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NASA SP-7037(148)

AERONAUTICAL ENGINEERING

A CONTINUING BIBLIOGRAPHY WITH INDEXES

(Supplement 148)

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 April 1982 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 512 reports, journal articles, and other documents originally announced in April 1982 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA).*

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

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

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

An annual cumulative index will be published.

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All publications abstracted in this bibliography are available to the public through the sources as indicated in the *STAR Entries* and *IAA Entries* sections. It is suggested that the bibliography user contact his own library or other local libraries prior to ordering any publication inasmuch as many of the documents have been widely distributed by the issuing agencies, especially NASA. A listing of public collections of NASA documents is included on the inside back cover.

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N82-10021*# Kansas Univ. Center for Research, Inc., Lawrence. Flight Research Lab.
ICING TUNNEL TEST OF A GLYCOL-EXUDING POROUS LEADING EDGE ICE PROTECTION SYSTEM ON A GENERAL AVIATION AIRFOIL Final Report
David L. Kohlman, William G. Schweikhard, and Alan E. Albright
Sep. 1981 37 p refs
(Grant NAG3-71)
(NASA-CR-165444; KU-FRL-464-1) Avail: NTIS
HC A03/MF A01 CSCL 01C

Test results show that the system is very effective in preventing ice accretion (anti-ice mode) or removing ice from an airfoil. Minimum glycol flow rates required for antiicing are a function of velocity, liquid water content in the air, ambient temperature, and droplet size. Large ice caps were removed in only a few minutes using anti-ice flow rates, with the shed time being a function of the type of ice, size of the ice cap, angle of attack, and glycol flow rate. Wake surveys measurements show that no significant drag penalty is associated with the installation or operation of the system tested. T.M.

TYPICAL CITATION AND ABSTRACT FROM *IAA*

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A82-11317 # **Development of aircraft production engineering discipline at IIT, Bombay.** N. K. Naik (Indian Institute of Technology, Bombay, India). *Aeronautical Society of India, Journal,* vol. 31, Feb.-Nov. 1979, p. 119-125.

The aircraft production engineering courses offered at the Indian Institute of Technology, in Bombay, are discussed. To demonstrate the value of the courses, the fundamentals of aircraft production are outlined, the discussion being confined to airframe production. The loft-template method is described, and the principal loft-template scheme used in aircraft production is shown. Also described are the theory and laboratory courses offered at the institute. C.R.

AERONAUTICAL ENGINEERING

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IAA ENTRIES

A82-18874 † **Soviet helicopter construction /2nd revised and enlarged edition/ (Sovetskoe vertoletostroenie /2nd revised and enlarged edition/).** A. M. Izakson. Moscow, Izdatel'stvo Mashinostroenie, 1981. 295 p. 61 refs. In Russian.

A brief history is presented of the development of helicopter construction in the Soviet Union. Following a review of the fundamental design characteristics of the basic classes of helicopters and of the major steps in the development of the Soviet helicopter industry, the prehistory of helicopter construction is traced from the designs of Leonardo da Vinci to Russian helicopter designs in the second half of the 19th century. The first stages in actual construction beginning with advances in aviation in the early 20th century are outlined, and the first Soviet helicopters to be built and operated successfully are presented, including the TsAGI 1-EA, 5-EA and 11-EA models. Attention is then given to the subsequent development of autogyros, true vertical lift helicopters, and present-day helicopters for various applications as exemplified by the Mi, Ka, and Yak series and foreign designs. An evaluation of the current status and future problems in helicopter design is also presented. A.L.W.

A82-18893 **Transient two-dimensional temperature distributions in air-cooled turbine blades.** K. Gue, X. Ge, and X. Sun (China University of Science and Technology, Hefei, People's Republic of China). *Engineering Thermophysics in China,* vol. 1, July-Sept. 1980, p. 255-264. 10 refs. Translation.

The effect of using varying time increments is studied for finite element techniques for unsteady conduction problems, and a FORTRAN program for solving two-dimensional unsteady temperature field of air-cooled turbine blades is presented. The differential equation of two-dimensional unsteady conduction problems is defined with Robin's condition for inner and outer walls of the blade exchanging heat with the fluid by convection. After discretization into spatial triangular elements, three different discretizations of time are shown: a weighted-residual method, assuming the temperature distribution to be a linear time function, a weighted-residual method, assuming the temperature to be a quadratic time function between each step, and a technique treating the difference quotient of temperature to time as a linear function of time. The highest temperature of the blade was found to occur at the trailing edge and the burning-gas side, using the third time discretization method. M.S.K.

A82-18894 **Impingement cooling of concave surfaces of turbine airfoils.** J. Cheng and B. Wang (Nanjing Aeronautical Engineering College, Nanjing, People's Republic of China). *Engineering Thermophysics in China,* vol. 1, July-Sept. 1980, p. 275-291. 12 refs. Translation.

Experimental results of impingement cooling of two aluminum specimens of different sizes with three impingement tubes are presented in this paper. The specimens, simulating the leading edge of a turbine blade, were preheated and cooled by jets from different impingement tubes at various flow rates and distances. The lumped capacity method was used to determine the cooling rate of the aluminum specimen. The mean heat transfer coefficients were calculated and correlated with dimensionless parameters. The results of the Nusselt numbers obtained from experiments were consistent with those calculated from the recommended formula. Furthermore, these results were compared with the correlations of Metzger and those of Ravuni and Tabakoff, and it was concluded that the formula proposed by this paper was more reasonable. (Author)

A82-18898 † **The city and aviation (Gorod i aviatsiia).** A. I. Borodach, B. N. Mel'nikov, V. I. Chernikov, and B. I. Berdnik. Moscow, Stroiizdat, 1980. 184 p. 22 refs. In Russian.

Basic information is presented on various types of air transportation facilities that serve cities: airports for conventional aircraft and for STOL and V/STOL aircraft, helicopter stations, and railroad stations connecting the city with the airports. Attention is given to requirements concerning the location of airports in relation to cities; problems of convenient access, noise reduction, and flight safety are considered. The basic principles of the organization of transportation between cities and airports are examined. B.J.

A82-18899 † **Accidents of surface effect ships and hydrofoil craft (Avarii sudov na vozdushnoi podushke i podvodnykh kryