controller on the board, with customized characteristics such as memory expansion, commonality, and socketed ICs. M.S.K.

A83-11121

**F-16 VOICE MESSAGE SYSTEM STUDY**

G. DAVIS and G. STOCKTON (General Dynamics Corp., Fort Worth, TX) In: NAECON 1982, Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982 Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 324-331 refs

The Voice Message System (VMS) under preparation for the F-16 fighter, which will allow the pilot freedom to maintain visual surveillance while being alerted to abnormal conditions, is discussed with attention to both the human factors involved in combat environment speech recognition and the integration of the VMS hardware. The two message categories selected for study referred to conditions requiring immediate corrective action or significant flight restrictions to maintain flight safety, and conditions that could become critical with respect to flight safety if the pilot were not informed. Control logic will be used in the VMS processor in order to inhibit the presentation of secondary messages. A female voice will be employed for all messages due to its higher register and more distinctive quality. O.C.

A83-11122

**TESTING OF VOICE CONTROL DEVICE FOR AIRCRAFT AVIONICS APPLICATIONS**

A VANBRONKHORST and R ABRACZINSKAS (Lear Siegler, Inc., Instrument Div., Grand Rapids, MI) In: NAECON 1982, Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982 Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 332-338.

Testing with standard taped data is proposed as a method for specifying voice control device performance in military aircraft avionics applications. The voice control device must be able to operate effectively despite high ambient noise generated by engines and environmental control systems, physiological noises, and changes in voice characteristics due to pilot emotional or physical stress. To operate most reliably in such an environment, the voice control device must be made speaker-dependent by being programmed to respond to the voice of a particular operator prior to flight through his reading of the desired vocabulary onto 'templates' that are then stored by the device. The test tapes employed in the present study included F-16 spectrum background noise, the voices of operators under applied accelerations ranging from 2 to 6 G and with applied vibrations, and F-16 environmental control system background noise during both ground and flight tests. O.C.

A83-11123

**VOICE TECHNIQUES ON BOARD AIRCRAFT - AN EXPERIMENTAL APPROACH**

J. R. COSTET (Crouzet, Division Aerospatial et Systemes, Valence, Drome, France) In: NAECON 1982, Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 339-342.

An experimental program is described for the validation of speech recognition/generation techniques in military aircraft environments. An ergonomic study was conducted on a simulator to study the incorporation of speech processing procedures during an interception mission. It has been found that the pilot's voice recognition performance depends on the quality of the feedback features of the system. The pilot must be able to clearly, immediately and effortlessly perceive the state of the speech recognition system, and the effect of his own speech input. Feedback may be visual or auditory. It has also been determined that while speech recognition is practicable in maneuvers of up to 4 g, voice distortion becomes excessive at higher values, due both to breathing difficulties and the downward movement of the pilot's face mask. O.C.

A83-11125

**ADVANCED SPEECH TECHNOLOGY IN FIGHTER COCKPITS - A NEW PERSPECTIVE ON ISSUES AND APPLICATIONS**

R ANDERS and J T. KRYWAY (Logicon, Inc., San Diego, CA) In: NAECON 1982, Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982 Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 351-355 refs

The prospects for long term development of Advanced Speech Technology (AST) are assessed, with attention to the impact of speech recognition and generation capabilities which have been fully integrated into the avionics of tactical aircraft. Such AST systems would have to be capable of recognizing and generating connected digits and limited connected words using rigid syntactical constraints that are complemented by isolated phrase recognition. A comprehensive training program would be required which would exhaust the possibilities for utilization of the intelligent avionics package of future fighters while teaching the requisite vocabulary and collecting voice data. Also required would be an intelligent interface between the syntax and semantic post processors, on the one hand, and the avionics knowledge base on the other. O.C.

A83-11126

**BUS PROTOCOLS FOR A DIGITAL AUDIO DISTRIBUTION SYSTEM**

E M WOLF (Fairchild Weston Systems, Inc., Syosset, NY) In: NAECON 1982, Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982 Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 357-361.

This technical report discusses bus protocols for a digital audio distribution system (DADS). The audio is assumed to be either voice communications or a limited, pre-defined number of aural warning tones, with major emphasis on the former. It is further assumed that the audio signals are digitized in some manner and the resultant digital data stream is time multiplexed and is transmitted serially over the data bus. System requirements are developed and analyzed and then compared to the performance obtainable with various bus architectures. The advantages and disadvantages of using the MIL-STD-1553 data bus are discussed. Alternative approaches including a modified MIL-STD-1553 protocol and a bus contention scheme are also considered. (Author)

A83-11127

**STRAPDOWN INERTIAL PERFORMANCE NEEDED FOR THE 1990S**

G J. ROBINETTE (USAF, Avionics Laboratory, Wright-Patterson AFB, OH) and R M SCHWARZ (McDonnell Aircraft Co., Avionics Engineering Div., St Louis, MO) In: NAECON 1982, Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 364-371. refs

A description of the Strapdown Performance Study program is presented. This program is being conducted to determine and quantify the improvements in strapdown inertial technology that will be required to meet the navigation and weapon delivery requirements associated with advanced tactical fighters (ATF) and advanced cruise missiles (ACM) of the 1990s. In addition, the results of an analysis of ATF and ACM performance goals, and the analytical procedure that was used to determine strapdown inertial reference system performance sensitivities, drivers and improvement guidelines are examined. The improvements in strapdown inertial technology that are required for the 1990s are discussed relative to the current state-of-the-art in strapdown ring-laser-gyro inertial system technology, initialization, and gravity modeling. N.B.

A83-11128

**THE RELIABILITY ANALYSIS OF A DUAL, PHYSICALLY SEPARATED, COMMUNICATING IMU SYSTEM**

P. MOTYKA (Charles Stark Draper Laboratory, Inc., Cambridge, MA) In: NAECON 1982, Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p 372-379. refs  
(Contract F33615-78-C-1563)

The reliability analysis of a fault-tolerant, dual, physically separated, communicating inertial measurement unit (IMU) system is presented. Each IMU consists of four laser gyros symmetrically distributed about the surface of a cone. The two IMU's are physically separated along the fuselage of a tactical fighter aircraft, and their outputs are used for both navigation and flight control purposes. A combined failure detection and isolation (FDI) performance model and Markov model, defined in terms of the operational states of the system, is used to predict reliability performance through figures of merit. The reliability of the dual, separated, communicating IMU system is compared with that of other candidate IMU configurations such as dual, separated, noncommunicating or single IMU systems. The results of parametric studies are presented and discussed. (Author)

A83-11140

**UNAIDED TACTICAL GUIDANCE FLIGHT TEST RESULTS**

J. E. RYAN (USAF, Armament Laboratory, Eglin AFB, FL), L. D. PERLMUTTER, J. T. RITLAND, and G. R. WATERS (McDonnell Douglas Astronautics Co., St. Louis, MO) In: NAECON 1982, Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p 466-473. refs  
(Contract F08635-79-C-0175)

Results are presented for a captive flight test program, the Unaided Tactical Guidance Validation program, which was conducted using the US Air Force Low-Cost Inertial Guidance Subsystem (LCIGS) as the strapdown inertial reference assembly. The strapdown, navigation, and alignment filter software that were developed for this program are described. The Brassboard LCIGS unit was tested during the first phase of the program, and an engineering model unit was employed during the second phase. The radio-inertial Completely Integrated Range Instrumentation System served as the master navigation reference for transfer alignment and calibration during the Brassboard LCIGS tests, while the pure-inertial Carrier Aircraft Inertial Navigation System was used for the second phase of the program. Ground and flight tests were accomplished using the Central Inertial Guidance Test Facility at Holloman Air Force Base. N.B.

A83-11141

**RADIONAVIGATION TECHNIQUES FOR WEAPON GUIDANCE**

S. D. ROEMERMAN and T. VALENTINE (Texas Instruments, Inc., Lewisville, TX) In: NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 474-481. refs

A comparison of radio-navigation systems is presented, in terms of accuracy, electronic countermeasure (ECM) resistance, coverage area, usefulness, and guidance system impact. For weapon guidance applications, weapon delivery accuracy is one of the primary requirements of radio-navigation systems. First, the Omega system is described as a hyperbolic ranging system which provides two-dimensional coverage with a 200 m position accuracy. Second, the Loran C system provides two-dimensional coverage and an accuracy of up to 180 m. This passive system has no user number limitations. Third, the Tacan passive and transponder system is limited to use with base stations which are fixed, portable, or ship-borne. Finally, the NAVSTAR Global Positioning System (GPS) is being developed by the U.S. Department of Defense. It is designed for three-dimensional measurements with a nominal accuracy of 16 m for the precision code, and also offers high ECM resistance, worldwide coverage, and low cost. R K R.

A83-11146

**TERRAIN FOLLOWING/TERRAIN AVOIDANCE FOR ADVANCED PENETRATING AIRCRAFT**

G. L. DUNN and F. M. LIGHTFOOT (Boeing Military Airplane Co., Seattle, WA) In: NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p 560-567

Terrain following and avoidance systems in present use suffer from two major deficiencies: (1) the emissions from the terrain following radar may compromise the position of the penetrating aircraft, and (2) the radar may be susceptible to countermeasures which may result in false maneuvers. This paper describes a concept which addresses these deficiencies by employing the following features: (1) a digital map data base to predict terrain irregularities, (2) one or more short range sensors for forward obstacle detection and altimetry and designed to reduce emission detection, (3) a navigation system to register the sensors and maps, and (4) a processor to perform the integration of all functions. Various sensor technologies have been considered for the low-observable, short range and altitude sensors. These technologies include lasers, optical, and long wave, infrared rangefinders, as well as millimeter wave radars and passive rangefinders. A description of the power requirements and detectability of a millimeter wave radar operating in the oxygen absorption band is given. (Author)

A83-11160#

**INTEGRATED FLIGHT AND FIRE CONTROL DEVELOPMENT AND FLIGHT TEST ON AN F-15B AIRCRAFT**

K. L. SIMS, G. K. HELLMANN, J. A. KOCHER, and K. C. GREEN (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) In: NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 672-678. USAF-sponsored research

The Integrated Flight and Fire Control (IFFC) program is a USAF Advanced Development Program to integrate a fighter aircraft fire control system with its flight control system to allow automatic fire control steering. The IFFC F-15B automatic coupler and modified flight control system steers out tracking errors calculated by a director fire control system using information from an ATLAS II electro-optical tracker. The F-15B testbed aircraft will demonstrate this capability in air-to-air gunnery, air-to-ground gunnery and bombing weapon delivery modes. The IFFC system is designed to provide a significant amount of flight test flexibility in order to evaluate alternate mechanizations, to assess the contribution of each system element, and to make changes as flight test results dictate. Since the start of flight test in July 1981, all systems have been operated and the feasibility of the IFFC system has been demonstrated. (Author)

A83-11180

**FIBER OPTIC AIRCRAFT MULTIPLEX SYSTEMS - PLANNING FOR THE 1990S**

R. W. UHLHORN, S. L. STOROZUM, J. W. HIGGINBOTHAM, and M. S. MICHEL (McDonnell Aircraft Co., St. Louis, MO) In: NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 826-832. Navy-supported research refs

There is an urgent need for realistic definition of fiber optic data transmission systems to satisfy requirements for advanced fighter and attack aircraft multiplex systems. This paper discusses the program currently under way at McDonnell Aircraft Company for flight-qualified data bus and point-to-point systems. The elements include the interconnect configuration, optical distribution components, fiber optic transmitter and receiver designs, and data bus interface hardware suitable for 10 Mbps and greater data rates, and the test equipment to support these systems. (Author)

A83-11181

**FIBER OPTICS WAVELENGTH DIVISION MULTIPLEXING FOR AIRCRAFT APPLICATIONS**

J. C. WILLIAMS and S. E. GOODMAN (ITT, Electro-Optical Products Div., Roanoke, VA) New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 833-840 (Contract F33615-81-C-1481)

Wavelength division multiplexing (WDM) techniques provide increased information carrying capacity per optical fiber in aircraft fiber optics systems, using 20 nm-wide channels throughout the 760-1600 nm spectral region currently available for aircraft system use. Although most of the components required to demonstrate avionics WDM techniques have been developed to the laboratory prototype stage, full system design analyses have not yet been conducted. Three possible systems are described whose two most important design parameters, in the interest of low risk, are transmission loss due to successive passage through channel components and cross talk due to optical power received in one channel from another. O.C.

A83-11182

**VIDEO DISTRIBUTION REQUIREMENTS FOR FUTURE TACTICAL AIRCRAFT**

J. C. WYATT, W. D. ELAM (Harris Corp., Melbourne, FL), and K. C. TRUMBLE (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) In: NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982 Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 841-848. refs (Contract F33615-81-C-1501)

Video signal transmission subsystems are considered, trends influencing video requirements are discussed, and several approaches for coax and fiber optic media are presented. The major subsystems which require video information signal interconnects include target acquisition and weapon delivery, countermeasures, and navigation. Factors influencing requirement trends are discussed, such as technology improvements, standardization, and multimission roles. In order to provide more information on the video display, color video is being proposed. It is anticipated that the use of video onboard tactical aircraft will result in an increase in the total number of signals, a transition to color with resolution requirements from 525 to 875 lines, and the use of processed digital video for sensors. In addition, the use of coaxial systems with multiplexed bus architecture offers reduced wiring, increased modularity, and enhanced operational flexibility. Finally, the use of fiber optics has the additional advantage of weight savings. R.K.R.

A83-11183\* National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.

**DESCRIPTION AND PLANNED USE OF A DATA DISTRIBUTION EVALUATION SYSTEM FOR FIBER OPTIC DATA BUSES**

J. L. SPENCER (NASA, Langley Research Center, Hampton, VA) and R. L. HIMKA (Boeing Aerospace Co., Seattle, WA) In: NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982 Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 849-861.

A general description of a laboratory data distribution evaluation system (DDES) is given and some plans to use the system. The DDES is a microprocessor-based evaluation system consisting of three identical terminals. The DDES provides the capability for evaluating different system protocols and data word structures by making appropriate software changes, and different transmission medias and modulation schemes by making front-end hardware changes. A data multiplexing standard for fiber optic data transmission which parallels MIL-STD-1553B has proposed four different data modulation schemes. These modulation schemes will be described along with the plans to evaluate each of them. NASA-Langley has also been developing a data distribution approach which utilizes optical wavelength division multiplexing (WDM). A four-port, four-wavelength WDM system will be described

along with the planned use of the DDES to evaluate its performance. (Author)

A83-11184#

**FUTURE NAVY DATA BUS REQUIREMENTS - MODULAR APPROACH FOR FLEXIBLE EVOLUTION**

J. S. VERDI (U.S. Naval Air Development Center, Warminster, PA) In: NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 862, 863.

A design approach for intersubsystem communications is presented, involving an effort to enable modular specification of protocol functions for future avionics systems. Studies include consideration of the Distributed Data Processing System (DDPS) in terms of system processing functions executed on a network of multiple, physically dispersed processors, static and/or dynamic subsystem reconfiguration/function re-allocation capabilities, and maximum subsystem availability. In considering an advanced bus implementation, other issues which must be considered are increased data rate/data throughput capability, security and classification provisions, reliability, and maintainability. R.K.R.

A83-11191#

**DEVELOPMENT AND EVALUATION OF ADVANCED AIR-TO-AIR MISSILE FIRE CONTROL ALGORITHMS AND DISPLAYS**

D. E. CHAFFIN and T. D. ROSS (USAF, Avionics Laboratory, Wright-Patterson AFB, OH) In: NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 904-907.

This paper summarizes the approach, results, and lessons learned during a 3 year AF Avionics Laboratory air-to-air missile fire control algorithm and display development effort. The missile launch envelope algorithm development and evaluation (MISVAL) program developed missile launch envelope (MLE) algorithms from initial concept definition through real-time ground simulation and flight test. The paper begins with a brief introduction followed by discussion of missile fire control requirements, algorithm development, display development, and integration and test. Next is an outline of lessons learned and finally a summary and current status paragraph. (Author)

A83-11192

**MAXIMIZING SURVIVABILITY AND EFFECTIVENESS OF AIR-TO-GROUND GUNNERY USING A MOVEABLE GUN**

E. BAUMAN (Colorado, University, Colorado Springs, CO) and R. SHEPARD (U.S. Air Force Academy, Colorado Springs, CO) In: NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 908-915 (Contract F08635-81-K-0096)

The capabilities of a sensor-directed moveable gun system for air-to-ground and air-to-air weapon delivery are investigated with a view to enhancing the probability of destroying a target while maximizing attacker survivability. Particular attention is given to the tradeoff of the amount of gun motion for target destruction and attacker survivability. It is shown that a 1.5-deg moveable gun can significantly improve target destruction probability, but attacker vulnerability remains about the same as for a fixed gun. A 3-deg moveable gun will allow accelerating sweep trajectories during attack with a modified helix firing trajectory, resulting in increased target destruction probability and reduced attacker vulnerability, compared to a fixed gun. V.L.

**A83-11201**

### **USE OF THE ONBOARD SIMULATION CONCEPT FOR THE INTEGRATED FLIGHT AND FIRE CONTROL PROGRAM**

R. E. LAMBERT (McDonnell Aircraft Co., St. Louis, MO) In: NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982 Volume 2 New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 971-978 USAF-sponsored research

An overview of a program, sponsored by the US Air Force, to design, build, test, and evaluate an Integrated Flight and Fire Control (IFFC) system on an F-15B fighter aircraft is presented, with particular emphasis on the Inboard Simulation (OBS) feature. This system is designed to steer out tracking errors determined by a fire control system using information from an ATLAS II electro-optical tracker. The test bed aircraft will demonstrate this capability in the air-to-air gunnery, air-to-ground, and bombing weapon delivery modes. The OBS concept provides a unique capability to perform closed loop system checks for all weapon delivery modes both on the ground and at safe airborne altitudes without the expense of live targets. Ground based simulation tests have demonstrated that there is very good correlation between the results obtained using the onboard simulation and those results obtained using live targets. N.B.

**A83-11219**

### **COMPARISON OF SOME MATCHING METHODS**

J. E. BERRY and C. G. REED (Goodyear Aerospace Corp., Akron, OH) In: NAECON 1982, Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 3. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 1112-1119 refs

The historical development of scene matching and feature matching is reviewed. Implementation technology, including ATRAN, AIMPOINT, RADAG, and ROCS, is surveyed, and a comparison of scene matching and feature matching techniques is presented. An examination of various scene matching guidance systems shows that there has been a trend of increased performance, and decreases in weight, power, and volume requirements. This trend is the result of advances made in electronics, particularly in digital electronics. B.J.

**A83-11222#**

### **AUTOMATIC CHANGE DETECTION OF SYNTHETIC APERTURE RADAR IMAGERY**

R. L. OREAR and R. L. WITHMAN (USAF, Aeronautical Systems Div., Wright-Patterson AFB, OH) In: NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982 Volume 3. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 1140-1148. refs

The large amount of imagery collected by synthetic aperture radars coupled with the requirement for real-time exploitation drives the need for automatic aids to exploitation. The most common used aid is comparing a reference image to a current mission image thereby detecting changes. This paper describes an Automatic Change Detection System (ACDS) which consists of four segments: control, data base, registration, and change detection/analysis. The automatic change detection process of the ACDS is done in a pipeline manner on a ring array of 25 special purpose, micro-coded, processors called flexible processors controlled by a PDP-11/34A minicomputer. A detailed description of each of the ACDS segments is given. A discussion of the advantages and increased capabilities provided by the ACDS is presented. The results of the ACDS acceptance testing are presented and analyzed. Finally, possible enhancements to the system are proposed. (Author)

**A83-11224**

### **MULTISCENARIO IMAGING SENSOR AUTOPROCESSOR**

D. P. PANDA and R. K. AGGARWAL (Honeywell Systems and Research Center, Minneapolis, MN) In: NAECON 1982, Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 3. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 1165-1168 refs

The next generation autoprocessor, being developed by Honeywell under contract with AFWAL, will perform automatic FLIR target recognition in multiple scenarios and, in FHSIC implementation, will have lower size/weight/power consumption. The autoprocessor will extract the target motion information and slant range to target from the input image. Clutter rejection, target detection, and recognition will be performed by statistical techniques for targets at long to medium ranges and by syntactic techniques for targets at medium to short ranges. Images will then be compressed by jam resistant bandwidth compression technique before being transmitted via video link. Simultaneously, the autoprocessor result will be displayed to the autoprocessor operator. The transmitted image will be reconstructed from the compressed data by artificial intelligence techniques in the receiving station (ground or airborne). The algorithms used in the autoprocessor will operate in multiple scenarios (e.g. day and night, wooded and desert terrain) without requiring operator intervention. (Author)

**A83-11234#**

### **OPERATIONAL SENSITIVITY OF EW RECEIVERS**

J. B. Y. TSUI and R. L. SHAW (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) In: NAECON 1982, Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982 Volume 3. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 1234-1240

The effect of changing the radio frequency (RF) video bandwidth ratio on the probability of false alarm and the probability of detection is investigated in microwave receivers which have high RF to video bandwidth ratios. Results show that when the video bandwidth of a microwave receiver is taken into consideration, the probability density of the video detector output will be changed. The higher the value of the bandwidth ratio, the narrower the video output distribution. This phenomenon is explained by the fact that the video filter smooths the output from the detector. As a consequence, the threshold can be set at some value with a very low false alarm rate and a good probability of detection with less signal-to-noise ratio than a system excluding the video bandwidth. Experiments were conducted which confirm the predicted results. N.B.

**A83-11235**

### **A TECHNIQUE FOR PREDICTING ANTENNA-TO-ANTENNA ISOLATION AND ELECTROMAGNETIC COMPATIBILITY FOR AIRCRAFT**

S. CHANCE and D. WOOD (Boeing Military Airplane Co., Wichita, KS) In: NAECON 1982, Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 3. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 1241-1245. refs

An electromagnetic interference/compatibility (EMIC) prediction model is presented, for making predictions of new and proposed system installations on the B-52. The method used determines the coupling between two antenna systems on the airplane model, providing a graphical presentation of interference/compatibility levels. The most significant improvement in EMIC prediction model accuracy is a result of the Gx concept, defined as the gain of an antenna in the direction of the coupling path. Measured Gx data were obtained for omni-directional and directional antennas. EMIC predictions consist of the receiver susceptibility curve and the composite curve. This method has a measured accuracy of 95% when applied to the analysis of the ALQ-153 TWS installation on the B-52. R.K.R.

A83-11239

**KA-BAND PASSIVE/ACTIVE AIRBORNE RADAR**

F. J. PORADISH (Texas Instruments, Inc., Dallas, TX) In: NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 3 New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p 1262-1269 Research supported by Texas Instruments, Inc refs

A multimode Ka-band radiometric imaging system is discussed. The basic operating principles of a conventional imaging radiometer are reviewed and two methods of image enhancement are presented for a typical battlefield scenario. The first enhancement method utilizes a low power bistatic illuminator in conjunction with a conventional radiometer. A passive image is subtracted from a coincident illuminated image to provide better contrast and improved detection of metallic targets. The second enhancement method incorporates an inverse filter algorithm to yield better than real beam resolution in high contrast images. A two dimensional spatial high pass filter is used to counteract the low pass filter effect of the antenna beam. A conceptual multi-mode imaging system is presented along with performance calculations for a typical airborne imaging scenario. A 36 GHz ground based radiometric test bed was developed to demonstrate the passive and illuminated modes. The system hardware and performance parameters are discussed and images from several scenarios are presented (Author)

A83-11241

**ADVANCED TERRAIN FOLLOWING RADAR FOR LANTIRN**

L. CHASTEEN and A. WOODWARD (Texas Instruments, Inc., Dallas, TX) In: NAECON 1982, Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 3 New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p 1277-1283

It is contended that as the defenses of possible adversaries improve, avionics equipment must also improve to maintain the effectiveness of low-level operational systems. While radar and other avionics hardware could be improved, improvements to the basic system approach will also significantly improve the low-level capability. Extension of the computing techniques to encompass the storing, correlating, and processing capabilities of digital processors greatly improves the flexibility of a terrain-following radar (TFR) system by requiring less dedicated radar collection time. This reduced need for radar data collecting allows the radar to remain silent for improved probability of penetration, to collect additional azimuth data for improved turning performance, or to be used for other modes (such as ground mapping) to give additional capabilities (Author)

A83-11242

**ANALYSIS OF THREE HIERARCHICAL MOTION COMPENSATION SYSTEMS FOR SYNTHETIC APERTURE RADARS**

J. N. DAMOULAKIS and A. VANBRONKHORST (Lear Siegler, Inc., Instrument Div., Grand Rapids, MI) In: NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 3. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 1284-1294

(Contract F33615-80-C-1096)

This paper describes the analysis, by simulation, of the performance of three motion compensation system mechanizations for a Synthetic Aperture Radar (SAR) in a maneuvering tactical aircraft. The mechanizations include (1) a low-cost strapdown inertial system in conventional master/slave-transfer-alignment configuration, (2) a method of estimating aircraft angular rate by differentiation of gimbal angles and extrapolation through the separation lever arm between the inertial set and the radar antenna, and (3) complementing this latter mechanization with only three orthogonal accelerometers at the antenna to measure high-frequency motion. The simulation comprises a driving function input of aircraft thrust and turbulence wind conditions that approximates empirically derived data. (Author)

A83-11243

**A RAY TRACING COMPUTER ANALYSIS PROGRAM /RAYCAP/ FOR AIRBORNE SURVEILLANCE RADAR APPLICATIONS**

R. P. WASKY (Science Applications, Inc., Dayton, OH) In: NAECON 1982, Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 3 New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p 1295-1300 refs

A fast and accurate Ray Tracing Computer Analysis Program (RAYCAP) is described which predicts the effects of atmospheric ducting, superrefraction, and subrefraction, as well as multipath fading on airborne radar performance. Using vertical profiles of the atmospheric index on refraction obtained from weather radiosonde data, typical output from RAYCAP is shown for airborne emitters located in the vicinity of superrefracting and ducting layers. Results are also presented which compare RAYCAP calculations with experimental data and waveguide mode theory predictions for an over-water atmospheric duct

A83-11251

**A TECHNIQUE TO EMPIRICALLY MODEL CLUTTER SIGNALS IN AIRBORNE PULSE DOPPLER RADAR**

E. R. ADDISON and J. HAVRILLA (Westinghouse Defense and Electronic Systems Center, Baltimore, MD) In: NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 3 New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 1345-1348.

A technique based on real recorded data for the modeling of clutter signals in airborne pulse Doppler radar is presented. The technique uses digital third IF and FFT data, and a three-dimensional computer plot routine was employed for the evaluation process. Sufficient flight data will assist in achieving the desired accuracy. This technique offers the ability to test various scenarios using simulation, and the addition of other signals such as targets, sidebands, and jamming to the clutter signal is possible for total scenario simulation. As a result, the capability of performing radar system predictions is improved. (Author)

A83-11253

**STABILITY OF THE DECENTRALIZED ESTIMATION IN THE JTIDS RELATIVE NAVIGATION**

W. S. WIDNALL and G. F. GOBBINI (MIT, Cambridge, MA) In: NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 3. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 1357-1365 USAF-supported research. refs

The JTIDS (Joint Tactical Information Distribution System) includes a relative navigation capability with which each member can estimate its own position by utilizing the broadcast position estimates of other members plus the measured times of arrival of the radio signals. Previous simulation studies of the system have shown that unrestricted ranging between members can produce unstable navigation errors, but a covariance based hierarchy may be stable. The stability of a closely related organization, a fixed rank hierarchy, is analytically proved. For all ownstate organizations time domain equations are presented for computing estimation error covariance and for analyzing stability. A simple simulation is able to demonstrate the stability issues. (Author)

A83-11255

**APPLICATIONS OF AUTOPATH TECHNOLOGY TO TERRAIN/OBSTACLE AVOIDANCE**

R. V. DENTON and J. P. MARSH (Systems Control Technology, Inc., Palo Alto, CA) In: NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 3. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p 1373-1377. (Contract DAAH01-81-C-B196)

A systematic treatment of Terrain and Obstacle Avoidance (T/OA) is described that makes use of Autopath technology. Autopath is an optimization-based global flight trajectory generation procedure that automatically incorporates T/OA. This technology

is being developed for implementation onboard strategic and tactical aircraft. The theory and various applications of Autopath are sketched. The paper also includes a comparison of manual vs automatic procedures for generating flight trajectories, and shows that Autopath procedures lead to significantly improved performance, especially in the case of dense threat laydowns.

(Author)

#### A83-11260

##### THE A6E /TRAM/ ALL-WEATHER WEAPON SYSTEM

R. A. CARLSTROM and V. J. HALL (Grumman Aerospace Corp., Bethpage, NY) In: NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 3. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 1418-1422. (Contract N00019-72-C-0628)

The A6E TRAM weapon system configuration is presented, with the addition of a Forward Looking Infrared (FLIR) sensor and a laser illuminator. Weapon system capabilities have been enhanced by these innovations, and existing visual and radar capabilities have been retained. Radiation is imaged in the FLIR in the 8-12 micron window, and a 13x magnification is provided by the continuous zoom optical system. Several thousand new words of program were required to support the FLIR and laser functions and to integrate these capabilities with existing attack modes. With this innovation, the accuracy of bombing with unguided weapons has been improved by 30%, and the likelihood of hitting targets unintentionally has been reduced.

R. K. R.

#### A83-11460

##### SYMBOLIC PATTERN MATCHING FOR TARGET ACQUISITION

P. M. NARENDRA, J. J. GRABAU, and B. L. WESTOVER (Honeywell Systems and Research Center, Minneapolis, MN) In: Conference on Pattern Recognition and Image Processing, Dallas, TX, August 3-5, 1981, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1981, p. 481-486 refs. (Contract DAAK70-79-C-0114)

This paper describes a symbolic pattern matching system for autonomous target acquisition, which requires matching widely disparate views of a scene. The pattern matching system exploits both the object-to-object similarities in the two images and the consistency of configurations of candidate matches. The consistency is evaluated under a general transformation which accounts for a large difference in the sensor positions between the two views. The matching of the symbolic features between the two images is cast in a combinatorial framework. An efficient branch and bound algorithm is developed to find the best match optimizing the criterion function, which measures the goodness of a candidate match. The result of applying the pattern matching system simulation to several pairs of real infrared images are presented both to illustrate the approach and to quantify its performance.

(Author)

#### A83-11557

##### USE OF AIRCRAFT-DERIVED DATA TO ASSIST IN ATC TRACKING SYSTEMS. II - SOME PRACTICAL TRACKING FILTERS

H. W. THOMAS and C. C. LEFAS (Manchester, Victoria University, Manchester, England) IEE Proceedings, Part F - Communications, Radar and Signal Processing, vol. 129, pt. F, no. 5, Oct 1982, p. 359-365. Research supported by Eurocontrol.

Attention is given to practical filters for aircraft tracking which are capable of incorporating down-linked measurements of aircraft heading and air speed. Numerical analyses are presented for tracking filters using roll-angle measurements, an acceleration bias filter, and tracking and wind-speed estimation using TAS and heading measurements. Simplified versions of these filters have been proposed for high-quality aircraft data in which case the resulting filters require no more computation time than first-order filters.

S. C. S.

#### A83-11902\* Kansas Univ., Lawrence.

##### A FAST MICROPROCESSOR COMMUNICATION NETWORK DESIGN FOR INTERPROCESSOR COMMUNICATIONS FOR AN INTEGRATED FLIGHT CONTROL SYSTEM

G. L. KELLY and P.-W. JIANG (Kansas University, Lawrence, KS) In: Mini and microcomputers in control and measurement; Proceedings of the International Symposium, San Francisco, CA, May 20-22, 1981. Anaheim, CA and Calgary, Alberta, Canada, Acta Press, 1982, p. 1-6. refs. (Contract NSG-4026)

A node design with connectivity four is presented whose communication processor handles data at four million bits/sec on each of the four channels into the node, and on each of the four channels out of the node, for a total node capacity of 32 million bits/sec. An integrated flight control system real-time application of this communication network design is discussed. It is shown that such high speed node communication hardware, arranged in the topological configuration of a minimum diameter graph with connectivity four and all links active, has good potential for real time control applications requiring reliability, availability, and survivability characteristics.

O. C.

#### A83-11918

##### SOLID STATE, 95 GHZ TRACKING RADAR SYSTEM

J. A. SCHEER and P. P. BRITT (Georgia Institute of Technology, Atlanta, GA) Microwave Journal, vol. 25, Oct 1982, p. 59-65. Research supported by the General Electric Co.

A state-of-the-art millimeter-wave tracking radar system developed by the Georgia Institute of Technology, Engineering Experiment Station (GIT/EES) is described, noting that the system is being used by the Massachusetts Institute of Technology, Lincoln Laboratory (MIT/LL) in the laboratory's Millimeter Terminal Homing Program as an instrument to help evaluate various millimeter wave system concepts. The system is being used in a closed-looped mode on a helicopter platform to evaluate various tracking and signal-processing techniques. The helicopter flies a flight profile approaching a target, the radar, mounted in the chin of the helicopter, operates in conjunction with a data acquisition system to provide detection and tracking data for later evaluation. The radar is of the pulse Impatt type; it has a frequency of 94-95 GHz, a pulse length of 100 ns, and a chirp bandwidth of 250 MHz nominal. The airborne platform makes possible an evaluation of tracking performance for actual targets in a realistic clutter environment at realistic depression angles.

C. R.

#### A83-12099

##### A CONCEPT FOR REDUCING HELICOPTER IFR LANDING WEATHER MINIMUMS - OFFSHORE

L. LA VASSAR (Boeing Vertol Co., Philadelphia, PA) Vertiflite, vol. 28, Nov.-Dec. 1982, p. 30-34.

After assessing the development status and effectiveness of Microwave Landing System approach guidance equipment for the case of support helicopters flying to offshore oil rigs with IFR in poor-visibility weather, attention is given to the advantages of improved information displays and of IR imaging. Thermal imaging devices have demonstrated virtually daytime VFR image quality during oil rig approaches at night, with clear imaging of sea state and surface vessels from an altitude of 2000 ft. IR forward-looking imaging devices are further applicable to search and rescue, law enforcement, medical emergency and environmental surveillance helicopter missions.

O. C.

#### A83-12225

##### TIMING A LORAN-C CHAIN

C. F. LUKAC and L. G. CHARRON (U.S. Naval Observatory, Washington, DC) Navigation, vol. 29, Fall 1982, p. 235-245.

The determination of the timing relationship between the majority of LORAN-C station chains which are extensively used in offshore air navigation, and the U.S. Naval Observatory's Master Clock (USNO MC) monitoring of the LORAN chains, entails a dependence on monitoring stations which are within groundwave coverage of the chains. A discussion is presented of the methodology used in forming and calibrating remote time scales.

for individual stations employed in the determination of a time scale for the LORAN-C LC/9970 chain. Portable clock measurements and satellite time transfers are used as the calibration devices. The maximum scatter in values of USNO MC minus LC/9970, determined by individual stations forming the MEAN time scale, amounts to about 0.15 microsec. O.C.

**A83-12878****APPLICATION OF IMAGE UNDERSTANDING TO AUTOMATIC TACTICAL TARGET ACQUISITION**

A. R. HELLAND, T. J. WILLETT, and G. E. TISDALE (Westinghouse Electric Corp., Systems Development Div., Baltimore, MD) In Techniques and applications of image understanding; Proceedings of the Meeting, Washington, DC, April 21-23, 1981. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1981, p. 26-31. refs

Real-time equipment has been developed and is now being tested for automatic recognition of targets on an individual basis. The recent use of frame-to-frame integration techniques has significantly improved the classification performance with this equipment to the point where the human interpreter can sometimes be surpassed. For some imagery, however, initial target segmentation remains unsatisfactory, causing targets to be missed, and the level of false alarms may be too high. As a result, more sophisticated image processing techniques are now being addressed which could provide a comprehensive understanding of overall image content. These include the use of such scene analysis operations as the derivation of motion vectors for passive ranging, false alarm discrimination, and detection of target motion. Additional areas of interest lie in the 'intelligent' tracking of multiple targets, and the autonomous handoff of targets between sensors. The paper discusses the evolution of these areas, and their probable impact on the target acquisition process. It also addresses their impact on hardware implementation. (Author)

**A83-12879****INTELLIGENT CONTROL OF TACTICAL TARGET CUEING**

O. FIRSCHEIN, C. M. BJORKLUND, M. Z. HANNAH, and D. L. MILGRAM (Lockheed Research Laboratories, Palo Alto, CA) In: Techniques and applications of image understanding; Proceedings of the Meeting, Washington, DC, April 21-23, 1981. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1981, p. 32-37

(Contract DARPA ORDER 3608)

A navigation system for a small, low flying vehicle based on passively sensed imagery is considered. The dead reckoning is based on motion stereo, with corrections made periodically using the analysis of landmarks found in images. Because the system uses such a database of terrain landmarks, an investigation is being carried out regarding the possibility of enhancing this database for target cueing purposes by providing image processing parameter settings and final screening checks for the target cue. As an example, the usefulness of target-to-sensor range data is discussed. B.J.

**A83-12895****BOOTSTRAP STEREO ERROR SIMULATIONS**

M. J. HANNAH (Lockheed Research Laboratories, Palo Alto, CA) In: Techniques and applications of image understanding; Proceedings of the Meeting, Washington, DC, April 21-23, 1981. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1981, p. 306-310.

Over the past three years, Lockheed has been working in navigation of an autonomous aerial vehicle using passively sensed images. One technique which has shown promise is bootstrap stereo, in which the vehicle's position is determined from the perceived locations of known ground control points. Successive pairs of known vehicle camera positions are then used to locate corresponding image points on the ground, creating new control points. This paper describes a series of error simulations which have been performed to investigate the error propagation as the number of bootstrapping iterations increases. (Author)

**A83-13008****GENERAL CONDITIONS OF OPERATIONAL AND TECHNICAL UTILIZATION OF ILS DURING CATEGORY III OPERATIONS [CONDITIONS GENERALES D'UTILISATION OPERATIONNELLE ET TECHNIQUE DES ILS DANS LES OPERATIONS DE CATEGORIE III]**

,Navigation (Paris), vol 30, Oct 1982, p. 405-412. In French

The technical requirements, operational conditions, and certification procedures necessary to establish an all-weather, instrument landing system (ILS) are reviewed. The entire system comprises the ILS, the aircraft, and the automatic pilot, with certification requiring a probability of accident being limited to 1 in 10 million. Every accident is thoroughly examined and the causes reported to the manufacturers of ILS instruments. A block diagram of the flight and landing trials to produce certification for an on-board ILS is presented. Specific requirements and error rates for the on-board, ground-based emitter, and automatic pilot components of the systems are mentioned, noting that for visibility conditions below 100 ft, the ILS station must feature a system integrity of one error in 500 million, with an MTBF of 4000 hr.

M.S.K.

**A83-13009****NAVSTAR GPS - STATE OF DEVELOPMENT AND FUTURE OF THIS GLOBAL NAVIGATION SYSTEM [NAVSTAR GPS - ENTWICKLUNGSSTAND UND WEITERE ZUKUNFT DIESES GLOBALEN NAVIGATIONSSYSTEMS]**

J. P. TJARDTS (Marine, Bereich Marineamt, Wilhelmshaven, West Germany) Ortung und Navigation, no. 2, 1982, p. 148-158. In German.

Certain disadvantages related to the employment of the Navy Navigation Satellite System (NNSS) led finally to a decision in 1973 in favor of the Global Positioning System (GPS) NAVSTAR. The organizational structure of NAVSTAR GPS is discussed along with the principles of operation, the GPS system, the GPS program schedule, the phase I navigation performance results, questions of range determination, generic receiver operation, and GPS military and civil applications. The user needs fulfilled by the GPS navigation system are related to enroute nautical and aeronautical navigation, time transfer, mine laying and sensor delivery, field artillery and shore bombardment, photomapping, phototargeting, coordinate bombing, antisubmarine warfare, harbor control, all weather landing approach aids, geodesy and survey, and VTOL, STOL, and helicopter takeoff, landing, and cruise operations. A navigation system comparison is provided, taking into account GPS, Loran-C, Omega, Std INS, Tacan, and Transit. G.R.

**A83-13013****ACCURACY AND AVAILABILITY OF VARIOUS MODERN NAVIGATION PROCEDURES [GENAUIGKEIT UND VERFUEGBARKEIT VERSCHIEDENER MODERNER NAVIGATIONSVERFAHREN]**

B. BERKING (Hamburg, Fachhochschule, Hamburg, West Germany) Ortung und Navigation, no. 2, 1982, p. 215-237. In German.

The modern navigation systems considered include the systems Decca, Loran-C, Transit, and GPS. The present investigation is concerned with the question whether the currently available knowledge regarding the accuracy and the availability of the navigation systems is adequate, taking into account the possibility that problems might arise in connection with a discrepancy concerning the requirements of practical applications and the actually available data for German waters. U.S. plans with respect to surface navigation are considered. The Omega system is used as an example to show that a navigation system provides reliable information at any time only if the system and its properties, in particular with respect to the propagation characteristics, are accurately known. Attention is given to the necessity for continuing research, requirements for the systematic study of the applicability of the various procedures, and political considerations with respect to the GPS system. G.R.

A83-13014

**THE EMPLOYMENT OF DIGITAL SIGNAL PROCESSING IN RADAR DEVICES - ADVANTAGES AND DISADVANTAGES FOR THE PRACTICE [EINSATZ DER DIGITALEN SIGNALVERARBEITUNG BEI RADARGERÄTEN - VOR- UND NACHTEILE FÜR DIE PRAXIS]**

R. ZIESE (Krupp Atlas-Elektronik, Bremen, West Germany) *Ortung und Navigation*, no. 2, 1982, p. 238-240, 242-244. In German

Certain problems regarding the visual indications obtained with the aid of a cathode-ray tube in the case of conventional radar devices are related to the brightness of the displayed information. The brightness level is determined by the relation between display time and pulse repetition frequency. In a given illustrative example, only a time interval of 12 microseconds is available for the excitation of the phosphor of the tube, while an interval of 488 microseconds passes without excitation. The present investigation is concerned with an approach which overcomes the considered difficulty by employing storage circuits. The operational concept makes use of the recognition that it is not necessary to display signals simultaneously with their arrival. Attention is given to a scheme for the digitization of a pulse, a procedure for suppressing noise, radar display devices with a digital intermediate storage capacity, and the development of a device in which a radar picture is retained in mass storage systems. G.R.

A83-13016

**A PROCEDURE FOR THE UTILIZATION OF THE SIGNALS OF A DME TRANSPONDER TO DETERMINE THE POSITION OF AN AIRCRAFT FROM THE GROUND [EIN VERFAHREN ZUR AUSNUTZUNG DER SIGNALE EINES DME-TRANSPONDERS, UM DIE POSITION EINES FLUGZEUGES VOM BODEN AUS ZU BESTIMMEN]**

B. FORSELL (ELAB, Trondheim, Norway) *Ortung und Navigation*, no. 2, 1982, p. 258-268. In German

Small airports have usually not the equipment needed to determine the position of aircraft which arrive or which leave the airport. However, for reasons related to traffic control applications, it would be desirable to have more information regarding the traffic conditions in the adjacent air space. The necessity of a transmission of positional information from the aircraft to the airport appears inconvenient, and the cost for the acquisition of an airport radar is usually too high for small airports with little traffic. The present investigation is concerned with an approach which makes it possible to obtain the desired positional information regarding an aircraft without the employment of the considered radar device. All airliners and many small aircraft are equipped with a DME (distance measuring equipment) interrogator-responder, while the majority of Norwegian airports have a DME transponder. The pulses emitted by the transponder are reflected by the aircraft. The reflected pulses provide the basis for the determination of aircraft position. G.R.

**N83-10027\*# Honeywell, Inc., Minneapolis, Minn. Avionics Div. DEMONSTRATION ADVANCED AVIONICS SYSTEM (DAAS) FUNCTION DESCRIPTION**

A. J. BAILEY, D. G. BAILEY, R. J. GAABO, T. G. LAHN, J. C. LARSON, E. M. PETERSON, J. W. SCHUCK, D. L. RODGERS, and K. A. WROBLEWSKI. Moffett Field, Calif. NASA. Ames Research Center. Jan. 1982. 204 p. Prepared in cooperation with King Radio Corp., Olathe, Kans. (Contract NAS2-10021)

(NASA-CR-166282; NAS 1.26:166282) Avail: NTIS HC A10/MF A01 CSCL 01D

The Demonstration Advanced Avionics System, DAAS, is an integrated avionics system utilizing microprocessor technologies, data busing, and shared displays for demonstrating the potential of these technologies in improving the safety and utility of general aviation operations in the late 1980's and beyond. Major hardware elements of the DAAS include a functionally distributed microcomputer complex, an integrated data control center, an electronic horizontal situation indicator, and a radio adaptor unit. All processing and display resources are interconnected by an IEEE-488 bus in order to enhance the overall system effectiveness,

reliability, modularity and maintainability. A detail description of the DAAS architecture, the DAAS hardware, and the DAAS functions is presented. The system is designed for installation and flight test in a NASA Cessna 402-B aircraft. Author

**N83-10028#** Toronto Univ., Downsview (Ontario). Inst. for Aerospace Studies

**THE LANDING APPROACH IN VARIABLE WINDS: CURVED GLIDE-PATH GEOMETRIES AND WORST-CASE WIND MODELING**

A. B. MARKOV. Dec. 1981. 376 p. refs. Sponsored by National Research Council and Natural Sciences and Engineering Research Council

(UTIAS-254, ISSN-0082-5255) Avail: NTIS HC A17/MF A01

Analytical and computational techniques that may be applied to predicting aircraft response to hazardous variable winds encountered on the landing approach and to modeling such wind conditions were investigated. A literature review identified a number of areas requiring further study. Of these areas, worst-case wind modeling techniques and modified glidepath geometries based on an estimate of the existing wind profile were pursued. A nonlinear longitudinal and lateral dynamic model is posed for a twin engine STOL transport using look-up table, quasisteady, nonlinear aerodynamics. This dynamic model is employed in computer simulations predicting the aircraft dynamic behavior flying curved glidepath geometries that are based on an a priori estimate of the existing wind profile. These results are assessed to determine the effects of incorrect estimates of the wind profile and the suitability of the kinematic assumptions used in deriving the curved glidepath geometry. Worst-case wind modeling techniques where the form of the wind model is not specified a priori are considered, and extensions to an existing technique are proposed. The worst-case wind modeling problem is viewed as a conflict of interest between the aircraft controller and a wind controller. Author

**N83-10029\*# Textron Bell Helicopter, Fort Worth, Tex. INVESTIGATION OF ADVANCED NAVIGATION AND GUIDANCE SYSTEM CONCEPTS FOR ALL-WEATHER ROTORCRAFT OPERATIONS**

H. W. UPTON, G. E. BOEN, and J. MOORE. Aug. 1982. 212 p. refs

(Contract NAS2-10743)

(NASA-CR-166274; NAS 1.26:166274) Avail: NTIS HC A10/MF A01 CSCL 17G

Results are presented of a survey conducted of active helicopter operators to determine the extent to which they wish to operate in IMC conditions, the visibility limits under which they would operate, the revenue benefits to be gained, and the percent of aircraft cost they would pay for such increased capability. Candidate systems were examined for capability to meet the requirements of a mission model constructed to represent the modes of flight normally encountered in low visibility conditions. Recommendations are made for development of high resolution radar, simulation of the control display system for steep approaches, and for development of an obstacle sensing system for detecting wires. A cost feasibility analysis is included. A.R.H.

**N83-10030#** Army Test and Evaluation Command, Aberdeen Proving Ground, Md.

**FLIGHT TESTING OPERATIONS PROCEDURE Final Report**

Jan. 1982. 42 p. refs

(AD-A116984; TOP-6-3-120) Avail: NTIS HC A03/MF A01 CSCL 17G

This TOP establishes procedures and provides guidance for the testing of an aircraft heading reference system. The primary objective of this document is to determine if the heading reference system under test performs its intended function, within the aircraft environment, with an accuracy and reliability as determined through the appropriate requirements document. Author (GRA)

**N83-10031#** Federal Aviation Administration, Washington, D C  
System Research and Development Service  
**DIRECT AIRCRAFT VELOCITY DETERMINATION BY L-BAND  
MOVING TARGET DETECTOR RADAR Final Report**  
J A. SHANNON Jun. 1982 41 p refs  
(AD-A117512, DOT/FAA/RD-82/41) Avail: NTIS HC A03/MF  
A01 CSCL 171

The Moving Target Detector (MTD) radar can be used to measure the phase difference of echoes from aircraft returns. From these measurements one can determine directly the radial component of aircraft velocity. Present practice is to determine velocity indirectly from radar position measurements. Results of measuring phase shift differences and corresponding aircraft velocities using an L-Band MTD radar are presented. Observations were made in a clutter free environment. The standard deviation of phase shift differences made from observations on a B727 airplane at a distance of 100 nmi was generally found to be 5 degrees, corresponding to a standard deviation of velocity component of 1.2 knots. The standard deviation of phase shift observed from six slower moving airplanes indicates the standard deviation of phase is generally 18 degrees or less, corresponding to a standard deviation of velocity component of 4.3 knots or less. Reliability is generally 94% for the B727 airplane and about 90% for the small airplanes, although poorer reliability is observed with tangential flight paths. Direct measurement of velocity can be used to provide increased precision in predicting aircraft motion over the short term (2 minutes) GRA

**N83-10032#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany) Inst. fuer Flugfuehrung  
**TECHNIQUES FOR AIR TRAFFIC PLANNING AND HANDLING IN THE TERMINAL AREA**  
M. SCHUBERT Jan. 1982 35 p refs In GERMAN, ENGLISH summary  
(DFVLR-MITT-82-04) Avail: NTIS HC A03/MF A01; DFVLR, Cologne DM 14,90

The planning of landing sequence and aircraft handling was examined at Frankfurt airport. Analysis of air traffic samples for various traffic loads shows that planning depends on the individual tactics of the approach controller. The first heading instruction after the entry of an aircraft into the terminal area influences landing sequence, air traffic handling, integration of different traffic flows, and utilization of disposable runway capacity. Author (ESA)

**N83-10033#** Office of Technology Assessment, Washington, D.C.  
**AIRPORT AND AIR TRAFFIC CONTROL SYSTEM**  
Jan 1982 152 p refs  
(PB82-207606, OTA-STI-175) Avail: NTIS HC A08/MF A01 CSCL 01B

Needed improvements in the United States Air Traffic Control (ATC) system are discussed. Included are scenarios of future growth in air transportation, alternative ways to increase airport and terminal capacity, technological and economic alternatives to the ATC system modification, and alternatives to the ATC process L.F.M

**N83-11101\*#** Analytical Mechanics Associates, Inc., Mountain View, Calif  
**MODELING METHODOLOGY FOR MLS RANGE NAVIGATION SYSTEM ERRORS USING FLIGHT TEST DATA**  
M. S. KARMALI and A. V. PHATAK Apr. 1982 33 p refs  
(Contract NAS2-10670)  
(NASA-CR-166411; AMA-82-19; NAS 1.26:166411) Avail: NTIS HC A03/MF A01 CSCL 17G

Flight test data was used to develop a methodology for modeling MLS range navigation system errors. The data used corresponded to the constant velocity and glideslope approach segment of a helicopter landing trajectory. The MLS range measurement was assumed to consist of low frequency and random high frequency components. The random high frequency component was extracted

from the MLS range measurements. This was done by appropriate filtering of the range residual generated from a linearization of the range profile for the final approach segment. This range navigation system error was then modeled as an autoregressive moving average (ARMA) process. Maximum likelihood techniques were used to identify the parameters of the ARMA process. Author

**N83-11102\*#** Analytical Mechanics Associates, Inc., Mountain View, Calif.  
**SENSITIVITY ANALYSIS OF HELICOPTER IMC DECELERATING STEEP APPROACH AND LANDING PERFORMANCE TO NAVIGATION SYSTEM PARAMETERS**  
M. S. KARMALI and A. V. PHATAK Apr 1982 81 p refs  
Sponsored in part by Army  
(Contract NAS2-10670)  
(NASA-CR-166412; NAS 1.26:166412, AMA-82-18) Avail: NTIS HC A05/MF A01 CSCL 17G

Results of a study to investigate, by means of a computer simulation, the performance sensitivity of helicopter IMC DSAL operations as a function of navigation system parameters are presented. A mathematical model representing generically a navigation system is formulated. The scenario simulated consists of a straight in helicopter approach to landing along a 6 deg glideslope. The deceleration magnitude chosen is 0.3g. The navigation model parameters are varied and the statistics of the total system errors (TSE) computed. These statistics are used to determine the critical navigation system parameters that affect the performance of the closed-loop navigation, guidance and control system of a UH-1H helicopter. Author

**N83-11104#** Federal Aviation Administration, Atlantic City, N.J. Technical Center  
**COMPARISON OF THE MODE S SYSTEM TO THE AUTOMATED RADAR TERMINAL SYSTEM (ARTS) WITH RESPECT TO RANGE AND AZIMUTH RESOLUTION Interim Report, Sep. 1980 - Apr. 1981**  
J. J. BRADY and J. L. MCMILLEN Washington Jul. 1982 40 p refs  
(Contract FAA PROJ. 034-243-510)  
(AD-A118247; FAA-CT-82-38, FAA-RD-82-35) Avail: NTIS HC A03/MF A01 CSCL 17G

A series of flight tests were conducted at the Federal Aviation Administration Technical Center to compare the range and azimuth resolution capabilities of the Mode S (formerly the Discrete Address Beacon System (DABS)), in the Air Traffic Control Radar Beacon /System (ATCRBS) mode, to an existing Automated Radar Terminal System (ARTS) III. The minimum achievable range and azimuth separation of two aircraft, without garbling of either aircraft's A-Code, was determined for both systems. The resolution results were compared to positional aircraft separation data, collected concurrently by a precision Range Instrumentation System, to determine the relationship between A-Code garbling and aircraft separation. The flight test results indicate that the 89 percent beacon resolution achieved the correlated-only Mode S sensor has the best overall resolution in the aircraft separation intervals of 0 deg to 2 deg in azimuth and 0 to 10,000 feet in range. The combined correlated and uncorrelated Mode S reports were 80 percent resolved, whereas, the ARTS reports for the same aircraft separation intervals were 62 percent resolved. The minimum achievable range separation, without garbling, was approximately 10,000 feet for both systems. The azimuth separation was 2 deg for the Mode S system and 3.2 for the ARTS system. GRA

**N83-11105#** Air Force Inst of Tech, Wright-Patterson AFB, Ohio. School of Engineering.  
**APPLICATION OF OUTPUT PREDICTIVE ALGORITHM CONTROL TO A TERRAIN FOLLOWING AIRCRAFT SYSTEM M.S. Thesis**  
M. E. BISE Mar. 1982 118 p refs  
(AD-A118038; AFIT/GE/EE/82M-1) Avail: NTIS HC A06/MF A01 CSCL 17G

An effective automatic terrain following command generation system is required to safely maintain a desired clearance altitude

## 04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

above the terrain. For survivability, the aircraft must penetrate at transonic or high subsonic speeds at very low altitudes above ground level. This introduces new problems such as wind gusts, a faster radar update of the terrain, faster aircraft response time, and increased pilot workload. To ensure survivability, a control algorithm must be capable of interpreting all of the above input data and perform flawlessly during a terrain following mission. This report uses the terrain following scenario to evaluate a new digital controller, the Output Predictive Algorithmic Controller. This controller was able to track, during low level penetration, actual terrain data using as an aircraft model the F-111/MAW (Mission Adaptive Wing). The F-111/MAW was chosen for this study due to its direct lift capability. Two wing sweeps (35 degrees and 58 degrees) were chosen to evaluate the effectiveness of direct lift during terrain following missions. Author (GRA)

**N83-11106#** Federal Aviation Administration, Atlantic City, N.J.  
**TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM LOGIC EVALUATION. VOLUME 1: UNEQUIPPED THREAT PHASE Final Report, Mar. - Dec. 1981**  
B. R. DILLMANN Jul. 1982 74 p  
(AD-A118256, DOT/FAA/CT-82/52-VOL-1, DOT/FAA/RO-82/30-VOL-1) Avail NTIS HC A04/MF A01 CSCL 01B

The purpose of this report is to characterize the performance of the Traffic Alert and Collision Avoidance System (TCAS) logic which was developed by the Mitre Corporation. The evaluation was based on baseline logic documentation and logic changes made between January to October 1981. The report is the first part of a three-volume series and reflects the evaluation of logic performance using the Fast-Time Encounter Generator as the logic test bed for unequipped threats. The study was conducted in two phases. The initial phase addressed the identification and correction of logic flaws. After the improvements in the logic were coordinated with are provided by Mitre, the second phase assessed the TCAS logic performance for a wide variety of two-aircraft encounters. The report identifies the logic deficiencies and the results of the analysis. In general, TCAS logic performance was excellent

Author (GRA)

**N83-11107#** Anacapa Sciences, Inc., Santa Barbara, Calif.  
**IMPORTANCE OF TOPOGRAPHIC FEATURES AND TACTICAL ANNOTATIONS ON MAPS USED BY ARMY AVIATORS FOR NAP-OF-THE-EARTH FLIGHT Interim Technical Report, Aug. 1981 - Jan. 1982**  
S. P. ROGERS Jan 1982 51 p  
(Contract DAAK80-81-C-0089)  
(AD-A118101, USAAVRADCOM-81-0089-1; REPT-459-1) Avail NTIS HC A04/MF A01 CSCL 05H

This report describes a survey conducted to assist in the definition of requirements for the display of topographic and tactical information for Army aviators. The introductory section of the report describes Army Aviation tasks, difficulties with map use in the performance of these tasks, and the solution of these difficulties through the development of a computer-generated topographic display system. The general objective of the reported project was to support the development of such a computer-based system through identification of the most important topographic and tactical features used in meeting Army aviation mission requirements. One hundred and seven Army aviators participated in the project, completing an extensive survey by rating the importance and frequency of use of specific features. The report presents a series of tables summarizing the results of the project including average importance ratings of each feature, and rankings of features by importance ratings. A discussion of the overall pattern of results is also provided. Author (GRA)

**N83-11108#** Lincoln Lab., Mass. Inst. of Tech., Lexington.  
**APPLICATION OF ADVANCED SIGNAL PROCESSING TECHNIQUES TO ANGLE OF ARRIVAL ESTIMATION IN ATC NAVIGATION AND SURVEILLANCE SYSTEMS**  
J. E. EVANS, D. F. SUN, and J. R. JOHNSON 23 Jun. 1982  
383 p refs  
(Contract F19628-80-C-0002; DOT-FA74WAI-461)  
(AD-A118306; TR-582, FAA-RD-82-42) Avail: NTIS HC A13/MF A01 CSCL 17B

This report focuses on the mitigation of multipath and/or incoherent (cochannel) interference on receiving antenna arrays since these phenomenon represent a principal challenge to many existing ATC systems. The improved signal processing techniques considered explicitly assume that interfering signals may be present and estimate the interference parameters (e.g., power and angle of arrival) as well as the desired signal parameters. By thus identifying the nature of the interference, it is then possible to reduce its effects on the desired signal angle of arrival estimates. GRA

**N83-11109#** Ohio Univ., Athens. Dept. of Electrical Engineering.  
**PERFORMANCE TESTS RESULTS OF AUTOMATIC DIRECTION FINDER RECEIVER INTERFERENCE SUSCEPTIBILITY Final Report**  
T. MULLINS and R. LUEBBERS Dec 1981 101 p refs  
(Contract DTFA01-8-C-10072)  
(AD-A118438, FAA-RD-81-83) Avail: NTIS HC A06/MF A01 CSCL 17G

The intent of this effort was to measure the interference susceptibility of present-day ADF equipment and to determine if RTCA and ICAO documents dealing with this subject are still representative. The results of these tests show that the equipment tested meet the specifications of DO-142 Category A. Recent works had indicated that the interference susceptibility characteristics of ADF receivers may be dependent primarily on the absolute level of the undesired signal, and secondarily on the ratio of the desired to the undesired signal. The data presented in this report, however, demonstrated that the interference characteristics of the aircraft ADF system are a function of the ratio of the desired to the undesired signal levels present at the antenna, and are not correlated to the absolute undesired signal levels. Author (GRA)

**N83-11110#** IIT Research Inst., Annapolis, Md.  
**MICROWAVE LANDING SYSTEM (MLS) CHANNEL PLANS AND TRAFFIC LOADING Final Report**  
A. KOSHAR and J. SMITHMYER Washington FAA May 1982  
94 p  
(AD-A117597, ECAC-CR-82-032; FAA-RD-81-113) Avail: NTIS HC A05/MF A01 CSCL 01E

A Standard Traffic Loading Model (STLM) was constructed and the pulse traffic within the STLM was determined. Four proposed channel plans were compared to determine their ability to satisfy the channel requirements within the STLM. Author (GRA)

## 05

### AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

**A83-10179#**  
**COMBAT SURVIVABILITY WITH ADVANCED AIRCRAFT PROPULSION DEVELOPMENT**  
L. THRONDSO (U.S. Naval Weapons Center, China Lake, CA)  
Journal of Aircraft, vol. 19, Nov. 1982, p 915-920.  
(Previously cited in issue 19, p. 3262, Accession no. A81-40913)

A83-10182#

**APPLICATION OF PULSE CODE MODULATION TECHNOLOGY TO AIRCRAFT DYNAMICS DATA ACQUISITION**D. BROWN (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, OH) *Journal of Aircraft*, vol. 19, Nov 1982, p. 934-939 refs

(Previously cited in issue 20, p. 3464, Accession no. A81-43173)

A83-10186\*# Mitre Corp, McLean, Va

**ESTIMATION OF AIRCRAFT FUEL CONSUMPTION**B. P. COLLINS (Mitre Corp., McLean, VA) *Journal of Aircraft*, vol. 19, Nov. 1982, p 969-975 U.S Department of Transportation refs

(Contract NAS1-16430, DOT-FA79WA-4184; DOT-RS57-80-C-00103)

(Previously cited in issue 14, p 2299, Accession no. A81-33883)

A83-10188#

**AIR BAG IMPACT ATTENUATION SYSTEM FOR THE AQM-34V REMOTE PILOTED VEHICLE**C. T. TURNER (Teledyne Ryan Aeronautical Co., San Diego, CA) and L. A GIRARD, JR. (Goodyear Aerospace Corp, Akron, OH) *Journal of Aircraft*, vol. 19, Nov. 1982, p. 984-989

(Previously cited in issue 01, p 9, Accession no. A82-10403)

A83-10191\*# Textron Bell Helicopter, Fort Worth, Tex.

**IN-FLIGHT STRUCTURAL DYNAMIC CHARACTERISTICS OF THE XV-15 TILT-ROTOR RESEARCH AIRCRAFT**J. M. BILGER, R. L. MARR, and A. ZAHEDI (Bell Helicopter Textron, Fort Worth, TX) (In: 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. 431-439) *Journal of Aircraft*, vol. 19, Nov. 1982, p 1005-1011.

(Contract NAS2-7800)

(Previously cited in issue 12, p. 1935, Accession no. A81-29474)

A83-10192\*# National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.

**ANALYSIS AND FLIGHT DATA FOR A DRONE AIRCRAFT WITH ACTIVE FLUTTER SUPPRESSION**J. R. NEWSOM (NASA, Langley Research Center, Loads and Aeroelasticity Div., Hampton, VA) and A. S. POTOTZKY (Kentron International, Inc, Hampton, VA) (In 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 644-653) *Journal of Aircraft*, vol 19, Nov. 1982, p. 1012-1018. refs

(Previously cited in issue 12, p. 1935, Accession no. A81-29495)

A83-10193#

**SWEPT COMPOSITE WING AEROELASTIC DIVERGENCE EXPERIMENTS**M. BLAIR (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) and T. A. WEISSHAAR (Purdue University, West Lafayette, IN) *Journal of Aircraft*, vol 19, Nov. 1982, p 1019-1024. refs

(Previously cited in issue 20, p. 3464, Accession no. A81-43152)

A83-11087

**IN-FLIGHT LIGHTNING DATA MEASUREMENT SYSTEM FOR FLEET APPLICATION - FLIGHT TEST RESULTS**

G. J. VON BOKERN (Boeing Commercial Airplane Co., Seattle, WA) In: NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 25-31. refs

The results of an instrumented 1981 in-flight lightning research program are presented. A Boeing lightning measurement system

was installed on a F-106B as part of NASA's Storm Hazards '81 program. Data from a direct lightning strike to the F-106 is presented (Author)

A83-11088

**METHODS FOR MINIMIZING THE EFFECTS OF LIGHTNING TRANSIENTS ON AIRCRAFT ELECTRICAL SYSTEMS**

D. L. SOMMER (Boeing Military Airplane Co., Seattle, WA) In: NAECON 1982, Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p 32-40. refs

The results of attempts to develop a lightning-tolerant aircraft electrical system are presented. The main hazards of lightning-induced EM interference are magnetically induced voltages appearing between wires and between wires and the airframe. Tests were performed to simulate lightning strikes carrying 200 and 20 kA peak currents. Due to the poor conductivity of composite structures in aircraft, an examination was made of wire routing, equipment location, fiber optics as an alternative wiring method, and bonding, as well as usage of a ground return wire to protect internal electronic circuitry from EM flux associated with lightning strikes. Attention was given to shielding for power cables and signal wires, filtering, and coating protection. An example is provided for a lightning threat analysis of the F-18 fighter.

M.S.K.

A83-11144

**SOFTWARE CONFIGURATION CONTROL IN A REAL-TIME FLIGHT TEST ENVIRONMENT**

D. W. ROBBINS (McDonnell Aircraft Co., St. Louis, MO) In: NAECON 1982, Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 510-514

This paper describes a system which was implemented to maintain configuration control of mission computer software for the F/A-18A Hornet during its flight test program at the Naval Air Test Center (NATC), Patuxent River, MD. It describes the procedures established by which new operational flight programs, reassembled programs, and software patches were incorporated into flight test aircraft. The need for flexibility is addressed along with the techniques used to achieve this flexibility. Problems encountered included various aircraft configurations, various mission computer system configurations, simultaneous one-computer and two-computer versions of the mission computer operational flight programs, and tailoring of the operational flight programs for individual aircraft (Author)

A83-11805

**AIR-TO-AIR MISSILES - FLIGHT TEST IN THE 80'S**R. C. HEAD (U.S. Navy, Pacific Missile Test Center, Point Mugu, CA) *Cockpit*, vol. 17, Jan.-Mar 1982, p. 6-18.

Various techniques and methods for the testing of the Advanced Medium Range Air-to-Air Missile (AMRAAM) are presented, and AMRAAM development is discussed. The missile is comprised of the airframe, flight control section, guidance section, fuse, warhead, propulsion, data link, and telemetry, each of which must be evaluated for optimum mission performance. Testing and evaluation techniques include analytical studies, laboratory and field tests, simulation, and airborne testing (captive carry, separation, and jettison stages). A fully guided missile flight test is performed as an air-to-air intercept against unmanned targets representing the projected threat, and it is found that good launch/simulation correlation for heavier missiles is easier with large moments of inertia, and that fewer assets are required to complete the expansion of the launch envelope for a heavier missile. R.K.R.

## 05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

**A83-11806\*** National Aeronautics and Space Administration Flight Research Center, Edwards, Calif.

### **WAKE VORTEX ATTENUATION FLIGHT TESTS - A STATUS REPORT**

M. R. BARBER (NASA, Flight Research Center, Edwards AFB, CA) and J. J. TYMCZYSZYN (FAA, Los Angeles, CA) (Society of Experimental Test Pilots, Annual Symposium, 13th, Rottach-Egern, West Germany, May 4-6, 1981) Cockpit, vol. 17, Apr.-June 1982, p. 6-26.

(Previously announced in STAR as N81-19057)

**A83-12097**

### **MILITARY POTENTIAL OF THE ABC**

G. PRICE (United Technologies Corp., Sikorsky Aircraft Div., Stratford, CT) Vertiflite, vol. 28, Nov.-Dec 1982, p. 12-14.

Helicopters incorporating the Advancing Blade Concept (ABC) coaxial hingeless rotor design are capable of increases in speed and altitude of 100 knots and 10,000 feet, respectively, over comparable conventional designs. Due to the use of stiff, hingeless rotors, ABC helicopters retain high agility and maneuverability throughout their speed range, and present the possibility of superior gun platform stability. The XH-59A technology demonstration aircraft has completed its test program, achieving a maximum speed of 260 knots and an altitude of over 25,000 feet. Attention is given to the future military requirements addressed by the modification of the present demonstration aircraft to a ducted pusher propeller configuration, with a propulsion system that incorporates a new main gearbox and two T700 turboshaft engines. O.C.

**A83-12665#**

### **NOMOGRAM FOR TAKE-OFF PERFORMANCE OF THE V/STOL AIRPLANE**

T. S. PATEL (Indian Institute of Technology, Bombay, India) and D. K. SHARMA (Aeronautical Society of India, Journal, vol. 33, Aug.-Nov. 1981, p. 93-95).

Calculations for the takeoff performance of V/STOL aircraft with jet powerplants are obtained and presented in the form of a nomogram for quick estimation of the desired parameters at the preliminary design stage. The takeoff analysis is developed from the equations of equilibrium, and the resulting differential equation is simplified by neglecting small tail lift. The propulsive thrust is assumed to vary with the square of the forward velocity. Numerical calculations are carried out for the specified ranges of different parameters. It is found from the calculations that the variation in all-up weight of aircraft has no significant effect on ground run. C.D.

**A83-12934**

### **THE UH-60A BLACK HAWK - A WORLD-WIDE FORCE MULTIPLIER**

B. KEFFORD (United Technologies Corp., Sikorsky Aircraft, Stratford, CT) (Internationales Hubschrauberforum, 14th, Brueckeberg, West Germany, May 20, 21, 1982.) Aircraft Engineering, vol. 54, Oct. 1982, p. 9-15.

The UH-60A Black Hawk helicopter is the U.S. Army's first assault helicopter capable of carrying a squad of troops. Its primary mission is to transport infantry units into combat, resupply them, and perform the associated functions of aeromedical evacuation and repositioning of reserves. The Black Hawk incorporates such state-of-the-art technologies as composite material main rotor blades, high twist advanced airfoils, forged titanium main rotor hub, bearingless graphite tail rotor, digital flight control system, and self-tuned bifilar vibration absorber. The helicopter's External Stores Support System has been designed to carry, in addition to auxiliary fuel tanks, 16 Hellfire missiles, gun pods, ECM pods, side-looking radar, and Stinger air-to-air missiles. The multiservice derivatives of the Black Hawk and its export possibilities are discussed. O.C.

**A83-12969#**

### **THE IMPACT OF COMPOSITE TECHNOLOGY ON COMMERCIAL TRANSPORT AIRCRAFT**

D. G. SMILLIE (Douglas Aircraft Co., Long Beach, CA) (Canadian Symposium on Aerospace Structures and Materials, 1st, Toronto, Canada, June 14, 1982) Canadian Aeronautics and Space Journal, vol. 28, June 1982, p. 135-147. refs

An assessment is undertaken of the structural performance improvements, construction cost reductions and structural weight savings derivable from the application of fiber-reinforced composite construction methods to the primary, as well as the more often addressed secondary structures, of commercial transport aircraft. Attention is given to such key technical issues as the maximization of crashworthiness, through reduction of mechanical forces upon impact and the maintenance of fuel tank integrity, and the composite structure manufacturing processes which are the most important determinants of costs. An especially important driver of construction costs is quality assurance, which according to current composite construction practices requires 56% more inspection time than for comparable metallic components. O.C.

**A83-13017**

### **ACA-ECA OR PIPEDREAM; INDUSTRY NEEDS IT - BUT WHO WILL PAY**

B. WANSTALL Interavia, vol. 37, Nov 1982, p. 1191-1193.

An assessment is presented of the factors, such as availability of funding, agreement among interested governments on common specifications, and the possibility of export markets, which bear on the design and production of an Agile Combat Aircraft (ACA) in the 1990s in order to replace aging F-104 and F-4 interceptors. The air forces and governments in question, which are those of Britain, Germany and Italy, have not yet made definite commitments and are not expected to be able to provide development funding. The fighter is tentatively defined by German and British industry proposals as a twin-engined, single-seat canard configuration powered by turbofans of the RB 199, 8800-kg thrust class. The designs employ carbon/epoxy composites in primary structures and digital fly-by-wire active controls. Two mockups of such aircraft have been exhibited at air shows in 1980 and 1982. O.C.

**A83-13025**

### **U.S. ARMY CONSIDERS AQUILA RPV READY TO FIELD**

B. M. ELSON Aviation Week and Space Technology, vol. 117, Nov. 29, 1982, p. 54, 55, 57, 60

The Aquila RPV is to be used by the U.S. Army in future battlefields to provide visual ground imagery, ensuring that weapons are fired against their intended targets rather than the associated signal emitters which first drew attention to a target area. By focusing on the area starting 5 km beyond the forward line of enemy troops, where ground-based observation systems are ineffective and the risk to manned aircraft is high, Aquila will extend a division commander's attack capability to the full range of artillery weapons. The Aquila system is intended to work in concert with conventional artillery, multiple launch rocket systems, laser-guided bombs, and such laser-guided projectiles and missiles as the Copperhead, Hellfire and Maverick. In addition to variable field of view optics and an electronic zoom feature, a forward-looking IR sensor is planned to extend Aquila mission capabilities into night operations. O.C.

**N83-10034\*#** National Aeronautics and Space Administration Langley Research Center, Hampton, Va.

### **THE DESIGN INTEGRATION OF WINGTIP DEVICES FOR LIGHT GENERAL AVIATION AIRCRAFT**

R. V. GIFFORD and C. P. VANDAM (Kansas Univ., Lawrence) Aug. 1982 8 p refs Presented at the ICAS/AIAA Aircraft Systems and Technol Conf, Seattle, 24 Aug. 1982 Previously announced in IAA as A82-40933 (NASA-TM-83252, NAS 1.15.83252) Avail: NTIS HC A02/MF A01 CSCL 01C

For abstract see A8240933

**N83-10035\*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.  
**FLUTTER CLEARANCE OF THE HORIZONTAL TAIL OF THE BELLANCA SKYROCKET II AIRPLANE**  
 R. H. RICKETTS, F. W. CAZIER, JR., and M. G. FARMER Sep 1982 50 p refs  
 (NASA-TM-84528, L-15453, NAS 1.15:84528) Avail NTIS HC A03/MF A01 CSCL 01C

The Skyrocket II is an all composite constructed experimental prototype airplane. A flutter clearance program was conducted on the horizontal tail so that the airplane could be safely flown to acquire natural laminar flow aerodynamic data. Ground vibration test data were used in a lifting surface flutter analysis to predict symmetric and antisymmetric flutter boundaries. Subcritical response data which were acquired during flight tests are compared with the analytical results. The final flutter clearance placard speed was based on flight test data. S.L.

**N83-10036#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.  
**DESIGN OF THE LEADING EDGE OF A DELTA WING**  
 X. DEKANG 21 Jun 1982 17 p Transl. into ENGLISH from Guoji Hangkong (China), no. 1, 1982 p 18-20  
 (AD-A117469, FTD-ID(RS)T-0470-82) Avail NTIS HC A02/MF A01 CSCL 20D

Wind tunnel tests prove that for a large sweptback blunt leading edge, it is necessary to control the leading edge flow field only on the outer side of the wing in order to obtain a large angle of incidence, high lift, and low drag. A 60 deg sweptback wing with an elliptic arc blunt leading edge; a small fence on the leading edge; a chordwise slot, and a vortex producing blade under the leading edge are four proposed designs which are simple structures with noticeable effects which improve the longitudinal stability of the wing. When the angle of incidence is small, all four configurations require added drag, especially the spanwise plate which showed the best results with a large angle of incidence and decreased drag. With the vortex producing blade, the drag of the small angle of incidence was somewhat larger. A.R.H.

**N83-10037#** Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Information und Dokumentation  
**DESIGN SIMPLIFICATION AND COST REDUCTION OF HELICOPTER TAIL ROTOR DRIVE SYSTEM BY USE OF COMPOSITES**  
 C. M. HERKERT, D. BRAUN, and K. PFEIFFER 1982 28 p  
 Presented at 2nd Intercontinental Soc. for the Adv. of Mater and Process Eng. (SAMPE) Conf., Stresa, Italy, 8-10 Jun 1982  
 (MBB-UD-348) Avail: Issuing Activity

A fiber composite drive shaft and coupling for the BO 105 tail rotor were developed. Design requirements, analytical evaluation and testing, manufacturing and costs of the fiber composite solution for this drive shaft system are explained. Manufacturing technology and tool design are discussed. Static test results are compared with analysis. Dynamic test results for both short and long drive shafts as well as for connector components are shown and evaluated in terms of flight hours. Comparison between metal and composite designs illustrates the cost effectiveness of the later. Author (ESA)

**N83-10039#** Magrath (Howard A.), Dayton, Ohio  
**EVALUATION REPORT: THE SPECIALISTS' MEETING ON DYNAMIC ENVIRONMENTAL QUALIFICATION TECHNIQUES**  
 H. A. MAGRATH AGARD Jul 1982 33 p refs Sponsored by AGARD  
 (AGARD-AR-183; AD-A119561) Avail: NTIS HC A03/MF A01

The blast pressures, from the muzzle of a gun from the properties of the propellant exhaust were determined. A theory which is based upon an analogy of gun blast with an explosive releasing energy at a constant rate and having strong directional effects due to the momentum of the propellant gas flow is extended. The apparent center of the explosion in the shock bottle is placed at a distance of about six gun calibers from the muzzles instead of at it. Pressure predictions based on this model agree well with

experimental data for a 7.62 mm (30 caliber) rifle and a 27 mm aircraft gun. Gun blast measurements were also obtained experimentally on a surface near the gun muzzle. It was found that these can be predicted with reasonable accuracy if regular acoustic reflection occurs, but in the region of Mach reflection the agreement is poor particularly for small distances between the line of fire and the reflecting surface. Mach reflection occurs when the reflected waves tend to coalesce with the incoming waves. Under such circumstances the pressure on reflecting surfaces can be as high as four to eight times the pressure of the incident waves, instead of the usual pressure doubling on rigid surfaces that intercept acoustic waves. S.L.

**N83-10238#** Hughes Aircraft Co., Fullerton, Calif.  
**VIBRATION QUALIFICATION OF EQUIPMENT MOUNTED IN TURBOPROP AIRCRAFT**  
 L. G. SMITH In Shock and Vibration Information Center Shock and Vibration Bull., Pt. 2 p 69-72 May 1982  
 Avail: NTIS HC A11/MF A01 CSCL 01C

A test program required the derivation and implementation of environmental criteria for qualification of equipment mounted in turboprop aircraft. The vibration portion of the program is discussed. Both the criteria and the test control methods are unique and are applicable to other programs for qualifying equipment for the turboprop aircraft vibratory environment. Author

**N83-10240#** Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio. Flight Dynamics Lab.  
**VIBRATION TEST LEVEL CRITERIA FOR AIRCRAFT EQUIPMENT**  
 P. S. HALL In Shock and Vibration Information Center Shock and Vibration Bull., Pt. 2 p 81-91 May 1982 refs Previously announced as N81-25070  
 Avail: NTIS HC A11/MF A01 CSCL 01C

The Combined Environment Reliability Test (CERT) Evaluation Program utilized different methodologies to formulate the vibration test conditions. The problems of mission profiling the vibration environmental stresses are varied. Each methodology is examined for ease of vibration test condition formulation, utilization, and resultant reliability of the specimens tested. A recommendation is made on vibration test criteria for CERT based upon five years of experience and test results. Author

**N83-10270#** Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio. Structures and Dynamics Div.  
**AIRCRAFT RESPONSE TO OPERATIONS ON RAPIDLY REPAIRED BATTLE DAMAGED RUNWAYS AND TAXIWAYS**  
 T. G. GERARDI and L. R. CALDWELL (Air Force Engineering and Services Center, Tyndall AFB, Fla.) In Shock and Vibration Information Center The Shock and Vibration Bull., Pt. 3 p 205-211 May 1981 refs  
 Avail: NTIS HC A12/MF A01 CSCL 01C

A rapid runway repair/aircraft response project is summarized. Current Air Force requirements (AFM 93-2) call for the repair of a 15.24m x 1524m (50 x 5000 ft) minimum operating strip within four hours after the attack. These rapid repairs are made using aluminum AM-2 mats and result in a surface that is rougher than normal and consequently higher than normal loads are induced into the aircraft. The goals of the project are to determine the ground loads capabilities of various aircraft configurations. The planned approach for reaching these goals is through computer simulation, flight testing, and subsequent repair criteria development. M.G.

## 05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

**N83-11045#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

### **AN ADJUSTMENT METHOD AND ENGINEERING REALIZATION FOR CONTROL CURVES OF THE 2-VARIABLE FUNCTION**

S. RONGSHI *In its* J. of Aeron. (FTD-ID(RS)T-0621-82) p 124-139 21 Jul. 1982 refs Transl into ENGLISH from Acta Aeron. et Astron Sinica (China), v. 3, no. 1, Mar 1982

Avail: NTIS HC A08/MF A01 CSCL 01C

Through designing a bypass-door system for a supersonic aircraft, which implemented adjustment in conformity to the control curves of the two-variable function, a method for engineering realization of some separable multivariable functions was put forward. It means, for any control function of  $n$  variables the function, called separable by the author, can be divided into subfunction of each single variable, then the sum of these subfunctions is just equal to the original function. A practical bridge circuit with parameters realizing the control curves for the bypass-door was designed. Moreover, the simple method of changing the characteristics of the control curves by adjusting resistors on the bridge arms was adopted according to the test flight requirements of the system, and an actual numerical example was given. R.J.F.

**N83-11054#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

### **THE GENERAL ASSEMBLY AND PAINTING OF THE YIER - 86 PASSENGER PLANE**

W. ZHONGZHI *In its* Intern. Aviation (Selected Articles) (FTD-ID(RS)T-0679-82 p 22-34 15 Jul 1982 Transl. into ENGLISH from Guoji Hangkong (China), no. 2, Feb 1982 p 25-27, 42-45 and 48

Avail NTIS HC A03/MF A01 CSCL 01C

Procedures followed in assembling and painting the Yier-86 passenger aircraft are described. N.W.

**N83-11113\*#** Bolt, Beranek, and Newman, Inc., Cambridge, Mass.

### **AN OPTIMAL CONTROL MODEL APPROACH TO THE DESIGN OF COMPENSATORS FOR SIMULATOR DELAY Final Report**

S. BARON, R. LANCRAFT, and A. CAGLAYAN Washington NASA Oct. 1982 119 p refs

(Contract NAS2-10907) (NASA-CR-3604; NAS 1.26:3604, BBN-5004) Avail: NTIS HC A06/MF A01 CSCL 01C

The effects of display delay on pilot performance and workload and of the design of the filters to ameliorate these effects were investigated. The optimal control model for pilot/vehicle analysis was used both to determine the potential delay effects and to design the compensators. The model was applied to a simple roll tracking task and to a complex hover task. The results confirm that even small delays can degrade performance and impose a workload penalty. A time-domain compensator designed by using the optimal control model directly appears capable of providing extensive compensation for these effects even in multi-input, multi-output problems. M.G.

**N83-11114\*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

### **OPDOT: A COMPUTER PROGRAM FOR THE OPTIMUM PRELIMINARY DESIGN OF A TRANSPORT AIRPLANE**

S. M. SLIWA and P. D. ARBUCKLE Sep. 1980 110 p refs (NASA-TM-81857; NAS 1.15:81857) Avail: NTIS HC A06/MF A01 CSCL 01C

A description of a computer program, OPDOT, for the optimal preliminary design of transport aircraft is given. OPDOT utilizes constrained parameter optimization to minimize a performance index (e.g., direct operating cost per block hour) while satisfying operating constraints. The approach in OPDOT uses geometric descriptors as independent design variables. The independent design variables are systematically iterated to find the optimum design. The technical development of the program is provided and a program listing with sample input and output are utilized to illustrate its use in preliminary design. It is not meant to be a

user's guide, but rather a description of a useful design tool developed for studying the application of new technologies to transport airplanes. Author

**N83-11115\*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va

### **LOW-SPEED AERODYNAMIC CHARACTERISTICS OF A TRANSPORT CONFIGURATION HAVING A 42 DEG SWEEP SUPERCRITICAL AIRFOIL WING AND THREE TAIL HEIGHT POSITIONS**

P. G. FOURNIER and W. C. SLEEMAN, JR Dec. 1974 56 p refs (NASA-TM-X-3149; L-9852; NAS 1.15:X-3149) Avail: NTIS HC A04/MF A01 CSCL 01C

A low speed investigation was conducted in the Langley V/STOL tunnel to define the static stability characteristics of an advanced high subsonic speed transport aircraft model in the cruise configuration (no high lift system). The wing of the model had 42 deg sweep of the quarter chord line, an aspect ratio of 6.78, and supercritical airfoil sections. Three different horizontal tail configurations (high, mid, and low) were investigated on the complete model and for the model with the wing removed in order to assess effects of the wing flow field on the tail contributions to both longitudinal and lateral stability characteristics. All the model configurations investigated were tested over an angle of attack range from approximately -5 to 23 deg. Some model configurations were also tested over an angle of attack range from about 11 to 38 deg in order to explore the aerodynamic characteristics in the deep stall region. M.G.

**N83-11116\*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va

### **WIND-TUNNEL INVESTIGATION OF AERODYNAMIC LOAD DISTRIBUTION ON A VARIABLE-WING-SWEEP FIGHTER AIRPLANE WITH A NASA SUPERCRITICAL AIRFOIL**

J. B. HALLISSY and C. D. HARRIS Oct 1974 37 p refs (NASA-TM-X-3095; L-9146; NAS 1.15:X-3095) Avail: NTIS HC A03/MF A01 CSCL 01C

Wind-tunnel tests have been conducted at Mach numbers of 0.85, 0.88, and 0.90 to determine the aerodynamic load distribution for the 39 deg swept-wing configuration of a variable-wing-sweep fighter airplane with a NASA supercritical airfoil. Chordwise pressure distributions were measured at two wing stations. Also measured were the overall longitudinal aerodynamic force and moment characteristics and the buffet characteristics. The analysis indicates that localized regions of shock-induced flow separation may exist on the rearward portions of the supercritical wing at high subsonic speeds, and caution must be exercised in the prediction of buffet onset when using variations in trailing-edge pressure coefficients at isolated locations. Author

### **N83-11117\*#** Kaman Aerospace Corp., Windsor, Conn **ROTOR DYNAMIC SIMULATION AND SYSTEM IDENTIFICATION METHODS FOR APPLICATION TO VACUUM WHIRL DATA**

A. BERMAN, N. GIANANTE, and W. G. FLANNELLY 30 Sep. 1980 188 p refs Sponsored in part by Army Aviation Research and Development Command (Contract NAS1-13710)

(NASA-CR-159356; NAS 1.26:159356; R-1496) Avail: NTIS HC A09/MF A01 CSCL 01C

Methods of using rotor vacuum whirl data to improve the ability to model helicopter rotors were developed. The work consisted of the formulation of the equations of motion of elastic blades on a hub using a Galerkin method; the development of a general computer program for simulation of these equations; the study and implementation of a procedure for determining physical parameters based on measured data; and the application of a method for computing the normal modes and natural frequencies based on test data. R.J.F.

**N83-11118#** Boeing Military Airplane Development, Seattle, Wash. Advanced Airplane Branch.

**FIRE RESISTANT AIRCRAFT HYDRAULIC SYSTEM Final Report, May 1976 - May 1980**

E. T. RAYMOND, D. W. HULING, R L SHICK, JR., E. C WAGNER, and W. E. WILLARD Wright-Patterson AFB, Ohio AFWAL Jul 1982 386 p refs (Contract F33615-76-C-2064, AF PROJ. 3145) (AD-A118169, AFWAL-TR-80-2112) Avail NTIS HC A17/MF A01 CSCL 11H

This document reports a study to select a nonflammable hydraulic fluid for possible use in future military aircraft in which the Halocarbon Products Corporation AO-8 chlorotrifluoroethylene (CTFE) fluid was selected as the most promising fluid which meets the specified Aero Propulsion Laboratory and Aeronautical Systems Division nonflammability criteria. It also reports the results of the component compatibility tests conducted to evaluate that fluid under typical system conditions. GRA

**N83-11119#** General Accounting Office, Washington, D. C Procurement Logistics and Readiness Div.

**AIR LAUNCHED CRUISE MISSILE: LOGISTICS PLANNING PROBLEMS AND IMPLICATIONS FOR OTHER WEAPONS SYSTEMS**

10 May 1982 12 p refs (AD-A118129, GAO/PLRD-82-68; B-207053) Avail: NTIS HC A02/MF A01 CSCL 15E

Document reviewed the integrated logistics support (ILS) planning for the Air Force's air-launched cruise missile (ALCM) and the related B-52 carrier aircraft modifications and identified problems which will inhibit the economy and effectiveness of logistics support for the systems. These problems were primarily caused by the program's concurrent development and production acquisition strategy, which was adopted to meet the required operational availability date for the ALCM. Author (GRA)

**N83-11120#** Fraunhofer-Inst fuer Betriebsfestigkeit, Darmstadt (West Germany).

**OPERATIONAL LOADS AT NOSE AND MAIN LANDING GEAR OF AN AIRPLANE OF TYPE AIRBUS A 300 B2 DURING NORMAL SERVICE OF THE GERMAN LUFTHANSA Final Report, Jan. 1982**

O. BUXBAUM, V. LADDA, and J. M ZASCHEL Bonn Bundesministerium fuer Forschung und Technologie Jul 1982 138 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie (BMFT-FB-W-82-010; ISSN-0170-1339) Avail. NTIS HC A07/MF A01; Fachinformationszentrum, Karlsruhe, West German DM 27,50

Measurement and analysis of the operational loads at the main and nose landing gear of a wide body airplane of type Airbus A 300 B2 during normal service are presented. The aim of the investigation was to improve and to complete knowledge on the design loads of modern aircraft landing gears. The loads were analyzed in dependence on the significant load cases. The results are presented as cumulative frequency distributions. In addition, probabilities of occurrence of extreme values are derived with which the loads can be extrapolated to the design life of the airplane. Relations between the load components at main gear and the loads at main and nose gear are determined. Moreover, ground reaction factors were calculated with regard to generalizing the results for the design of landing gears of other airplanes

Author (ESA)

**N83-11121#** Dornier-Werke G.m b.H., Friedrichshafen (West Germany).

**MODERN WING TECHNOLOGY FOR GENERAL AVIATION AIRCRAFT. PHASE 3: FLIGHT TESTING Final Report, Mar. 1981**

H FRIEDEL, W. HABERLAND, G. HALFMANN, and R MATECKI Bonn Bundesministerium fuer Forschung und Technologie Jul 1982 121 p refs In GERMAN, ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie (BMFT-FB-W-82-012; ISSN-0170-1339) Avail: NTIS HC A06/MF A01, Fachinformationszentrum, Karlsruhe, West Germany DM 25,50

A general view of the entire research program advanced wing technology (TNT) for general aviation application, a summary of the flight test results, and consideration of economic aspects are presented. The evaluation of the flight tests with the TNT experimental aircraft shows that the flight performances exceed the expectation of calculations and wind tunnel tests by far, and that the flight mechanics are compatible with conventional wing technology. The proof of the economic advantage is presented. The commercial application of advanced wing technology allows significant economic advantages compared to conventional wing aerodynamics and structure. Low fuel cost and high transport efficiency result in a reduction of the direct operating cost by 30% on average compared to existing designs. The outstanding flight test results fully justify the realization of an experimental program. A wing technology was developed for application.

Author (ESA)

**N83-11122#** Avions Marcel Dassault-Breguet Aviation, Saint-Cloud (France)

**DIGITAL SIMULATION OF TRANSONIC 3-DIMENSIONAL FLOWS OF PERFECT COMPRESSIBLE FLOWS AROUND AIRCRAFT BY THE METHODS OF FINITE ELEMENTS AND OF LEAST SQUARES**

G POIRIER Nov. 1981 46 p refs In FRENCH; ENGLISH summary Sponsored by French Aeronautics and Astronautics Association (PB82-213448; NT-81-25) Avail: NTIS HC A03/MF A01 CSCL 01C

Gradient algorithms combined with least square formulations are presented and possible computer programs derived from the method for many three dimensional industrial configurations, wing surfaces, air intakes, and complete aircraft are analyzed from the standpoints of data processing capabilities and quality of results. Results of experimental digital calculations are presented in graphic form. A.R.H.

06

AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices, and flight instruments.

**A83-10187#**  
**ICE DETECTOR EVALUATION FOR AIRCRAFT HAZARD WARNING AND UNDERCOOLED WATER CONTENT MEASUREMENTS**

E. N BROWN (National Center for Atmospheric Research, Boulder, CO) Journal of Aircraft, vol. 19, Nov. 1982, p. 980-983. refs

A Rosemount ice detector was installed on a Research Aviation Facility Queen Air for evaluation. It was used during a winter stratus cloud experiment at Muskegon, Mich. (1978) and during a cumulus cloud experiment (HIPLEX) in 1980 at Big Spring, Tex. Results indicate that the detector is an extremely sensitive instrument with a reasonable dynamic range. The instrument will provide a measure of icing severity and valid computed water content values only for conditions of small water content and/or low temperature. The dynamic range of this measurement technique for stratus cloud studies is probably adequate, its use at temperatures of -5 to -10

## 06 AIRCRAFT INSTRUMENTATION

C in cumulus clouds will provide only a relative measure of icing severity and large underestimates of the computed liquid water content. (Author)

**A83-10442#**

### **ACCELERATED LIFE TESTS OF AIRCRAFT THERMOCOUPLES [PRZYSPESZONE BADANIA TRWALOSCI TERMOPAR LOTNICZYCH]**

J. SEROKA and A. LESIUK Instytut Lotnictwa, Prace, no 87, 1981, p. 43-47. In Polish.

Certain factors affecting the life of aircraft-engine thermocouples are examined. A simplified model for determining the life of a thermocouple is presented, and the possibility of performing accelerated life tests on thermocouples is discussed. B.J.

**A83-11097**

### **DESIGN OF AN AIRCRAFT ICE DETECTOR USING MICROCOMPUTER ELECTRONICS TO ENHANCE SYSTEM AVAILABILITY**

B. SCHWARTZ and R. SHELDON (Rosemount, Inc., Eden Prairie, MN) In NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 100-104

A new ice detector designed to optimize reliability, testability, and maintainability while meeting rigid performance specifications is described. The instrument utilizes a single chip microcomputer, which reduces the electronic parts count and simplifies the control circuitry, thereby increasing the ice detector reliability. The ice detector has extensive self-test capability, a failure output enunciates any malfunction discovered. Twenty-eight serially outputted bits of ice detector status and failure data provide enhanced maintainability. Using an interface instrument, this data provides fast failure isolation to the component group level. Modular design enables technicians to repair the ice detector in minimal time. (Author)

**A83-11098**

### **ADVANCED MULTIPLE OUTPUT AIR DATA SENSOR FOR ANGLE OF ATTACK, PITOT AND STATIC PRESSURE MEASUREMENTS**

F. W. HAGEN and R. V. DELEO (Rosemount, Inc., Eden Prairie, MN) In NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 105-112.

An air data sensor is described which has pneumatic angle of attack outputs in addition to conventional pitot and static pressure outputs. The L-shaped sensor has no moving parts and is designed for mounting on the forward side of an aircraft fuselage. The sensor, identified as a Model 857E type, will provide a normal pitot pressure and an aerodynamically compensated static pressure to meet requirements of MIL-P-83206 and MIL-P-26292. In addition, it will provide a differential pressure proportional to angle of attack. A wind tunnel calibration is presented for a complete air data system consisting of the 857E sensor and an air data computer. The computer obtains pressure inputs from the Model 857E and provides output voltages proportional to static pressure, impact pressure, and angle of attack. (Author)

**A83-11100**

### **FOUR-CHANNEL MULTIPLEXED RESOLVER-TO-DIGITAL CONVERTER**

R. WIDNER (Texas Instruments, Inc., Dallas, TX) In: NAECON 1982, Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 122-129.

The design requirements and a description of a dual-speed, resolver-to-digital converter assembly intended for the FLIR system on the F-18 are presented. A numerical model is developed for the functioning of the resolver in extracting the output angle from four voltage outputs. Separate determinations are made of the

error function algorithm, the static case, and the rotating case. A four-channel, multiplexed dual-speed converter is described with digital outputs at an 800 Hz rate. Comparisons are provided of various resolver converters, along with a functional block diagram of the converter. Two channels operate in a 16:1 dual-speed and a third is 36:1 dual-speed. Details of the system hardware are described. M.S.K.

**A83-11101**

### **THE MCP-100 - A TURNKEY SYSTEM FOR IMPLEMENTING MULTIVARIABLE FLIGHT CONTROL LAWS**

R. H. TRAVASSOS (Integrated Systems, Inc., Palo Alto, CA) In: NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 130-138 refs.

This paper describes the development of Integrated Systems' MCP-100, a high-speed digital processor which can implement a wide-class of multivariable flight control laws and estimation algorithms. The MCP-100 uses a 16-bit processor with 4K of data memory, 4K of program memory and is capable of performing 8 million operations per second (8MOPS). The high-speed and turnkey nature of the design allows multivariable flight controllers with up to 32 states, 16 measurements and 8 controls to be rapidly implemented and evaluated in the laboratory or in flight. The design is suitable for flight applications because it uses less than 15 watts of power and occupies less than 1 cu ft of space. (Author)

**A83-11119**

### **MARCONI AVIONICS STANDARD CENTRAL AIR DATA COMPUTER**

S. R. FROST (Marconi Avionics, Ltd., Rochester, Kent, England) In: NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 308-312.

A standard central air data computer (SCADC) is described in terms of user benefits, design philosophy, performance, and program aims. The most significant benefits include improved reliability, lower costs, and spares with more than 80% commonality in each SCADC configuration. A pair of transducer modules, an air data processor module, and a series of analogue output modules are components of the core module, ensuring maximum hardware commonality for a range of computers. In addition, reliability figures for each configuration are up to 7,000 hours MTBF. Finally, the program will focus on the expedient fielding of new SCADC's for selected aircraft. R.K.R.

**A83-11120**

### **THE U.S. AIR FORCE AND U.S. NAVY STANDARD CENTRAL AIR DATA COMPUTER**

R. L. HARPENAU and D. W. GASTON (Airesearch Manufacturing Co., Torrance, CA) In: NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 313-322. USAF-Navy-sponsored research.

The Standard Central Air Data Computer (SCADC) is a state-of-the-art, digital air data computer design in four alternative configurations which share a common core module set in order to satisfy the retrofit requirements of 10 different Air Force and Navy aircraft. The form, function, and digital synthesis of analog outputs of the SCADC are indistinguishable from those of the systems to be replaced. Internal self-testing of the unit can distinguish between SCADC and aircraft faults, and capture transient faults for subsequent analysis. All attributes of the system, including commonality and standardization, have been directed toward the achievement of low life cycle costs. Attention is given to the main functional modules of the SCADC, including the microprocessor, memory, pressure transducers and power supply. O.C.

A83-11134#

**COLOR, PICTORIAL DISPLAY FORMATS FOR FUTURE FIGHTERS**

J. M. REISING (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, OH) In NAECON 1982, Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982 Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 488-495. refs

The coupling of high resolution shadow mask CRTs with computer-generated imagery enables the tactical aircraft crewstation designer to produce formats for situational awareness data that are at once more complete than conventional data displays and clearer. Such color pictorial formats will also enable a pilot to stay ahead of his mission tasks, permitting him to function as a faster information assessor. The hardware needed for such cockpit systems is approaching the stage of deployment, but poses the need to convince potential users of advantages that compensate for the complexity of such systems. It is noted that although tests with prototype systems have shown pilots to favor pictorial display formats, the inclusion of some symbolic information was needed for the sake of efficiency O.C.

A83-11135

**AIRBORNE ELECTRONIC TERRAIN MAP DISPLAY - AN UPDATE**

J. W. WEBER, R. L. HERBELIN, R. E. HUSS (Hughes Aircraft Co., El Segundo, CA), and D. M. SMALL (USAF, Avionics Laboratory, Wright-Patterson AFB, OH) In NAECON 1982, Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 419-424.

The Airborne Electronic Terrain Map System (AETMS) program has been developed for applications in the improvement of mission performance through better displays, reducing pilot workload, and the integration of active sensor data with stored information. These digitized terrain data have been applied to synthesize electronic displays for the generation of pictorial map displays. Terrain information can be integrated with real-time data producing displays which can be assimilated with more facility, thus improving mission performance. To improve survivability during the ingress or penetration phases of a mission, terrain data can be used for masking-information generation. AETMS hardware and software are being developed, and regional memory, data processor, and display processor designs have been completed R.K.R.

A83-11147

**MULTIFUNCTION CO2 NOE SENSOR - A STATUS REPORT**

B. B. SILVERMAN (United Technologies Research Center, East Hartford, CT) In NAECON 1982, Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982 Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 568-575. (Contract DAAK80-79-C-0302)

The design, fabrication, and testing of a flight-hardened, compact, multifunction CO2 laser radar sensor for nap-of-the-earth helicopter flight are considered. Phase I of this NOE sensor program will demonstrate the simultaneous functions of terrain following, obstacle avoidance, and three-dimensional Doppler velocity sensing. Phase II, which will start flight testing early in 1984, will demonstrate the additional functions of target detection, acquisition, ranging, tracking, and classification. The Phase I sensor will be contained in a pod 9 x 9 x 62 inches in size, and will weigh approximately 160 lbs; the Phase II system will fit within the same envelope and will weigh slightly more. This paper reviews the background of the overall program, describes the design of the Phase I system, and presents performance predictions for the flight system and initial performance measurements made on a breadboard system at a laser radar range. B.J.

A83-11171

**HOLOGRAPHIC HUDS DE-MYSTIFIED**

J. H. GARD (Kaiser Aerospace and Electronics Corp., Kaiser Electronics Div., San Jose, CA) In NAECON 1982, Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982 Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 752-759.

The optical principles involved in holographic head-up displays (HUD) are described. Refractive HUDs are reviewed, and the development of the reflective HUD is recounted. The latter's advantage is that it permits installation of a larger collimator closer to the pilot, giving a larger instantaneous field of view. Disadvantages include larger size and complexity and disturbing visual effects. Holographic optical elements are discussed and their fabrication and theoretical aspects are described, including volume Bragg holograms. The effect of combining the reflective HUD concept with the holographic reflector is addressed. Higher reflective efficiency and improved optical shape result, but the difficulties of the reflective HUD concept remain. Some holographic elements whose functions can only be realized by diffractive techniques are shown, and computer-originated holographic optical elements are briefly discussed C.D.

A83-11172

**VIDEO STAND-ALONE INSTRUMENT MULTI-FUNCTION COCKPIT DISPLAY SYSTEM**

W. I. HUGHES (Rockwell International Avionics and Missile Group, Collins Government Avionics Div., Cedar Rapids, IA) In NAECON 1982, Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 760-767.

A stand-alone/multi-function cockpit display system capable of displaying raster generated composite video with stroke generated graphics is presented. Such systems have been applied in the areas of general aviation, air transport, and government avionics. The benefits of using two or more stand-alone instruments are redundancy/survivability, cost effective safety analysis, and system flexibility. Multi-function cockpit display offers flexibility, and allows the choice of instruments while taking the space and weight of one instrument set. A stroke overlay of raster presentation is discussed, and a horizontal situation video display currently being used is presented. Parameters of the horizontal display system, which employs two stand-alone multi-function cockpit display systems, include a required input power of 28 V dc. R.K.R.

A83-11186#

**AN AN/APN-194/V/ RADAR ALTIMETER/MIL-STD-1553 INTERFACE CIRCUIT**

C. G. ADAMS (USAF, Aeronautical Systems Div., Wright-Patterson AFB, OH) In NAECON 1982, Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 872-878.

It is shown how, with fairly simple interface circuitry, the APN-194 radar altimeter can operate as a subsystem in a system based on the MIL-STD-1553 multiplexed data bus. The subsystem interface unit obtains the digital altitude word from the APN-194, which is operated in simulated flight, and transmits the data word to the multiplex terminal unit upon command. The multiplex terminal unit then encodes the data and transmits it via the MIL-STD-1553 multiplexed bus V.L.

## 06 AIRCRAFT INSTRUMENTATION

**A83-11188**

### **SENSOR SNAP AND NARROW FIELD-OF-VIEW INSET FOR TERRAIN AVOIDANCE FLIGHT**

J. C. SIMONS (Systems Research Laboratories, Inc., Dayton, OH) In: NAECON 1982, Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 2 New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 885-889.

(Contract F33657-77-C-0479; AF PROJECT 2357)

The paper presents the simulation results of providing the pilot with a control that snaps a forward-looking sensor to predetermined and fixed off-boresight positions. In addition, a narrow field-of-view (NFOV) inset was flown during a gun pass. The snap was later adapted for a two-seat A-10/Night-Adverse Weather configuration and an ASD pod development. A NFOV inset within a wide field-of-view (WFOV) imaging heads-up (HUD) was also flown on the Martin-Marietta Orlando simulator and basic shape and size factors were determined. (Author)

**A83-11227**

### **THE DESIGN AND IMPLEMENTATION OF THE KC-135 AVIONICS HOT BENCH MONITOR**

R. E. PHILLIPS and R. S. EVANS (TRW Defense Systems Group, Redondo Beach, CA) In: NAECON 1982, Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982 Volume 3. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 1185-1190. refs

The design and implementation of the Hot Bench Monitor (HBM) system for the KC-135 Avionics Modernization Hot Bench (AMHB) is presented. Applications of this system are in the capability of monitoring parameters within the simulation software, and/or activities occurring on the multiplex data bus. In order to perform real-time monitoring of the AMHB simulation status and data, the HBM has been developed to function within the KC-135 AMHB system. The HBM subsystem includes six tasks and 12 HBM components, and two major categories of interfaces. Various displays are discussed, such as the fuel system status display and the parameter plot display. It is noted that the HBM provides a good foundation for the development of performance monitoring systems R. K. R.

**A83-11233**

### **HIGH SPEED DATA LINK CONCEPTS FOR MILITARY AIRCRAFT**

E. M. DROGIN and A. M. LEOPARDI (Eaton Corp., Electronic Warfare Systems Div., Deer Park, NY) In: NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 3. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 1226-1233. refs

Attention is given to recent technological advances that have made it possible to consider wide-band data links for internal communications, command, and control on military aircraft. Advanced avionics systems, among them the system for the B-1B Long Range Combat Aircraft, have established a need for bit rates well in excess of the current 1 megabit per second (MBS) standard. Accordingly, both 40 MBS and 80 MBS data links have been designed, implemented, and demonstrated employing either single coaxial or fiber optic cable at distances of up to 100 feet. Data bus concepts are reviewed, and the demonstration links are described in some detail C.R.

**A83-11240**

### **TF/TA BY MEANS OF INTEGRATED FLIR AND RADAR SENSORS**

R. L. WIEDER and N. E. THURLOW (Westinghouse Defense and Electronic Systems Center, Baltimore, MD) In: NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 3. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 1270-1276

A unique Terrain Following/Terrain Avoidance (TF/TA) display has been flight tested on the A-10 attack aircraft. Two WX-50

radar generated terrain profiles, a TF command steering box, and the aircraft velocity vector are superimposed on Forward Looking Infrared (FLIR) imagery to produce an uncluttered, easily assimilated Head-Up Display (HUD). The integration of the FLIR and radar sensors provides high resolution imagery which is essential for low altitude penetration in adverse weather, low visibility conditions, and at night. Data from the flight test program formed a baseline in the development of a computer simulation of the TF/TA radar mode intended to investigate areas where enhanced capability was desirable and to respond to the comments of the pilots using the system. The simulation was implemented with graphics routines to emulate the actual display format of the TA profiles and the TF symbol of the HUD. A new configuration of the WX-50 radar incorporating the results of the simulation will be flight tested within the next six months. (Author)

**A83-11257**

### **DOT-MATRIX DISPLAY LIGHT MEASUREMENT AND INTERPRETATION TECHNIQUES**

K. T. BURNETTE (Burnette Engineering, Fairborn, OH) and T. P. BARRY (Systems Control Technology, Inc., Fairborn, OH) In: NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982 Volume 3. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 1394-1407.

The objective of this paper is to describe computer automated luminance and color measurement, analysis and graphing techniques that were developed for use in the electro-optical characterization of large area medium to high picture element density dot-matrix displays. The issue of how to interpret dot-matrix display light measurements in terms of a pilot's perception of the visual information presented on them is also considered. Display qualification test techniques, methods of verifying them and aircraft cockpit illumination environment test conditions area also described (Author)

### **A83-11258\* Air Force Systems Command, Washington, D.C. DISTRIBUTED PROCESSING AND FIBER OPTIC COMMUNICATIONS IN AIR DATA MEASUREMENT**

K. A. FARRY (USAF, Washington, DC) and R. F. STENGEL (Princeton University, Princeton, NJ) In: NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 3 New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 1408-1414. refs

(Contract N00014-78-C-0257; NGL-31-001-252)

This paper describes the application of distributed processing, fiber optics, and hardware redundancy to collecting airstream data in Princeton's digitally controlled Variable-Response Research Aircraft (VRA). Microprocessor-controlled instrumentation packages in each wingtip of the aircraft collect angle-of-attack and sideslip data in digital form; after scaling, filtering, and calibrating the data, they send it to the aircraft's microprocessor Digital Flight Control System (micro-DFCS) via digital fiber optic data links. Each wingtip's package is independent of the other; therefore, the system has dual hardware redundancy. The fiber optic link design is presented as well as a description of the calibration and communications software. Translation of the system's dual redundancy into fault tolerance is also covered. Results of preliminary flight tests are included (Author)

**A83-11261**

### **SECONDARY AIR DATA MEASUREMENT TECHNOLOGY**

K. J. SCHRAM (Rosemount, Inc., Minneapolis, MN) In: NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 3. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 1425-1433.

Transducers for secondary air data measurements are considered, the two types being differential and absolute. Transducer electronics can be grouped into six circuits: oscillator circuit, linearization network, detector circuit, output amplifier, reference voltage circuit, and temperature compensation circuit.

Analog transducer accuracy is considered in terms of static, operating, dynamic, and stability accuracy, and the principal error contributors are discussed. Repeatability, hysteresis, resolution, temperature (one of the major sources of error), and overpressure are examples of such contributors. Power requirements are approximately 1 W for a + or - 15 VDC input, and 1.5 W for a + or - 28 VDC input. Other features discussed include output signals, and external reference. These transducers can be applied to numerous military environments including humidity (up to 100% RH), vibration, and mechanical shock. R.K.R.

A83-11459

**REAL-TIME INFRARED IMAGE PROCESSING**

T R HUSSON (U.S. Navy, Naval Research Laboratory, Washington, DC) and A. M. ABDALLA (George Washington University, Washington, DC) In: Conference on Pattern Recognition and Image Processing, Dallas, TX, August 3-5, 1981, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1981, p 478-480.

This paper describes a system which was designed to perform real-time image analysis. The result of this design is a flyable, real-time infrared image processing and data collection system. The system is modular in both hardware and software. This provides the flexibility to allow easy testing of various processing algorithms. A description of this operational system which has a pipelined architecture and its associated processing algorithms are presented (Author)

A83-11575

**THE COMPLETE BOOK OF COCKPITS**

D. DWIGGINS Blue Ridge Summit, PA, TAB Books, Inc., 1982 233 p \$40

A photographic account is given of the development and variety of aircraft cockpit instrumentation and control systems, ranging over commercial and military aircraft from the First World War to the present, with attention also given to home-built experimental and general aviation aircraft. Color plates are included for the cockpits of such historically and technologically noteworthy aircraft as the Messerschmitt Bf 109G and Me 262, the U.S. Air Force's B-52H, F-15 and F-16, the Space Shuttle Columbia, and a next-generation L-1011 airliner cockpit mockup incorporating multicolor CRT avionics displays. The photographic sections of the book are preceded by an historical account of the development of avionics and instrument flying rules, with attention to the operating principles of such basic cockpit instrumentation as magnetic compasses, attitude and airspeed indicators, altimeters and tachometers. O.C.

A83-11807

**SOME THOUGHTS ON THE DEVELOPMENT OF COMPUTER-BASED SYSTEMS**

T ARMSTRONG (USAF, Washington, DC) Cockpit, vol 17, Apr.-June 1982, p 27-32

The systems being considered are computer-based airborne systems. The total cost per unit is shown to be the sum of (1) the fixed cost for developing and maintaining the product divided by the number of units plus (2) the variable cost of producing each unit. The fixed-cost portion of the equation would thus be the development costs of the hardware and software, the documentation, the modification costs to the line of products, and all other costs incurred regardless of the volume of production. The variable costs would comprise the cost of all hardware components, production labor, field service, and all other costs that vary as a function of the number of units produced. It is pointed out that the area where cost savings can best be achieved is dependent on the number of units produced. For small numbers, it is best to minimize fixed costs. This involves the use of higher-order languages, hardware that is designed for high reliability and ease of debugging, and a general emphasis on development speed rather than low-cost production. For high-volume production, it is necessary to absolutely minimize production costs. C.R.

A83-11903\* Kansas Univ., Lawrence

**DATA ACQUISITION/REDUCTION SYSTEM FOR FLIGHT TESTING GENERAL AVIATION AIRCRAFT**

D I. RUMMER, M. A. MOSSER, and R. R. L. RENZ (Kansas, University, Lawrence, KS) In: Mini and microcomputers in control and measurement; Proceedings of the International Symposium, San Francisco, CA, May 20-22, 1981. Anaheim, CA and Calgary, Alberta, Canada, Acta Press, 1982, p 7-10. refs (Contract NSG-4019)

The development of a data acquisition/reduction system for use in the flight testing of general aviation aircraft is described. Design objectives for the system are adequate accuracy, ease of installation and removal from aircraft, simplicity of operation, and low cost. A 16-channel working system has been constructed, and tested in the collection of flight test data from a Cessna 172 aircraft, which uses as the basis of its design an AIM65 microcomputer. Data is reduced with a MINC minicomputer system. Attention is given to the onboard installation of computer, battery and transducer modules incorporated by the system O.C.

A83-12935

**FLIGHT SIMULATOR DISPLAY CAPABILITY SIGNIFICANTLY ADVANCED**

S ANDERSON (Rediffusion, Ltd., Orpington, Kent, England) Aircraft Engineering, vol 54, Oct. 1982, p 18-21.

A description is presented of the Wide-angle Infinity Display Equipment (WIDE) flight simulation display system, whose flight deck design provides fields of view for three-crew member simulations in which the flight engineer is an integral part of operations. WIDE has been designed for use with all current computer-generated image systems, and accommodates specific training demands through variations in its geometry. The 40 deg above the horizontal axis, can be redistributed to give greater upward vision for in-flight refueling simulations, and greater downward vision for ground-related training exercises. The system employs three projectors, a back-projection screen and a large collimating mirror, which extends external scenes around the flight deck structure O.C.

A83-13010

**TREND ANALYSIS CONCERNING THE DISPLAYS AND THE KEYBOARD OF GPS NAVIGATION RECEIVERS FOR DIFFERENT APPLICATIONS [TRENDANALYSE FUER DAS ANZEIGE- UND TASTENFELD VON GPS-NAVIGATIONS-EMPFÄNGERN VERSCHIEDENER ANWENDUNGEN]**

A. STILLER (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne, West Germany) Ortung und Navigation, no. 2, 1982, p 160-181. In German. refs

Developments led to a general standardization of aircraft instrumentation. No significant changes concerning this instrumentation with respect to measurement principles and methods occurred during the last 25 years, although internal design changes were necessary in connection with the replacement of vacuum tubes by transistors and integrated circuits. However, at the present time changes related to information display and information acquisition are imminent in connection with the introduction of microprocessors. The display of GPS positional and navigational information is discussed, taking into account approaches for the suitable display of the information by means of light emitting diodes, liquid crystal displays, and cathode-ray tubes. Attention is given to the digital storage of maps and their display on a screen, the five large groups of users of the Global Positioning System (GPS), and the special needs of the users. G.R.

## 06 AIRCRAFT INSTRUMENTATION

**N83-10040\*** National Aeronautics and Space Administration, Pasadena Office, Calif.

### **CAT ALTITUDE AVOIDANCE SYSTEM Patent**

B. L. GARY, inventor (to NASA) (JPL, California Inst. of Technology, Pasadena) 31 Aug 1982 23 p Filed 12 Jan. 1981 Supersedes N81-16677 (19 - 07, p 0947) Sponsored by NASA (NASA-CASE-NPO-15351-1; US-PATENT-4,346,595; US-PATENT-APPL-SN-224231; US-PATENT-CLASS-73-178R; US-PATENT-CLASS-73-170R, US-PATENT-CLASS-343-100ME, US-PATENT-CLASS-374-122; US-PATENT-CLASS-374-123)

Avail. US Patent and Trademark Office CSCL 01D

A method and apparatus are provided for indicating the altitude of the tropopause or of an inversion layer wherein clear air turbulence (CAT) may occur, and the likely severity of any such CAT, includes directing a passive microwave radiometer on the aircraft at different angles with respect to the horizon. The microwave radiation measured at a frequency of about 55 GHz represents the temperature of the air at an "average" range of about 3 kilometers, so that the sine of the angle of the radiometer times 3 kilometers equals the approximate altitude of the air whose temperature is measured. A plot of altitude (with respect to the aircraft) versus temperature of the air at that altitude, can indicate when an inversion layer is present and can indicate the altitude of the tropopause or of such an inversion layer. The plot can also indicate the severity of any CAT in an inversion layer. If CAT has been detected in the general area, then the aircraft can be flown at an altitude to avoid the tropopause or inversion layer.

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

**N83-10041#** Federal Aviation Administration, Atlantic City, N.J. **LIGHT AIRCRAFT PISTON ENGINE CARBURETOR ICE DETECTOR/WARNING DEVICE SENSITIVITY/EFFECTIVENESS Final Report, Jun. 1979 - Oct. 1981**

W. CAVAGE, J. NEWCOMB, and K. BIEHL Jun 1982 93 p (Contract FAA PROJ. 184-32-130)

(AD-A117745, DOT/FAA/CT-82/44) Avail: NTIS HC A05/MF A01 CSCL 01D

A comprehensive test cell data collection and evaluation effort to review sensitivity and accuracy of 'off-the-shelf' carburetor ice detection/warning devices for general aviation piston engine aircraft was conducted. Presented herein are results, observations, and conclusions drawn from over 150 hours of test cell engine carburetor ice operations on a Teledyne Continental Motors O-200A engine. Static sea level test cell engine operations were conducted to review carburetor ice detectors/warning devices sensitivity and accuracy during actual carburetor icing, determine internal carburetor ice accumulation locations, ascertain how ice formation propagates through the carburetor, observe carburetor performance during ice build-up and consider most advantageous location for a carburetor ice detector. Also presented is a review of the Federal Aviation Administration's carburetor accident/incident data relative to aircraft type, pilot qualifications, time of year and location by state where carburetor ice was a factor. Author (GRA)

**N83-10042#** Royal Australian Air Force, Edinburgh Aircraft Research and Development Unit.

### **EVALUATION OF NEW IROQUOIS TORQUEMETER PN 73-30-1**

L. R. WARD Jun. 1982 32 p refs (AD-A117747; ARDU-TI-778, AR-002-491) Avail: NTIS HC A03/MF A01 CSCL 01C

The purpose of this investigation was to supervise the installation of a prototype torquemeter in an Iroquois UH-1H and to evaluate the accuracy, damping, drift and ergonomic aspects of the new torquemeter. Tests showed that torquemeter accuracy was unacceptable and the indicating system was prone to significant drift. Tradesmen found adjustment of the 'zero set' difficult to perform due to poor access to the adjustment screw. Instrument markings in the range greater than 30 psi were obscured when viewed from the co-pilot's seat. The night-lighting of the instrument and the reflection characteristics of the glass cover were also unsatisfactory. The procedure for torquemeter adjustment for installed engine Data Plate Torque was found to be in error and a revised procedure is proposed. Several modifications to the

instrument are recommended to be made before fleet-wide installation. A limited number of flight tests should be made to check that the production torquemeter and the new performance calculator are compatible. If significant delays occur before introduction of a suitable production torquemeter, an interim method of displaying maximum permissible torque is proposed. GRA

**N83-10043#** National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.

### **ANALYSIS OF POSSIBLE INTERFERENCE IN RADIO ALTIMETERS INDUCED BY A POSITION MARKER SYSTEM CALLED RASP**

O. B. M. PIETERSEN and F. KLINKER 13 Nov. 1981 20 p refs

(NLR-TR-81135-U) Avail: NTIS HC A02/MF A01

A model which calculates the power ratio between the radio altimeter signal and the interfering RASP signal for normal RASP use (RASP antenna 80 m from runway) was developed. It is shown that the RASP signal is unlikely to cause significant interference in the radio altimeter if the aircraft is below 70 m, flying directly in front of the RASP antenna. For very poorly adjusted altimeters an equivalent minimum height of 30 m is found. At other points along the runway center line these values are higher. Author (ESA)

**N83-11123#** Arinc Research Corp., Annapolis, Md. **DEVELOPMENT OF AVIONICS INSTALLATION INTERFACE STANDARDS Summary Report, 29 Aug. 1980 - 15 Jun. 1981**

S. BAILEY, N. SULLIVAN, and A. SAVISAAR Aug. 1981 217 p Revised

(Contract F04606-79-G-0082)

(AD-A116852; REPT-2258-03-2-2477R) Avail: NTIS HC A10/MF A01 CSCL 01C

This report summarizes ARINC Research Corporation's efforts under Air Force Contract FO4606-79-G-0082, 'Standard Rack-Mounted and Panel-Mounted Avionics Interface Concepts Analysis'. The period of performance was 29 August 1980 through 15 June 1981. The technical areas addressed were the analysis and potential specification of rack-mounted avionics, cockpit-mounted control panels, and panel-mounted instruments. Contract tasks included conceptual studies of potential configurations of a Standard Avionics Integrated Control System (SAICS). The results of the SAICS analyses are reported separately in ARINC Research Publication 2258-02-1-2439, Cost Benefit and Failure Criticality Analyses of the Standard Avionics Integrated Control System (SAICS) Concept, June 1981. The concepts-analysis project described herein continues a contractual effort initiated by the Air Force in 1979 to determine whether a comprehensive Packaging, Mounting, and Environmental (PME) avionics interface standard would benefit Air Force aircraft. Comprehensive findings of that effort are documented in ARINC Research Publication 1753-01-1-2124, Standard Avionics Packaging, Mounting, and Cooling Baseline Study, January 1980, which addresses the applicability of commercial airline avionics to military aircraft, the cost benefits associated with Air Force PME standards, and a possible implementation scenario with recommended activities and schedules. GRA

**N83-11124#** Anacapa Sciences, Inc., Santa Barbara, Calif. **APPLICATION OF CODING METHODS IN DEVELOPMENT OF SYMBOLOGY FOR A COMPUTER GENERATED TOPOGRAPHIC DISPLAY FOR ARMY AVIATORS Interim Technical Report, Aug. 1981 - Feb. 1982**

M. C. MCCALLUM and S. P. ROGERS Mar. 1982 130 p refs (Contract DAAK80-81-C-0089)

(AD-A118142, REPT-459-2; USAAVRADCOM-81-0089-2) Avail: NTIS HC A07/MF A01 CSCL 09B

This report presents the results of a literature review conducted to identify previous research that could provide guidelines during the initial design of a new symbol system for topographic and tactical data display. Methods of symbol design based on ten dimensions of visual coding -- shape, alphanumeric, size, numerosity, inclination, brightness, color, flash rate, stereo depth, and apparent movement -- are identified and evaluated. The

evaluation of alternative coding methods is based on three design-oriented criteria: amount of information conveyed, types of data coded, and aid to operator visual search. These criteria are considered in the review of research investigating both unidimensional and more complex multidimensional symbol systems. A model is presented which identifies the relationships between many factors and symbology system characteristics that ultimately affect the design of symbol systems. Author (GRA)

**N83-11394#** Royal Signals and Radar Establishment, Malvern (England)  
**IMAGE GENERATION AND DISPLAY**  
 T. R. BERRY. In *AGARD Image Process Tech* 25 p. May 1982. refs  
 Avail. NTIS HC A11/MF A01

The various scanning patterns used by conventional airborne sensors and the implications of displaying the data generated by them on a cockpit display based on commercial interlaced TV are reviewed. The challenge posed by flat panel displays to the dominance of the CRT in the TV field is considered briefly, and the relative merits of photographic film and magnetic tape as a means of providing a permanent record of the displayed data are explored. Author

## 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.

**A83-10184\*#** National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio  
**ROTOR WAKE CHARACTERISTICS RELEVANT TO ROTOR-STATOR INTERACTION NOISE GENERATION**  
 L. M. SHAW and J. R. BALOMBIN (NASA, Lewis Research Center, Cleveland, OH). *Journal of Aircraft*, vol. 19, Nov. 1982, p. 954-962. refs  
 (Previously cited in issue 01, p. 13, Accession no. A82-10456)

**A83-10444#**  
**AUTOMATIC PLOTTING OF THE RESULTS OF BENCH TESTS OF TURBINE ENGINES [AUTOMATYZACJA GRAFICZNEGO OPRACOWYWANIA WYNIKOW BADAN HAMOWNIANYCH SILNIKOW TURBINOWYCH]**  
 D. GORCZYCA and R. KROLIKOWSKI. Instytut Lotnictwa, Prace, no. 88, 1982, p. 45-53. In Polish.

The paper describes a technique for the automatic plotting of the static characteristics of gas turbine engines using values of engine parameters obtained from measurements under stationary conditions. The approach involves the approximation of the static characteristics by polynomials using simplex linear programming; Lagrange interpolation can also be used. B.J.

**A83-10660#**  
**EFFECT OF OXYGEN ADDITION ON IGNITION OF AERO-GAS TURBINE AT SIMULATED ALTITUDE FACILITY**  
 N. K. CHEN, Y. H. ZHAO, S. S. WU, Q. S. ZHAO (Beijing Institute of Aeronautics and Astronautics, Beijing, People's Republic of China), and J. S. CHIN. *Journal of Energy*, vol. 6, Nov.-Dec. 1982, p. 425-429.  
 (Previously cited in issue 19, p. 3266, Accession no. A81-40891)

**A83-10666#**  
**CHARACTERISTIC TIME IGNITION MODEL EXTENDED TO AN ANNULAR GAS TURBINE COMBUSTOR**  
 J. E. PETERS and A. M. MELLOR (Purdue University, West Lafayette, IN). *Journal of Energy*, vol. 6, Nov.-Dec. 1982, p. 439-441. Army-sponsored research. refs

Ignition data from an annular combustor are investigated in light of the Peters and Mellor (1982) characteristic time ignition model, which has previously been applied to other combustor geometries. The model states that for ignition to occur, the energy of a spark must heat an initial volume such that the heat release rate within the volume is greater than the loss rate. Application of the model to the F101 engine annular combustor demonstrates that the critical features of the ignition model's application to combustors of this type are the drop size estimates, via empirical equations, and the equivalence ratio evaluations based on the fuel spray and spark plug locations. O.C.

**A83-10675**  
**THE THEORY OF AIRCRAFT ENGINES [TEORIJA AVIATIONNYKH DVIGATELEI]**  
 S. I. LOVINSKII. Moscow, Izdatel'stvo Mashinostroenie, 1982. 224 p. refs

Gas turbine engines used in modern aircraft are reviewed with reference to the main engine components, the principles of engine operation, basic performance characteristics, and engine operation analysis. The engine components examined include air intake devices, various types of compressors, combustion chambers, gas turbines, and exit nozzles. Among other topics the discussion covers specific engine parameters in relation to cycle variables, engine efficiency and energy balance, operation modes, thermal and gas dynamic analyses, and approximate computation of velocity and altitude characteristics. V.L.

**A83-10866**  
**THUNDER POWER FOR EXECUTIVE AND AG-AIRCRAFT**  
 B. SWEETMAN. *Interavia*, vol. 37, Oct. 1982, p. 1048, 1049.

The 700-hp Thunder engine is a silicon-aluminum alloy-block 90 deg V-8 aimed primarily at two specific aircraft classes, of which the largest market is represented by the 4000 U.S.-designed agricultural aircraft. Also considered for retrofit are turboprop business aircraft. An important attribute of the new engine is its compactness, and although its specific fuel consumption varies according to the way it is operated, normal cruise ratings are estimated at 0.26-0.27 kg/kWh per hour, or 70% of the figure for a typical turboprop of similar power rating. The engine is virtually flat-rated from sea level to 17,000-20,000 ft, and loses relatively little power at higher altitudes. The two turbosuperchargers employed are integral to the engine, with each being driven by one bank of cylinders. O.C.

**A83-10867**  
**ENGINES FOR FUTURE COMBAT AIRCRAFT**  
 P. CONDOM. *Interavia*, vol. 37, Oct. 1982, p. 1050-1052.

In the 1992-1995 time period, both the U.S. and European air forces will begin replacing their present generations of combat aircraft. Because the development of a new military turbofan engine requires substantial information concerning airframe requirements, engine constructors have resorted to a similar policy which divides development efforts into three phases: the improvement of components and materials, the construction of demonstrator engines incorporating those new technologies, and the development of service-standard engines. In the interest of increasing turbine entry temperatures, attention is being given to both the formulation of totally new materials and the improvement of cooling techniques. Engines to which such developments will be applied include the RB 199, M88, F 100 and F 404. Also under development are directional solidification, powder metallurgy, metal-matrix composites and protective coatings. O.C.

## 07 AIRCRAFT PROPULSION AND POWER

### **A83-10871 DIGITAL ENGINE CONTROL FOR V/STOL AND V/TOL AIRCRAFT**

Aircraft Engineering, vol. 54, Sept. 1982, p 19-22

A group of full authority digital engine controls (FADEC) are being developed for applications on all types of gas turbine engines. FADEC offer reduced pilot workload, simplified maintenance and construction, and fuel savings. Features which give improved control include the precise observation of limits providing observational flexibility, the use of a non-dimensional closed loop acceleration control results in consistent and repeatable engine performance, and the use of the digital microprocessor which can indicate 98% of all faults thus reducing unnecessary equipment removal. FADEC history is discussed in terms of applications on the Pegasus engine, and conditions such as powerdrop are discussed. It is noted that improved response is one of the major advantages of the FADEC system. R.K.R.

### **A83-11151 AIRCRAFT POWER MANAGEMENT CONTROL SYSTEM DESIGNED FOR FAST RESPONSE AND HIGH RELIABILITY**

W. ROSE (Grumman Aerospace Corp., Bethpage, NY) In: NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 601-607.

The Solid State Electric Logic (SOSTEL) power management system is being developed to replace the conventional aircraft electric control and distribution system. Electromechanical switches are replaced by electronic transducers and the power distribution function is accomplished with solid state power controllers. The heart of this SOSTEL system is the control group, which consists of remote terminals that gather control information from the transducers and provide outputs to the power controllers. These are all under the control of a central processor (an AN/AYK-14 computer). This paper addresses the design and implementation of this SOSTEL control group. (Author)

### **A83-11202 ADAPTIVE POWER MANAGEMENT - A HIERARCHICAL/CONTROL SYSTEM WITH A CENTRAL MULTIPLEX SYSTEM**

W. F. HONEY (Westinghouse Electric Corp., Baltimore, MD) In: NAECON 1982, Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 3. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 996-1005. refs

The Adaptive Power Management (APM) system is a hierarchical/distributed system which centralizes the command and control of the power distribution system while off-loading to each distributed network the responsibility of seeking the solution of the Boolean equations for control and load. The DAIS/Data Bus Military Standards lend themselves to an independent master bus controller with a poll-bid command/response protocol. The APM architecture facilitates the hierarchical/nearest neighbor concept for carrying out monitoring and adaptive processing. The current APM structure may be suitable for future airframe applications such as Vought's concept for the advanced technology multiengine aircraft. B.J.

### **A83-11203 EASY5 BALANCED LOAD SIMULATION OF A BANG-BANG VOLTAGE REGULATOR CONTROLLED SYNCHRONOUS GENERATOR**

T. G. LIANG (Boeing Co., Seattle, WA) In: NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 3. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 1006-1013. refs

The EASY5 engineering analysis program is used to model a 400 hertz salient rotor aircraft synchronous generator and to aid in a preliminary design of a bang-bang voltage regulator. Since the equations are written in terms of phase variables, responses

to unbalanced load changes may be easily simulated, although in this work we concentrate only on balanced loads. The voltage regulator taps field input power and the air gap power as dynamic feedback variables. EASY5 simulations of time responses of the generator-exciter-regulator system to step changes in generator loads are illustrated. (Author)

### **A83-11205 INTEGRATED ELECTRICAL POWER AND AVIONICS CONTROL SYSTEM**

G. L. DUNN and P. J. LEONG (Boeing Military Airplane Co., Seattle, WA) In: NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 3. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 1020-1026.

An advanced aircraft electrical system is being developed in which the electrical system control is being integrated with the Digital Avionics Information System using a single bus architecture. The preliminary design of the electrical system has been completed. The system performs the functions of power generation, distribution and control of power to loads, system protection, and load management. A critical element in the design is the 'intelligent' electrical load management center containing solid state power controllers for the control of power from source to load. In this paper the major system elements of the integrated avionics and power system are discussed. Major component functional requirements and operational philosophy are also presented. (Author)

### **A83-11206 ON THE DESIGN AND TEST OF AN ADVANCED CONTAINMENT STRUCTURE FOR PM MACHINES**

E. U. A. SIDDIQUI (General Electric Co., Erie, PA) In: NAECON 1982, Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 3. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 1027-1030. refs

The design and development of an advanced containment structure for high-speed permanent magnet machines for use in the electrical power systems of modern aircraft are described. The containment ring is bimetallic with alternate magnetic and nonmagnetic segments, and amortisseur bars are incorporated to reduce commutating inductance for improved converter performance. A finite element model of the rotor is presented as well as resulting stress contour plots. The highest stress levels were found to occur around the amortisseur holes but are within the permissible level. Results of a 50 hour test verify the integrity of the design. B.J.

### **A83-11207# A 400 HZ STARTER/GENERATOR SYSTEM**

W. U. BORGER (USAF, Aero Propulsion Laboratory, Wright-Patterson AFB, OH) In: NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 3. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 1031-1036. refs

The paper discusses a 400 Hz, 60 kVA starter/generator system which is configured for service test on the USAF A-10A. Program origins and basic system operation are described, and laboratory test status, including performance and qualification, is considered. TF-34 engine starting test results are discussed, and the weight, cost, and reliability advantages of the starter/generator concept on a class of USAF aircraft are identified. B.J.

A83-11512

**METHODS FOR CALCULATING THE STABILIZATION LIMITS OF A FLAME OF INHOMOGENEOUS MIXTURES USING A BLUFF BODY [METODIKA I RASCHET PREDVELOV STABILIZATSII PLAMENI NEODNORODNYKH SMISEI PLOKHOOTBEKAEMYM TELOM]**

V. L. APOLLONOV, V. N. GRUZDEV, and A. V. TALANTOV (Kazanski Aviatsonnyi Institut, Kazan, USSR) *Inzhenerno-Fizicheski Zhurnal*, vol. 43, Oct. 1982, p. 548-554. In Russian. refs

An expression is obtained for calculating the overall excess-air coefficient at the moment a flame is extinguished. The calculation depends on the excess-air coefficient when a flame of a homogeneous mixture is extinguished under the given conditions, on the extent to which the fuel has vaporized, and on the initial temperature of the flow. It also depends on the coefficient measuring the precipitation of drops onto the stabilizer and on the exchange function, which assesses the contribution of the evaporation of liquid on the stabilizer and the diffusion of vapor to the composition of the mixture in the zone of circulation. C.R.

A83-11627

**ROTARIES FOR GA - NASA GETS SERIOUS**

J. MOXON *Flight International*, vol. 122, Oct. 23, 1982, p. 1223, 1224.

NASA-sponsored studies of stratified-charge, turbocharged Wankel rotary engines for general aviation aircraft are described. NASA development goals for engines of this type and class include the achievement of 250 shp under cruise conditions at 25,000 ft altitude, with a specific fuel consumption of 0.38. Advantages cited for Wankel rotary engines which make them attractive for general aviation aircraft are turbine-like smoothness and quietness, low weight, a mechanical simplicity that favorably affects reliability and maintenance, and the ability to run on a variety of fuels, including diesel. Attention is given to the advantages derivable from the use of stratified charge fuel injection, together with turbocharging. Study results suggest that rotary engines will displace piston engines and compete against low-cost turboprops in the 1990s. O.C.

A83-11949

**REPAIR OF THE AUXILIARY POWER PLANTS OF AIRCRAFT [REMONT VSPOMOGATEL'NYKH SILOVYKH USTANOVOK SAMOLETOV]**

N. I. PAVLOVSKII and K. V. PETROV Moscow, *Izdatel'stvo Transport*, 1981. 256 p. In Russian. refs

The design and performance characteristics of the auxiliary power plants of commercial aircraft TA-8, TA-6A, and AI-9 are briefly reviewed. Routine repair and complete overhaul of the auxiliary power plants are then discussed with particular reference to troubleshooting procedures, repair of the most common engine defects, replacement and adjustment of engine components, engine disassembly, cleaning, and post-repair testing. V.L.

A83-12077

**MEASURED AND PREDICTED SOOT PROFILES IN A GAS TURBINE COMBUSTOR**

J. A. CLARK (Purdue University, West Lafayette, IN) *Combustion and Flame*, vol. 48, Nov. 1982, p. 121-133 refs

Radiation intensity and emissivity measurements were made for a DF-2 flame in a model gas turbine combustor. This same flame was also mapped for temperature and soot mass concentration. Finally, a movable, cold traversing background was used to determine the contribution to total radiation intensity from the individual sections of the flame. A computer program which integrated the radiative transfer equation with respect to path length and frequency was then used to predict a soot profile, based on temperature, radiation intensity, emissivity, and cold traversing background results. Though the predicted soot concentrations were considerably higher than the measured levels, the agreement between the predicted and measured shapes of the soot profile was good. The discrepancy between predicted and measured soot

mass concentrations was attributed to soot particle deposition in the probe. (Author)

A83-12098

**ENGINE TECHNOLOGY FOR THE NEXT DECADE**

J. ACURIO (U.S. Army, Propulsion Laboratory, Cleveland, OH) *Vertiflite*, vol. 28, Nov.-Dec. 1982, p. 16-20.

It is projected that helicopter turboshaft engines of 2000 hp, having design pressure ratios of over 20.1 and turbine inlet temperatures in excess of 2550 F, will have been developed by 1990. Emerging technologies in transmission, compressor, combustor and turbine design which may be applicable to such 1990s engines, given sufficient research and development attention in the near future, are assessed with attention to the tradeoffs which may be entailed between engine mechanical complexity, specific fuel consumption, reliability and maintainability, and performance levels. The advanced T700, PLT 34A and GMA 500 helicopter engines are discussed as indicators of development trends. O.C.

A83-12343#

**NOISE GENERATED BY A PROPELLER OR A HELICOPTER ROTOR**

R. LEGENDRE (ONERA, Chatillon-sous-Bagneux, Hauts-de-Seine, France) *La Recherche Aeronautique (English Edition)*, no. 3, 1982, p. 1-5.

Noise generated sound intensity calculations are considered, by determining an acoustics equation for thickness and lift noises generated by propellers. It is found through the reasoning for thickness noise and lift noise estimations that calculations are not sufficiently valid, unless ample precautions based on steady distribution pressure on the blades propagating in an inviscid and non-turbulent fluid are considered. In examining various sources of propeller noise, it is concluded that they are too numerous, varied, complex, and large to predict sound levels to within a few decibels. R.K.R.

A83-12350#

**STUDY OF FAN NOISE SOURCES THROUGH THIN FILM PRESSURE TRANSDUCERS**

J. LAMBOURION *La Recherche Aeronautique (English Edition)*, no. 3, 1982, p. 75-80 refs

Real-time results of a study of compressor noise using thin film transducers are presented, and technical improvements to the transducers provided a larger number of results. These transducers are fitted at 80 percent of the blade span, corresponding to the zone highest in noise sources. Real-time processing procedures performed include time signatures of the transducers on the blades, spectral analysis of the same signals, and spectral analysis of the signals from microphones. The time signature is obtained using an oscilloscope triggered by the machine's rotation signal, and it is shown that at a speed rotation of 70 percent of the nominal speed, the mean form of the signals from transducers 1 and 5 are the same for one revolution. At 5 kHz, the difference between two frequency response curves is negligible. In addition, it is indicated that the turbulence screen reduces the power of the radiated noise. Finally, it is noted that such aspects as the evolution along the cord require further analysis. R.K.R.

A83-12933

**ROLLS-ROYCE ENGINE STATUS REPORT**

*Aircraft Engineering*, vol. 54, Oct. 1982, p. 2-8, 21.

Development and production status reports are given for current aircraft gas turbine engine programs of Rolls-Royce Limited. The powerplants covered are the RB 211 turbofan family engines, whose 211-22B and 211-524 versions power 747, and TriStar airliners and whose 535 version is to be included among engine alternatives for the 757 airliner; the RB 199 turbofan used by the Tornado fighter; the various versions of the trainer/light fighter Adour turbofan engine; and the Pegasus vectored-thrust turbofan employed by Harrier and Sea Harrier aircraft, whose latest version is to be used by the Harrier II after development has improved its

## 07 AIRCRAFT PROPULSION AND POWER

thrust rating to the 28,000-30,000 lb class. Engines of secondary importance are the Spey and RJ 500 turbofans, the Olympus 593 turbojet of the Concorde SST, and the GEM turboshaft engine for military helicopters O.C.

**A83-12966#**

### **THE USE OF COMPOSITE MATERIALS IN AIRCRAFT PROPELLERS**

D. G. HALL and J. H. YOUNG (United Technologies Corp., Hamilton Standard Div., Windsor Locks, CT) (Canadian Aeronautics and Space Institute, Annual General Meeting, 29th, Toronto, Canada, May 5, 1982) Canadian Aeronautics and Space Journal, vol 28, June 1982, p. 97-107.

The development of aircraft propellers employing composite materials is described and the variety of configurations and structural types designed to meet the challenges of specific applications are highlighted. Attention is given to the design features and functional characteristics of the spar/shell blade construction, which has emerged as the standard in most applications and incorporates the best features of solid and monocoque blade types. Emphasis is placed on the consideration of complex combinations of both steady and vibratory loads. Materials selection is made primarily on the basis of tensile strength, density and elastic modulus. Candidate materials include E-glass, Kevlar 49, high modulus carbon fiber and boron fiber reinforcements in epoxy resin matrices, usually in the form of thin, foam-filled sheaths, covering solid aluminum spars, constitute both the aerodynamic surfaces of the blades and which a means of isolating spars from structural damage O.C.

**A83-13095**

### **THE INFLUENCE OF EQUIVALENCE RATIO VARIATION ON POLLUTANT FORMATION IN A GAS TURBINE TYPE COMBUSTOR**

J. R. NOYCE (Rolls-Royce, Ltd., Bristol, England) and C. G. W. SHEPPARD (Leeds University, Leeds, England) Combustion Science and Technology, vol. 29, no 1-2, 1982, p 37-51. Research supported by Rolls-Royce, Ltd. refs

A research gas turbine type combustor has been used to examine the effect on performance of variation in primary zone equivalence ratio. The chamber, which comprised a conventional tubular primary zone followed by a lengthy plug flow section, was fueled by propane vapor and operated over the equivalence ratio range 0.25-0.77 at atmospheric pressure. Comprehensive internal gas analysis surveys were undertaken and contour maps of gas concentration and derived information have been compiled. Substantially superequilibrium CO levels persisted throughout the burner, although a closer approach to equilibrium was obtained in the plug flow section at the higher equivalence ratios. This was qualitatively in accord with the predictions of a simple computer model presented previously. The data are being used for the verification and development of mathematical models of varying degrees of complexity. (Author)

**A83-13100**

### **A STUDY OF TRANSVERSE TURBULENT JETS IN A CROSS FLOW**

P. V. CHLEBOUN, P. J. CRAIG (Rolls-Royce, Ltd, Bristol, England), F. B. SEBOWA, and C. G. W. SHEPPARD (Leeds University, Leeds, England) Combustion Science and Technology, vol 29, no. 1-2, 1982, p. 107-111. Research supported by Rolls-Royce, Ltd. refs

The isothermal flow of multiple jets transversely discharging from an annulus into a ducted flow is modelled as part of an investigation in the application of a finite difference formulation to a burner having most of the characteristics of a practical gas turbine combustor (Noyce et al., 1981) The model is based on the finite difference solution of the averaged forms of the governing partial differential equations of continuity, momentum, and energy transport. The presence of reverse flow regions implies that the full three-dimensional elliptic differential equations must be solved. The turbulence transport model used is the two equation k-epsilon model, and the resulting seven equations are solved using a finite

difference scheme. Results show that a finite difference modelling method, incorporating the standard k-epsilon turbulence sub-model, can be useful in displaying the general flow field for practical geometries. N.B.

**N83-10013#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

### **THE EFFECT OF THE STATOR WITH UNEQUAL PITCH CASCADES ON THE COMPRESSOR BLADE VIBRATION**

Z. LI *In its* Acta Aeron Astronautica Sinica (FTD-ID(RS)T-0285-82) p 117-127 23 Jun. 1982 refs Transl into ENGLISH from Acta Aeron. Astronautica Sinica (China), v 2, no 3, Sep. 1981 11 p Original language document announced as A82-22119 Avail NTIS HC A08/MF A01

Dynamic stress tests of the compressor blade in a gas turbine engine in which the compressor stator has cascades of unequal pitches are analyzed to determine the effect of two kinds of such arrangements on the blade vibration. In comparison with stators having equally pitched cascades, the average vibratory stress of one arrangement was determined to decrease by 30.8% and the other by 42%. Some relatively complex phenomena observed are discussed. It was observed that the frequency of resonant revolutions greatly increased and the beat phenomenon appeared in all the vibratory signals of one of the arrangements. Stress test results are analyzed by expanding the wake excitation force of the stator by the Fourier series. The resulting frequency spectrum of the excitation forces agrees well with tested results. The solution of the forced vibration equation of the blade is also investigated in order to explain the dynamic response and the beat phenomenon observed in the tests. Author

**N83-10044\*#** Pratt and Whitney Aircraft Group, East Hartford, Conn Commercial Products Div.

### **DEVELOPMENT OF ADVANCED HIGH-TEMPERATURE HEAT FLUX SENSORS**

W. H. ATKINSON and R. R. STRANGE Sep. 1982 214 p refs

(Contract NAS3-22133)  
(NASA-CR-165618, NAS 1 26-165618, PWA-5723-27) Avail:  
NTIS HC A10/MF A01 CSCL 21E

Various configurations of high temperature, heat flux sensors were studied to determine their suitability for use in experimental combustor liners of advanced aircraft gas turbine engines. It was determined that embedded thermocouple sensors, laminated sensors, and Gardon gauge sensors, were the most viable candidates. Sensors of all three types were fabricated, calibrated, and endurance tested. All three types of sensors met the fabricability, survivability, and accuracy requirements established for their application. Author

**N83-10045\*#** National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

### **FURTHER INDUSTRIAL TESTS OF CERAMIC THERMAL BARRIER COATINGS**

C. H. LIEBERT and S. R. LEVINE Sep 1982 10 p refs  
(NASA-TP-2057; E-1184; NAS 1.60:2057) Avail. NTIS HC  
A02/MF A01 CSCL 21E

The NASA Lewis Research Center made technical assistance arrangements (contracts) with several commercial organizations under which Lewis designed plasma-sprayed thermal-barrier coatings (TBC) for their products. Lewis was then furnished with the test conditions and evaluations of coating usefulness. The coating systems were developed and sprayed at Lewis. All of the systems incorporated a two-layer, ceramic-bond coating concept. Coating thickness and chemical composition were varied to fit three applications: the leading edges of first-stage turbine vanes for an advanced gas turbine engine, the flame impingement surfaces of a combustor transition section, and diesel engine valves and head surfaces. The TBC incorporated yttria-stabilized zirconia, which lowered metal temperatures, protected metal parts, and increased metal part life. In some cases metal burning, melting, and warping were eliminated. Additional benefits were realized from these endeavors. hands-on experience with thermal-barrier

coatings was provided to industry; the success of these endeavors encourages these and other organizations to accelerate the implementation of TBC technology. Author

**N83-10046#** General Motors Corp., Indianapolis, Ind  
**LIFE UTILIZATION CRITERIA IDENTIFICATION IN DESIGN (LUCID) Final Report, Sep. 1978 - Dec. 1981**  
 J. E. HOLMES Wright-Patterson AFB, Ohio AFWAL Jun. 1982 68 p  
 (Contract F33615-78-C-2072, AF PROJ 3066)  
 (AD-A117807; AFWAL-TR-82-2039, EDR-10982) Avail. NTIS HC A04/MF A01 CSCL 21E

LUCID has developed and demonstrated the capability to predict realistic engine usage during the conceptual design phase of a gas turbine design cycle. A method has been developed and demonstrated to include life and usage considerations as well as performance aspects in the process of selecting the optimal engine and aircraft definitions for an advanced military high performance application. This process also defines usage and life data for subsequent design and development efforts on the selected engine. These LUCID techniques allow trade-offs of engine life and performance parameters to be identified. Author (GRA)

**N83-10247#** Air Force Wright Aeronautical Labs, Wright-Patterson AFB, Ohio Flight Dynamics Lab.  
**ANALYSIS OF THE EFFECTS OF EXPLOSIVE FUEL IGNITION ON AN AIRCRAFT NOISE SUPPRESSOR SYSTEM**  
 V. R. MILLER, E. R. HOTZ, and D. L. BROWN *In* Shock and Vibration Information Center Shock and Vibration Bull., Pt 2 p 169-176 May 1982 refs  
 Avail. NTIS HC A11/MF A01 CSCL 21E

The results are presented from a test in which the door acceleration and the pressure environment were measured in an aircraft noise suppressor system, following the delayed ignition of the augmentor fuel of a turbofan engine such that an explosion of this fuel occurred. The system was instrumented with hydrophones, as well as accelerometers and a high temperature microphone. The resulting data were used to define the effects of the augmentor fuel explosion pressure on the noise suppressor system and its components. Author

**N83-11041#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div  
**SHOCK WAVE BOUNDARY LAYER INTERACTION IN COMPRESSOR CASCADES**  
 Y. SHEN *In its* J. of Aeron. (FTD-ID(RS)T-0621-82) p 75-84 21 Jul. 1982 refs Transl. into ENGLISH from Acta Aeron. et Astron Sinica (China), v. 3, no. 1, Mar 1982 Document also announced at A82-34643  
 Avail. NTIS HC A08/MF A01 CSCL 21E

Shock wave boundary layer interaction in compressor cascades is discussed. It is shown by calculation and analysis that the main form of the interaction in compressor cascades is the interaction between shock waves and turbulent boundary layer in channels. The analysis made clear that the separation criterion proposed by Pearcey is an empirical criterion obtained from wind tunnel tests of a RAE102 airfoil. The conditions are quite different from the restrained channel flow in compressor cascades with strong adverse pressure gradient. As for compressor cascades, the boundary layer grows rapidly and separates at lower Mach number upstream of the shock wave. The length of separated region and the location of vortex sheet are all different from those in the case of Pearcey's single airfoil. The conclusion was drawn that it is inappropriate to apply Pearcey's separation criterion directly to shock wave boundary layer interaction in compressor cascades. It is proposed that the separation criterion for shock wave boundary layer interaction in compressor cascades be in the form which involves the effects of pressure gradients in front of and behind the shock wave. R.J.F.

**N83-11042#** Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div  
**EXPERIMENTAL STUDY ON DISCHARGE AND LOSS COEFFICIENTS OF COMBUSTOR SWIRLERS**  
 Z. CHUNXIA and W. YULIAN *In its* J. of Aeron. (FTD-ID(RS)T-0621-82) p 85-95 21 Jul. 1982 refs Transl into ENGLISH from Acta Aeron. et Astron. Sinica (China), v. 3, no. 1, Mar. 1982 Document also announced as A82-34644  
 Avail. NTIS HC A08/MF A01 CSCL 21E

Some test results of blade-type swirlers with different stagger angles, numbers of blades, and flow areas in jet engine combustors are presented. A set of discharge characteristics and relations between loss coefficient and swirl number, stagger angle or blade number are provided. In addition, the correlation of loss coefficient to discharge coefficient of blade-type swirlers was established. It is found that the discharge coefficient varies from 0.6 to 0.9 for swirlers with different stagger angles. The selection of swirl number must retain the loss coefficient at an acceptable level (aerodynamically). It can be seen from the test results that the blade loss for a straight blade swirler with stagger angle varying from 68 to 70 degrees. The tests proved that the twisted blade swirler is superior to the straight one from the aerodynamic point of view, but its manufacture is more complicated. R.J.F.

**N83-11050#** Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div  
**DEVELOPMENT OF DOUBLE-ROTOR SUPERCHARGED TURBOJET ENGINES IN THE USSR AS SEEN FROM MODELS R11 TO R29**  
 L. CHUNYI *In its* Intern. Aviation (Selected Articles) (FTD-ID(RS)T-0606-82) p 16-27 15 Jul 1982 Transl into ENGLISH from Guoji Hangkong (China), no. 2, 1982 p 2-10  
 Avail: NTIS HC A03/MF A01 CSCL 21E

The development of double rotor turbojet aircraft engines in the USSR is described. The Soviet philosophy in their development of jet engines is compared with that of the West. L.F.M.

**N83-11052#** Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.  
**THE PROBLEMS OF REFITTING AERO-GAS TURBINE ENGINES FOR MULTIPLE USES**  
 C. GUANG *In its* Intern. Aviation (Selected Articles) (FTD-ID(RS)T-0679-82) p 1-14 15 Jul. 1982 Transl. into ENGLISH from Guoji Hangkong (China), no. 2, Feb 1982 p 25-27, 42-45 and 48  
 Avail. NTIS HC A03/MF A01 CSCL 21E

When aerogas turbine engines (including turbojets, turbofans, turboprops and turboshafts) are changed into gas turbines for use other than in aviation (industry and ships) most of the time the aerogas turbine engine is transformed into a gas generator. Linking the gas generator and power turbine are a diffuser box and air intake device. In order to adapt to the changes of industrial conditions, it is necessary to make relevant modifications of the structural and cyclical parameters in the refit. Many of the present refitting problems concerning the multiple uses of aerogas turbine engines are addressed. Author

**N83-11125\*#** National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.  
**ANALYTICAL AND EXPERIMENTAL INVESTIGATION OF STATOR ENDWALL CONTOURING IN A SMALL AXIAL-FLOW TURBINE. 1: STATOR PERFORMANCE**  
 J. E. HAAS Oct. 1982 26 p refs  
 (NASA-TP-2023, E-1180, NAS 1.60:2023, AVRADCOM-TR-82-C-4) Avail. NTIS HC A03/MF A01 CSCL 21E

Three stator configurations were studied to determine the effect of stator outer endwall contouring on stator performance. One configuration was a cylindrical stator design. One contoured stator configuration had an S-shaped outer endwall, the other had a conical-convergent outer endwall. The experimental investigation consisted of annular surveys of stator exit total pressure and flow angle for each stator configuration over a range of stator pressure.

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ratio Radial variations in stator loss and aftermixed flow conditions were obtained when these data were compared with the analytical results to assess the validity of the analysis, good agreement was found. A.R.H.

**N83-11127\*#** General Electric Co., Cincinnati, Ohio Aircraft Engine Business Group.

**ANALYSIS, DESIGN, FABRICATION AND TESTING OF AN OPTICAL TIP CLEARANCE SENSOR Final Report, Jun. 1979 - Jan. 1981**

G. L. POPPEL, D. T. F. MARPLE, and J. D. KINGSLEY May 1981 84 p refs

(Contract NAS3-21843)

(NASA-CR-165265, NAS 1.26:165265; R81AEG215) Avail:

NTIS HC A05/MF A01 CSCL 21E

Analyses and the design, fabrication, and testing of an optical tip clearance sensor with intended application in aircraft propulsion control systems are reported. The design of a sensor test rig, evaluation of optical sensor components at elevated temperatures, sensor design principles, sensor test results at room temperature, and estimations of sensor accuracy at temperatures of an aircraft engine environment are discussed. Room temperature testing indicated possible measurement accuracies of less than 12.7 microns (0.5 mils). Ways to improve performance at engine operating temperatures are recommended. The potential of this tip clearance sensor is assessed. Author

**N83-11128\*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

**ARMY/NASA SMALL TURBOSHAFT ENGINE DIGITAL CONTROLS RESEARCH PROGRAM**

J. F. SELLERS and A. N. BAEZ (AVRADCOM Research and Technology Labs., Cleveland, Ohio) 1981 16 p refs Prepared for presentation at the Rotary Wing Propulsion System Specialist Meeting, Williamsburg, Va., 16-18 Nov. 1982, sponsored by the Am. Helicopter Soc.

(NASA-TM-82979; E-1408, NAS 1.15:82979;

AVRADCOM-TR-82-C-14, AHSRWP-7) Avail. NTIS HC A02/MF A01 CSCL 21E

The emphasis of a program to conduct digital controls research for small turboshaft engines is on engine test evaluation of advanced control logic using a flexible microprocessor based digital control system designed specifically for research on advanced control logic. Control software is stored in programmable memory. New control algorithms may be stored in a floppy disk and loaded directly into memory. This feature facilitates comparative evaluation of different advanced control modes. The central processor in the digital control is an Intel 8086 16 bit microprocessor. Control software is programmed in assembly language. Software checkout is accomplished prior to engine test by connecting the digital control to a real time hybrid computer simulation of the engine. The engine currently installed in the facility has a hydromechanical control modified to allow electrohydraulic fuel metering and VG actuation by the digital control. Simulation results are presented which show that the modern control reduces the transient rotor speed droop caused by unanticipated load changes such as cyclic pitch or wind gust transients. A.R.H.

**N83-11129\*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

**TECHNOLOGY AND BENEFITS OF AIRCRAFT COUNTER ROTATION PROPELLERS**

W. C. STRACK, G. KNIP, A. L. WEISBRICH (Hamilton Standard, Windsor Locks, Conn.), J. GODSTON (Pratt and Whitney Aircraft, East Hartford, Conn.), and E. BRADLEY (Lockheed-Georgia Co., Marietta, Ga.) 1981 35 p refs

(NASA-TM-82983; E-1414; NAS 1.15:82983) Avail: NTIS HC A03/MF A01 CSCL 01C

Results are reported of a NASA sponsored analytical investigation into the merits of advanced counter rotation propellers for Mach 0.80 commercial transport application. Propeller and gearbox performance, acoustics, vibration characteristics, weight, cost and maintenance requirements for a variety of design

parameters and special features were considered. Fuel savings in the neighborhood of 8 percent relative to single rotation configurations are feasible through swirl recovery and lighter gearboxes. This is the net gain which includes a 5 percent acoustic treatment weight penalty to offset the broader frequency spectrum noise produced by counter rotation blading. Author

**N83-11130\*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

**EXPERIMENTAL PROGRAM FOR THE EVALUATION OF TURBOFAN/TURBOSHAFT C CONVERSION TECHNOLOGY**

J. G. MCARDLE and L. M. WENZEL 1981 25 p refs Prepared for presentation at the Rotary Wing Propulsion System Specialist Meeting, Williamsburg, Va., 16-18 Nov. 1982, sponsored by Am. Helicopter Soc.

(NASA-TM-82988; E-1420; NAS 1.15:82988; AHS-RWP-19)

Avail. NTIS HC A02/MF A01 CSCL 21E

A TF34 turbofan engine is being modified to produce shaft power from an output coupling on the fan disk when variable inlet guide vanes are closed to reduce fan airflow. The engine, called a convertible engine, could be used on advanced rotorcraft such as X-wing, ABC (Advanced Blade Concept), and Folding Tilt Rotor, and on V/STOL craft in which two engines are cross-coupled. The engine will be tested on an outdoor static test stand at NASA Lewis Research Center. Steady-state tests will be made to measure performance in turbofan, turboshaft, and combined power output modes. Transient tests will be made to determine the response to the engine and a new digital engine control system for several types of rapid changes in thrust and shaft loads. The paper describes the engine modifications, the test facility equipment, proposed testing techniques for several types of tests, and typical test results predicted from engine performance computer programs. Author

**N83-11132#** Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

**AN AERODYNAMIC DESIGN METHOD FOR TRANSONIC AXIAL FLOW COMPRESSOR STAGE**

F. Y. ZHU and X. H. ZHOU 21 Jul 1982 21 p refs Transl. into ENGLISH of attachment to IR-1572-0093-79 (China), 1979 p 37-49

(AD-A118278, FTD-ID(RS)T-0348-82) Avail. NTIS HC A02/MF A01 CSCL 20D

A three dimensional aerodynamic design method for transonic axial flow compressor stage is described. The method is comprised of three main parts: the mean streamsurface calculation, the approximate calculation of streamsurface of revolution, and defining the blade element on the conical surface and stocking the blade airfoil sections. The method is unusual in that the calculation stations for making the streamsurface calculations are curves and particularly in that the airfoil parameters of blade are calculated on a plane tangent to the streamsurface of revolution. On the tangential plane, two dimensional flow is used as a basis model to calculate the Mach wave system on the suction surface of cascade entrance region. Author

**N83-11134#** Rolls-Royce Ltd., Derby (England). Div of Operations.

**TRIED AND PROVEN ENGINE TECHNOLOGY: A VITAL KEY TO IMPROVING AIRLINE ECONOMICS**

D. A. HEAD 1982 11 p

(PNR-90112) Avail: NTIS HC A02/MF A01

It is argued that engine related cost reduction in airline operation will come from the perfecting of current technologies. Drastic changes in engine design, comparable to the introduction of big fan engines in the 1960's, are ruled out. Trends towards increased automation of production, and multinational product development are noted. The need for better management in order to gain maximum benefit from technological advances is stressed.

Author (ESA)

**N83-11135#** Rolls-Royce Ltd., Derby (England). Product Support Div.

**ASPECTS OF THE RELIABILITY AND MAINTENANCE OF TURBOPROPS AND LARGE TURBOFAN ENGINES**

J. J. DONNELLY and K. GODDARD Nov. 1981 10 p Conf. held at Belgrade, Sponsored by Belgrade Univ. Faculty of Transport and Traffic Engineering

(PNR-90113) Avail: NTIS HC A02/MF A01

Design features which lead to high reliability in aero gas turbines, and techniques used to monitor reliability and improve maintainability are discussed. The RB 211 and Dart engines are considered. Dart features include single lever engine control, self contained oil system, readily removable combustion chambers, and a narrow annular intake shielded by the propeller to minimize foreign object ingestion. The RB 211 modular design facilitates maintenance by allowing on-wing functional testing of replaced modules. Condition monitoring and a reliability management plan reduce disruption caused by having to remove engines for maintenance. Author (ESA)

**N83-11136#** Rolls-Royce Ltd., Derby (England)

**THE FUEL EFFICIENT JET ENGINE**

D. J. PARFITT 1982 14 p

(PNR-90114) Avail: NTIS HC A02/MF A01

The development of the RB 211 engine modules is described and the ways in which the RB 211 overcomes problems which reduce fuel efficiency are outlined. Low fuel consumption is achieved by keeping installation losses (intake cowling drag, air and power offtakes) low. High component efficiency, with duct losses and leakages from the core engine minimized is sought. The conflict between the high bypass ratio with low maximum cycle temperature for low jet velocity, and high pressure ratio with high maximum cycle temperature for high thermodynamic cycle efficiency, is resolved by running the engine to the highest temperature consistent with achieving an acceptable high pressure turbine blade life. Author (ESA)

**N83-11138#** Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).

**FLUID DYNAMICS PANEL SYMPOSIUM ON AERODYNAMICS OF POWER PLANT INSTALLATION Technical Evaluation Report**

W. P. HENDERSON Jun. 1982 15 p Symp. held at Toulouse, 11-14 May 1981 Prepared in cooperation with NASA. Lewis Research Center

(AGARD-AR-173; ISBN-92-835-1436-2, AD-A119357) Avail: NTIS HC A02/MF A01

Powerplant installations involve complex flows, strongly influenced by viscous effects and often with important aerodynamic interactions between the airframe and propulsion system. The introduction of vehicle propulsion concepts, and points of emphasis in aircraft and missile design requirements, provide an expanding range of aerodynamic problems which call for both experimental and theoretical study. Aerodynamic problems in powerplant installation are surveyed and work which has improved basic understanding or has enhanced prediction and design methods in this field is reviewed. Powerplant installation effects for both combat and transport aircraft are emphasized. S.L.

**AIRCRAFT STABILITY AND CONTROL**

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

**A83-10250**

**MINIMUM-TIME 180 DEG TURNS OF AIRCRAFT**

K. H. WELL and E. BERGER (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Wessling, West Germany) Journal of Optimization Theory and Applications, vol 38, Sept 1982, p. 83-96 refs

Computations are made of three-dimensional minimum-time 180-deg turns of a fighter aircraft for several initial velocities and altitudes. Equations of motion similar to those used by Humphreys et al (1972) and Miele (1962) are used, but the thrust component perpendicular to the flight path is not neglected. In addition, results are generated from a greater variety of initial velocities. This fact produces the main result, which states that there exists a maneuver sequence from split-S to half-loop maneuvers, provided that the initial velocities vary from small to high subsonic speeds (the sequence being independent of the altitude). A highly accurate algorithm is used to solve the two-point boundary value problem, which, it is noted, is the multiple-shooting algorithm described by Stoer and Bulirsch (1973) and Deufhard (1975). The results obtained are independent of the aircraft model. C.R.

**A83-10439#**

**ATTEMPT TO DETERMINE THE POWER DEMAND OF A HELICOPTER CONTROL SYSTEM ON THE BASIS OF FLIGHT TESTS [PROBA OKRESLENIA OBIAZEN UKLADU STEROWANIA SMIGLOWCA W SWIETLE BADAN W LOCIE]**

B. CIAS, J. KRECISZ, and J. MORAWSKI Instytut Lotnictwa, Prace, no. 87, 1981, p. 3-18. In Polish refs

The objective of the present study was to determine the power produced by the control servos of a helicopter under real flight conditions. A statistical analysis of flight test results showed that the nominal power of the servos actually utilized is relatively low. This may be associated with a low value of the servo synchronism coefficient, due probably to the sequential manner in which particular control channels are operated, typical for manual control. B.J.

**A83-10577#**

**VTOL AIRCRAFT STABILITY [CU PRIVIRE LA STUDIUL STABILITATII AVIOANELOR CU DECOLARE SI ATERIZARE VERTICALA]**

M. M. NITA (Bucuresti, Institutul Politehnic, Bucharest, Rumania) Studii si Cercetari de Mecanica Aplicata, vol 40, Nov-Dec. 1981, p. 801-810. In Rumanian. refs

Flight stability at a fixed point for VTOL aircraft is analyzed using the general equation of motion. The aircraft is considered a variable mass system through simultaneous ingestion and ejection of particles (liquid, air, gases). In the linear equations for the turbulent motion, the specific terms for the variable mass systems are found, noting their dependence on the parameters defining the propulsion/hovering system and the positioning of the intake/exhaust sections. N.D.

**A83-11148#**

**DESIGN AND APPLICATION OF A MULTIVARIABLE, DIGITAL CONTROLLER TO THE A-7D DIGITAC II AIRCRAFT MODEL**

D. S. PORTER (USAF, Directorate of Avionics, Wright-Patterson AFB, OH) and J. J. DAZZO (U.S. Air Force Institute of Technology, Wright-Patterson AFB, OH) In: NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 576-583 refs

This paper investigates a singular perturbation method in the design of a digital multivariable, error-actuated digital tracking controller for the Mach 0.18 flight condition of the A-7D Digitac II

aircraft. The study uses a computer-aided design package to accomplish the control law design and simulation. The six degree-of-freedom aircraft model contains separately actuated left and right horizontal stabilator control surfaces. Thus, the equations of motion cannot be decoupled for the design of the control laws. The design process used to obtain a tracker control law is presented. The paper includes a brief discussion of the robustness of the control law when it is used for the same aircraft at various flight conditions. The effect on aircraft stability is also discussed in the event of the failure of the right horizontal stabilator. It is concluded that digital tracker control laws can be designed for this aircraft model. Additional modification of the control law is required to improve the robustness and reconfiguration requirements. Also, a more accurate aircraft model should be developed to provide further analysis (Author)

**A83-11156\*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.  
**ECONOMIC MODELING OF FAULT TOLERANT FLIGHT CONTROL SYSTEMS IN COMMERCIAL APPLICATIONS**  
 G B FINELLI (NASA, Langley Research Center, Hampton, VA) In: NAECON 1982, Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 635-642. refs

This paper describes the current development of a comprehensive model which will supply the assessment and analysis capability to investigate the economic viability of Fault Tolerant Flight Control Systems (FTFCS) for commercial aircraft of the 1990's and beyond. An introduction to the unique attributes of fault tolerance and how they will influence aircraft operations and consequent airline costs and benefits is presented. Specific modeling issues and elements necessary for accurate assessment of all costs affected by ownership and operation of FTFCS are delineated. Trade-off factors are presented, aimed at exposing economically optimal realizations of system implementations, resource allocation, and operating policies. A trade-off example is furnished to graphically display some of the analysis capabilities of the comprehensive simulation model now being developed. (Author)

**A83-11175**  
**INTEGRATED AIRFRAME/PROPULSION CONTROLS TECHNOLOGY**

N. K GUPTA and R. H. TRAVASSOS (Integrated Systems, Inc., Palo Alto, CA) In: NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 780-791. refs

Integrated aircraft control technologies and issues are examined and potential approaches to integrated airframe/propulsion control development are reviewed. Classical control architecture and the manner in which it meets aircraft control requirements are shown. Aircraft control requirements and emerging technologies which will help meet future mission requirements are discussed. Advanced multivariable control methods such as hierarchical control and frequency-shaping methods which are useful for integrated control computations are described. Integrated control system architectures are addressed, including the Multivariable Control Processor, the Redundant Common Bus Processor, and the Centralized Processor Redundant Actuator/Sensor System. C.D

**A83-11179**  
**DESIGN OF DIRECT DIGITAL ADAPTIVE FLIGHT-MODE CONTROL SYSTEMS FOR HIGH-PERFORMANCE AIRCRAFT**

B. PORTER and A. BRADSHAW (Salford, University, Salford, Lancs., England) In: NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 818-824. refs  
 (Contract F49620-81-C-0026)

The requirement for accurate state-space models of linear multivariable plants which are also assumed to be time-invariant

can be removed by the use of fast-sampling error-actuated digital adaptive controllers. These controllers are simple to implement and provide excellent non-interacting tracking behavior throughout a wide flight envelope. Their use is illustrated by designing fast-sampling error-actuated digital adaptive controllers and associated transducers which effect the fuselage pitch pointing and vertical translation maneuvers in the case of the F-16 aircraft. (Author)

**A83-11208**  
**DYNAMIC CHARACTERISTICS OF AN INTEGRATED FLIGHT AND FIRE CONTROL SYSTEM**

R P QUINLIVAN (General Electric Co., Fairfield, CT) In: NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 3. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 1038-1043.

A coupled flight/fire control system (similar to the system developed in the Firefly II study program and carried into flight test on the 1FFC-1 and Firefly III programs) is considered in regard to its dynamic response to target maneuver, tracker noise, and pilot inputs. The impact on system dynamics of a poor assumption in the formulation of the target state estimator (TSE) is examined, and emphasis is placed on an examination of pitch axis dynamics. It is shown that a properly formulated TSE does not couple with the control system dynamics, and that target maneuver is effective in generating system error at long range due primarily to TSE bandwidth, not control system bandwidth. Control response from pilot inputs is shown to be sufficiently favorable for effective pilot modulation of control error should that be desirable. B.J.

**A83-11209**  
**APPLICATION OF MODEL REFERENCE ADAPTIVE CONTROL TO A RELAXED STATIC STABILITY TRANSPORT AIRCRAFT**

K SOBEL and E. Y SHAPIRO (Lockheed-California Co., Burbank, CA) In: NAECON 1982, Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 3. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 1044-1051. refs

A direct model reference adaptive control algorithm is applied to a relaxed static stability transport aircraft. Simple models are used by reason of the complexity involved in satisfying the sufficient conditions for stability. Simulation results indicate that the algorithm could be tuned to provide excellent pitch rate model following in response to a pilot command. B.J.

**A83-11210**  
**THE USE OF MODAL CONTROL TO MINIMIZE ERRORS IN THE ANALYTICAL RECONSTRUCTION OF FLIGHT CONTROL SENSOR SIGNALS**

R. H ROONEY and E. Y. SHAPIRO (Lockheed-California Co., Burbank, CA) In: NAECON 1982, Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 3. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 1052-1057. refs

Realistic applications of observers have an attendant mismatch of initial conditions on the aircraft and the observer; this mismatch occasionally leads to unacceptable transient behavior and should be eliminated. This paper examines the mechanism as to how the initial condition mismatch affects the aircraft-observer-controller transient response and presents new design procedures for observers. Recent advances in assigning the eigenstructure of a closed-loop system are described, and are applied to placing the eigenvectors of observers in a prescribed manner. Software simulations comparing 'standard' observer results with 'modalized' observer results are presented. The eigenvalue/eigenvector assignment methods are shown to be very useful in designing observers whose performance is superior to that of observers designed by certain 'classical' methods. B.J.

A83-11254

**ADVANCED AUTOMATIC TERRAIN FOLLOWING/TERRAIN AVOIDANCE CONTROL CONCEPTS STUDY**

M. J. WENDL, D. R. KATT (McDonnell Aircraft Co., St. Louis, MO), and C. D. YOUNG, JR. (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) In NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982 Volume 3 New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p 1366-1372.

Algorithms applicable to automatic terrain following/terrain avoidance (TF/TA) control are developed in order to allow operation at low altitudes. The sensitivity of these algorithms to parametric variations was analyzed, and interface requirements were established. Particular attention was given to the computation of three-dimensional TF/TA trajectories based on: (1) optimum aircraft performance, (2) navigation along a preselected penetration path within a threat environment, and (3) blending stored and measured terrain/obstacle data. A feasible directions algorithm is used to solve the TF/TA problem, which can be applied to tactical and strategic aircraft. Studies show that this method may significantly improve aircraft operation. R.K.R

A83-11808

**A-10 STALL/POST-STALL TESTING - A STATUS UPDATE**

J. M. HOFFMAN (USAF, Flight Test Center, Edwards AFB, CA) (Society of Experimental Test Pilots', Mini-Symposium, 12th, San Diego, CA, Apr 2, 3, 1982.) Cockpit, vol 17, July-Sept. 1982, p. 5-16. refs

An assessment is made of the test methods used and performance results gathered in the course of high angle of attack stall/spin and recovery tests of the A-10 aircraft. Testing extended to both the prototype single-seat YA-10, the production A-10A, and the two-seat YA-10B. The stall/post-stall characteristics of the A-10A were judged excellent for the design mission of close air support under conditions of poor visibility and low ceilings, exhibiting good resistance to departure and extreme resistance to spins. Testing of the two-seat YA-10B gave attention to handling qualities, flutter, loads and engine/airframe compatibility, in order to demonstrate the degree of similarity with the single-seat A-10A's operating envelope and flight characteristics. The same resistance to departure and spin was noted for the YA-10B. O.C

A83-11809

**F-18 HORNET HIGH ANGLE OF ATTACK /AOA/ PROGRAM**

D. D. BEHM (McDonnell Aircraft Co., St. Louis, MO) (Society of Experimental Test Pilots, Mini-Symposium, 12th, San Diego, CA, Apr. 2, 3, 1982) Cockpit, vol 17, July-Sept 1982, p 17-29.

The F-18's combination of advanced aerodynamics, derived from the YF-17, and control scheduling and recovery logic from the F-15, provide the basis for the development of its high angle of attack (AOA) handling qualities. The high AOA program spanned 325 hours over 200 flights, and investigated over 2400 test points involving stalls or attempts at departure. Attention was given to stores configurations, stalls at maximum AOAs of 25 deg, departures which were mostly characterized by an inertial and kinematic coupling phenomenon. Spins, spin recoveries, post-stall phenomena, asymmetric loadings, engine effects, and the development of the recovery mode control logic are noted. Modifications undertaken as a consequence of test program results include the adjustment of leading and trailing edge flap schedules to optimize stability and control above 20 deg AOA. O.C

A83-12458\*# Purdue Univ., Lafayette, Ind.

**QUADRATIC SYNTHESIS OF INTEGRATED ACTIVE CONTROLS FOR AN AEROELASTIC FORWARD-SWEPT-WING-AIRCRAFT**

M. G. GILBERT, D. K. SCHMIDT, and T. A. WEISSHAAR (Purdue University, West Lafayette, IN) In: Guidance and Control Conference, San Diego, CA, August 9-11, 1982, Collection of Technical Papers Conference sponsored by the American Institute of Aeronautics and Astronautics New York, American Institute of Aeronautics and Astronautics, 1982, p. 675-684. refs (Contract NAG1-157)

State variable representations of flexible aircraft are obtained using a modeling approach which first defines a mean-reference axis coordinate system. The active system design approach for forward-swept-wing aircraft also expresses structural deformations of the wing in terms of free normal vibration modes relative to this mean reference axis. Calculations which assume quasi-steady incompressible aerodynamics are performed to obtain generalized force expressions for flight conditions. The use of this quadratic synthesis technique shows that increased performance and redundancy over decentralized approaches can be achieved using integrated active longitudinal stability augmentation and aeroelastic stabilization. R.K.R

**N83-10047\*# Systems Technology, Inc., Mountain View, Calif AN ANALYSIS OF AIRLINE LANDING FLARE DATA BASED ON FLIGHT AND TRAINING SIMULATOR MEASUREMENTS Final Report**

R. K. HEFFLEY, T. M. SCHULMAN, and T. M. CLEMENT Aug 1982 117 p refs Revised (Contract NAS1-10817)

(NASA-CR-166404, NAS 1.26.166404; STI-TR-1172-1R-REV)

Avail: NTIS HC A06/MF A01 CSCL 01C

Landings by experienced airline pilots transitioning to the DC-10, performed in flight and on a simulator, were analyzed and compared using a pilot-in-the-loop model of the landing maneuver. By solving for the effective feedback gains and pilot compensation which described landing technique, it was possible to discern fundamental differences in pilot behavior between the actual aircraft and the simulator. These differences were then used to infer simulator fidelity in terms of specific deficiencies and to quantify the effectiveness of training on the simulator as compared to training in flight. While training on the simulator, pilots exhibited larger effective lag in commanding the flare. The inability to compensate adequately for this lag was associated with hard or inconsistent landings. To some degree this deficiency was carried into flight, thus resulting in a slightly different and inferior landing technique than exhibited by pilots trained exclusively on the actual aircraft. Author

N83-10048\*# National Aeronautics and Space Administration Ames Research Center, Moffett Field, Calif.

**AN INTEGRATED USER-ORIENTED LABORATORY FOR VERIFICATION OF DIGITAL FLIGHT CONTROL SYSTEMS: FEATURES AND CAPABILITIES**

P. DEFEO, D. DOANE, and J. SAITO Aug. 1982 60 p refs (NASA-TM-84276, A-9011; NAS 115:84276) Avail: NTIS HC A04/MF A01 CSCL 01C

A Digital Flight Control Systems Verification Laboratory (DFCSVL) has been established at NASA Ames Research Center. This report describes the major elements of the laboratory, the research activities that can be supported in the area of verification and validation of digital flight control systems (DFCS), and the operating scenarios within which these activities can be carried out. The DFCSVL consists of a palletized dual-dual flight-control system linked to a dedicated PDP-11/60 processor. Major software support programs are hosted in a remotely located UNIVAC 1100 accessible from the PDP-11/60 through a modem link. Important features of the DFCSVL include extensive hardware and software fault insertion capabilities, a real-time closed loop environment to exercise the DFCS, an integrated set of software verification tools, and a user-oriented interface to all the resources and capabilities. Author

## 08 AIRCRAFT STABILITY AND CONTROL

**N83-10049\*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif  
**A PILOTTED SIMULATOR INVESTIGATION OF STABILITY AND CONTROL, DISPLAY AND CREW-LOADING REQUIREMENTS FOR HELICOPTER INSTRUMENT APPROACH. PART 1: TECHNICAL DISCUSSION AND RESULTS**  
J. V. LEBACQZ, R. D. FORREST (FAA, Moffett Field, Calif.), and R. M. GERDES Sep. 1982 84 p refs  
(NASA-TM-84258-PT-1; A-9056-PT-1, NAS 1 15 84258-PT-1)  
Avail: NTIS HC A05/MF A01 CSCL 01C

A ground-simulation experiment was conducted to investigate the influence and interaction of flight-control system, flight-director display, and crew-loading situation on helicopter flying qualities during terminal area operations in instrument conditions. The experiment was conducted on the Flight Simulator for Advanced Aircraft at Ames Research Center. Six levels of control complexity, ranging from angular rate damping to velocity augmented longitudinal and vertical axes, were implemented on a representative helicopter model. The six levels of augmentation were examined with display variations consisting of raw elevation and azimuth data only, and of raw data plus one-, two-, and three-cue flight directors. Crew-loading situations simulated for the control-display combinations were dual-pilot operation (representative auxiliary tasks of navigation, communications, and decision-making). Four pilots performed a total of 150 evaluations of combinations of these parameters for a representative microwave landing system (MLS) approach task. Author

**N83-10050\*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif  
**A PILOTTED SIMULATOR INVESTIGATION OF STABILITY AND CONTROL, DISPLAY AND CREW-LOADING REQUIREMENTS FOR HELICOPTER INSTRUMENT APPROACH. PART 2: SUPPORTING DATA**  
J. V. LEBACQZ, R. D. FORREST (FAA, Moffett Field, Calif.), and R. M. GERDES Sep 1982 120 p  
(NASA-TM-84258-PT-2; A-9056-PT-2; NAS 1 15 84258-PT-2)  
Avail: NTIS HC A06/MF A01 CSCL 01C

Pilot rating comments and standard deviation measures of flight performance and control use are presented. N.W.

**N83-10051\*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif  
**A MATHEMATICAL MODEL OF A SINGLE MAIN ROTOR HELICOPTER FOR PILOTTED SIMULATION**  
P. D. TALBOT, B. E. TINLING, W. A. DECKER, and R. T. N. CHEN Sep. 1982 52 p refs  
(NASA-TM-84281; A-9033, NAS 1.15:84281) Avail: NTIS HC A04/MF A01 CSCL 01C

A mathematical model, suitable for piloted simulation of the flying qualities of helicopters, is a nonlinear, total force and moment model of a single main rotor helicopter. The model has ten degrees of freedom: six rigid body, three rotor flapping, and the rotor rotational degrees of freedom. The rotor model assumes rigid blades with rotor forces and moments radially integrated and summed about the azimuth. The fuselage aerodynamic model uses a detailed representation over a nominal angle of attack and sideslip range of + or - 15 deg., as well as a simplified curve fit at large angles of attack or sideslip. Stabilizing surface aerodynamics are modeled with a lift curve slope between stall limits and a general curve fit for large angles of attack. A generalized stability and control augmentation system is described. Additional computer subroutines provide options for a simplified engine/governor model, atmospheric turbulence, and a linearized six degree of freedom dynamic model for stability and control analysis. Author

**N83-10052#** Royal Aircraft Establishment, Farnborough (England)  
**SOME MEASUREMENTS OF WING BUFFETING ON A FLUTTER MODEL OF A TYPICAL STRIKE AIRCRAFT**  
D. G. MABEY and B. E. CRIPPS Jan 1982 43 p refs  
(RAE-TR-82007; RAE-STRUCT-BF/B/0893; BR83884) Avail: NTIS HC A03/MF A01

Wing buffeting of an aeroelastic scale model was measured in the Mach number range 0.45 to 0.94 at Reynolds numbers from 600,000 to 1.7 million. Model suitability was examined. Wing rock started close to the maximum limit of buffet penetration achieved in flight. Significant variations were noted in aerodynamic damping with flow separations for both the low frequency roll mode and the higher frequency first wing bending mode. For the roll mode, these variations can be predicted by quasi-steady strip theory, but not for the fundamental bending mode. The tests indicate limitations of buffeting measurements on wind tunnel models, particularly for half models. Author (ESA)

**N83-10053#** Technische Hogeschool, Delft (Netherlands). Dept. of Aerospace Engineering.  
**DIGITAL CALCULATION OF THE PROPAGATION IN TIME OF THE AIRCRAFT GUST RESPONSE COVARIANCE MATRIX**  
H. L. JONKERS, F. K. KAPPETIJN, and J. C. VANDERVAART Sep 1981 99 p refs  
(VTH-LR-266) Avail: NTIS HC A05/MF A01

By basic principles of modern system theory, variances, or rms values of aircraft variables are calculated in the case where system dynamics and statistical properties of the disturbing signals, e.g., atmospheric turbulence, are a function of time. Properties of transient and steady state covariance response are summarized while the required format of aircraft and turbulence filter equations is given. Results are shown for numerical example of the symmetric motions of a jet transport in a coupled approach, followed by an automatic landing, the airplane being perturbed by Gaussian atmospheric turbulence. An example is also treated of transient variance response in which the variance overshoots the steady state value. The possible effects of the choice of initial conditions on the results of a stepwise covariance propagation calculation are elaborated. Author (ESA)

**N83-10054#** Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).  
**CRITERIA FOR HANDLING QUALITIES OF MILITARY AIRCRAFT**  
Jun 1982 317 p refs Symp. held in Fort Worth, Colo., 19-22 Apr. 1982  
(AGARD-CP-333, ISBN-92-835-0313-8) Avail: NTIS HC A14/MF A01

The status of flying qualities criteria for CTOL, V/STOL, and VTOL aircraft is reviewed and current and advanced flight control design techniques and handling quality requirements are examined with attention given to specifications for military aircraft.

**N83-10055#** Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio. Flight Dynamics Lab.  
**PRESENT STATUS OF FLYING QUALITIES CRITERIA FOR CONVENTIONAL AIRCRAFT**  
D. J. MOORHOUSE and R. J. WOODCOCK In AGARD Criteria for Handling Qualities of Mil Aircraft 14 p Jun. 1982 refs  
Avail: NTIS HC A14/MF A01

The development of the U.S. military flying qualities specification up to MIL-F-8785B, issued in 1969 is reviewed and significant criteria proposed in the late 1960s and 70s many are discussed. The equivalent system approach was chosen for MIL-F-8785C and is discussed at length. Future requirements and developments in flying qualities criteria are examined. A.R.H.

**N83-10056#** Naval Air Development Center, Warminster, Pa. Aircraft and Crew Systems Technology Directorate.

**STATUS OF VTOL AND VSTOL FLYING QUALITIES CRITERIA DEVELOPMENT: WHERE ARE WE AND WHERE ARE WE GOING?**

J. W. CLARK, JR and K. W. GOLDSTEIN *In* AGARD Criteria for Handling Qualities of Mil. Aircraft 18 p Jun 1982 refs  
Avail: NTIS HC A14/MF A01 CSCL 01C

Over the past decade, a number of weaknesses and omissions were uncovered in the VSTOL and Helicopter Flying Qualities Specifications (MIL-F-83300 and MIL-H-8501A). Identification of these weaknesses spawned technology development in a number of areas. Both interim and final results in some of these areas, the status of existing data bases, and the future criteria development needs as perceived by the US Navy are presented. Specific areas addressed include (1) information display and IMC (Instrument Meteorological Conditions) flight requirements, (2) criteria definition for highly augmented, multi-mode control schemes; (3) requirements unique to the small seaborne platform operational environment; and (4) requirements unique to varied rotor configurations. Both fixed-wing and rotary-wing criteria are considered. A.R.H.

**N83-10057#** McDonnell Aircraft Co., St. Louis, Mo.  
**EQUIVALENT SYSTEMS CRITERIA FOR HANDLING QUALITIES OF MILITARY AIRCRAFT**

J. HODGKINSON *In* AGARD Criteria for Handling Qualities of Mil Aircraft 11 p Jun. 1982 refs  
Avail: NTIS HC A14/MF A01 CSCL 01C

Low order equivalent systems appear viable for mapping high order augmented systems into a lower dimensional form suitable for specifying flying qualities. Degrees of allowable mismatch between high and low order systems are defined in tentative new criteria. Alternative specification methods, such as the Neal-Smith method and the bandwidth method, are fundamentally similar to equivalent systems. Because the alternative methods involve mapping, they too exhibit mismatch. Author

**N83-10058#** British Aerospace Public Ltd Co., Preston (England).

**PILOTTED HANDLING QUALITIES DESIGN CRITERIA FOR HIGH ORDER FLIGHT CONTROL SYSTEMS**

J. C. GIBSON *In* AGARD Criteria for Handling Qualities of Mil. Aircraft 15 p Jun. 1982 refs  
Avail: NTIS HC A14/MF A01

Several aircraft brought into service with 1970's utilize full authority fly-by-wire control systems. Such systems have not always reached their full potential to provide handling qualities superior to much simpler aircraft of the past. Sluggish response and pilot induced oscillations (PIO) in both pitch and roll axes typify the experience with a high proportion of FBW aircraft. The basic response characteristics of 'low order' aircraft (aircraft with insignificant control system dynamics) are reviewed and satisfactory ranges derived from in-flight experiments are presented. It is shown how 'high order' aircraft responses can be directly and simply related to "low order" requirements as expressed in MIL-F-8785. Several criteria are presented which permit adjustment of handling qualities for some specific tasks, including one assuring satisfactory control at touchdown. A.R.H.

**N83-10059#** Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany). Aircraft Div.  
**GAIN AND PHASE MARGIN AS A BASIS OF LONGITUDINAL FLYING QUALITIES EVALUATION**

W. ROEGER and H. BEH *In* AGARD Criteria for Handling Qualities of Mil Aircraft 11 p Jun 1982 refs  
Avail: NTIS HC A14/MF A01

A criterion is presented that allows an evaluation of the longitudinal maneuvering characteristics of modern fighter aircraft. The required parameters are the 'gain margin' and the 'phase margin' of the frequency response characteristic of pitch attitude to control force. This criterion permits an evaluation of the dynamic characteristics as well as the steady-state and assumes that the

pilot is always looking for a compromise between stability and response time. The criterion enables the estimation of PIO-tendencies, gives a survey about the influence of different parameters like time delay, lead time, natural frequency, damping ratio and the ratio of control force per normal load factor. The design of an advanced flight control system as an example illustrates the conformity of this criterion with MIL-F-8785.

Author

**N83-10060#** Avions Marcel Dassault-Breguet Aviation, Saint-Cloud (France) Dept. Dynamique du Vol.

**FLY BY WIRE CONTROL: TOWARDS NEW NORMS FOR JUDGING FLIGHT QUALITIES. AN EXAMPLE: THE MIRAGE 2000 [LES COMMANDES DE VOL ELECTRIQUES: VERS DE NOUVELLES NORMES DE JUGEMENT DES QUALITES DE VOL. UN EXEMPLE: LE MIRAGE 2000]**

P. L. MATHE *In* AGARD Criteria for Handling Qualities of Mil Aircraft 6 p Jun 1982 *In* FRENCH  
Avail: NTIS HC A14/MF A01

Two fundamental objectives were met by selecting a strictly electric control system for the Mirage 2000 aircraft. The aircraft was made capable of flying in notably natural longitudinal instability conditions, and a significant step was taken in improving piloting qualities as compared with classical control methods. The direct and indirect advantages of suppressing the constraint of longitudinal stability in optimizing aerodynamics and in improving operational efficiency are examined. Transl. by A.R.H.

**N83-10061#** National Aerospace Lab., Amsterdam (Netherlands).

**HANDLING QUALITIES OF TRANSPORTS WITH ADVANCED FLIGHT CONTROL SYSTEMS**

H. A. MOOIJ and M. F. C. VANGOOL *In* AGARD Criteria for Handling Qualities of Mil. Aircraft 15 p Jun. 1982 refs  
Sponsored by Netherlands Agency for Aerospace Programs and Dept. of Civil Aviation  
Avail: NTIS HC A14/MF A01

Adequate handling quality criteria applicable to system design as well as to airworthiness rule-making are required for the introduction of closed loop primary flight control systems when active control technology, particularly the relaxed static stability principle, is applied to future aircraft. Flight simulation and in-flight simulation using mathematical models of aircraft with rate command/attitude-hold primary flight control systems were performed for the approach and landing flight phase in order to generate data for criteria development. Configurations featuring in addition blended direct-lift control were evaluated as well. Based primarily on pilot ratings and commentary, boundaries between "satisfactory" and "acceptable" handling qualities (Cooper-Harper rating 3.5) were established for a number of criterion formats. While several criteria related to aircraft response are discussed for pitch and roll control, pilot-in-the-loop criteria are proposed for high-precision pitch attitude and altitude control tasks especially.

A.R.H.

**N83-10063#** Systems Technology, Inc., Hawthorne, Calif.  
**BANDWIDTH: A CRITERION FOR HIGHLY AUGMENTED AIRPLANES**

R. H. HOH, D. G. MITCHELL, and J. HODGKINSON (McDonnell Aircraft Co., St. Louis) *In* AGARD Criteria for Handling Qualities of Mil. Aircraft 11 p Jun. 1982 refs  
(Contract F33615-78-C-3615; F33615-80-C-3604)  
Avail: NTIS HC A14/MF A01

A criterion to discriminate between desirable, acceptable, and unacceptable handling qualities for highly augmented airplanes is presented. The criterion is based on an old and well accepted idea, namely, that bandwidth is a key measure of the quality of an airplane's handling characteristics in a tight tracking situation. Correlations are made using recent experimental data for pitch attitude control. Possible shortcomings of the criterion are also discussed. Author

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**N83-10064#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany).

### **HANDLING QUALITIES ASPECTS OF CTOL AIRCRAFT WITH ADVANCED FLIGHT CONTROLS**

D. HANKE, K. WILHELM, and H. H. LANGE *In* AGARD Criteria for Handling Qualities of Mil. Aircraft 17 p Jun 1982 refs  
Avail: NTIS HC A14/MF A01

The problems which occur in applying the existing MIL-F-8785C short period frequency requirements to DLC enhanced aircraft in flight path control situations are described. It is indicated that the MIL-Spec. boundaries are only pitch related and not applicable to path control problems. A new generalized flight path control criterion is processed which considers the multiloop landing approach situation characterized by the pitch inner loop and the altitude outer loop. The criterion philosophy is based on the frequency separation of the two control loops necessary for good handling characteristics. The flight path to pitch attitude phase at the frequency of pilot closed inner loop was selected as criterion parameter in representing the pitch/heave harmony or loop separation. This phase criterion is suitable for conventional or DLC enhanced aircraft. It is shown that by using a rate command/attitude hold system to augment pitch inner loop the pilot exhibits discrete control behavior and open loop type control techniques RC/AH systems lead to very low pilot activity and, combined with DLC, flight path control is improved. E A K

**N83-10065#** Army Research and Technology Labs, Moffett Field, Calif. Aeromechanics Lab.

### **THE STATUS OF MILITARY HELICOPTER HANDLING QUALITIES CRITERIA**

D. L. KEY *In* AGARD Criteria for Handling Qualities of Mil Aircraft 9 p Jun 1982 refs  
Avail: NTIS HC A14/MF A01

Current helicopter specifications were assessed. It is indicated that MIL-F-83300 has clear advantages in its broad coverage of important handling qualities aspects and its systematic structure. Its disadvantages are that it is primarily based on V/STOL data, and explicit helicopter characteristics are only lightly covered. The deficiencies resulted in a major effort to develop a new specification containing mission oriented handling qualities requirements. A revised specification for adoption as MIL-H-8501B is planned. E.A.K.

**N83-10066#** Giravions Dorand Co., Suresnes (France)

### **THE IMPACT OF ACTIVE CONTROL ON HELICOPTER HANDLING QUALITIES**

M. KRETZ *In* AGARD Criteria for Handling Qualities of Mil Aircraft 10 p Jun. 1982 refs *In* FRENCH and in ENGLISH  
Avail: NTIS HC A14/MF A01

Changes have occurred in the concepts of controlling the working conditions of helicopter rotors. New trends, prompted by the techniques of active control applied to fixed wings, are oriented towards the automatic control of dynamic phenomena (vibration, instability) and aerodynamic phenomena (stall effects, interaction, gusting). The new trends feature frequency responses much wider than those of conventional autopilots, extending up to 30 Hz. Military helicopter design is much more demanding with regard to handling qualities: higher disk loading, NOE mission requirement, advent of advanced rotor aircraft concepts and a general broadening of the flight envelope. The impact of active control on handling qualities and its benefits in their implementation are analyzed. It is concluded that present day control system limitations due to the use of monocyclic swashplate principles will have to be removed in the future by unconventional control systems based on multiloop self adaptive control resulting in higher order optimization of handling qualities. E.A.K.

**N83-10067#** Army Air Corps, Stockbridge (England)

### **OPERATIONAL CRITERIA FOR THE HANDLING QUALITIES OF COMBAT HELICOPTERS**

W. STEWARD *In* AGARD Criteria for Handling Qualities of Mil Aircraft 5 p Jun 1982 refs  
Avail: NTIS HC A14/MF A01

To minimize the threat from air and ground based weapon systems, combat helicopter operations require the use of concealed low level flight. The tasks facing the combat helicopter pilot during a typical antiarmor mission are discussed. Primary consideration is given to daylight operations in VMC, but the requirements for missions at night and in adverse weather, and for training are also addressed, together with the implications for handling qualities posed by the threat of armed helicopters in the air to air role. It is concluded that, by reducing the flying workload, assisting in the exploitation of maximum aircraft performance, and enhancing control accuracy, better handling qualities can contribute to improved operational effectiveness. E.A.K.

**N83-10068#** National Aeronautical Establishment, Ottawa (Ontario). Flight Research Lab

### **FLIGHT EXPERIMENTS WITH INTEGRATED ISOMETRIC SIDE-ARM CONTROLLERS IN A VARIABLE STABILITY HELICOPTER**

M. SINCLAIR *In* AGARD Criteria for Handling Qualities of Mil Aircraft 9 p Jun. 1982 refs  
Avail: NTIS HC A14/MF A01

The suitability of integrated, multiaxis, isometric controllers for use in helicopters were investigated. The 3 axis and 4 axis isometric side arm control configurations were flown successfully through a wide variety of demanding visual flight tasks and a brief instrument flight precision approach evaluation. The experimental tasks, the evaluated controller arrangements and the developed control laws are described, and the results of comparative assessments between isometric side arm control and conventional control arrangements are presented. E.A.K.

**N83-10069#** Messerschmitt-Boelkow-Blöhm G.m.b.H., Munich (West Germany)

### **STABILITY AND CONTROL FOR HIGH ANGLE OF ATTACK MANEUVERING**

W. KRAUS, H. PRZIBILLA, and U. HAUX *In* AGARD Criteria for Handling Qualities of Mil Aircraft 11 p Jun. 1982 refs  
Avail: NTIS HC A14/MF A01

The possibilities of maneuvering a fighter aircraft at and beyond maximum lift were examined. On a delta canard configuration an optimum division of control devices for maximum control power at high angle of attack is shown and a special trim schedule gives best directional and lateral stability in this flight regime. The aircraft configuration was used for an air to air combat simulation. The control system layout at high incidence included thrust vectoring in pitch and yaw to support the aerodynamic control surfaces. Simulation results in terms of rates and accelerations in pitch, roll and yaw axis for a set of different poststall maneuvers shown that the aircraft is controllable and that active tactical maneuvers can be flown in this flight region. E.A.K.

**N83-10070#** British Aerospace Public Ltd Co, Preston (England).

### **EXPERIENCE OF NON-LINEAR HIGH INCIDENCE AERODYNAMIC CHARACTERISTICS**

D. BOOKER and K. MCKAY *In* AGARD Criteria for Handling Qualities of Mil Aircraft 5 p Jun. 1982 refs  
Avail: NTIS HC A14/MF A01

The impact of aerodynamic nonlinearities on aircraft behavior at high angle of attack from both an analytical and a flight test experience viewpoint was considered. The form of some of these nonlinearities and their importance to the design of high incidence control systems is examined. Considerations for the design of future military aircraft for operation at high angle of attack are suggested. E.A.K.

**N83-10071#** Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.

**A COMPARISON OF ANALYTICAL TECHNIQUES FOR PREDICTING STABILITY BOUNDARIES FOR SOME TYPES OF AERODYNAMIC OR CROSS-COUPLING NONLINEARITIES**

A. J. ROSS *In* AGARD Criteria for Handling Qualities of Mil Aircraft 12 p Jun. 1982 refs

Avail: NTIS HC A14/MF A01

The need to predict stability boundaries for flight at high angles of attack and the possibility of using analytical techniques, rather than studying computed responses is discussed. Two analysis methods are described and compared, for particular forms of nonlinearities, and a relationship is established between nonlinear stability characteristics and linear stability boundaries in terms of the magnitudes of the response variables. The techniques are used to predict some of the flight characteristics likely to occur for a high incidence research model, which is tested to provide wind tunnel and free flight data for establishing mathematical models of aerodynamics at high angles of attack. E.A.K.

**N83-10072#** Calspan Advanced Technology Center, Buffalo, NY Flight Research Dept

**EFFECT OF CONTROL SYSTEM DELAYS ON FIGHTER FLYING QUALITIES**

R. E. SMITH and R. E. BAILEY *In* AGARD Criteria for Handling Qualities of Mil. Aircraft 16 p Jun. 1982 refs Sponsored by AFFDL

Avail. NTIS HC A14/MF A01

The significant effects of time delay on fighter flying qualities, both longitudinal and lateral was confirmed. The flying qualities problems of latest fighter aircraft are most often related to the time delay which is introduced into the flight control system by the advanced, typically complex, control system design. Data from inflight simulators demonstrate this point. Typical sources of flight control system time delay and the methods of time delay measurement are reviewed. The application of several candidate flying qualities evaluation criteria or requirements, which are applicable to highly augmented fighter aircraft, is discussed. E.A.K.

**N83-10073#** Royal Netherlands Air Force, The Hague  
**EFFECT OF CONTROL SYSTEM DELAYS ON FIGHTER FLYING QUALITIES**

J. T. BAKKER *In* AGARD Criteria for Handling Qualities of Mil Aircraft 3 p Jun. 1982

Avail: NTIS HC A14/MF A01

The effect of head up display (HUD) time delays on power approach handling qualities of the F-16 are discussed. Delays of 30 ms for the flight path marker presentation and of up to 50 ms in angle of attack presentation are observed. The effects of this 80 ms delay of F-16 handling during the approach, landing, and landing roll-out are considered. Modifications of the flight control system to correct the problem of nose-rise during roll-out and problems in the take off and landing phases are described. J.D.

**N83-10074#** Societe Nationale Industrielle Aerospatiale, Toulouse (France)

**AN EXAMPLE OF LONGITUDINAL AND TRANSVERSAL OSCILLATION COUPLING: THE EPSILON AIRCRAFT CORK SCREW**

J. IRVOAS *In* AGARD Criteria for Handling Qualities of Mil. Aircraft 13 p Jun. 1982 refs

Avail: NTIS HC A14/MF A01

A design analysis of the prototype EPSILON trainer aircraft is presented. During test flights of the prototype aircraft a corkscrew oscillation, a combination of incidence oscillation and Dutch roll, was observed. Wind tunnel tests performed on models installed on a yaw-pitch head simulation by modeling with six degrees of freedom are described. A combined incidence oscillation and yawing criterion was derived. Determination of the structural causes of the corkscrew oscillation is described. Design modifications resulting from the design analysis were implemented, and

successful flight tests of the preproduction aircraft performed

J.D.

**N83-10075#** Honeywell Systems and Research Center, Minneapolis, Minn.

**ADVANCED FLIGHT CONTROL DESIGN TECHNIQUES AND HANDLING QUALITY REQUIREMENTS**

T. B. CUNNINGHAM and R. E. POPE *In* AGARD Criteria for Handling Qualities of Mil Aircraft 13 p Jun. 1982 refs (Contract N00014-75-C-0144; ET-78-C-01-3391)

Avail: NTIS HC A14/MF A01

The application of control analysis and synthesis techniques in the frequency domain to the analysis of multi-input system performance and stability characteristics is described. A bandwidth hypothesis criterion is applied to specify handling qualities of 6 degrees of freedom systems. The control perspective for multi-input, multi-output systems is described. The use of linear quadratic Gaussian (LQG) design techniques to meet frequency design goals is discussed. These techniques are applied to the design of a YF-4 (F-4 with horizontal canards) J.D.

**N83-10076#** Societe Nationale Industrielle Aerospatiale, Toulouse (France).

**ANALYZING THE ROLE OF CLOSED LOOP SYSTEMS FOR A SUBSONIC AIRCRAFT WITH REDUCED LONGITUDINAL STABILITY [ANALYSE DU ROLE DES ASSERVISSEMENTS POUR UN AVION SUBSONIQUE A STABILITE LONGITUDINALE REDUITE]**

F. IANNARELLI *In* AGARD Criteria for Handling Qualities of Mil Aircraft 15 p Jun. 1982 *In* FRENCH

Avail: NTIS HC A14/MF A01

Introduced essentially to restore acceptable piloting qualities to centering in the rear, closed loop attitude control systems, thanks to their numerous possibilities, will finally be used to improve pilot comfort to the maximum. Both elementary closed loop systems (whose role is to modulate the position of fundamental points of the aircraft) and closed loop systems dictated by conditions (whose function is to assure the automatic trim of the aircraft or the maintenance of conditions) are discussed. These systems are adapted to an aircraft with reduced longitudinal stability such as the AIRBUS. Transl. by A.R.H.

**N83-10077#** Air Force Flight Test Center, Edwards AFB, Calif Flight Test Technology Branch

**DEVELOPMENT OF HANDLING QUALITIES TESTING IN THE 70'S: A NEW DIRECTION**

B. L. SCHOFIELD, T. R. TWISDALE, W. G. KITTO, and T. A. ASHURST *In* AGARD Criteria for Handling Qualities of Mil Aircraft 16 p Jun. 1982 refs

Avail: NTIS HC A14/MF A01

An overview of the evolution of handling qualities testing at the Air Force Flight Test Center is presented, with emphasis on the significant changes which occurred during the 1970s. The System Identification and Tracking (SIFT) handling qualities test and evaluation techniques are discussed. Examples of SIFT test results are presented and discussed. J.D.

**N83-10078#** Bundesamt fuer Wehrtechnik und Beschaffung, Munich (West Germany).

**EXPERIENCE WITH SYSTEM IDENTIFICATION FROM TRACKING (SIFT) FLIGHT-TEST-TECHNIQUES AT THE GERMAN AIR FORCE FLIGHT TEST CENTER**

E. BUCHACKER *In* AGARD Criteria for Handling Qualities of Mil. Aircraft 22 p Jun. 1982 refs

Avail: NTIS HC A14/MF A01

Pilot induced oscillations (PIO) which occurred mainly during landing approach of a medium size cargo helicopter with a suspended load were investigated using SIFT techniques. The flight test program which was set up to gain insight into the problem is briefly described. Data evaluation showed that a bad combination of eigenfrequencies from a suspended load and the helicopter caused a very poorly damped eigenmode. This mode could be excited by the pilot but was not controllable for a human being.

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because of the frequency (approximately 11 rad/sec) involved. A good correlation between pilot comments and flight test data evaluation was found. Author

**N83-10079\*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

### **PREDICTION OF AIRCRAFT HANDLING QUALITIES USING ANALYTICAL MODELS OF THE HUMAN PILOT**

R. A. HESS *In* AGARD Criteria for Handling Qualities of Mil Aircraft 8 p Jun. 1982 refs Document also announced as N82-24208

Avail: NTIS HC A14/MF A01 CSCL 01C

The optimal control model (OCM) of the human pilot is applied to the study of aircraft handling qualities. Attention is focused primarily on longitudinal tasks. The modeling technique differs from previous applications of the OCM in that considerable effort is expended in simplifying the pilot/vehicle analysis. After briefly reviewing the OCM, a technique for modeling the pilot controlling higher order systems is introduced. Following this, a simple criterion for determining the susceptibility of an aircraft to pilot-induced oscillations (PIO) is formulated. Finally, a model-based metric for pilot rating prediction is discussed. The resulting modeling procedure provides a relatively simple, yet unified approach to the study of a variety of handling qualities problems. Author

**N83-10080#** Calspan Advanced Technology Center, Buffalo, N.Y. Flight Research Dept.

### **SIMULATION FOR PREDICTING FLYING QUALITIES**

P. A. REYNOLDS *In* AGARD Criteria for Handling Qualities of Mil. Aircraft 11 p Jun. 1982 refs

Avail: NTIS HC A14/MF A01

The role of in-flight simulation in predicting and reproducing flying qualities is discussed. Reliable flying qualities predictions can be difficult. Measuring workload is technically challenging. There are psychological and political pressures on the evaluation pilot. The variety of dynamics and the number of parameters involved in airplane flying qualities are large. The tasks are frequently difficult to accurately simulate on the ground. Examples from several airplane development programs are presented to illustrate some of the faulty predictions that have been made with ground simulators. These examples provide flying qualities situations that can be used for more formal comparisons of ground simulation with in-flight simulation and for developing general hypotheses which could then be tested. Modern in-flight simulation capability is discussed emphasizing model-following accuracy, model complexity, and special effects such as artificial crosswinds, turbulence, and ground effects. Cost effectiveness is addressed. A role complementary to ground simulation is seen for in-flight simulation. The improvement of simulation planning by performing these formal experiments to define the predictive value of various ground simulator features such as large motion and high-quality visual cues is suggested. Author

**N83-10269#** Royal Aircraft Establishment, Farnborough (England).

### **ANALYSIS OF SUBCRITICAL RESPONSE MEASUREMENTS FROM AIRCRAFT FLUTTER TESTS**

J. C. COPLEY *In* Shock and Vibration Information Center The Shock and Vibration Bull., Pt. 3 p 199-211 May 1981 refs

Avail: NTIS HC A12/MF A01 CSCL 01C

A method for the analysis of subcritical response measurements obtained during aircraft flutter tests is described. Suitable forms of input signal, and the derivation of transfer functions using fast Fourier transforms are discussed. The transfer functions are subsequently analyzed to give frequency and damping estimates. Because the effects of atmospheric turbulence degrade the measurements, and hence the estimated parameters, a method for assessing the magnitude of the accuracy of the estimates is developed. Examples of the application of the analysis method to typical response data are given. M.G.

**N83-11139\*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

### **GAIN SELECTION METHOD AND MODEL FOR COUPLED PROPULSION AND AIRFRAME SYSTEMS**

P. C. MURPHY 4 Nov. 1982 33 p refs

(NASA-TP-2067; L-15215; NAS 1 60:2067) Avail: NTIS HC

A03/MF A01 CSCL 01C

A longitudinal model is formulated for an advanced fighter from three subsystem models: the inlet, the engine, and the airframe. Notable interaction is found in the coupled system. A procedure, based on eigenvalue sensitivities, is presented which indicates the importance of the feedback gains to the optimal solution. This allows ineffectual gains to be eliminated; thus, hardware and expense may be saved in the realization of the physical controller. Author

**N83-11140\*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

### **DESIGN OF A HELICOPTER AUTOPILOT BY MEANS OF LINEARIZING TRANSFORMATIONS**

G. MEYER, R. L. HUNT, and R. SU Oct. 1982 14 p refs

(NASA-TM-84295; A-9091; NAS 1 15:84295) Avail: NTIS HC

A02/MF A01 CSCL 01C

An automatic flight control systems design methods for aircraft that have complex characteristics and operational requirements, such as the powered lift STOL and V/STOL configurations are discussed. The method is effective for a large class of dynamic systems that require multi-axis control and that have highly coupled nonlinearities, redundant controls, and complex multidimensional operational envelopes. The method exploits the possibility of linearizing the system over its operational envelope by transforming the state and control. The linear canonical forms used in the design are described, and necessary and sufficient conditions for linearizability are stated. The control logic has the structure of an exact model follower with linear decoupled model dynamics and possibly nonlinear plant dynamics. The design method is illustrated with an application to a helicopter autopilot design. S.L.

**N83-11141\*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

### **STABILITY AND CONTROL CHARACTERISTICS AT MACH NUMBERS 1.60 TO 2.86 OF A VARIABLE-SWEEP FIGHTER CONFIGURATION WITH SUPERCRITICAL AIRFOIL SECTIONS**

S. M. DOLLYHIGH Jun. 1971 82 p refs

(NASA-TM-X-2284, L-7583; NAS 1.15:X-2284) Avail: NTIS HC

A05/MF A01 CSCL 01C

Tests were conducted in the Mach number range from 1.60 to 2.86 to determine the longitudinal and lateral aerodynamic characteristics of a variable-sweep fighter configuration with supercritical airfoil sections, twin rectangular inlets, twin vertical tails, and boom-mounted aft horizontal tails. The results indicate that the configuration has longitudinal stability characteristics and a relatively high horizontal-tail control effectiveness. This horizontal-tail effectiveness, coupled with relatively high levels of zero-lift pitching moment, results in a high instantaneous normal-acceleration capability for the configuration at a Mach number of 1.60 and an altitude of 10668 m (35000 ft). The lateral-stability results, however, indicate rather poor directional characteristics for an angle of attack greater than 10 deg. For the Mach number range of the tests, static directional stability was maintained only to angles of attack of 10 deg to 12 deg, which were well below the angles of attack at which the configuration had longitudinal trim capability. A.R.H.

## 09 RESEARCH AND SUPPORT FACILITIES (AIR)

**N83-11142\*#** National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.

**WIND-TUNNEL INVESTIGATION OF LONGITUDINAL AND LATERAL-DIRECTIONAL STABILITY AND CONTROL CHARACTERISTICS OF A 0.237-SCALE MODEL OF A REMOTELY PILOTED RESEARCH VEHICLE WITH A THICK, HIGH-ASPECT-RATIO SUPERCRITICAL WING**

T A BYRDSONG and C. W. BROOKS, JR. Jul. 1980 218 p refs

(NASA-TM-81790; L-13389; NAS 1.15:81790) Avail NTIS HC A10/MF A01 CSCL 01C

A 0.237-scale model of a remotely piloted research vehicle equipped with a thick, high-aspect-ratio supercritical wing was tested in the Langley 8-foot transonic tunnel to provide experimental data for a prediction of the static stability and control characteristics of the research vehicle as well as to provide an estimate of vehicle flight characteristics for a computer simulation program used in the planning and execution of specific flight-research mission Data were obtained at a Reynolds number of  $165 \times 10^6$  to the 6th power per meter for Mach numbers up to 0.92. The results indicate regions of longitudinal instability; however, an adequate margin of longitudinal stability exists at a selected cruise condition. Satisfactory effectiveness of pitch, roll, and yaw control was also demonstrated.

A R H.

**N83-11145#** Messerschmitt-Boelkow-Blohm G.m.b.H , Hamburg (West Germany). Transport Aircraft Div

**AIRCRAFT WITH REDUCED LONGITUDINAL STABILITY Final Report, Nov. 1981**

B. FISCHER, B. KIEKEBUSCH, A. KROEGER, B. TROSKY, and K. WEISE Bonn Bundesministerium fuer Forschung und Technologie Jul 1982 137 p refs In GERMAN, ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie

(BMFT-FB-W-82-004, ISSN-0170-1339) Avail NTIS HC A07/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 29

Yield and effort of a more aft center of gravity (CG), resulting in drag saving effects, were quantified in order to elaborate a reasonable proposition for realizing reduced stability in transport aircraft Basic work, concerning handling qualities in relation to stability margins, as well as methods to redesign the tailplane, according to the new tasks, are also presented The trim tank system with integral tailplane (or fin) tank offers a highly flexible solution to cover normal CG movements and rearward flight limits moved aft in development steps The envisaged stability margins guarantee acceptable handling qualities which, normally, are augmented by artificial means. The fuel and operating cost savings, especially on longer stages, prove the system to be economically attractive The first implementation of such a system within the Airbus program is planned

Author (ESA)

**N83-11143#** Air Force Inst of Tech , Wright-Patterson AFB, Ohio. School of Engineering.

**DIGITAL FLIGHT CONTROL SYSTEM DESIGN USING SINGULAR PERTURBATION METHODS M.S. Thesis**

J. S SMYTH Dec 1981 224 p refs

(AD-A118117; AFIT/EE/GE/81D-55) Avail. NTIS HC A10/MF A01 CSCL 01C

In this report a single longitudinal tracker is developed for the aircraft for three different flight conditions The method used is the singular perturbation method applied to fast-sampling, output-feedback digital control Each flight condition has three command modes: positive pitch pointing, vertical translation and straight climb A sensitivity study is performed to validate the design and illustrate design parameter influences on system response A computer-aided-design program, MULTI, is developed to assist in the iterative design process. The program is fully interactive, user-oriented, and provides error protection. The program allows complete design and simulation of three types of control law designs: known-regular plants, known irregular plants, and unknown plants The report contains a brief but complete summary of each of these control law design methods A user's manual and a programmer's manual are provided for further development of the program.

Author (GRA)

**N83-11144#** Air Force Inst. of Tech , Wright-Patterson AFB, Ohio. School of Engineering.

**DESIGN AND ANALYSIS OF A MULTIVARIABLE, DIGITAL CONTROLLER FOR THE A-7D DIGITAC 2 AIRCRAFT AND THE DEVELOPMENT OF AN INTERACTIVE COMPUTER DESIGN PROGRAM M.S. Thesis**

D. S. PORTER Dec. 1981 106 p refs

(AD-A118134, AFIT/GE/EE/81D-48) Avail NTIS HC A06/MF A01 CSCL 01C

A multivariable error-actuated digital tracking controller is developed for the Mach 0.18 flight condition of the A-7D Digitac 2 aircraft using a singular perturbation method The design is accomplished and simulated after the development of an interactive computer program named MULTI. The complete designed process is presented; a discussion of the robustness of the control law over a range of flight conditions and the effect of an aircraft flight control surface failure is also included. A more accurate aircraft model is required before further testing is accomplished to study the possibilities of other controller designs. The computer package is available to the engineering community

GRA

## 09

### RESEARCH AND SUPPORT FACILITIES (AIR)

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

**A83-10178#**

**IMPROVED G-CUEING SYSTEM**

E B. BOSE, W. P. LEAVY, and S. RAMACHANDRAN (Goodyear Aerospace Corp., Akron, OH) (In Flight Simulation Technologies Conference, Long Beach, CA, June 16-18, 1981, Technical Papers, p. 139-146.) Journal of Aircraft, vol 19, Nov. 1982, p. 909-914. refs

(Previously cited in issue 16, p. 2692, Accession no A81-36572)

**A83-10189#**

**ADVANCED FACILITY FOR PROCESSING AIRCRAFT DYNAMIC TEST DATA**

D. J. STODER (Douglas Aircraft Co , Long Beach, CA) Journal of Aircraft, vol 19, Nov. 1982, p 990-998.

(Previously cited in issue 03, p. 428, Accession no. A82-14377)

**A83-10732**

**ATE SUPPORT OF RF LINE REPLACEABLE UNITS**

O F PETTIT (Grumman Aerospace Corp , Bethpage, NY) and E. L SHANEYFELT (USAF, Aeronautical Systems Div., Wright-Patterson AFB, OH) In: AUTOTESTCON '81; Proceedings of the Conference, Orlando, FL, October 19-21, 1981. New York, Institute of Electrical and Electronics Engineers, Inc., 1981, p. 39-44

This paper discusses the 17 RF LRU (line replaceable units) of the EF-111A aircraft, which consist of countermeasure receivers, high power RF amplifiers/transmitters, RF calibrator, and a multiband exciter (modulator driver). Consideration is given to the various stages of definition, development/design, test, and verification/validation demonstration. The ATE and its RF test capability are outlined; typical basic RF subroutines are described, the readability and self-documentation aspects of the RF ATLAS

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test programs are demonstrated; and personnel skills requirements are considered B.J.

### A83-10737#

#### AIRCRAFT SYSTEMS TEST REQUIREMENTS ANALYSIS

J. ESTRADA and F. PAXTON (U.S. Navy, Pacific Missile Test Center, Point Mugu, CA) In AUTOTESTCON '81; Proceedings of the Conference, Orlando, FL, October 19-21, 1981. New York, Institute of Electrical and Electronics Engineers, Inc., 1981, p. 73-78.

The philosophy underlying the analysis described here involves taking a system to be analyzed and successively decomposing it into increasingly smaller semi-independent blocks or modules. Each module is independent except for clearly defined interfaces which carefully control information flow. The decomposition ceases when each block is small enough to contain just one predominant idea; it is stressed that it should be small enough to be under the analyst's intellectual span of control. The test requirements are not defined until the system is completely decomposed, this way the analyst retains a feel for the overall organization of the system at hand before beginning the actual work. It is considered imperative that test tolerance be organized so that the test requirements defined correlate with the different support levels. This is illustrated by a tolerance pyramid which defines the test tolerance allowance from basic design tolerance through the various support levels to an operating tolerance C.R.

### A83-10739

#### THE EVOLUTION OF NAVY FLIGHT LINE EW TESTERS FROM AN/ALM-66 TO AN/USM-406C

R. L. SCHERER and R. RAY (Sanders Associates, Inc., Electronic Warfare Div., Nashua, NH) In AUTOTESTCON '81, Proceedings of the Conference, Orlando, FL, October 19-21, 1981. New York, Institute of Electrical and Electronics Engineers, Inc., 1981, p. 84-87.

The evolution of Navy Electronic Warfare flight line testing from simple Built-In-Test (BIT) and walk-around test sets to the present sophisticated BIT and automatic end-to-end flight-line test systems is traced. The testing systems have developed in response to the increasingly difficult problems encountered in maintaining highly sophisticated integrated avionic EW systems. It is contended that even though BIT techniques have improved dramatically end-to-end flight line testing is required even more today than it was 20 years ago. C.R.

### A83-10751#

#### SIMULATED MISSION ENDURANCE CONTROL SYSTEM

G. G. WILHELM (U.S. Naval Air Propulsion Center, Trenton, NJ) In: AUTOTESTCON '81; Proceedings of the Conference, Orlando, FL, October 19-21, 1981. New York, Institute of Electrical and Electronics Engineers, Inc., 1981, p. 166-171.

The Cruise Missile engine testing program requires engines to perform satisfactorily under simulated flight conditions for terrain following operations. The Mission Endurance Control System, a computerized closed-loop distributive control system, was created to perform this task. The main function of the system is to track pre-programmed mission profiles and provide the set points to the individual controllers. The computer will control open-loop during a parameter ramp and then closes the loop during steady state portions of the profile. Another function of the computer is the performance of real-time diagnostics on three critical parameters, inlet and exhaust pressure, and power level voltage. The diagnostics look for high values and high pressure fluctuations in the inlet and exhaust. When limits are exceeded the computer takes positive action and gives verbal warnings. A real-time video display in the control room is updated every second showing the status of the system. (Author)

### A83-10752

#### PETTS /PROGRAMMABLE ENGINE TRIM TEST SET/

G. B. LAWRENCE (United Technologies Corp., Government Products Div., West Palm Beach, FL) and W. L. FAULKNER (United Technologies Corp., Hamilton Standard Div., Windsor Locks, CT) In AUTOTESTCON '81; Proceedings of the Conference, Orlando, FL, October 19-21, 1981. New York, Institute of Electrical and Electronics Engineers, Inc., 1981, p. 172-175.

PETTS was developed to meet the needs of the Navy for a man-portable automated test system that would facilitate shipboard and land-based organizational-level aircraft engine testing. It is noted that by far the most severe environmental constraints include electromagnetic radiation and shipboard storage and handling. The resulting hardware will satisfy military specifications while making accurate measurements and comparing measured parameters with stored performance tables at various ambient conditions and levels of engine power. A unique real-time multi-tasking software operating system makes it possible for the PETTS to perform the complex calculations and system functions required to automate the test procedures while providing a continuous display of data. The PETTS prototype has proven the advantage of automated testing by attaining trim check tests with only 32 minutes of engine run time, compared with average manual tests of more than 60 minutes. C.R.

### A83-10755

#### TARPS TEST PROGRAM SET /PARALLEL DEVELOPMENT OF AVIONICS AND ITS SUPPORT CAPABILITY/

H. DAVIS (U.S. Naval Air Systems Command, Washington, DC), P. NICHOLAS, C. WERNER (Harris Corp., PRD Electronics Div., Syosset, NY), and P. BRADLEY (U.S. Naval Air Engineering Center, Syosset, NY) In AUTOTESTCON '81; Proceedings of the Conference, Orlando, FL, October 19-21, 1981. New York, Institute of Electrical and Electronics Engineers, Inc., 1981, p. 197-205.

It is noted that with the development of the Tactical Airborne Reconnaissance Pod System (TARPS), total Operation Test Program Set (OTPS) support of the Weapon Replaceable Assemblies (WRA's) was for the first time demonstrated before fleet certification for use of the avionics system. The TARPS Operation Test Program Set has so far been successfully deployed at four US Navy sites. In addition, the TARPS OTPS ability has been expanded to test a fourth WRA. It is noted that while the schedule was a determining factor in the Navy's decision to implement this type of procurement, the TARPS test program development will serve as a model for future Navy TPS procurement. C.R.

### A83-11059#

#### ASTF TEST INSTRUMENTATION SYSTEM DETAIL DESIGN

J. R. RICKARD, D. C. BOND (USAF, Arnold Engineering Development Center, Arnold Air Force Station, TN), and M. W. LAWLEY (Sverdrup Technology, Inc., Arnold Air Force Station, TN) In: ICIASF '81; International Congress on Instrumentation in Aerospace Simulation Facilities, Dayton, OH, September 30, 1981, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1981, p. 61-70 refs.

A Test Instrumentation System (TIS) has been designed for the Aeropropulsion System Test Facility (ASTF), now under construction, which will provide a test bed for jet engines of up to 75,000 lb thrust, with a growth capacity to accommodate engines of up to 100,000 lb thrust. The TIS is an integral part of the ASTF which acquires, conditions, processes, records, and displays data from engine tests. Design details are presented for the major hardware groupings of the TIS: the data conditioning system, the wide-band recording system, the static data acquisition and processing system, the dynamic data acquisition and processing system, the mass data storage facility, the executive data-processing system, the display system, and the prime engine parameter subsystem. V.L.

A83-11069

**THE MEASUREMENT OF IMPULSIVE FORCES ON A WIND TUNNEL MODEL WITH A CONVENTIONAL STRAIN GAGE BALANCE**

J M COOKSEY and C E. ZIEGLER (Vought Corp, Dallas, TX)  
In: ICIASF '81, International Congress on Instrumentation in Aerospace Simulation Facilities, Dayton, OH, September 30, 1981, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1981, p 179-187 refs

A newly developed technique for the measurement in a wind tunnel of the angular and linear components of the force impulse produced on a model by a transverse, pyrotechnic reaction jet is described. Measurements are made with a strain gage balance. Special processing of the indicated balance forces, representing the response of the model-balance-sting system, allows recovery of the components of the unknown input impulse. (Author)

A83-11074

**SUPPORT INTERFERENCE IN STATIC AND DYNAMIC TESTS**

L E. ERICSSON and J P. REDING (Lockheed Missiles and Space Co, Inc., Sunnyvale, CA) In ICIASF '81, International Congress on Instrumentation in Aerospace Simulation Facilities, Dayton, OH, September 30, 1981, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1981, p. 213-223. refs

The existing information about support interference has been reviewed, with particular emphasis on dynamic interference effects and the special problems encountered at high angles of attack. It is found that the support interference effects are much more severe in dynamic than in static tests. Furthermore, the support interference is aggravated greatly by a boat-tail or dome-shaped base, even by modest base shoulder roundness, from what it is for a flat-based model. The general conclusion is that asymmetric stings or sting-strut combinations should be avoided. (Author)

A83-11079

**DYNAMIC SIMULATION IN WIND TUNNELS**

B KRAG (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Institut fuer Flugmechanik, Brunswick, West Germany) In: ICIASF '81; International Congress on Instrumentation in Aerospace Simulation Facilities, Dayton, OH, September 30, 1981, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1981, p 271-282 refs

The installation for Dynamic Simulation is a new wind tunnel facility which uses remotely controlled wind tunnel models in conjunction with a special model suspension rig. This experimental facility allows the study of both rigid body motion and elastic deformations, combining flight mechanic and aeroelastic testing. The model is usually of a specific aircraft and is fully instrumented. Model command and control, as well as the data processing of measurements, is computerized. Uses of the facility to date include the identification of dynamic flight mechanics derivatives, basic research into active control systems technology, and the development of a general aviation aircraft ride smoothing system. Attention is given to the development and testing of four different gust generators employed in the simulation of realistic flight environments. O.C.

A83-11080

**THE WATER TUNNEL - A HELPFUL SIMULATION FACILITY FOR THE AIRCRAFT INDUSTRY**

R. STIEB and U. GROSS (Messerschmitt-Boelkow-Blohm GmbH, Munich, West Germany) In: ICIASF '81; International Congress on Instrumentation in Aerospace Simulation Facilities, Dayton, OH, September 30, 1981, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1981, p 283-291.

The advantages of flow observation techniques employing small water tunnels are discussed, and the mechanical details and operational procedures of a typical water tunnel test facility (i.e., the MBB tunnel) are described. It is noted that water tunnel flow visualization is three-dimensional, permitting observation both in the model boundary layer and in the free flow, and will exhibit dynamic effects in slow motion for the sake of clarity. Engine jets and intake flows can be simulated simply, and experimental results

can be obtained quickly and at relatively little expense by comparison with conventional wind tunnels. As a consequence of the small model size and low flow velocity, however, Reynolds numbers not larger than 50,000 are typically achievable for a model aircraft wing in constant operation. In addition, because water is incompressible, only low subsonic flow conditions may be simulated. O C

A83-11081

**THE NATIONAL TRANSONIC CASCADE TUNNEL**

M S RAMACHANDRA, K M. M SWAMY, M R. NARASIMHA SWAMY, and P. A. PARANJPE (National Aeronautical Laboratory, Bangalore, India) In ICIASF '81, International Congress on Instrumentation in Aerospace Simulation Facilities, Dayton, OH, September 30, 1981, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1981, p. 292-300

A versatile test facility has been developed by the National Aeronautical Laboratory, Bangalore, India, which has the capability of testing turbomachinery blade cascades at transonic/supersonic inlet Mach numbers. The tunnel has a large test section and is equipped with suitable instrumentation, control, and safety systems. A description of this facility is presented, along with details of the instrumentation and control systems, and typical tunnel characteristics and calibration results are also given. It is concluded that the versatility of the tunnel makes it well equipped to take up a wide range of research and developmental activities connected with transonic flows inside turbomachinery blade passages. N B.

A83-11082

**DEVELOPMENT AND TRIAL OF A ROTARY BALANCE FOR THE 3 M LOW SPEED WIND TUNNELS OF WEST GERMANY**

B SCHULZE (Messerschmitt-Boelkow-Blohm GmbH, Munich, West Germany) In: ICIASF '81; International Congress on Instrumentation in Aerospace Simulation Facilities, Dayton, OH, September 30, 1981, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1981, 11 p. Research sponsored by the Bundesministerium fuer Forschung and Technologie. refs

A rotary balance for 3 meter, low speed wind tunnels has been developed which allows aircraft dynamic stability derivatives to be determined in the wind tunnel on continuously rotating aircraft models. Principal design aspects of the mechanical set-up and the measuring system are presented. Test results from a calibration model of the rotary balance show a good correlation with existing reference data. N B.

A83-11178\* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif

**A DIGITAL FLIGHT CONTROL SYSTEM VERIFICATION LABORATORY**

P DE FEO (NASA, Ames Research Center, Moffett Field, CA) and S SAIB (General Research Corp., Santa Barbara, CA) In NAECON 1982, Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982 Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 811-816. refs

A NASA/FAA program has been established for the verification and validation of digital flight control systems (DFCS), with the primary objective being the development and analysis of automated verification tools. In order to enhance the capabilities, effectiveness, and ease of using the test environment, software verification tools can be applied. Tool design includes a static analyzer, an assertion generator, a symbolic executor, a dynamic analysis instrument, and an automated documentation generator. Static and dynamic tools are integrated with error detection capabilities, resulting in a facility which analyzes a representative testbed of DFCS software. Future investigations will ensue particularly in the areas of increase in the number of software test tools, and a cost effectiveness assessment. R.K.R.

## 09 RESEARCH AND SUPPORT FACILITIES (AIR)

**A83-11228**

### **F-4F FIRE CONTROL SYSTEM SOFTWARE SUPPORT - AN INTEGRATED APPROACH TO GROUND AND FLIGHT TESTING**

G H LINDNER (Bundesamt fuer Wehrtechnik und Beschaffung, Landsberg, West Germany) and H. FLUESS (Messerschmitt-Boelkow-Blohm GmbH, Ottobrunn, West Germany) In. NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982 Volume 3 New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 1191-1198. refs

The benefits of the co-location and integration of agencies, tasks, and test tools for the Operational Flight Program (OFP) update cycle given severe limitations on expertise, personnel, funds, and test ranges are described. It is shown that by using the Flight Computer Monitor (FLICOM) approach for flight test instrumentation, the procedures for the OFP change cycle in a closed-loop process are predetermined. The approach described here is not limited to the software support phase. It can also be used in the development cycle of a whole new system. It requires the realization that testing is the most time-consuming and expensive part of a program in the development phase as well as during the support phase  
C.R.

**A83-11237#**

### **TOWARD 'COMBAT REALISTIC' TESTS, EVALUATIONS, EXERCISES - AND TRAINING**

A W. RITTER (USAF, Nellis AFB, NV) In: NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982 Volume 3 New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 1253-1256.

The need for improved combat simulation models is discussed, with attention given to the areas of command, control, and data capture on electronic combat ranges. The three major considerations are combat realism, range user needs in relation to the opposing forces, and range user needs regarding type, quality, quantity, etc. of data capture. Finally, the applications of these training and testing programs to aspects of modern warfare must be considered, such aspects include synergism of simultaneous multimission forces, the use of high technology weapons, and the use of invisible effects for self-protection and attack.  
R.K.R.

**A83-11238#**

### **NEW THREAT SIMULATOR /NETS/ A MULTI-SENSOR R & D TOOL FOR EW DEVELOPMENT**

J. F. CARDENIA (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) In NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 3. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 1257-1259.

A new threat simulator (NETS) for electronic warfare (EW) development is presented, as it will provide a means of measuring the synergistic effectiveness of multi-spectral techniques. Generic EW R & D tools are reviewed, including EW digital math models, flight testing, and, the most advantageous tool, laboratory simulation. Laboratory simulation areas in need of development are low level air-to-ground scenarios, clutter, complex targeting scattering, upgraded electronic counter countermeasures, and EO/IR/RF integration. The two major simulators at the Wright-Patterson Air Force Base, the dynamic electromagnetic environment simulator, (DEES) and the electronic defense evaluator (EDE), are used for radar warning receivers evaluation and RF jammer evaluation, respectively. The proposed NETS will be integrated with DEES, and will be capable of evaluating countermeasure techniques against EW threats where sensor interaction analysis is essential. A federation of modules will comprise NETS, including the extended targets subsystem and the clutter subsystem.  
R.K.R.

**A83-12008**

### **AN OSCILLATING RIG FOR THE GENERATION OF SINUSOIDAL FLOWS**

H STAPOUNTZIS (Imperial College of Science and Technology, London, England) Journal of Physics E - Scientific Instruments, vol. 15, Nov. 1982, p. 1173-1176. refs

An oscillating rig consisting of two 'two-dimensional' aerofoils enclosed between two vertical wind tunnel walls, is capable of generating upwash and/or streamwise sinusoidal gusts. This design has certain advantages over some previous unsteady flow wind tunnels. The upwash velocity predicted from potential flow for aerofoil pitching oscillations, is in reasonable agreement with that obtained from the experiment.  
(Author)

**N83-10082\*#** National Aeronautics and Space Administration, Langley Research Center, Hampton, Va

### **SENSITIVITY ANALYSIS OF COOL-DOWN STRATEGIES FOR A TRANSONIC CRYOGENIC TUNNEL**

J J. THIBODEAUX Sep 1982 31 p refs  
(NASA-TM-84527; L-14366; NAS 1.15:84527) Avail NTIS HC A03/MF A01 CSCL 14B

Guidelines and suggestions substantiated by real-time simulation data to ensure optimum time and energy use of injected liquid nitrogen for cooling the Langley 0.3-Meter Transonic Cryogenic Tunnel (TCT) are presented. It is directed toward enabling operators and researchers to become cognizant of criteria for using the 0.3-m TCT in an energy- or time-efficient manner. Operational recommendations were developed based on information collected from a validated simulator of the 0.3-m TCT and experimental data from the tunnel. Results and trends, however, can be extrapolated to other similarly constructed cryogenic wind tunnels  
Author

**N83-10083#** Transportation Systems Center, Cambridge, Mass.  
**AIRPORT LANDSIDE. VOLUME 1. PLANNING GUIDE Final Report, Jan. 1978 - Sep. 1980**

L. MCCABE and M. GORSTEIN Jun 1982 78 p refs 5 Vol.  
(AD-A117599; DOT-TSC-FAA-82-4-1; FAA-EM-80-8-1) Avail: NTIS HC A05/MF A01 CSCL 01E

This volume describes a methodology for performing airport landside planning by applying the Airport Landside Simulation Model (ALSIM) developed by TSC. For this analysis, the airport landside is defined as extending from the airport boundary to the aircraft gate. The model routes simulated enplaning and deplaning passenger groups through a series of essential processing facilities. At the simulated facilities, queuing and service processes are modeled. Flow, queuing time, queue length, and occupancy statistics are produced. The guide describes how the model output may be applied to a landside capacity analysis. It also discusses using the model for management of daily operations and airport design. A description of input data necessary for model operation is presented with examples using data from Miami, Denver, and La Guardia airports  
GRA

**N83-10084#** Transportation Systems Center, Cambridge, Mass.  
**AIRPORT LANDSIDE. VOLUME 2. THE AIRPORT LANDSIDE SIMULATION MODEL (ALSIM) DESCRIPTION AND USERS GUIDE Final Report, Jan. 1978 - Sep. 1980**

L. MCCABE and M. GORSTEIN Jun. 1982 101 p 5 Vol.  
(AD-A117600; DOT-TSC-FAA-82-4-2; FAA-EM-80-8-2) Avail: NTIS HC A06/MF A01 CSCL 01E

This volume provides a general description of the Airport Landside Simulation Model. A summary of simulated passenger and vehicular processing through the landside is presented. Program operating characteristics and assumptions are documented and a complete description of the input data required for simulation operation is furnished. Model outputs necessary for analysis of landside congestion include flow, queue length, queuing time and occupancy. Summaries of values of these parameters, obtained from a simulation run, are shown as examples. Time series of flow and queue length produced during the simulation run are also exhibited.  
GRA

**N83-10085#** Transportation Systems Center, Cambridge, Mass  
**AIRPORT LANDSIDE. VOLUME 3. ALSIM CALIBRATION AND VALIDATION Final Report, Jan. 1978 - Sep. 1980**  
 L. MCCABE and M. GORSTEIN Jun 1982 209 p 5 Vol.  
 (AD-A117601; DOT-TSC-FAA-82-4-3; FAA-EM-80-8-3) Avail:  
 NTIS HC A10/MF A01 CSCL 01E

This volume discusses calibration and validation procedures applied to the Airport Landside Simulation Model (ALSIM), using data obtained at Miami, Denver and La Guardia Airports. Criteria for the selection of a validation methodology are described. The chosen methodology consists of two parts: (1) plotted comparisons of ALSIM output and corresponding field data, and (2) a hypothesis test based upon the probability of occurrence of field data within two simulated standard deviations of the simulated mean at each time point. Five simulation runs with different random number streams were used to produce time series of flow and queue length data at landside processors selected for comparison. Mean values and standard deviations were obtained at each time point for plotted and statistical comparison. Results are displayed in this volume. Satisfactory results were obtained at security stations, parking facility exits, customs and immigration. Ticket counter and curbside facilities failed to display good agreement. Gates, bagclaim areas and car rental counters were not compared for reasons specified in the report. GRA

**N83-10086#** Transportation Systems Center, Cambridge, Mass.  
**AIRPORT LANDSIDE. VOLUME 4. APPENDIX A. ALSIM AUXILIARY AND MAIN PROGRAMS Final Report, Jan. 1978 - Sep. 1980**  
 L. MCCABE and M. GORSTEIN Jun 1982 279 p 5 Vol.  
 (AD-A117602; DOT-TSC-FAA-82-4-4; FAA-EM-80-8-4) Avail:  
 NTIS HC A13/MF A01 CSCL 01E

This Appendix describes the Program Logic of the Airport Landside Simulation Model (ALSIM) AUXILIARY and MAIN Programs. Both programs are written in GPSS-V. The AUXILIARY program is operated prior to the MAIN Program to create GPSS transactions representing Enplaning Passenger groups from the input flight schedule. The transactions are written on a JOBTAPE file for subsequent use by the MAIN program. The MAIN Program creates greeter and deplaning passenger transactions and enacts the movements of all passengers and visitors through the landside. GRA

**N83-10087#** Transportation Systems Center, Cambridge, Mass  
**AIRPORT LANDSIDE. VOLUME 5. APPENDIX B. ALSIM SUBROUTINES Final Report, Jan. 1978 - Sep. 1980**  
 L. MCCABE and M. GORSTEIN Jun 1982 321 p 5 Vol.  
 (AD-A117603; FAA-EM-80-8-5; DOT-TSC-FAA-82-4-5) Avail:  
 NTIS HC A14/MF A01 CSCL 01E

This Appendix describes the operation of ten subroutines used to support the AUXILIARY and MAIN programs of ALSIM. Flow charts and listings of all programs are provided. The major portion describes the FORTRAN subprogram FORTM which is used to read input data, assign values to matrix elements, perform matrix searches and assign parameters to GPSS transactions during simulation model execution. Six other subroutines, mostly written in IBM System/370 Assembly Language, are used in the initialization phase of the simulation to link FORTM to the MAIN program and to provide an in-core read and write capability. Two additional assembly language subroutines and a FORTRAN subroutine are used during simulation of the airport landside. The first assembly language subroutine assigns the number of passenger bags to be retrieved by the deplaning passenger transaction and generates random numbers to simulate waiting times at the bag claim facility. The second subroutine performs the same function as ASSIGN and LOGIC blocks of GPSS, but is FORTRAN callable. The FORTRAN subroutine of this group detects argument errors of the previous subroutine and prints error messages. GRA

**N83-11037#** Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div  
**PRELIMINARY STUDY ON VARIABLE POROSITY WALLS FOR A TRANSONIC WIND TUNNEL**  
 Z. QIWEI In its J of Aeron. (FTD-ID(RS)T-0621-82) p 20-32  
 21 Jul. 1982 refs Transl. into ENGLISH from Acta Aeron et Astron. Sinica (China), v 3, no. 1, Mar. 1982  
 Avail: NTIS HC A08/MF A01 CSCL 14B

In order to reduce the wall interference and improve quality of the flow field in a transonic wind tunnel, a set of variable porosity walls with 60 degree inclined holes was designed and manufactured. The open-area ratio of the walls can vary continually from zero to 9.2 percent. The walls were used in a 600 mm x 600 mm tran- and supersonic wind tunnel with solid side walls. The general characteristics of the variable porosity walls and the preliminary results of calibration at Mach numbers ranging from 0.6 to 1.2 are described. R J.F.

**N83-11146#** National Aerospace Lab., Tokyo (Japan) Second Aerodynamics Div  
**CONSTRUCTION AND PERFORMANCE OF NAL TWO-DIMENSIONAL TRANSONIC WIND TUNNEL**  
 Feb. 1982 54 p refs  
 (NAL-TR-647T; ISSN-0389-4010) Avail: NTIS HC A04/MF A01

The construction and the results of initial calibration of a wind tunnel built to meet the requirements of high Reynolds number testing of wing sections at transonic regime are described. The blowdown tunnel has a test section of 0.3 m x 1.0 m. The required capability of this wind tunnel is for Mach numbers ranging from 0.2 to 1.2 and for a Reynolds number up to 40 x 10 to the 16th power at Mach number 0.8 with sufficient running time. The design objectives are outlined and the completed facilities, i.e., the wind tunnel, the instrumentation and operation system, the silencer and auxiliary equipment of the air compressor and the air reservoir, are described. The performance of the tunnel is assessed based on experimental results. High Reynolds number testing can be achieved in this wind tunnel without any difficulty. Reynolds number effects on the airfoil characteristics are clarified experimentally. A R.H.

**N83-11147#** Arinc Research Corp., Annapolis, Md  
**AUTOMATIC CARRIER LANDING SYSTEM (ACLS) CATEGORY 3 CERTIFICATION MANUAL**  
 A. P. SCHUST, P. N. YOUNG, and W. R. SIMPSON Jul 1982  
 220 p  
 (Contract N00421-81-C-0187)  
 (AD-A118181; REPT-1506-01-1-2750) Avail: NTIS HC A10/MF A01 CSCL 01B

The purpose of this Automatic Carrier Landing System (ACLS) Certification Manual is to give information and guidance for the proper conduct of an ACLS certification. Information contained herein is a compilation of pertinent data, tests, and methods intended to guide the user through the complete planning, testing, and reporting required during a certification effort. Author (GRA)

**N83-11149#** Systems Technology, Inc., Mountain View, Calif.  
**DETERMINATION OF MOTION AND VISUAL SYSTEM REQUIREMENTS FOR FLIGHT TRAINING SIMULATORS Final Report**  
 R. K. HEFFLEY, W. F. CLEMENT, R. F. RINGLAND, W. F. JEWELL, H. R. JEX, D. T. MCRUER, and V. E. CARTER Aug. 1981 253 p refs  
 (Contract MDA903-80-C-0235; DA PROJ. 2Q2-63744-A-795)  
 (AD-A117555; STI-TR-546, ARI-TR-546) Avail: NTIS HC A12/MF A01 CSCL 05I

Fidelity requirements for Army flight training simulators are explored using a manual control theory approach. The first step is to define 'simulator fidelity' in operational terms which provide a basis for each of the subsequent steps. This definition is accompanied by a taxonomy of measurable fidelity parameters. The next step, also of a preparatory nature, is the analysis of Army flight training missions. Author (GRA)

## 09 RESEARCH AND SUPPORT FACILITIES (AIR)

**N83-11150#** Kilkeary, Scott and Associates, Inc., Annapolis, Md.

**A STATE-OF-THE-ART SURVEY OF THE DEVELOPMENT OF TAXIWAY GUIDANCE AND CONTROL SYSTEMS Final Report**  
C A. DOUGLAS Washington FAA Sep. 1982 41 p refs  
(Contract N68335-80-C-2008, DOT-FA77WAI-786)  
(AD-A117520, FAA-RD-81-87) Avail: NTIS HC A03/MF A01  
CSCL 01E

This study consisted of a review and analysis of the historical background of taxiway lighting and marking, its functions and development. The study emphasized the block control system used at Heathrow, the problems associated with manual and automated control of stop, hold and clearance bars, and the problems associated with automated surface movement control. The study provides the present status of developments and recommendations for future research endeavors. Author (GRA)

**N83-11151#** Federal Aviation Administration, Atlantic City, N.J. Technical Center.

**IDENTIFICATION OF EXIT TAXIWAYS (RETROREFLECTIVE MARKERS ONLY) Interim Report, Mar. 1981 - May 1982**  
L. W. HACKLER Washington Jun. 1982 14 p refs  
(Contract FAA PROJ. 081-502-540)  
(AD-A117487, FAA-CT-82-77) Avail: NTIS HC A02/MF A01  
CSCL 01E

This project is being performed in response to an SRDS request to perform a more extensive evaluation and inservice test of a method using surface retroreflective markers for identifying short-radius exit taxiways (low-speed exits). The markers were installed at the Atlantic City (Federal Aviation Administration Technical Center) Airport. The evaluation provided additional information to help insure that the system will be acceptable to users. This report describes the results and gives plans for conducting the inservice test. Author (GRA)

**N83-11152#** Dornier-Werke G.m.b.H., Friedrichshafen (West Germany). Abteilung Theoretische Aerodynamik.

**ESTIMATION OF SIMULATION ERRORS AND INVESTIGATIONS OF OPERATING RANGE EXTENSIONS FOR THE EUROPEAN TRANSONIC WIND TUNNEL (ETW) Final Report, Mar. 1981**

B. WAGNER Bonn Bundesministerium fuer Forschung und Technologie Jul. 1982 162 p refs In GERMAN, ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie  
(BMFT-FB-W-82-003; ISSN-0170-1339) Avail: NTIS HC A08/MF A01, Fachinformationszentrum, Karlsruhe, West Germany DM 32,50

The influence of viscous effects in combination with real gas effects and heat transfer at not correctly cooled model surfaces was investigated with respect to the simulation accuracy in the planned cryogenic European Transonic Wind tunnel. Changes in separation behavior and skin friction were calculated for the transonic shock wave turbulent boundary layer interaction by solving the full Navier-Stokes equations numerically and for profile flows by use of a nonadiabatic boundary layer method. Both methods include a description of the real gas behavior by the Beattie-Bridgeman equation. The results show no considerable differences for the separation behavior although always small systematic deviations in skin friction occur. In particular, the shock boundary layer interaction process does not exhibit a special sensitivity. Two dimensional calculations for inviscid transonic flows with equilibrium condensations reveal that small amounts of condensate are admissible without affecting the accuracy of the measurements. Author (ESA)

**N83-11153#** Department of Transportation, Washington, D. C.  
**AIRPORT DELAY AND IMPROVEMENT STUDY: JOHN F. KENNEDY INTERNATIONAL AIRPORT AND LAGUARDIA AIRPORT**

Oct. 1981 28 p  
(PB82-195884) Avail: NTIS HC A03/MF A01 CSCL 01E

Air traffic delay in the New York area, its causes, and solutions were studied. Delay reduction measures which reduce the level

and costs of delay at John F. Kennedy International and LaGuardia Airports were identified. The cost savings outlined for each airport are not intended to represent absolutes but rather to offer a means for comparing benefits which would accrue should the particular delay reduction measures be implemented. GRA

## 10

### ASTRONAUTICS

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

**N83-10102#** Societe Nationale Industrielle Aerospatiale, Paris (France)

**ANTITANK MISSILES NIGHT FIRING FROM AEROSPATIALE HELICOPTERS**

G DEWINTER 1982 18 p Presented at Assoc. Aeron. et Astronautique de France (AAAF) 8th European Rotorcraft Forum, Aix-en-Provence, 31 Aug.-3 Sep. 1982  
(SNIAS-822-320-101, PAPER-12.4) Avail: NTIS HC A02/MF A01

A day/night firing system for HOT antitank missiles was developed and mounted on a HAC/PAH2 helicopter, equipped with a suitably adapted sight. Night fighting requirements for a helicopter that is armed with antitank missiles are recalled. The selection of a sensor is discussed. The design of a platform in order to fulfill the observation and firing mission is described. Night antitank action is analyzed. Characteristics of a thermal imager which solves the identified problems of night firing are given. Author (ESA)

## 11

### CHEMISTRY AND MATERIALS

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

**A83-10458**

**THE EFFECT OF ADDITIVE COMPOSITIONS ON THE OXIDATION STABILITY OF T-6 FUEL [VLIANIE KOMPOZITSII PRISADOK NA ANTIKISLITEL'NIU STABIL'NOST' TOPLIVA T-6]**

O. P. LYKOV, V. M. VESELIANSKAIA, B. A. ENGLIN, and E. A. GUREVICH (Moskovskii Institut Neftekhimicheskoi i Gazovoi Promyshlennosti, Moscow, USSR) Khimiia i Tekhnologia Topliv i Masel, no 9, 1982, p. 17, 18. In Russian. refs

A study has been carried out to investigate the effect of compositions based on amine- and phenol-type additives on the antioxidation characteristics of jet fuel T-6. It is shown that a synergistic effect is achieved with the compositions (1) ionol - aromatic amine and (2) Mannich base of ionol - aromatic amines having mole ratios of 1:1 and 5:1, respectively. V.L.

**A83-10466**

**MATERIALS FOR THE MANUFACTURE OF AIRCRAFT INSTRUMENTS AND STRUCTURES [MATERIALY DLIA AVIATSIONNOGO PRIBOROSTROENIIA I KONSTRUKTSII]**

A. F. BELOV, (ED) Moscow, Izdatel'stvo Metallurgii, 1982. 400 p. In Russian.

Conducting, semiconducting, dielectric, magnetic, and structural materials used for the manufacture of aircraft instrumentation and

structures are discussed with reference to their electrical, magnetic, and mechanical properties. Emphasis is placed on the dependence of material properties on their composition and structure. Materials examined include those materials that have special physical and physicochemical properties, such as metal semiconductors, superconducting materials, thin ferromagnetic films, magnetic recording materials, and corrosion and radiation resistant magnetic alloys. Other materials discussed are shape memory alloys, beryllium and beryllium alloys, and composite materials. Finally, nonmetal materials including organic and inorganic materials, film-forming materials, adhesives, varnishes, fibers, plastics, and polymer composites are reviewed. V.L.

**A83-10653#**  
**FUEL PROPERTY EFFECTS ON AIR FORCE GAS TURBINE ENGINES - PROGRAM GENESIS**

T. A. JACKSON (USAF, Aero Propulsion Laboratory, Wright-Patterson AFB, OH) Journal of Energy, vol 6, Nov-Dec. 1982, p. 376-383 refs

(Previously cited in issue 12, p. 1972, Accession no. A81-29926)

**A83-10655\*#** General Electric Co., Cincinnati, Ohio  
**IMPACTS OF BROADENED-SPECIFICATION FUELS ON AIRCRAFT TURBINE ENGINE COMBUSTORS**

D. W. BAHR (General Electric Co., Cincinnati, OH) Journal of Energy, vol 6, Nov-Dec 1982, p. 392-398. NASA-USAF-FAA-sponsored research. refs

(Previously cited in issue 12, p. 1972, Accession no. A81-29927)

**A83-11050\*#** Southwest Research Inst., San Antonio, Tex.  
**TESTS OF BLENDING AND CORRELATION OF DISTILLATE FUEL PROPERTIES**

J. ERWIN and J. N. BOWDEN (Southwest Research Institute, San Antonio, TX) American Institute of Chemical Engineers, Summer National Meeting, Cleveland, OH, Aug 29-Sept. 1, 1982, Paper 38 p.

(Contract NAS3-22783)

The development of a fuel test matrix, results from tests of several blends of distillate aircraft fuels, and the use of correlations in formulation determination during a NASA-sponsored program to identify new aircraft fuels are described. The program was initiated in order to characterize fuel blends which are appropriate for different types of combustors in use and under development. The fuels were required to feature a specified range of properties. Attention is given to fuel volatility, hydrogen content, aromatic content, freezing point, kinematic viscosity, and naphthalene content. Paraffinic and naphthenic base stocks were employed, using alkyl benzene, naphthene benzenes, and naphthalenes to adjust the blend properties. Categories for the test fuels comprised source-controlled and composition controlled fuels. Test results and compositions of various fuels are provided. M.S.K.

**A83-11482\*#** Utah Univ., Salt Lake City.  
**A CARBON-13 AND PROTON NUCLEAR MAGNETIC RESONANCE STUDY OF SOME EXPERIMENTAL REFERENCE BROADENED-SPECIFICATION /ERBS/ TURBINE FUELS**

D. K. DALLING and R. J. PUGMIRE (Utah, University, Salt Lake City, UT) American Institute of Chemical Engineers, Summer National Meeting, Cleveland, OH, Aug 29-Sept. 1, 1982, Paper 20 p. refs

(Contract NAG3-27)

Preliminary results of a nuclear magnetic resonance (NMR) spectroscopy study of alternative jet fuels are presented. A reference broadened-specification (ERBS) aviation turbine fuel, a mixture of 65 percent traditional kerosene with 35 percent hydrotreated catalytic gas oil (HCGO) containing 12.8 percent hydrogen, and fuels of lower hydrogen content created by blending the latter with a mixture of HCGO and xylene bottoms were studied. The various samples were examined by carbon-13 and proton NMR at high field strength, and the resulting spectra are shown. In the proton spectrum of the 12.8 percent hydrogen fuel, no prominent

single species is seen while for the blending stock, many individual lines are apparent. The ERBS fuels were fractionated by high-performance liquid chromatography and the resulting fractions analyzed by NMR. The species found are identified. C.D.

**A83-11492\*#** General Motors Corp., Indianapolis, Ind.  
**MULTIFUEL EVALUATION OF RICH/QUENCH/LEAN COMBUSTOR**

A. S. NOVICK, D. L. TROTH (General Motors Corp., Detroit Diesel Allison Div., Indianapolis, IN), and J. NOTARDONATO (NASA, Lewis Research Center, Cleveland, OH) IEEE, ASME, and ASCE, Joint Power Generation Conference, Denver, CO, Oct. 18, 1982, Paper 9 p. Research supported by the U.S. Department of Energy. refs

Test results on the RQL low NO(x) industrial gas turbine engine are reported. The air-staged combustor comprises an initial rich burning zone, followed by a quench zone, and a lean reaction and dilution zone. The combustor was tested as part of the DoE/NASA program to define the technology for developing a durable, low-emission gas turbine combustor capable of operation with minimally processed petroleum residual, synthetic, or low/mid-heating value gaseous fuels. The properties of three liquid and two gaseous fuels burned in the combustor trials are detailed. The combustor featured air staging, variable geometry, and generative/convective cooling. The lean/rich mixtures could be varied in zones simultaneously or separately while maintaining a specified pressure drop. Low NO(x) and smoke emissions were produced with each fuel burned, while high combustor efficiencies were obtained. M.S.K.

**A83-11800**  
**A PRODUCTION ENGINEERS VIEW OF ADVANCED COMPOSITE MATERIALS**

R. L. KING (British Aerospace Public Ltd., Co., Weybridge, Surrey, England) Materials and Design, vol 3, Aug. 1982, p. 515-522 refs

The influence on design practices and performance levels in aircraft and automotive applications are assessed, for carbon fiber and Kevlar-reinforced epoxy composites. Attention is also given to the impact of such materials on production tooling and manpower costs, by comparison with metallic aircraft structures. Although advanced composites were originally developed for aerospace structures because of their weight-saving potential, manufacturing cost savings are able, in the wake of new fabrication techniques and cooperation between design and production engineers, to exceed the greater initial cost of these advanced materials. O.C.

**A83-12014**  
**WATER-DISPLACING ORGANIC CORROSION INHIBITORS - THEIR EFFECT ON THE FATIGUE CHARACTERISTICS OF ALUMINIUM ALLOY BOLTED JOINTS**

A. S. MACHIN and J. Y. MANN (Department of Defence, Structures Div., Melbourne, Australia) International Journal of Fatigue, vol 4, Oct 1982, p. 199-208 refs

Results of fatigue tests, performed in repeated tension under constant amplitude and multi-load level sequences on aluminum alloy bolted joints are presented, in order to examine the effect of inhibitors on the fatigue lives of bolted joints. Three 1200 x 3660 mm sheets of 3.6 mm thick clad 2024-T3 aluminum alloy were investigated, using two cyclic frequencies (2.5 and 17 Hz). Data show first end failure and second end failure of each specimen, and several conclusions are drawn. It is determined that the fatigue lives of double-lap bolted joints using either of the water-displacing corrosion-inhibitors (LPS-3 or PX-112) are not significantly different. In addition, no significant differences in fatigue lives of high load transfer and low load transfer fully torqued bolted joints are detected under constant amplitude testing. Finally, the specific effect of water-displacing organic corrosion inhibitors on joint fatigue strength depends on joint design and construction, and on the severity of the loading spectrum. R.K.R.

## 11 CHEMISTRY AND MATERIALS

**A83-12971#**

**THE CANADAIR CHALLENGER ADVANCED COMPOSITE MATERIAL PROGRAM**

R. J. HEBERT (Canadair, Ltd., Montreal, Canada) (Canadian Symposium on Aerospace Structures and Materials, 1st, Toronto, Canada, June 14, 1982.) Canadian Aeronautics and Space Journal, vol 28, June 1982, p. 159-164

**N83-10173#** Aeronautical Research Labs, Melbourne (Australia)

**THE EFFECT OF WATER DISPLACING CORROSION PREVENTIVES ON STRESS CORROSION CRACKING OF ALUMINIUM ALLOY 7075-T651**

L. WILSON and R. S. G. DEVEREUX Mar 1982 8 p refs (ARL-MAT-NOTE-132; AR-002-341) Avail: NTIS HC A02/MF A01

The effectiveness of some commercial water displacing corrosion preventive formulations in inhibiting stress corrosion cracking of 7075-T651 aluminum alloy was investigated. Examples of three types of protective agents, viz. oily films, soft (grease like) films, and hard (resin like) films were used and all were found to be effective in reducing rates of stress corrosion crack growth in laboratory tests  
A R.H.

**N83-10207\*# Midwest Research Inst., Kansas City, Mo  
EVALUATION OF METHODS FOR RAPID DETERMINATION OF FREEZING POINT OF AVIATION FUELS Final Report**

B. MATHIPRAKASAM Sep. 1982 105 p refs (Contract NAS3-22543) (NASA-CR-167981, NAS 1.26:167981, MRI-7014-G) Avail NTIS HC A06/MF A01 CSCL 21D

Methods for identification of the more promising concepts for the development of a portable instrument to rapidly determine the freezing point of aviation fuels are described. The evaluation process consisted of (1) collection of information on techniques previously used for the determination of the freezing point, (2) screening and selection of these techniques for further evaluation of their suitability in a portable unit for rapid measurement, and (3) an extensive experimental evaluation of the selected techniques and a final selection of the most promising technique. Test apparatuses employing differential thermal analysis and the change in optical transparency during phase change were evaluated and tested. A technique similar to differential thermal analysis using no reference fuel was investigated. In this method, the freezing point was obtained by digitizing the data and locating the point of inflection. Results obtained using this technique compare well with those obtained elsewhere using different techniques. A conceptual design of a portable instrument incorporating this technique is presented  
J.D.

**N83-10210#** Ashland Petroleum Co., Ky. Research and Development Dept.

**REFINING OF MILITARY JET FUELS FROM SHALE OIL. PART 1. PRELIMINARY PROCESS DESIGN, ECONOMIC AND YIELD OPTIMIZATION, AND COMPUTER MODELING Interim Technical Report, Feb. - Jun. 1979**

C. JOHNSON, H. F. MOORE, and W. A. SUTTON Wright-Patterson AFB, Ohio AFWAL Apr. 1982 187 p refs (Contract F33615-78-C-2080; AF PROJ. 3048) (AD-A117511; AFWAL-TR-81-2056-PT-1) Avail. NTIS HC A09/MF A01 CSCL 21D

Phase I work performed was directed at the preparation of an overall processing method based on the application of current refining techniques and an extraction process for the removal of nitrogen from shale oil. This preliminary process analysis was aimed at demonstrating technical as well as economic feasibility. This phase explored two overall processing methods, one providing JP-8 type aviation turbine fuel, the other method providing JP-4 type aviation turbine fuel. It was concluded that this process design offers the potential of producing high yields of aviation turbine fuels from shale oil with product costs competitive with or lower than comparable product slates from other shale refineries. Processing steps are provided that will minimize hydrogen

consumption, provide a thermal efficiency greater than 70 percent, and produce residual fuel in quantities less than 10 percent of the total product slate  
Author (GRA)

**N83-10211#** Suntech, Inc., Marcus Hook, Pa.  
**AN EXPLORATORY RESEARCH AND DEVELOPMENT PROGRAM LEADING TO SPECIFICATIONS FOR AVIATION TURBINE FUEL FROM WHOLE CRUDE SHALE OIL. PART 4: PRODUCTION OF SAMPLES OF MILITARY FUELS FROM RAW SHALE OILS Interim Report, 1 Apr. 1980 - 30 Nov. 1981**

H. E. REIF, J. P. SCHWEDOCK, and A. SCHNEIDER Wright-Patterson AFB, Ohio AFWAL Feb 1982 73 p Presented at the 3rd Jet Fuel From Shale Oil Technol Rev., Miamisburg, Ohio, 17-18 Nov 1981 (Contract F33615-78-C-2024, AF PROJ 2480) (AD-A117526, AFWAL-TR-81-2087-PT-4) Avail: NTIS HC A04/MF A01 CSCL 21E

A total of 475 gallons of specification aviation turbine fuels (JP-4, JP-5 and JP-8) were prepared from Occidental Shale Oil based on Sun Tech's upgrading concept. Processing consists of six steps: (1) hydrotreating the whole shale oil to partially reduce total nitrogen content to minimize hydrogen consumption; (2) distilling the hydrotreated product into appropriate fractions for additional processing, (3) rehydrotreating the light distillate fraction to meet product specifications; (4) treating the wide boiling gas oil fraction with anhydrous hydrogen chloride (HCl) which yields a low nitrogen content raffinate and a high nitrogen content extract phase, (5) thermally decomposing the extract to recover anhydrous HCl and a nitrogen-rich extract, which is used for generating hydrogen by partial oxidation; and (6) hydrocracking the raffinate phase to maximize aviation turbine fuel yield. Five 5-gallon samples of specification military fuels were produced from Paraho shale oil (JP-4, JP-5, JP-8, DF-2 and DF Marine) using a modified process. Processing consists of severely hydrotreating raw shale oil followed by fractionation and finally hydrocracking the wide boiling gas oil fraction to produce the desired product slate.  
GRA

**N83-10214\*#** National Academy of Sciences - National Research Council, Washington, D C. Committee on Alternative Aviation Turbine Fuels, Aeronautics and Space Engineering Board.  
**AVIATION TURBINE FUELS: AN ASSESSMENT OF ALTERNATIVES Final Report**

Apr 1982 82 p refs (Contract NASW-3522) (NASA-CR-169395, NAS 1.26:169395; PB82-213737) Avail: NTIS HC A05/MF A01 CSCL 21D

The general outlook for aviation turbine fuels, the effect that broadening permissible aviation turbine fuel properties could have on the overall availability of such fuels, the fuel properties most likely to be affected by use of lower grade petroleum crudes, and the research and technology required to ensure that aviation turbine fuels and engines can function satisfactorily with fuels having a range of fuel properties differing from those of current specification fuel are assessed. Views of industry representatives on alternative aviation turbine fuels are presented.  
GRA

**N83-11053#** Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.  
**SUCCESS OF DYE FORGING TITANIUM DISCS ON A GUNPOWDER HAMMER**

L. CHENGGONG *In its* Intern. Aviation (Selected Articles) (FTD-ID(RS)T-0679-82) p 15-21 15 Jul. 1982 Transl. into ENGLISH from Guoji Hangkong (China), no 2, Feb. 1982 p 25-27, 42-45 and 48  
Avail: NTIS HC A03/MF A01 CSCL 11F

A 40 ton meter gunpowder hammer was developed and successfully used to forge titanium aircraft engine compressor disks. The gunpowder hammer is a dye forging device which uses gunpowder as the power source.  
Author

**883-11232#** Army Materials and Mechanics Research Center, Watertown, Mass.

**APPLICATION OF FOURIER TRANSFORM INFRARED SPECTROSCOPY FOR QUALITY CONTROL ANALYSIS OF EPOXY RESIN PREPREGS USED IN HELICOPTER ROTOR BLADES**

T. F. SAUNDERS, M. CIULLA, S. WEHNER, and J. BROWN *In its Proc of the Critical Rev.* p 243-250 May 1982  
Avail. NTIS HC A21/MF A01 CSCL 11C

Fourier transformation infrared (FT-IR) spectroscopy provides enough information from a single spectrum, with five functional group peak absorbances being measured, to allow acceptance or rejection of lots of prepreg FT-IR allows reproducible quantitative absorbance determinations of the 3400/cm -OH, 2180/cm -C (triple bond) N, 1140/cm aliph ether and 915/cm epoxide Spectra are obtained on thin films of THF/DMF extracts from the epoxy/glass prepreg cast on KBr plates ATR spectra were not good enough for precise quantitative determination. A.R.H

**883-11243\*#** National Aeronautics and Space Administration Langley Research Center, Hampton, Va.  
**DURABILITY OF COMMERCIAL AIRCRAFT AND HELICOPTER COMPOSITE STRUCTURES**

H. B. DEXTER *In Army Materials and Mechanics Research Center Proc of the Critical Rev.* p 423-452 May 1982  
Avail. NTIS HC A21/MF A01 CSCL 11D

The development of advanced composite technology during the past decade is discussed Both secondary and primary components fabricated with boron, graphite, and Kevlar composites are evaluated. Included are spoilers, rudders, and fairings on commercial transports, boron/epoxy reinforced wing structure on C-130 military transports, and doors, fairings, tail rotors, vertical fins, and horizontal stabilizers on commercial helicopters The development of composite structures resulted in advances in design and manufacturing technology for secondary and primary composite structures for commercial transports Design concepts and inspection and maintenance results for the components in service are reported. The flight, outdoor ground, and controlled laboratory environmental effects on composites were also determined Effects of moisture absorption, ultraviolet radiation, aircraft fuels and fluids, and sustained tensile stress are included. Critical parameters affecting the long term durability of composite materials are identified E.A.K

**883-11248\*#** Boeing Commercial Airplane Co., Seattle, Wash  
**ADVANCED COMPOSITE ELEVATOR FOR BOEING 727 AIRCRAFT Quarterly Technical Progress Report, 23 May - 22 Aug. 1978**

22 Aug. 1978 91 p refs  
(Contract NAS1-14952)  
(NASA-CR-157823; NAS 1.26:157823; QTPR-5) Avail NTIS HC A05/MF A01 CSCL 11D

Detail design activities are reported for a program to develop an advanced composites elevator for the Boeing 727 commercial transport. Design activities include discussion and results of the ancillary test programs, sustaining efforts, weight status, manufacturing producibility studies, quality assurance development, and production status. Author

**883-11251#** Technische Hogeschool, Delft (Netherlands) Dept of Aerospace Engineering.

**DESIGN, FABRICATION AND TESTING OF AN ADVANCED COMPOSITE ACCESS DOOR FOR USE IN A LOWER WING PANEL**

J. C. DARDELET and W. H. M. VANDREUMEL Oct. 1981 29 p refs  
(VTH-LR-335) Avail. NTIS HC A03/MF A01

For reasons of comparison, the dimensions and the load specification of a Fokker F-27 Friendship hatch at station 5000 were chosen The panel is designed as a carbon fiber sandwich construction in which the laminate type and thickness are determined by the strength of the mechanical joint A full scale

tensile test was carried out and a weight comparison was made with the original aluminum hatch. Author (ESA)

**883-11281#** Aeronautical Research Labs, Melbourne (Australia).

**THE INFLUENCE OF WATER-DISPLACING ORGANIC CORROSION INHIBITORS ON THE FATIGUE BEHAVIOUR OF 2024-T3 ALCALD ALUMINIUM ALLOY BOLTED JOINTS**

A. S. MACHIN and J. Y. MANN Jan 1982 37 p refs  
(ARL-STRUC-REPORT-390, AR-002-335) Avail NTIS HC A03/MF A01

Fatigue tests were carried out in repeated tension under both constant amplitude and multiloading level sequences on several types of 8 bolt double lap joint specimens of 2024-T3 alclad aluminum alloy sheet. These included both low and high (100%) load transfer joints, using high and low bolt clamping forces in each case. Complementary tests were made on each type of joint assembled with either dry components or components coated with the corrosion inhibitor preparations LPS-3 or PX-112 Contrary to the findings of previous investigations into the effect of inhibitors on riveted joints, the two corrosion inhibitors used were found, in general, to have either no effect or a beneficial effect on the fatigue lives of bolted joints It is concluded that the specific effects of a water displacing organic corrosion inhibitor on fatigue strength of joints are likely to be dependent on both the type of joint, its configuration and on the severity of the load spectrum involved. B.W.

**883-11282\*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

**COSAM (CONSERVATION OF STRATEGIC AEROSPACE MATERIALS) PROGRAM OVERVIEW**

Washington Oct 1982 227 p Workshop held at Cleveland, 14-15 Oct. 1982  
(NASA-TM-83006; E-1382, NAS 1.15:83006) Avail NTIS HC A11/MF A01 CSCL 11F

Abstracts and visual materials used to illustrate presentations reviewing progress in the Conservation of Strategic Materials Program (COSAM) are presented.

**883-11331\*#** Boeing Commercial Airplane Co., Seattle, Wash. Preliminary Design Dept

**AIRCRAFT SURFACE COATINGS STUDY: VERIFICATION OF SELECTED MATERIALS Final Report, Apr. - Dec. 1979**

Sep 1980 79 p refs  
(Contract NAS1-14742)  
(NASA-CR-159288, NAS 1.26:159288; D6-48669) Avail: NTIS HC A05/MF A01 CSCL 11C

Three liquid coatings and four films that might improve and/or maintain the smoothness of transport aircraft surfaces are considered Laboratory tests were performed on the liquid coatings (elastomeric polyurethanes) exposed to synthetic type hydraulic fluid, with and without a protective topcoat Results were analyzed of a 14-month flight service evaluation of coatings applied to leading edges of an airline 727. Two additional airline service evaluations were initiated. Laboratory tests were conducted on the films, bonded to aluminum substrate with various adhesives, to determine the best film/adhesive combinations. A cost/benefits analysis was performed and recommendations made for future work toward the application of this technology to commercial transports Author

**883-11340\*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

**RECENT TRENDS IN AVIATION TURBINE FUEL PROPERTIES**

R. FRIEDMAN Oct. 1982 33 p refs  
(NASA-TP-2056, E-1127, NAS 1.60:2056) Avail: NTIS HC A03/MF A01 CSCL 21D

Plots and tables, compiled from Department of Energy (and predecessor agency) inspection reports from 1969 to 1980, present ranges, averages, extremes, and trends for most of the 22 properties of Jet A aviation turbine fuel In recent years, average values of aromatics content, mercaptan sulfur content, distillation temperature of 10 percent recovered, smoke point, and freezing

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point show small but recognizable trends toward their specification limits. About 80 percent of the fuel samples had at least one property near specification, defined as within a standard band about the specification limit. By far the most common near-specification properties were aromatics content, smoke point, and freezing point. Author

**N83-11350#** Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France)  
**PROPULSION AND ENERGETICS PANEL, WORKING GROUP 13 ON ALTERNATIVE JET ENGINE FUELS. VOLUME 1: EXECUTIVE SUMMARY**

R. B. WHYTE, ed. Jul. 1982 16 p 2 Vol  
(AGARD-AR-181-VOL-1, AD-A119916) Avail NTIS HC A02/MF A01

Alternative fuels for gas turbine engines which may entail considerable changes in fuel properties and relaxation of key items in present specifications to ensure adequate supplies are studied. The physical properties as well as the hydrocarbon composition of the fuels and their effects on handling and storage, aircraft fuel systems and engines are investigated. S.L.

**N83-11351#** Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).

**PROPULSION AND ENERGETICS PANEL, WORKING GROUP 13 ON ALTERNATIVE JET ENGINE FUELS. VOLUME 2: MAIN REPORT**

R. B. WHYTE, ed Jul 1982 169 p 2 Vol  
(AGARD-AR-181-VOL-2, AD-A119917) Avail: NTIS HC A08/MF A01

Supply/demand of jet engine fuels for use by the in aeronautical research and development efforts was forecast The effects of potential variations in hydrocarbon fuel properties on the performance, operating envelope, exhaust emissions, durability, maintainability, reliability and safety of aviation gas turbine aircraft was assessed 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

**A83-10063**

**SIMULATION OF BACKGROUND CLUTTER**

D. F. STREZWILK (U.S. Army, Ballistics Research Laboratories, Aberdeen Proving Ground, MD) In: International Geoscience and Remote Sensing Symposium, Washington, DC, June 8-10, 1981, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1981, p 648-653 refs

A statistical background model has been developed to simulate the output of a passive 35 GHz radiometer mounted on a helicopter to find targets on the ground. The model assumes that the temperature versus time data of background radiation can be described by pulses, whose amplitudes are normally distributed and whose lengths are exponentially distributed. The statistical parameters, including the correlation coefficient, are determined from actual data. The model was needed to address two problem areas, which the computer studies of the system performance were unable to treat in the past, viz., false targeting and aiming errors caused by the distortion of the target signature by background noise. (Author)

**A83-10190\*#** National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.

**PREDICTION OF TRANSONIC FLUTTER FOR A SUPERCRITICAL WING BY MODIFIED STRIP ANALYSIS**

E. C. YATES, JR., E. C. WYNNE, M. G. FARMER, and R. N. DESMARAIS (NASA, Langley Research Center, Loads and Aeroelasticity Div., Hampton, VA) (In 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. 377-405) Journal of Aircraft, vol 19, Nov 1982, p 999-1004 refs

(Previously cited in issue 12, p 2022, Accession no. A81-29471)

**A83-10453**

**ANALYTICAL DESIGN OF THIN-WALL WINGS AT THE DRAFTING STAGE [ANALITICHESKOE PROEKTIROVANIE TONKOSTENNYKH KRYL'EV NA ETAPE ESKIZNOGO PROEKTA]**

A. V. KHALKIN Vychislitel'naya i Prikladnaya Matematika, no 45, 1981, p. 88-93. In Russian refs

The paper examines the design of a beveled thin-wall wing under the condition that design requirements be satisfied on a finite number of functionals reflecting the quality of the structure. A discrete-continuous scheme is used to analyze the stress-strain state of the wing. Special functionals are used to reduce the design problem to an optimal minimax problem, which is solved by an algorithm implemented in a package of KRYLO programs B.J.

**A83-10870**

**THE AVDEL MBC AEROSPACE BLIND RIVETING SYSTEM**

R. D. LACEY (Avdel, Ltd., Welwyn Garden City, Herts., England) Aircraft Engineering, vol. 54, Sept. 1982, p 15-18

MBC aerospace fastener design is discussed, with particular attention given to installation sequence, performance, materials, and user benefits. Two components comprise the MBC rivet, the body and the stem, both of which are fabricated by a cold forming process, and are crimped to ensure that they remain together during transit handling and installation. Installation can be accomplished in less than one second, and requires no skill contributions by the operator. Component materials are aluminum alloy or corrosion resistant steel (which offers the capability of operating at high temperatures without significant strength loss). Sheet take-up capability is high, resulting in cost savings and improved joint quality, and the mechanically locked stem offers design security. Other benefits include reduction in the risk of operator error, reduced aircraft structure weight, and reliability. R.K.R.

**A83-11076**

**OPTICAL METHODS OF FLOW DIAGNOSTICS IN TURBOMACHINERY**

C. J. MOORE, D. G. JONES, C. F. HAXELL, P. J. BRYANSTON-CROSS, and R. J. PARKER (Rolls-Royce, Ltd., Advanced Research Laboratory, Derby, England) In: ICASF '81; International Congress on Instrumentation in Aerospace Simulation Facilities, Dayton, OH, September 30, 1981, Record New York, Institute of Electrical and Electronics Engineers, Inc., 1981, p 244-255. refs

Holography and laser anemometry have been developed to furnish experimental data on turbomachinery aerodynamics. Holographic interferometry records the density distributions within turbomachine flow, yielding quantitative measurements of the density field in two-dimensional cascades, and the positions of such major features as shocks, vortices, wakes and boundary layers in the three-dimensional flow of actual blade rows. Laser anemometry is used to make point-by-point quantitative measurements of the flow velocity in both two- and three-dimensional flow. Because the mapping of the flow in an entire blade passage by means of laser anemometry is slow and difficult, the most efficient gathering of measurements in real turbomachinery is conducted by first using holography to show

the main features of the flow and then employing laser anemometry to fill in details in selected areas of blade passages O.C.

**A83-11085**  
**THE SOLUTION OF 'REAL-WORLD' AIRCRAFT EMC PROBLEMS USING THE AAPG COMPUTER PROGRAM**

H. H. HODES and H. P. WIDMER (IIT Research Institute, Annapolis, MD) In: NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 11-18.  
(Contract F19628-80-G-0042)

Antenna-to-antenna coupled EMC problems have traditionally been difficult to solve due to the complexity of the related analyses and the overwhelming quantities of data involved. The AAPG computer program was designed to assist in the analysis of these problems by combining state-of-the-art analytic geometry algorithms which determine GTD coupling paths and computer graphics displays which describe these computations to the analyst. This paper discusses the operational and design philosophies of the AAPG program as they relate to the investigation of 'real-world' antenna-to-antenna coupled EMC problems. The structure and usage of the AAPG program is briefly outlined. Five general classes of antenna-to-antenna coupled EMC applications of AAPG are discussed. The use of AAPG in the U.S. Navy ASEMICAP and the U.S. Air Force HAVE NOTE programs at ECAC is discussed. As a detailed example of the practical usage of AAPG, the assessment of the EMI potentials of 24 candidate missile warning systems on the F-16 aircraft is presented (Author)

**A83-11089**  
**INTEGRATED CNI AVIONICS MAXIMIZES RELIABILITY**

P. C. CAMANA and M. E. CAMBELL (TRW, Inc., Military Electronics Div., San Diego, CA) In: NAECON 1982, Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 42-45.  
(Contract F33615-81-C-1512)

An integrated architecture is presented for communications, navigation, and cooperative identification (CNI) functions in the avionics of fighter aircraft. Attention is given to the development of fault tolerant, gracefully degrading systems, where inputs may be rerouted if failure occurs in any prime circuit. A block diagram is provided for the recommended architecture. Major partitioning is noted in the L-band transmit/receive and HF/VHF/UHF-band transmit/receive sections, involving provision of alternative paths for up- and down-link circuits. Functional applications of the proposed circuitry in various geographic regions and hostile environments are discussed, particularly the substitution of function reliability for component/module reliability, producing a continuum of availability. Numerical modeling to define the capability of a system to meet a given mission is demonstrated. M.S.K.

**A83-11136#**  
**INTEGRATED PERCEPTUAL INFORMATION FOR DESIGNERS**

K. R. BOFF (USAF, Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH) In: NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 430-434 refs

The Integrated Perceptual Information for Designers (IPID) program has been developed in order to optimize the operator's contribution to system effectiveness. Information management objectives of the IPID program are: the consolidation of relevant sensory and perceptual data, the effective presentation of data to the designer, and accessibility to the data. Data pertain particularly to aircrew simulator and operational control/display designer needs. IPID data can be useful in generating design options, specifications, and standards, and in evaluating standards and examining alternatives. Specific applications of IPID data include supervisory control, operator interface definition in automated systems, and visual standards definitions. R.K.R.

**A83-11185**  
**SINGLE CHIP BUS INTERFACE UNIT EASES MIL-STD-1553B REMOTE TERMINAL/BUS CONTROLLER DESIGNS**

S. SCHAIRE and J. CAVIN (Grumman Aerospace Corp., Bethpage, NY) In: NAECON 1982, Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 864-871

A new single-chip 'Smart' Bus Interface Unit (BIU), which is basically a communications processor on a chip, has been developed for use as a remote terminal and a bus controller with MIL-STD-1553B. The BIU design approach allows for future multiplex terminals without the software or BIU becoming obsolete. The use of BIU without a processor and with 8-bit, 16-bit, and other microprocessors is discussed. A sample application with the M68000 microprocessor and the inherent flexibility of the proposed design for future applications are demonstrated. V.L.

**A83-11231**  
**INVESTIGATION OF NETWORK TREE TECHNOLOGY AS A TOOL FOR DEVELOPING EFFECTIVE FAULT ISOLATION PROCEDURES**

D. E. PETERSON (Boeing Co., Houston, TX) In: NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 3. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 1211-1218 refs

The use of the Sneak Circuit Analysis (SCA) for effective fault isolation procedure development is investigated, resulting in the definition of a structured methodology for creating logic trees with development and evaluation applications. A systems point-to-point electrical continuity is encoded in a card-image format in order to accomplish data entry, which should be performed via an interactive system. The sorting process should be as batch a process as possible, and the resulting groups are plotted in forest and network tree form. These trees are then used to determine normal and abnormal system response. Finally, the fault isolation procedure logic is developed. It is noted that the resulting methodology can be used for verification purposes, and for other systems analyses. R.K.R.

**A83-11505**  
**ULTRASONIC TOMOGRAPHY FOR NONDESTRUCTIVE EVALUATION**

J. W. EBERHARD (General Electric Co., Schenectady, NY) In: Annual review of materials science. Volume 12. Palo Alto, CA, Annual Reviews, Inc., 1982, p. 1-21 refs

The current status of ultrasonic tomography is reviewed in the context of the broader area of ultrasonic nondestructive evaluation (NDE). Acoustic velocity and attenuation are singled out as parameters of particular value in characterizing materials with distributed flaws, and tomographic images of acoustic velocity in metallic specimens are described. Several successful applications of NDE are detailed, including determination of residual stress in reactor vessels, of velocity variations in aircraft gas turbine materials, and flaw imaging in reflection geometry. Preliminarily, the fundamentals of fracture mechanics and standard NDE inspection procedures are summarized. C.D.

**A83-11628**  
**MASS-PRODUCED LASER GYROS**

R. WHITAKER Flight International, vol. 122, Oct. 23, 1982, p. 1229-1231.

The requirements and difficulties encountered in commercial production of ring-laser gyroscopes are discussed. These gyroscopes, whose design principles were first suggested 20 years ago, are sealed units employing two laser beams passing each other within the cavity in opposite directions and a readout detector which registers interference patterns due to resonant frequency differences between the laser beams; these differences are in turn due to varying angular rotation rates as an aircraft maneuvers. Three ring-laser gyroscopes mounted at mutually right angles suffice to obtain angular rotation rates in all directions. The main

difficulty encountered in mass production is that of machining the cervit glass chosen for its low thermal expansion coefficient in the 74 C to -54 C range, and its minimum inhibition of He/Ne lasing. Laser interferometry is used to check the polishing of the unit. O.C

**A83-11779**

**A NUMERICAL SIMULATION OF THREE-DIMENSIONAL TRANSONIC FLOWS OF COMPRESSIBLE PERFECT FLUIDS AROUND AIRCRAFT BY USE OF THE FINITE ELEMENT AND LEAST SQUARES METHODS [SIMULATION NUMERIQUE D'ECOULEMENTS TRIDIMENSIONNELS TRANSSONIQUES DE FLUIDES PARFAITS COMPRESSIBLES AUTOUR D'AVIONS PAR DES METHODES D'ELEMENTS FINIS ET DE MOINDRES CARRES]**

G. POIRIER (Avions Marcel Dassault-Breguet Aviation, Vaucresson, Hauts-de-Seine, France) Association Aeronautique et Astronautique de France, Colloque d'Aerodynamique Appliquee, 18th, Poitiers, France, Nov. 18-20, 1981, 44 p. In French. Direction des Recherches, Etudes et Techniques refs (Contract DRET-81-425) (AAAF PAPER NT 81-23)

A numerical method is presented for obtaining solutions, in a conservative form, for transonic equations of a perfect compressible fluid. A complicated geometry of an aircraft is accounted for using limiting conditions in a finite element method to form approximations. A least squares method is employed for nonlinear problems, such as shocks, and includes factors of lift and entropy. Algorithms for a gradient are introduced, linked to the least squares formulations, and demonstrated to be useful in computer schemes for designing three-dimensional industrial structures, e.g., aircraft, intake ducts, and wings M.S.K.

**A83-11857**

**OPTIMIZATION OF AIRCRAFT STRUCTURES [OPTIMISATION DES STRUCTURES D'AVION]**

C. PETIAU and G. LECINA (Avions Marcel Dassault-Breguet Aviation, Saint-Cloud, Hauts-de-Seine, France) Journal de Mecanique Theorique et Appliquee, vol 1, no 2, 1982, p 291-309. In French refs

A finite element method for weight minimization in the design of aircraft structures is presented. The economic utilization of the method depended on developing an iterative process which was cost-effective. The code that resulted, ELFINI, regrouped, around finite element cores, large branching analyses of the aeronautical structures. Algorithms were devised for linear and nonlinear static constraints, static aeroelasticity, load management, dynamic flutter damping, with transitory and forced response, heat transfer, isothermal mapping, and crack propagation. Partial derivatives are calculated for constraints on the optimization, limits to the flutter speed are defined, and the extremum of transitory response is derived. Two methods for explicit optimization are introduced, and it is noted that final changes, based on small variations in the basic parameters, can be investigated with interactive graphics at the CAD station. An example is presented in terms of designs of a carbon fiber empennage and a delta wing M.S.K.

**A83-11942**

**EFFECTS OF AMPLITUDE OF OSCILLATION ON THE WEAR OF DRY BEARINGS CONTAINING PTFE**

J. K. LANCASTER, R. W. BRAMHAM (Royal Aircraft Establishment, Materials Dept., Farnborough, Hants, England), D. PLAY (Lyon, Institut National des Sciences Appliquees, Villeurbanne, Rhone, France), and R. WAGHORNE (Fulmer Research Institute, Ltd., Stoke Poges, Bucks, England) ASME, Transactions, Journal of Lubrication Technology, vol. 104, Oct. 1982, p. 559-567. Direction des Recherches, Etudes et Techniques Ministry of Defence refs

(Contract DRET-77-1234; MOD-K/LR32B/2175) (ASME PAPER 81-LUB-6)

The friction coefficients and wear rates of two dry-bearing materials have been measured during oscillatory motion at different amplitudes. The materials were composites incorporating fabrics

of interwoven PTFE and glass fibers and differed in the pitch of the glass fiber at the surface. The worn surfaces were examined by SEM, EPMA, and XPS. The results show that when the amplitude of oscillation becomes less than the glass fiber pitch, third-body debris films on the counterface become increasingly nonuniform and surface roughness increases. The resulting trend toward increased bearing liner wear, however, is small provided that the amplitude of oscillation remains constant. The relevance of the results to the operation of airframe dry bearings operating under active control is discussed (Author)

**A83-12347#**

**OPTICAL SENSOR FOR MEASUREMENT OF POSITION AND DEFORMATIONS OF MODELS IN WIND TUNNEL**

J. SURGET, M. PHILBERT, and G. DUNET (ONERA, Chatillon-sous-Bagneux, Hauts-de-Seine, France) La Recherche Aeronautique (English Edition), no. 3, 1982, p 43-51

The design of an optical position sensor produced to allow the localization of the trailing edge of a wing placed in a wind tunnel is presented. The instrument consists of the sensor itself, an electronic cabinet, and a control box. In calibrating the instrument, it is noted that dispersion of the location of the tip of the optical fiber never exceeded plus or minus 0.01 mm, and no apparent drift was detected. Validation was performed by comparing position indications obtained using an optical sensor and a mechanical feeler. Tests are performed at three flow velocities, and it is found that the device functions satisfactorily. The principal advantages of such a device include sensitivity, absence of drift, and ease of operation. R.K.R.

**A83-12657#**

**LIFE DEVELOPMENT OF COMPONENTS/SYSTEMS OF AIRCRAFT**

R. DUGGAL (Indian Airlines, Bombay, India) Aeronautical Society of India, Journal, vol. 33, Feb.-May 1981, p 35-39

Three aspects of a maintenance program are described. The first, referred to here as hard time limit (HTL), involves the removal and complete overhaul of an aircraft component at fixed time intervals. A second type of maintenance procedure, referred to as 'on condition,' is used with parts that are allowed to remain in service until there is a failure, suspected failure, or scheduled inspection. The third type of procedure is called condition monitoring. This is used on items that are neither overhauled nor inspected on a regular basis. The unit or part is operated until failure occurs. Economies in maintenance can be achieved by a judicious combination of these procedures. C.R.

**A83-12660#**

**CUMULATIVE DAMAGE AND LIFE-ESTIMATIONS IN FATIGUE**

A BHATTACHARYA and P. C. UPADHYAYA (Banaras Hindu University, Varanasi, India) Aeronautical Society of India, Journal, vol 33, Aug.-Nov. 1981, p. 61-68. refs

A deterministic model is proposed to study the cumulative damage effect of different stress amplitudes on fatigue life. It is shown that the results derived from this model are much closer to the reported experimental values than the predictions of the other models. A cumulative damage parameter (termed as CD parameter) is introduced such that its maximum value corresponds to a conservative estimate of the design life. (Author)

**A83-12755**

**AN EFFICIENT TRIANGULAR PLATE BENDING FINITE ELEMENT FOR CRASH SIMULATION**

H. GARNET and A. B. PIFKO (Grumman Research and Development Center, Bethpage, NY) (Symposium on Advances and Trends in Structural and Solid Mechanics, Washington, DC, Oct 4-7, 1982.) Computers and Structures, vol 16, no. 1-4, 1983, p. 371-379. refs

The present study has been motivated by the need to develop a computationally economical triangular plate bending element for dynamic analysis. The developed element is simpler than existing high-order-accuracy elements, containing less than half as many degrees of freedom. It is demonstrated that the element has the

capability to treat a spectrum of static and dynamic structural problems which range over linear-elastic large deflection, and plastic effects. For evaluation, the element, designated as the TRP2 element, was introduced into DYCAST (DYNAMIC Crash Analysis of Structures), a nonlinear finite element program. DYCAST is capable of treating the nonlinear behavior of virtually the entire spectrum of structure problems, ranging in complexity from the simple beam to a three dimensional sheet-stringer aircraft fuselage. The principal application of this program has been in crashworthiness analyses. G R.

**A83-12756****ANISOTROPIC BEAM THEORY AND APPLICATIONS**

V. GIAVOTTO, M. BORRI, P. MANTEGAZZA, G. GHIRINGHELLI (Milano, Politecnico, Milan, Italy), V. CARMASCHI, G. C. MAFFIOLI, and F. MUSSI (Costruzioni Aeronautiche Giovanni Agusta S.p.A., Gallarate, Italy) (Symposium on Advances and Trends in Structural and Solid Mechanics, Washington, DC, Oct. 4-7, 1982.) Computers and Structures, vol. 16, no. 1-4, 1983, p. 403-413. Research supported by the Costruzioni Aeronautiche Giovanni Agusta S.p.A. refs

A formulation is presented of the problem of calculating the stiffness and the stress of a beam section made of anisotropic and non-homogeneous materials such as the rotor blades of a modern helicopter or of a large wind generator. Heterogeneity can cause conditions of three dimensional stress (which can also include significant interlaminar stresses), which are not found in homogeneous beams where the de Saint Venant hypotheses are correctly applied. The method allows the solution of a bidimensional problem which, discretized by the finite element technique, can be reduced to a set of simultaneous algebraic equations in the central zones and to the research of the eigensolutions of a matrix polynomial in the terminal zones. With these formulations it has been possible to develop the HANBA2 computer program, which has been verified by means of comparisons with analytical solutions and with experimental results. This paper also quotes some examples of such comparisons with a short discussion. (Author)

**A83-12764\*** Pratt and Whitney Aircraft Group, East Hartford, Conn.

**NONLINEAR STRUCTURAL AND LIFE ANALYSES OF A COMBUSTOR LINER**

V. MORENO, G. J. MEYERS (United Technologies Corp., Pratt and Whitney Group, East Hartford, CT), A. KAUFMAN, and G. R. HALFORD (NASA, Lewis Research Center, Cleveland, OH) (Symposium on Advances and Trends in Structural and Solid Mechanics, Washington, DC, Oct. 4-7, 1982.) Computers and Structures, vol. 16, no. 1-4, 1983, p. 509-515. refs

(Previously announced in STAR as N82-24501)

**A83-12765****THE APPLICATION OF NONLINEAR ANALYSIS TECHNIQUES TO PRACTICAL STRUCTURAL DESIGN PROBLEMS**

P. W. MASON, T. BALDERES, and H. ARMEN, JR (Grumman Aerospace Corp., Bethpage, NY) (Symposium on Advances and Trends in Structural and Solid Mechanics, Washington, DC, Oct. 4-7, 1982.) Computers and Structures, vol. 16, no. 1-4, 1983, p. 549-562 refs

This paper treats two distinct types of commonly occurring structural nonlinear phenomena within the framework of finite element methods. The first is associated with the diagonal tension behavior of stiffened thin-skin structural components, and the second is concerned with the variable contact between two deformable surfaces. The methodology associated with each problem area is presented in a concise manner. Application to practical design problems illustrate the usefulness of the methods. Their implementation in the flow of a general purpose finite element analysis program is also discussed. (Author)

**A83-12772#****MECHANISM CASE STUDIES VI**

R. S. BERKOF (Gulf and Western Advanced Development and Engineering Center, Swarthmore, PA) American Society of Mechanical Engineers, Design and Production Engineering Technical Conference, Washington, DC, Sept. 12-15, 1982, 9 p. (ASME PAPER 82-DET-47) MEMBERS, \$2.00; NONMEMBERS, \$4.00

A collection of eight case studies is presented, and summaries of specific mechanism problems and solutions are provided to demonstrate the relationship between theory and application. The case studies are related to the kinematic solution to a manufacturing problem, the design of an eight-bar Fowler wing flap linkage, a nonlinear force synthesis using a linear spring, roller release linkage, and a combined closed-form equation and optimization synthesis for four-bar linkage coupler positions. The modeling of the fly's oscillating wing mechanism, a semiautomatic philatelic stamp cancelling machine, and a spiral orifice dashpot timer are also considered. G R.

**A83-12777#****RELIABILITY MODEL FOR PLANETARY GEAR TRAINS**

M. SAVAGE (Akron, University, Akron, OH), C. A. PARIDON (Hewlett-Packard Co., Sunnyvale, CA), and J. J. COY (U.S. Army, Propulsion Laboratory, Cleveland, OH) American Society of Mechanical Engineers, Design and Production Engineering Technical Conference, Washington, DC, Sept. 12-15, 1982, 7 p refs

(ASME PAPER 82-DET-81) MEMBERS, \$2.00, NONMEMBERS, \$4.00

(Previously announced in STAR as N82-28643)

**A83-12783#****ON THE DAMPING EFFECT OF SLOSHING FLUID ON FLEXIBLE ROTOR SYSTEMS**

M. K. GHOSH, P. C. UPADHYAYA (Banaras Hindu University, Varanasi, India), and A. KUMAR American Society of Mechanical Engineers, Design and Production Engineering Technical Conference, Washington, DC, Sept. 12-15, 1982, 5 p. refs (ASME PAPER 82-DET-140) MEMBERS, \$2.00; NONMEMBERS, \$4.00

Results of an experimental investigation on the vibration attenuation characteristics of a free liquid sloshing in a rigid container are reported for a flexible rotor on a flexible foundation. Attenuation of the vibrational amplitude of the foundation is markedly seen in the experimental results. Free liquid sloshing in rigid containers can become an effective means of limiting vibration amplitude at resonances below 15 c.p.s. (Author)

**A83-12853****DEFLECTIONS OF INFLATED CYLINDRICAL CANTILEVER BEAMS SUBJECTED TO BENDING AND TORSION**

J. P. H. WEBBER (Bristol, University, Bristol, England) Aeronautical Journal, vol. 86, Oct. 1982, p. 306-312 refs

Aeronautical interest in inflated structures stems from the fact that they are lightweight and can be stored as a compact volume when deflated. Potential applications include RPVs and man-powered aircraft. Attention is given to inflated circular cylinders acting as cantilevers to form the main, load-carrying structure of a wing. Wrinkling occurs when the longitudinal compressive stress due to bending cancels out stress due to pressure, and the condition for final collapse comes when the cylinder wall's wrinkled region completely surrounds the root cross section. The present analysis is based on simple beam theory, and a numerical method is used to establish beam deflections. Tests conducted with Melinex plastic sheeting cylinders have yielded collapse load measurements for comparison with the present theory. O.C.

## 12 ENGINEERING

**A83-13004**

**NONLINEAR FLAPPING VIBRATIONS OF ROTATING BLADES**  
C VENKATESAN (Indian Institute of Science, Bangalore, India) and V. T. NAGARAJ (Hindustan Aeronautics, Ltd., Bangalore, India) *Journal of Sound and Vibration*, vol. 84, Oct 22, 1982, p 549-556 refs

The nonlinear equations of motion of a rotating blade undergoing extensional and flapwise bending vibrations are derived, including non-linearities up to  $O(\epsilon^3)$ . The strain-displacement relationship derived is compared with expressions derived by earlier investigators, and the errors and the approximations made in some of those are brought out. The equations of motion are solved under the inextensionality condition to obtain the influence of the amplitude on the fundamental flapwise natural frequency of the rotating blade. It is found that large finite amplitudes have a softening effect on the flapwise frequency and that this influence becomes stronger at higher speeds of rotation. (Author)

**N83-10223#** Anamet Labs, Inc., San Carlos, Calif Applied Mechanics Div

**FINITE ELEMENT PREDICTION OF DAMPING IN BEAMS WITH CONSTRAINED VISCOELASTIC LAYERS**

C D. JOHNSON, D. A. KIENHOLZ, and L. C. ROGERS (AFWAL) *In Shock and Vibration Information Center The Shock and Vibration Bull.*, Pt 1 p 71-81 May 1981 refs Sponsored by AFWAL Avail: NTIS HC A11/MF A01 CSCL 20K

Vibration control in structures by means of viscoelastic material in constrained layers has gained wide acceptance, particularly in the aerospace industry. A key to increased use of damping technology is the ability to analyze and define the candidate viscoelastically damped structure accurately and efficiently in a project environment. The validity of the modal strain energy approach is established. The modal strain energy approach uses the modal strain energy distributions, obtained by purely elastic analysis, to predict modal damping (loss) factors. These distributions may also be used by a designer as a tool to choose the best location and material for optimum damping. The approach described in the paper may easily be extended to complex structures. B W

**N83-10231#** Shock and Vibration Information Center (Defense), Washington, D C

**THE SHOCK AND VIBRATION BULLETIN. PART 2: ENVIRONMENTAL TESTING, SHOCK TESTING, SHOCK ANALYSIS**

May 1981 244 p refs Proc of the 51st Symp. on Shock and Vibration, San Diego, Calif., 21-23 Oct. 1980; sponsored by NOSC 3 Vol (AD-D432830; BULL-51-PT-2) Avail NTIS HC A11/MF A01 CSCL 20K

Environmental and shock testing are discussed. Shock analysis is also considered.

**N83-10234#** Pacific Missile Test Center, Point Mugu, Calif.

**RANDOM IMPACT VIBRATION TESTOR**

W. D. EVERETT *In Shock and Vibration Information Center Shock and Vibration Bull.*, Pt. 2 p 23-30 May 1982 refs Avail NTIS HC A11/MF A01 CSCL 20K

The Random Impact Vibration Testor (RIVT) is a new device that efficiently simulates realistic vibration in flight vehicles. The stimulus is repetitive impacts by small projectiles on the surface of the test vehicle. The nature of these impacts is random with respect to the relative location, time interval and intensity between successive impacts. The resultant vehicle vibration resembles that of flight with the characteristics of broad band random noise motion, in many directions, throughout the vehicle structure. Author

**N83-10253#** Shock and Vibration Information Center (Defense), Washington, D C.

**THE SHOCK AND VIBRATION BULLETIN. PART 3: ANALYTICAL METHODS, DYNAMIC ANALYSIS, VEHICLE SYSTEMS**

May 1981 255 p refs Proc. of the 51st Symp. on Shock and Vibration, San Diego, Calif., 21-23 Oct 1980; sponsored by NOSC 3 Vol. (AD-D432842; BULL-51-PT-3) Avail. NTIS HC A12/MF A01 CSCL 20K

Progress in work on shock and vibration is reported. Papers in the following categories are presented: analytical methods, torsional vibration analysis of branched systems, Guyan reduction of two degree freedom systems, estimating the error induced by Guyan reduction, critical speeds of multithron crankshafts using spatial line element method, dynamic analysis; and vehicle systems.

**N83-10295#** Transportation Research Board, Washington, D.C. **PAVEMENT ROUGHNESS AND SKID PROPERTIES**

1981 94 p refs (PB82-212309; TRB/TRR-836) Avail: NTIS HC A05/MF A01 CSCL 13B

Road roughness and roadway safety as it relates to both surface and air transportation are discussed. The role of road roughness in vehicle ride, the measurement of roughness, the evaluation of riding comfort, and the effect of grooving pavements are discussed. The effects of differential pavement friction on the response of cars in skidding maneuvers is discussed. GRA

**N83-10323\*#** Ohio State Univ., Columbus ElectroScience Lab. **ANALYSIS OF AIRBORNE ANTENNA PATTERNS Semiannual Technical Report**

R. G. ROJAS, E. H. NEWMAN, and W. D. BURNSIDE Sep. 1982 25 p refs (Contract NSG-1498) (NASA-CR-169448, NAS 1 26-169448) Avail NTIS HC A02/MF A01 CSCL 17I

The status of various efforts in support of the development of computer codes to analyze the radiation patterns of general aviation aircraft and simulate private aircraft is reported. Because of the significant amount of energy scattered by the windshield of private aircraft, a method is being developed to treat high frequency scattering by thin dielectric layers. To treat such aircraft at lower frequencies, i.e., where the aircraft surface area is less than 10 square wavelengths, a moment method code is being modified. The problem of plane (or surface) wave diffraction by the dielectric half plane is constructed and discussed. A R H.

**N83-10330#** McDonnell-Douglas Astronautics Co., St. Louis, Mo

**AIRBORNE FLIGHT TEST SYSTEM (AFTS) Final Technical Report**

J. A. MAYNARD and M. ROSS 26 Oct. 1981 84 p (Contract F33615-76-C-1002) (AD-A115100; SD-TR-82-2) Avail NTIS HC A05/MF A01 CSCL 17B

The objective of the AFTS program was to demonstrate the operation of a full 1000 Mbps laser communications system transmitting from an aircraft to a ground station receiver. The system was designed around a spaceborne terminal requirements and included prototype operational components. The six years of contract activity included design of a spaceborne high data rate transmitter, adapting the space platform design to operate on a KC-135 aircraft, development and fabrication of both the ground based receiver terminal, and the airborne transmitter. In addition to hardware development of an existing site at White Sands Missile Range was modified to accommodate laser communications equipment for test activities. Supporting the hardware development a series of 5 field tests (both airborne and ground to ground) were conducted to evaluate the field operation of system design concepts and actual hardware performance. The program culminated in a final field test conducted to fully evaluate the complete system which included autonomous acquisition, tracking,

10 pbs communications, 20 Kbps beacon communications, and 500 Mbps and 1000 Mbps downlink communications

Author (GRA)

**N83-10378\*#** National Aeronautics and Space Administration Ames Research Center, Moffett Field, Calif.

**HOLOGRAPHIC INTERFEROMETRY TECHNIQUE FOR ROTARY WING AERODYNAMICS AND NOISE**

J. K. KITTLESON and Y. H. YU 1981 15 p refs Presented at the Army Sci. Conf., West Point, N.Y., 15-18 Jun 1982 Prepared in cooperation with Army Aviation Research and Development Command, Moffett Field, Calif.

(NASA-TM-84723; NAS 1 15.84723; AD-A117425) Avail: NTIS HC A02/MF A01 CSCL 20D

The concepts of holography and holographic interferometry, as applied to the visualization and measurement of the three dimensional flow field near a rotor tip, are previewed, and initial experimental results of investigations of local shock structures and tip vortices behind the blade are presented. An additional method to visualize the flow in a three dimensional manner is demonstrated, and finally, a method to quantitatively measure the three dimensional flow, which will provide the necessary information to help improve helicopter performance and reduce noise, is introduced

Author

**N83-10403#** National Aerospace Lab., Amsterdam (Netherlands).

**EVALUATION REPORT: AGARD FLUID DYNAMICS PANEL SYMPOSIUM ON FLUID DYNAMICS OF JETS WITH APPLICATION TO V/STOL**

B. M. SPEE Jul. 1982 11 p refs

(AGARD-AR-187; AD-A119560) Avail: NTIS HC A02/MF/A01

Topics covered include: (1) jet interactions with neighboring surfaces; (2) jet structure and development; (3) wind tunnel simulation of flow field, forces moments; (4) injection and thrust augmentation, (5) theoretical models and their assessments, (6) two dimensional wall jets; and (7) the use of a tracer gas method for measuring entrainment of an axisymmetric free jet. Conclusions of a panel on the impact of military applications on rotorcraft and V/STOL aircraft design are summarized.

A.R.H.

**N83-10425\*#** National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

**LIFE AND RELIABILITY MODELS FOR HELICOPTER TRANSMISSIONS**

M. SAVAGE (Akron Univ., Ohio), R. J. KNORR (Akron Univ., Ohio), and J. J. COY 1982 14 p refs Proposed for presentation at the Rotary Wing Propulsion System Specialist Meeting, Williamsburg, Va., 16-18 Nov 1982, sponsored by the American Helicopter Society. Prepared in cooperation with Army Aviation Research and Development Command, Cleveland

(NASA-TM-82976; E-1405; NAS 1.15 82976; AHS-RWP-16, AVRADCOM-TR-82-C-15) Avail: NTIS HC A02/MF A01 CSCL 01C

Computer models of life and reliability are presented for planetary gear trains with a fixed ring gear, input applied to the sun gear, and output taken from the planet arm. For this transmission the input and output shafts are co-axial and the input and output torques are assumed to be coaxial with these shafts. Thrust and side loading are neglected. The reliability model is based on the Weibull distributions of the individual reliabilities of the in transmission components. The system model is also a Weibull distribution. The load versus life model for the system is a power relationship. The load versus life model for the system is a power relationship as the models for the individual components. The load-life exponent and basic dynamic capacity are developed as functions of the components capacities. The models are used to compare three and four planet, 150 kW (200 hp), 5:1 reduction transmissions with 1500 rpm input speed to illustrate their use.

A.R.H.

**N83-10433#** Shock and Vibration Information Center (Defense), Washington, D. C.

**THE SHOCK AND VIBRATION DIGEST, VOLUME 14, NO. 8 Monthly Report**

J. NAGLE-ESHLEMAN, ed Aug 1982 122 p refs

(AD-A119004) Avail: SVIC, Code 5804, Naval Research Lab., Washington, D.C. 20375 CSCL 20K

Structural noise transmission is reviewed. Noise transmission into aircraft is discussed. Nonlinear analysis of beams is surveyed.

**N83-10442\*#** National Aeronautics and Space Administration Langley Research Center, Hampton, Va.

**CRASH TESTS OF FOUR LOW-WING TWIN-ENGINE AIRPLANES WITH TRUSS-REINFORCED FUSELAGE STRUCTURE**

M. S. WILLIAMS and E. L. FASANELLA (Kentron International, Inc.) Sep. 1982 120 p refs

(NASA-TP-2070, L-15379, NAS 1 60 2070) Avail: NTIS HC A06/MF A01 CSCL 20K

Four six-place, low-wing, twin-engine, general aviation airplane test specimens were crash tested under controlled free flight conditions. All airplanes were impacted on a concrete test surface at a nominal flight path velocity of 27 m/sec. Two tests were conducted at a -15 deg flight path angle (0 deg pitch angle and 15 deg pitch angle), and two were conducted at a -30 deg flight path angle (-30 deg pitch angle). The average acceleration time histories (crash pulses) in the cabin area for each principal direction were calculated for each crash test. In addition, the peak floor accelerations were calculated for each test as a function of aircraft fuselage longitudinal station number. Anthropomorphic dummy accelerations were analyzed using the dynamic response index and severity index (SI) models. Parameters affecting the dummy restraint system were studied; these parameters included the effect of no upper torso restraint, measurement of the amount of inertia-reel strap pullout before locking, measurement of dummy chest forward motion, and loads in the restraints. With the SI model, the dummies with no shoulder harness received head impacts above the concussive threshold

M.G.

**N83-11390#** Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France)

**IMAGE PROCESSING TECHNIQUES**

May 1982 233 p refs Lecture held in Athens, 14-15 Jun. 1982, Paris, 17-18 Jun. 1982 and the Hague, 21-22 Jun 1982

Original document contains color illustrations (AGARD-LS-119, ISBN-92-835-1425-4; AD-A119489) Avail: NTIS HC A11/MF A01

Image processing techniques, the human visual system, digital imagery and display, image generation and display, picture formatting and hardware considerations, image processing system design and implementation, image transmission and coding, feature extraction, optical information processing, and remotely sensed phenomena are discussed.

**N83-11395#** Royal Signals and Radar Establishment, Malvern (England).

**PICTURE FORMATTING AND HARDWARE CONSIDERATIONS**

T. R. BERRY *in* AGARD Image Process. Tech. 21 p May 1982 refs

Avail: NTIS HC A11/MF A01

The basic requirements of an airborne Digital Scan Converter are explored, and the major design criteria established. Techniques for applying coordinate conversion are discussed in some detail, and two forms of polar to cartesian transformation compared. The effects of platform motion and the scanning mechanism of the sensors on the displayed imagery are considered and illustrated using simple examples. A distinction is made between real and off line viewing, and typical viewing times for various airborne sensors are determined.

Author

**N83-11484#** Rolls-Royce Ltd., Derby (England).  
**STRAIN GAUGES USED FOR TORQUE MEASUREMENT IN A GAS TURBINE ENVIRONMENT**

J. W. H. CHIVERS 1982 12 p  
 (PNR-90111) Avail: NTIS HC A02/MF A01

A technique of measuring the torque in the shaft between the low pressure turbine and the fan of the RB211 engine was developed. The low pressure system torque is measured by three independent strain gage bridges, oriented such that they are sensitive to torsional stress in the shaft and insensitive to axial and bending loads. The system was used in three separate engine tests. Absolute system accuracy of better than + or - 1% full scale torque is achieved. Agreement between the bridges is better than + or - 0.2% of mean torque value. Author (ESA)

**N83-11485#** Rolls-Royce Ltd., Derby (England). Electronics and Instrumentation Research Group  
**RADIATION PYROMETRY IN GAS TURBINE RESEARCH AND DEVELOPMENT**

J. DOUGLAS 1982 11 p  
 (PNR-90116) Avail: NTIS HC A02/MF A01

Applications of radiation pyrometers to rotating component and turbine blade test rigs, engine testing, and thermography are outlined. They monitor compressor and turbine disk temperatures in high temperature tests. In low pressure testing of turbine blades, the pyrometers ensure that components are not overheated, by controlling the rig cycle. These pyrometers can be used in tests as engine control transducers since pyrometer output can be correlated with gas stream temperature and used to indicate when the engine is at its maximum operating temperature. In thermography, pyrometer systems are used to visualize temperature distributions without the need for absolute temperature measurements. Author (ESA)

**N83-11486#** Rolls-Royce Ltd., Derby (England)  
**SOME LASER MEASUREMENT TECHNIQUES USED IN AERO ENGINE RESEARCH**

D. G. JONES 1982 4 p refs Presented at Appl of Lasers to Combustion Engines Seminar, 10 Mar. 1982  
 (PNR-90118) Avail: NTIS HC A02/MF A01

Holographic flow visualization and laser anemometry are described. Flow within a fan blade passage can be visualized in three dimensions by recording two superimposed holograms on the same film, using a double pulse laser. Interferometric fringes formed by the images represent a shearing of the density field with respect to itself, caused by rotor movement during the separation of the double pulse laser. Shocks, overtip vortices, wakes, shock interaction with the boundary layer, and separated boundary layers can be observed. The anemometer measures the time taken for particles to cross between two focused laser beams separated by a known amount. The backscattered light from each beam is recorded by two photomultipliers and the discriminated events from the two beams are cross correlated. Correlograms of events for selected angles of orientation of the two spots at gated positions in rotor passage provide a spatially localized, but time averaged, value of flow velocity. Author (ESA)

**N83-11513\*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va  
**FLIGHTWEIGHT RADIANTLY AND ACTIVELY COOLED PANEL: THERMAL AND STRUCTURAL PERFORMANCE**

C. P. SHORE, R. J. NOWAK, and H. N. KELLY Jan 1982 53 p refs  
 (NASA-TP-2074, L-15292, NAS 1 60:2074) Avail: NTIS HC A04/MF A01 CSCL 20K

A 2- by 4-ft flightweight panel was subjected to thermal/structural tests representative of design flight conditions for a Mach 6.7 transport and to off-design conditions simulating flight maneuvers and cooling system failures. The panel utilized Rene 41 heat shields backed by a thin layer of insulation to radiate away most of the 12 Btu/ft<sup>2</sup>-sec incident heating. A solution of ethylene glycol in water circulating through tubes in an aluminum-honeycomb-sandwich panel absorbed the remainder of

the incident heating (0.8 Btu/sq ft-sec). The panel successfully withstood (1) 46.7 hr of radiant heating which included 53 thermal cycles and 5000 cycles of uniaxial inplane loading of + or - 1200 lbf/in, (2) simulated 2g-maneuver heating conditions and simulated cooling system failures without excessive temperatures on the structural panel; and (3) the extensive thermal/structural tests and the aerothermal tests reported in NASA TP-1595 without significant damage to the structural panel, coolant leaks, or hot-gas ingress to the structural panel. Author

**N83-11514\*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

**BENDING-TORSION FLUTTER OF A HIGHLY SWEPT ADVANCED TURBOPROP**

O. MEHMED, K. R. V. KAZA, J. F. LUBOMSKI, and R. E. KIELB 1981 24 p refs Prepared for presentation at the 1982 Aerospace Congr. and Exposition, Anaheim, Calif., 25-28 Oct., 1982; sponsored by the Soc. of Automotive Engrs.  
 (NASA-TM-82975; E-1404; NAS 1 15:82975) Avail: NTIS HC A02/MF A01 CSCL 20K

Experimental and analytical results are presented for a bending-torsion flutter phenomena encountered during wind-tunnel testing of a ten-bladed, advanced, high-speed propeller (turboprop) model with thin airfoil sections, high blade sweep, low aspect ratio, high solidity and transonic tip speeds. Flutter occurred at free-stream Mach numbers of 0.6 and greater and when the relative tip Mach number (based on vector sum of axial and tangential velocities) reached a value of about one. The experiment also included two- and five-blade configurations. The data indicate that aerodynamic cascade effects have a strong destabilizing influence on the flutter boundary. The data was correlated with analytical results which include aerodynamic cascade effects and good agreement was found. Author

**N83-11520#** National Aeronautical Establishment, Ottawa (Ontario). Structures and Materials Lab.

**PRACTICAL APPLICATIONS OF FRACTURE MECHANICS IN AIRCRAFT AND AEROSPACE STRUCTURAL PROBLEMS**

J. J. KACPRZYNSKI Jun 1982 36 p refs In ENGLISH; FRENCH summary  
 (AD-A118321; NAE-LR-611, NRC-20415) Avail: NTIS HC A03/MF A01 CSCL 20K

Two computer programs, CRACKS-4 and FLAGRO 4, used for the analysis of crack growth in aircraft and aerospace structures are reviewed. The merits and limitations of each program are described using practical numerical examples. Requirements for the next generation of computer programs are specified. M.G.

**N83-11521#** Rockwell International Corp., Los Angeles, Calif Aircraft Operations Div.

**IMPROVED METHODS FOR PREDICTING SPECTRUM LOADING EFFECTS. VOLUME 1: TECHNICAL SUMMARY Final Report, 16 Jan. 1979 - 30 Nov. 1981**

J. B. CHANG, R. M. HIYAMA, and M. SZAMOSI Wright-Patterson AFB, Ohio AFWAL Oct. 1981 218 p refs 2 Vol.  
 (Contract F33615-77-C-3121; AF PROJ. 2401)  
 (AD-A118295; NA-81-234-VOL-1; AFWAL-TR-81-3092-VOL-1) Avail: NTIS HC A10/MF A01 CSCL 01C

This report presents the technical details of improved methods for predicting the load interaction effects on crack growth under flight spectrum loading developed in a research effort sponsored by the USAF. These include the cycle-by-cycle crack-growth prediction methods used in the detail design stage, the flight-by-flight crack-growth analysis method for individual aircraft tracking usage, and preliminary design trade-off studies. GRA

**N83-11526#** Technische Hogeschool, Delft (Netherlands) Dept. of Aerospace Engineering  
**OVERALL BUCKLING OF SPECIALLY ORTHOTROPIC Z-STIFFENED PANELS. PART 1: THEORY**  
 J. W. GUNNINK Apr. 1982 41 p refs  
 (VTH-LR-351-PT-1) Avail: NTIS HC A03/MF A01

A method is presented for the calculation of the buckling load of Z-stiffened panels built up from specially orthotropic laminated plates. This method is an extension of Van der Neut's method of calculating the overall buckling load of Z-stiffened panels of isotropic material. Author (ESA)

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## GEOSCIENCES

Includes geosciences (general); earth resources; energy production and conversion, environment pollution; geophysics; meteorology and climatology; and oceanography.

**N83-10559\*#** National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio  
**MULTIFUEL EVALUATION OF RICH/QUENCH/LEAN COMBUSTOR**

J. J. NOTARDONATO, A. S. NOVICK (Detroit Diesel Allison), and D. L. TROTH (Detroit Diesel Allison) 1982 12 p refs Presented at the Joint Power Conf., Denver, 17-21 October 1982 (Contract DE-AI01-77ET-13111)  
 (NASA-TM-82986; E-1418, DOE/NASA/13111-10; NAS 115:82986) Avail: NTIS HC A02/MF A01 CSCL 21B

The fuel flexible combustor technology was developed for application to the Model 570-K industrial gas turbine engine. The technology, to achieve emission goals, emphasizes dry NOx reduction methods. Due to the high levels of fuel-bound nitrogen (FBN), control of NOx can be effected through a staged combustor with a rich initial combustion zone. A rich/quench/lean variable geometry combustor utilizes the technology presented to achieve low NOx from alternate fuels containing FBN. The results focus on emissions and durability for multifuel operation. S.L.

**N83-11628#** Operations Research, Inc., Silver Spring, Md  
**SECOND NATIONAL CONFERENCE ON GENERAL AVIATION AIRPORT NOISE AND LAND USE PLANNING: SUMMARY OF PROCEEDINGS Final Report**

J. SCHETTINO, ed. and M. STAIANO, ed. Apr. 1982 298 p refs Conf. held in New Orleans, 1-3 Dec. 1981 (Contract EPA-68-01-6154)  
 (PB82-218520; EPA-550/9-82-337) Avail: NTIS HC A13/MF A01 CSCL 13B

The proceedings of the Second National Conference on General Aviation Airport Noise and Land Use Planning are processed. The implementation of solutions at the State and local level are emphasized. The development of a document dealing with general aviation airport noise and land use planning was discussed. It is suggested that the airport operators and the planners are more knowledgeable in this area due to ANCLUC studies at several general aviation airports. GRA

**N83-11629#** Bolt, Beranek, and Newman, Inc., Los Angeles, Calif.

**NOISE IN AMERICA: EXTENT OF THE NOISE PROBLEM**  
 M. SIMPSON and R. BRUCE Sep. 1981 186 p refs Sponsored by EPA  
 (PB82-219189; EPA-550/9-81-101) Avail: NTIS HC A09/MF A01 CSCL 13B

The number of Americans exposed to various levels of occupational and environmental noise is estimated. Estimates are made for 11 categories of noise producers (e.g., traffic, aircraft, construction) using the yearly day-night sound level (Ldn) or the 24-hour equivalent sound level (Leg) metrics. The assumptions in

the models used, including demographic projections, are made explicit for all estimates. Estimates for combined exposures to traffic and other community noise sources are also made, as well as indoor noise exposures from home equipment like fans and clothes washers. According to the estimates, 1.5 million people are exposed to outdoor noise levels (from all sources) of over 75 ldn, and over 90 million, to levels over 58 ldn. Over 9 million people are exposed to occupational noise in excess of 80 dB (Leg(24)). (GRA)

**N83-11661\*#** Electro Magnetic Applications, Inc., Denver, Colo  
**INTERPRETATION METHODOLOGY AND ANALYSIS OF IN-FLIGHT LIGHTNING DATA Final Report**

T. RUDOLPH and R. A. PERALA Washington NASA Oct. 1982 181 p refs Prepared for Research Triangle Inst., Research Triangle Park, N.C.  
 (Contract NAS1-16489)  
 (NASA-CR-3590; NAS 1.26:3590, EWA-82-R-21) Avail: NTIS HC A09/MF A01 CSCL 04B

A methodology is presented whereby electromagnetic measurements of in-flight lightning stroke data can be understood and extended to other aircraft. Recent measurements made on the NASA F106B aircraft indicate that sophisticated numerical techniques and new developments in corona modeling are required to fully understand the data. Thus the problem is nontrivial and successful interpretation can lead to a significant understanding of the lightning/aircraft interaction event. This is of particular importance because of the problem of lightning induced transient upset of new technology low level microcircuitry which is being used in increasing quantities in modern and future avionics. In-flight lightning data is analyzed and lightning environments incident upon the F106B are determined. B.W.

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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.

**A83-10455**  
**EXPERIMENT CONTROL IN PROBLEMS OF MINIMAX ESTIMATION [OB UPRAVLENIИ EKSPERIMENTOM V ZADACHAKH MINIMAKSNOGO OTSENIVANIИA]**  
 V. A. NAVRODSKII Vychislitel'naiя i Prikladnaiя Matematika, no. 45, 1981, p. 137-143. In Russian. refs

Experiment planning in problems of minimax estimation is considered. A solution is obtained to the problem of finding a control in the case of which the estimated parameters converge to the true ones. A minimax treatment of the sensitivity of dynamic-system parameters is discussed. The investigation of the longitudinal motion of a flight vehicle is considered as an example. B.J.

**A83-10763**  
**EMULATION, A COST EFFECTIVE ALTERNATIVE FOR REPLACING OBSOLETE ATE**

A. J. HADDAD and T. J. CROWLEY (Bendix Corp., Test Systems Div., Teterboro, NJ) In: AUTOTESTCON '81; Proceedings of the Conference, Orlando, FL, October 19-21, 1981. New York, Institute of Electrical and Electronics Engineers, Inc., 1981, p. 276-279.

Emulation is defined as a method for replacing obsolete test equipment with new technology ATE. With emulation, existing test programs and interface test adapters are preserved. Emulation in the ATE environment is defined, along with the emulation process and its advantages. An actual case of emulation is discussed; the case history traces the emulation system engineering process from conception to successful implementation. Emulation is seen as

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providing the shortest integration period possible with the fastest overall schedule. C.R.

### **A83-11104 EMBEDDED MICROPROCESSORS FOR AVIONIC APPLICATIONS**

S. W. BEHNEN and M. B. MCCALL (Boeing Military Airplane Co., Seattle, WA) In: NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 154-160. (Contract F33615-80-C-0120)

The use of embedded microprocessors has been surveyed for many commercial and military aircraft, including several that are still under development. Results are presented which describe current processing implementations in 8-bit microprocessors, 16-bit microprocessors, and minicomputers. It was found that most existing applications can be implemented with a monolithic 8-bit microprocessor that has 4K of ROM and 512 bytes of RAM. More recent applications frequently use 16-bit processors and a larger memory. Design considerations that affect microprocessor choices for new systems are discussed. Arguments are made for standardization on a 16-bit microprocessor for many avionic applications. (Author)

### **A83-11114 A DYNAMIC INTERFACE ERROR PERFORMANCE SIMULATION - IV&V FOR THE F-4F O/P**

F. C. BETTS In: NAECON 1982, Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 257-263.

The development, system features, testing, and results of use of a Dynamic Interface Error Performance Simulation (DIEPS) for use in verification of operational flight programs, performance of a change impact analysis, and to augment flight testing are described. Specific applications of the scheme were for verifying the air-to-air and air-to-ground programs for the German F-4 Phantom. Modules were produced to simulate the avionics systems. Signal traces were performed to provide a detailed signal flow analysis as a basis for a numerical model. The resultant math model was converted into a FORTRAN program. The simulations were verified on a component-by-component basis, and truth programs were devised to test the attack functions. The system provides algorithms which will be used in the evaluation of new weapons systems. M.S.K.

### **A83-11131 ANALYSIS OF SYSTEMS CONTAINING MULTIPLE, IRREGULAR SAMPLING**

V. J. SMALL (Boeing Commercial Airplane Co., Seattle, WA) In: NAECON 1982, Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 396-402. refs

Digital avionics systems are considered in which time-continuous analog signals are applied as inputs to be processed or transmitted by techniques which sample and digitize them. Methods are presented with which to analyze the degenerative double sampling of digitized analog signals, which may for example occur when such data are transmitted from one unit into the buffer of another whose processing is asynchronous with the first. It is found that the selection of such system parameters as sampling rate, data bus rates and processor program cycle times can affect the performance of both closed and open loop systems. It is recommended that systems employing multiple samplers be analyzed in this fashion during the design phase, to ensure that sample rates, etc., are chosen to optimally provide specified system performance without resort to very rapid sampling. O.C.

### **A83-11153 A PROTOTYPE PARALLEL COMPUTER ARCHITECTURE FOR ADVANCED AVIONICS APPLICATIONS**

M. S. ANASTAS and R. F. VAUGHAN (Boeing Aerospace Corp., Seattle, WA) In: NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 614-621. refs

Performance data have been obtained which demonstrate the practicality of the transition machine architecture (a new type of parallel computer architecture) and verify the accuracy of an analytic model (Vaughan and Anastas, 1980) which predicts the performance of tightly coupled multiprocessor systems. These demonstrated features lend credence to claims for effectively combining large numbers of microprocessors in tightly coupled configurations using transition machine concepts. The efficiency of the transition machine architecture and its amenability to conventional HOL programming provide low cost, easily programmed systems which can be used to obtain high throughput, fault tolerance, and modular expendability. B.J.

### **A83-11155 TECHNIQUES FOR SYSTEM READINESS ANALYSIS**

A. B. CALVO (Analytic Sciences Corp., Reading, MA) In: NAECON 1982, Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 628-634. refs

The paper examines several system support issues of interest to the program manager in responding to recent DoD initiatives addressing readiness. Particular attention is given to system readiness measures and readiness modeling techniques (SOAR, OAR, and dormant system analysis). It is suggested that careful consideration should be given to model selection for the evaluation of readiness related issues for various types of systems. A single generic model may not effectively capture the relevant issues; instead, models tailored to specific types of systems, i.e., dormant systems, pods, avionics internal to aircraft, capturing the essential operational and maintenance factors, may prove more efficient and relevant. B.J.

### **A83-11162 COMPUTER MODELS FOR DETERMINING COUNTERMEASURES EFFECTIVENESS OF EXPENDABLES IN AIR-TO-AIR ENGAGEMENTS**

J. R. MCDUGAL and R. G. CROSS (Boeing Military Airplane Co., Wichita, KS) In: NAECON 1982, Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 687-694.

The paper describes a program aimed at developing computer models for determining the effectiveness of RF and IR decoys in effecting the survival of a strategic aircraft in air-to-air engagements. FORTRAN computer models, implemented on a DEC VAX 11/780, were configured to permit the parametric analysis of the voluminous output data from such engagements. Four-color computer graphics were developed for the effective interpretation and display of these data. The model philosophy and implementation are described, and example results are presented. B.J.

### **A83-11163 A SURVEY OF AVIONICS SOFTWARE SUPPORT ENVIRONMENTS**

C. GANNON and M. E. SHARP (General Research Corp., Santa Barbara, CA) In: NAECON 1982, Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 696-704.

Results are presented from a study of research and development-support software environments, with a view to the definition of the requirements for an Integrated Support Software System (ISSS) whose goals are controlled software development and maintenance, configuration management, and the automatic

setup and running of simulations. The basis of the study is a series of interviews conducted with personnel from seven avionics software laboratories. The recommendations presented for ISSS are to be implemented at the U.S. Air Force's Avionics Systems Analysis and Integration Laboratory. Attention is given to the research and development management program currently being conducted for the F/A-18 aircraft's avionics suite. O.C.

**A83-11176**  
**AEDCS - A COMPUTER-AIDED SYSTEM DESIGN TOOL FOR INTEGRATED AVIONICS**

A. C. POFF, JR. (Northrop Corp., Aircraft Div., Hawthorne, CA) In: NAECON 1982, Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 792-800

The Avionics Engineering Data Collection System (AEDCS) makes use of selected attributes of automated information management concepts for the orderly one-time input, storage, update, manipulation, retrieval, and verification of avionics functions and interface parameters. It is shown that its design not only supports the development of functionally allocated electrical interfaces but also lends itself to the development of software module interfaces embedded within commercial systems as well as other types of large-scale integrated military systems. It is pointed out that with AEDCS an annual cost saving of 57% over the manual cost of developing and maintaining interface control documents is possible. C.R.

**A83-11177**  
**AN EXPERIMENT IN ASSESSMENT OF FLIGHT CONTROL SOFTWARE DEVELOPMENT TECHNIQUES**

P. R. CHANDLER (USAF, Flight Dynamics Laboratory, Wright-Patterson, AFB, OH) and R. R. JONES (Hughes Aircraft Co., Ground Systems Group, Fullerton, CA) In: NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 803-810

The development effort under way has two parts. The first involves a prototype software development methodology consisting of analytical techniques and automated tools. The second is an assessment, both technical and financial, of the viability of the tools and techniques to yield high-quality software free of flight safety-related errors for a sample digital flight control system based on the digital tactical aircraft. The most salient software issues are discussed, and a description is given of the prototype methodology and of digital flight control systems. Also described is a procedure for assessing the technical and financial merits of the tools and techniques. C.R.

**A83-11190#**  
**INVESTIGATION OF CONSTANT TURN-RATE DYNAMICS MODELS IN FILTERS FOR AIRBORNE VEHICLE TRACKING**

P. S. MAYBECK, W. H. WORSLEY, and P. M. FLYNN (USAF, Institute of Technology, Wright-Patterson AFB, OH) In: NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 896-903. refs

A constant turn-rate model for acceleration has been proposed as more representative of airborne vehicle motion characteristics than models currently employed, such as first order Gauss-Markov or Brownian motion. Target trackers in the form of extended Kalman filters based on these alternative dynamics models are developed and analyzed for both air-to-air gunnery (estimation in three dimensions) and FLIR image focal plane target intensity tracking (in two dimensions). In both applications, the filter based on the constant turn-rate model displays smaller estimation biases, indicative of a better internal model within the filter structure, but a moderate performance enhancement is offset by a significant increase in computational loading. (Author)

**A83-11200**  
**A COST EFFECTIVE APPROACH TO DESIGN EVALUATION OF ADVANCED SYSTEM DISPLAY SWITCHOLOGY**

R. P. WOOD and C. A. MOORE (General Dynamics Corp., Fort Worth, TX) In: NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 964-970

The use of low-cost personal computers as an aid in the preliminary evaluation of advanced display switchology designs is investigated. This approach offers the advantages of low cost, easy software development, and flexible system configuration. After a general consideration of this methodology, a specific example is presented of a system composed of five interconnected personal computers that was developed for evaluating the effectiveness of display switchology in an advanced aircraft cockpit environment. It is found that the cockpit mockup exhibits extremely low downtime, real-time operation, and a significantly increased number of avionic system functions over previous voice-interactive mockups. In addition, it was found that the development of the system was relatively easy, due to the architectural modularity and functional flexibility of the mockup. N.B.

**A83-11249**  
**INTEGRATED AND TRANSFERABLE HARDWARE/SOFTWARE CHECKOUT**

S. C. MCSWEENEY, J. L. FARRELL, and D. HEDLAND (Westinghouse Electric Corp., Systems Development Div., Baltimore, MD) In: NAECON 1982, Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 3. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 1334-1339. refs

A closed-loop modular automated test approach with the threefold benefit of design validation, operation flight software validation, and hardware-in-the-loop test capability is described. It is noted that while the immediate emphasis is slanted toward radar, the overall methodology is readily applicable to other systems as well. It is shown that generalized testing can be attained but only if the problem is analyzed at a fairly high level of abstraction. This is effected by first presenting a universal model for all real-time digitally controlled systems. Using this model as a guide, the procedure is then to study existing and proposed radar systems to learn how they conform to the model and, more important, what digital functions they may have in common. It is believed that the evolution of operation software can be guided by a succession of controlled experiments, as it grows to accommodate added modes and new requirements. C.R.

**A83-11910\*** Kansas Univ., Lawrence  
**IMPLEMENTATION OF THE DAST ARW II CONTROL LAWS USING AN 8086 MICROPROCESSOR AND AN 8087 FLOATING-POINT COPROCESSOR**

G. L. KELLY, G. BERTHOLD (Kansas, University, Lawrence, KS), and L. ABBOTT (NASA, Flight Research Center, Edwards, CA) In: Mini and microcomputers in control and measurement; Proceedings of the International Symposium, San Francisco, CA, May 20-22, 1981. Anaheim, CA and Calgary, Alberta, Canada, Acta Press, 1982, p. 58-60

A 5 MHz single-board microprocessor system which incorporates an 8086 CPU and an 8087 Numeric Data Processor is used to implement the control laws for the NASA Drones for Aerodynamic and Structural Testing, Aeroelastic Research Wing II. The control laws program was executed in 7.02 msec, with initialization consuming 2.65 msec and the control law loop 4.38 msec. The software emulator execution times for these two tasks were 36.67 and 61.18, respectively, for a total of 97.68 msec. The space, weight and cost reductions achieved in the present, aircraft control application of this combination of a 16-bit microprocessor with an 80-bit floating point coprocessor may be obtainable in other real time control applications. O.C.

## 15 MATHEMATICAL AND COMPUTER SCIENCES

**A83-11915\*** Kansas Univ., Lawrence.

### **A MICROCOMPUTER-BASED SYSTEM FOR NOISE CHARACTERISTICS ANALYSIS**

M. A. MOSSER, D. I. RUMMER, and R. NAVANEETHAN (Kansas, University, Lawrence, KS) In: Mini and microcomputers in control and measurement, Proceedings of the International Symposium, San Francisco, CA, May 20-22, 1981. Anaheim, CA and Calgary, Alberta, Canada, Acta Press, 1982, p 107-109 (Contract NCC1-6)

A description is given of the design and use of a microcomputer-based system for the analysis and prediction of interior noise levels in general aviation aircraft constructed from novel materials. The system consists of a test chamber divided into two parts by a panel which has been fabricated from the material or combination of materials to be tested. A noise generator applies noise to one side of the specimen, while the microcomputer system measures and records the noise spectra on both sides of the specimen, so that its attenuation properties may be calculated and displayed by both a color CRT and X-Y plotter hard copy.

O.C

**A83-12457\*#** Joint Inst. for Advancement of Flight Sciences, Hampton, Va.

### **APPLICATION OF MATRIX SINGULAR VALUE PROPERTIES FOR EVALUATING GAIN AND PHASE MARGINS OF MULTILoop SYSTEMS**

V. MUKHOPADHYAY (Joint Institute for Advancement of Flight Sciences, Hampton, VA) and J. R. NEWSOM (NASA, Langley Research Center, Loads and Aeroelasticity Div., Hampton, VA) In: Guidance and Control Conference, San Diego, CA, August 9-11, 1982, Collection of Technical Papers. Conference sponsored by the American Institute of Aeronautics and Astronautics. New York, American Institute of Aeronautics and Astronautics, 1982, p 420-428. refs

A stability margin evaluation method in terms of simultaneous gain and phase changes in all loops of a multiloop system is presented. A universal gain-phase margin evaluation diagram is constructed by generalizing an existing method using matrix singular value properties. Using this diagram and computing the minimum singular value of the system return difference matrix over the operating frequency range, regions of guaranteed stability margins can be obtained. Singular values are computed for a wing flutter suppression and a drone lateral attitude control problem. The numerical results indicate that this method predicts quite conservative stability margins. In the second example if the eigenvalue magnitude is used instead of the singular value, as a measure of nearness to singularity, more realistic stability margins are obtained. However, this relaxed measure generally cannot guarantee global stability. (Author)

**N83-10803\*#** Technion - Israel Inst of Tech, Haifa. Dept. of Aeronautical Engineering

### **PREDICTOR SYMBOLOLOGY IN COMPUTER-GENERATED PICTORIAL DISPLAYS Final Report**

A. J. GRUNWALD Nov 1981 121 p refs

(Contract NASW-3302)

(NASA-CR-169441; NAS 1.26 169441; TAE-470) Avail: NTIS HC A06/MF A01 CSCL 09B

The display under investigation, is a tunnel display for the four-dimensional commercial aircraft approach-to-landing under instrument flight rules. It is investigated whether more complex predictive information such as a three-dimensional perspective vehicle symbol, predicting the future vehicle position as well as future vehicle attitude angles, contributes to a better system response, and suitable predictor laws for the predictor motions, are formulated. Methods for utilizing the predictor symbol in controlling the forward velocity of the aircraft in four-dimensional approaches, are investigated. The simulator tests show, that the complex perspective vehicle symbol yields improved damping in the lateral response as compared to a flat two-dimensional predictor cross, but yields generally larger vertical deviations. Methods of using the predictor symbol in controlling the forward velocity of the vehicle are shown to be effective. The tunnel display with

superimposed perspective vehicle symbol yields very satisfactory results and pilot acceptance in the lateral control but is found to be unsatisfactory in the vertical control, as a result of too large vertical path-angle deviations. Author

**N83-10875#** Comptroller General of the United States, Washington, D.C.

### **DOD'S USE OF REMOTELY PILOTED VEHICLE TECHNOLOGY OFFERS OPPORTUNITIES FOR SAVING LIVES AND DOLLARS Report to the Congress**

3 Apr 1981 43 p

(MASAD-81-20; B-202379) Avail: NTIS HC A03/MF A01

The status of remotely piloted vehicle technology, reasons for its limited application by the Department of Defense, and the potential for applying this technology to nonmilitary uses are discussed. Recommendations are given. R.J.F.

**N83-11804\*#** National Aeronautics and Space Administration Langley Research Center, Hampton, Va

### **IPAD: INTEGRATED PROGRAMS FOR AEROSPACE-VEHICLE DESIGN**

Sep 1980 400 p refs Proc. of a Natl Symp. held at Denver, 17-19 Sep 1980; sponsored by Boeing Commercial Aircraft Co.

(NASA-CP-2143, L-13916, NAS 1 55:2143) Avail: NTIS HC

A17/MF A01 CSCL 09B

The conference was organized to promote wider awareness of the IPAD program and its coming impact on American industry. The program focuses on technology issues that are critical to computer-aided design and manufacturing. Included is a description of a representative aerospace design process and its interface with manufacturing, the design of a future IPAD integrated computer-aided design system, results to date in developing IPAD products and associated technology, and industry experiences and plans to exploit these products. Author

## 16

## PHYSICS

Includes physics (general), acoustics; atomic and molecular physics; nuclear and high-energy physics; optics; plasma physics; solid-state physics; and thermodynamics and statistical physics.

**A83-10183\*#** Boeing Co., Seattle, Wash.

### **TESTS OF A THERMAL ACOUSTIC SHIELD WITH A SUPERSONIC JET**

N. PICKUP, R. A. MANGIAROTTY, and J. V. OKEEFE (Boeing Co., Seattle, WA) Journal of Aircraft, vol 19, Nov. 1982, p. 940-946. refs

(Contract NAS3-22137)

(Previously cited in issue 24, p 4244, Accession no A81-48623)

**A83-10898**

### **JET NOISE AND THE EFFECTS OF JET FORCING**

D. G. CRIGHTON (Leeds University, Leeds, England) In: The role of coherent structures in modelling turbulence and mixing; Proceedings of the International Conference, Madrid, Spain, June 25-27, 1980. Berlin, Springer-Verlag, 1981, p. 340-362. refs

The state of the art in experimentation on the acoustic field of axisymmetric jets subjected to controlled excitation is assessed. It is noted that two distinct responses have been reported; a significant reduction in the broadband noise signal response to tonal forcing, except in bands around the tone and its harmonics and subharmonics; and a uniform increase in the entire broadband spectral level at all angles to the jet. Experimental data is reviewed on hot jets, hot and cold imperfectly expanded supersonic jets, cold perfectly expanded supersonic jets, and subsonic hot and cold coaxial jets. Broadband amplification linked to a turbulent shear layer and a high Reynolds number is stressed to be more

useful in applications studies than a highly ordered tonal structure at low Reynolds numbers. Theoretical approaches to modeling the phenomena are examined  
M.S.K

**N83-10235#** Pacific Missile Test Center, Point Mugu, Calif  
**PARAMETERS FOR DESIGN OF REVERBERANT ACOUSTIC CHAMBERS FOR TESTING AIR-CARRIED MISSILES**

T. W. ELLIOTT /in Shock and Vibration Information Center Shock and Vibration Bull., Pt. 2 p 31-39 May 1982 refs  
Avail: NTIS HC A11/MF A01 CSCL 20A

Rectangular box-shaped reverberant acoustic chambers were theoretically analyzed, using a normal-mode model, for the purpose of optimal design for simulating captive flight vibration of air-carried missiles. A mathematical derivation relating chamber volume to minimum usable frequency was derived. It was determined that minimum usable frequency varied inversely as the square root of the volume ratios. A computer program was generated to investigate the important parameters for design of these chambers. It was found that, apart from some general rules-of-thumb to avoid in acoustic chamber design, there was no over-riding reason to select one configuration over another  
Author

**N83-10272#** Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.

**ACOUSTIC ENVIRONMENT ON THE SURFACE OF A LARGE-SCALE POWERED MODEL OF A VECTORED-ENGINE-OVER-THE-WING STOL CONFIGURATION**

L. L. SHAW and S. Y. LEE /in Shock and Vibration Information Center The Shock and Vibration Bull., Pt. 3 p 225-235 May 1981 refs

Avail: NTIS HC A12/MF A01 CSCL 20A

The results of an acoustic measurement program on a large, powered, highly maneuverable, supersonic STOL fighter model. The model incorporated vectored engine over the wing (VEO) concept including spanwise blowing to provide lift augmentation. This concept exposes portions of the wing and flap structure to high fluctuating pressure levels. Twelve microphones were installed on the surface of the model to define this environment. Six of these were specially developed high temperature transducers capable of withstanding up to 1093 C. Test parameters included engine pressure ratio, wind tunnel dynamic pressure, angle of attack, yaw angle, flap angle, and canard angle. The effect of each of these parameters on the fluctuating pressure environment was defined. The results show that levels as high as 167 kB exist on the upper surface of the flap. Levels resulting from a prediction method in the literature agreed with the measured values for only very limited conditions.  
M.G.

**N83-10435#** Columbia Univ., New York. Inst. of Flight Structures

**RECENT RESEARCH ON NOISE TRANSMISSION INTO AIRCRAFT**

R. VAICAITIS /in Shock and Vibration Information Center The Shock and Vibration Dig., Vol 14, No. 8 p 13-18 Aug. 1982 refs

Avail: SVIC, Code 5804, Naval Research Lab., Washington, D.C. 20375 CSCL 20A

Noise transmission prediction into aircraft is surveyed. Noise transmission and cabin noise optimization for a propeller driven aircraft are considered.  
Author

**N83-10883\*#** National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.

**FLIGHT EFFECTS OF FAN NOISE**

D. CHESTNUTT, ed. Sep. 1982 128 p refs Presented at the Workshop on Res on the Simulation of In-Flight Fan Noise and Flight Effects, Hampton, Va., 26-27 Jan. 1982 (NASA-CP-2242; L-15493; NAS 1 55 2242) Avail: NTIS HC A07/MF A01 CSCL 20A

Simulation of inflight fan noise and flight effects was discussed. The status of the overall program on the flight effects of fan noise was reviewed, and flight to static noise comparisons with the JT15D engine were displayed.  
S.L.

**N83-10885\*#** National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio

**UTILIZING NUMERICAL TECHNIQUES IN TURBOFAN INLET ACOUSTIC SUPPRESSOR DESIGN**

K. J. BAUMEISTER 1982 23 p refs Presented at the 19th Ann. Meeting of the Soc. of Eng. Sci., Rolla, Mo., 27-29 Oct. 1982

(NASA-TM-82994, E-1427, NAS 1.15 82994) Avail: NTIS HC A02/MF A01 CSCL 20A

Numerical theories in conjunction with previously published analytical results are used to augment current analytical theories in the acoustic design of a turbofan inlet nacelle. In particular, a finite element-integral theory is used to study the effect of the inlet lip radius on the far field radiation pattern and to determine the optimum impedance in an actual engine environment. For some single mode JT15D data, the numerical theory and experiment are found to be in a good agreement  
Author

**N83-10887#** Rocketdyne, Canoga Park, Calif Energy System Group.

**ACOUSTIC-EMISSION MONITORING OF STEAM TURBINES Final Report**

L. J. GRAHAM, R. L. RANDALL, and C. HONG Apr. 1982 115 p refs

(Contract EPRI PROJ. 1266-14)

(DE82-904663, EPRI-CS-2367) Avail: NTIS HC A06/MF A01

A method for the on-line detection of crack growth in steam turbine rotors based on acoustic emission (AE) monitoring is discussed. A systematic study involving a number of tasks was performed to evaluate the potential for the detection and correct identification of crack growth AE signals during various turbine operating conditions. These included acoustic wave propagation and attenuation measurements, background noise characterization, laboratory rotor material tests, monitoring equipment optimization, dynamic stress analysis of the rotor under transient operation and on-line source location and signal characterization. No crack growth was detected during the monitoring periods but there was sufficient information from the combined tasks to estimate the flaw growth detectability during different operating conditions if it occurs. The experience also suggests that AE monitoring can be useful for diagnosis of other turbine problems such as blade rubbing, out-of-balance condition, bearing deterioration, lubricating oil contamination and perhaps boiler exfoliation and blade erosion.  
DOE

**N83-11838\*#** National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.

**A NEW MEASUREMENT METHOD FOR SEPARATING AIRBORNE AND STRUCTUREBORNE NOISE RADIATED BY AIRCRAFT TYPE PANELS**

M. C. MCGARY Sep. 1982 33 p refs

(NASA-TP-2079; L-15481, NAS 1.60 2079) Avail: NTIS HC A03/MF A01 CSCL 20A

The theoretical basis for and experimental validation of a measurement method for separating airborne and structure borne noise radiated by aircraft type panels are presented. An extension of the two microphone, cross spectral, acoustic intensity method combined with existing theory of sound radiation of thin shell structures of various designs, is restricted to the frequency range below the coincidence frequency of the structure. Consequently, the method lends itself to low frequency noise problems such as propeller harmonics. Both an aluminum sheet and two built up aircraft panel designs (two aluminum panels with frames and stringers) with and without added damping were measured. Results indicate that the method is quick, reliable, inexpensive, and can be applied to thin shell structures of various designs.  
A.R.H.

## 16 PHYSICS

**N83-11839\*#** Wyle Labs, Inc., El Segundo, Calif  
**LABORATORY STUDIES OF SCALES FOR MEASURING HELICOPTER NOISE Final Report**

J. B. OLLERHEAD Washington NASA Nov. 1982 123 p refs

(Contract NAS1-16276)

(NASA-CR-3610; NAS 1 26 3610, WR82-12) Avail NTIS HC A06/MF A01 CSCL 20A

The adequacy of the effective perceived noise level (EPNL) procedure for rating helicopter noise annoyance was investigated. Recordings of 89 helicopters and 30 fixed wing aircraft (CTOL) flyover sounds were rated with respect to annoyance by groups of approximately 40 subjects. The average annoyance scores were transformed to annoyance levels defined as the equally annoying sound levels of a fixed reference sound. The sound levels of the test sounds were measured on various scales, with and without corrections for duration, tones, and impulsiveness. On average, the helicopter sounds were judged equally annoying to CTOL sounds when their duration corrected levels are approximately 2 dB higher. Multiple regression analysis indicated that, provided the helicopter/CTOL difference of about 2 dB is taken into account, the particular linear combination of level, duration, and tone corrections inherent in EPNL is close to optimum. The results reveal no general requirement for special EPNL correction terms to penalize helicopter sounds which are particularly impulsive, impulsiveness causes spectral and temporal changes which themselves adequately amplify conventionally measured sound levels. Author

**N83-11840\*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio  
**NOISE OF THE 10-BLADED, 40 DEG SWEEP SR-6 PROPELLER IN A WIND TUNNEL**

J. H. DITTMAR, G. L. STEFKO, and R. J. JERACKI Sep. 1982 46 p refs

(NASA-TM-82950; E-1357, NAS 1 15 82950) Avail NTIS HC A03/MF A01 CSCL 20A

The noise generated by supersonic helical-tip-speed propellers is a likely cabin environment problem for future airplanes powered by these propellers. Three propeller models with different tip sweeps. SR-1M, SR-2, and SR-3, designed for 244 m/sec (800 ft/sec) tip speed at a flight Mach number of 0.8 were previously tested in the NASA Lewis 8- by 6-Foot Wind Tunnel. In order to investigate another design point condition, the SR-6 propeller was designed for 213 m/sec (700 ft/sec) tip speed at a flight Mach number of 0.8. The noise data from this propeller are reported herein. Curves of blade passing frequency noise versus tip Mach number (at constant advance ratio) showed that the SR-6 propeller behaved similarly to the SR-1M propeller. The noise of the SR-6 propeller at its design condition, helical tip Mach number of 1.07, is approximately 3 dB quieter than the SR-2 propeller at its higher design helical tip Mach number of 1.15, but about 2.5 dB noisier than SR-3 at its design condition. The helical tip Mach number shift of the steep noise rise followed the same progression as the blade sweep angle for all of the propellers. When operated at the SR-3 design point, the SR-6 propeller was approximately 1.5 dB quieter than SR-2 and 4 dB noisier than SR-3. Author

D. G. FERTIS and A. L. SIMON Oct. 1981 95 p refs  
(Contract NAG3-50; NGT-36-001-800; NGT-36-001-801)  
(NASA-CR-167943; NAS 1.26 167943; NAUFP-202-1) Avail NTIS HC A05/MF A01 CSCL 05I

The requisite methodology to solve linear and nonlinear problems associated with the static and dynamic analysis of rotating machinery, their static and dynamic behavior, and the interaction between the rotating and nonrotating parts of an engine is developed. Linear and nonlinear structural engine problems are investigated by developing solution strategies and interactive computational methods whereby the man and computer can communicate directly in making analysis decisions. Representative examples include modifying structural models, changing material, parameters, selecting analysis options and coupling with interactive graphical display for pre- and postprocessing capability. S.L.

**N83-10989#** Committee of Conference (U. S. Congress).  
**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION**

*In its* Making Appropriations for the Dept of Housing and Urban Develop., and for Sundry Independent Agencies, Boards, Comm., Corporations, and Offices p 11-12 1982  
Avail: US Capitol, House Document Room

Recommendations for resolving disagreements concerning Senate amendments to the House bill covering appropriations to NASA are presented. Changes in budget allocations are listed for space shuttle; Centaur upper stage development; and advanced communications satellite, planetary mission operations and data analysis, technology transfer and/or technology utilization, and for operation of the infrared telescope facility at Mauna Kea, Hawaii. Of the \$280,000,000 available for aeronautical research and technology, \$192,000,000 is to be available for the design, development, and procurement of liquid hydrogen-liquid oxygen upper stages. Appropriations for construction of facilities and for program management are included. A.R.H.

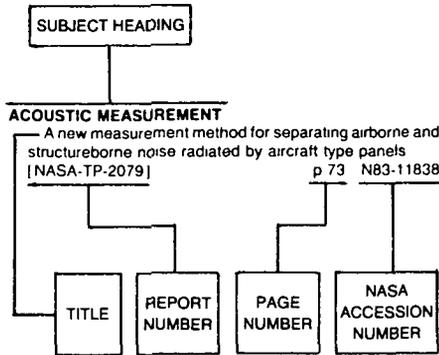
## 17

### SOCIAL SCIENCES

Includes social sciences (general); administration and management, documentation and information science; economics and cost analysis, law and political science; and urban technology and transportation.

**N83-10970\*#** Akron Univ., Ohio. Dept of Civil Engineering  
**NASA LERC/AKRON UNIVERSITY GRADUATE COOPERATIVE FELLOWSHIP PROGRAM AND GRADUATE STUDENT RESEARCHERS PROGRAM Interim Report**

## Typical Subject Index Listing



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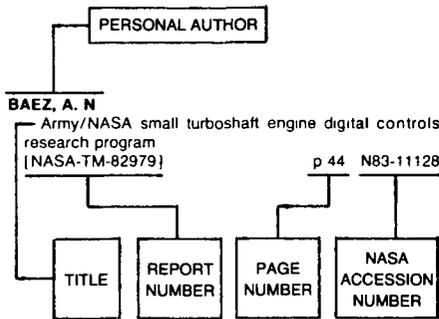
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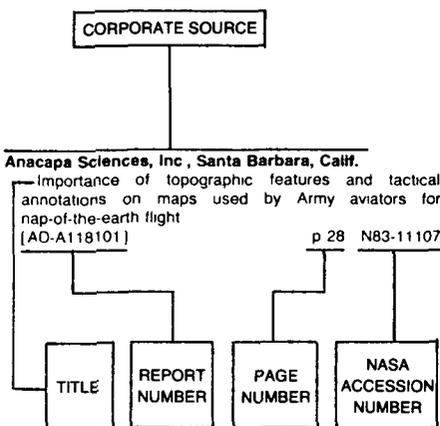
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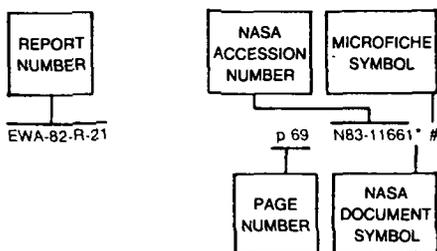
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AD-A117603	p 57	N83-10087 #	AGARD-LS-119	p 67	N83-11390 #	E-1357	p 74	N83-11840* #
AD-A117745	p 38	N83-10042 #	AHS-RWP-16	p 67	N83-10425* #	E-1382	p 61	N83-11282* #
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AD-A117807	p 43	N83-10046 #	AHSRWP-7	p 44	N83-11128* #	E-1405	p 67	N83-10425* #
AD-A117807	p 43	N83-10046 #	AMA-82-18	p 27	N83-11102* #	E-1408	p 44	N83-11128* #
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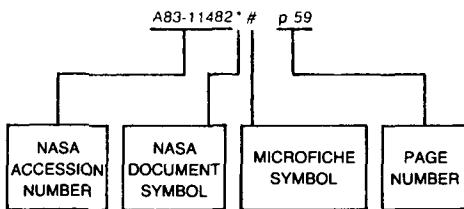
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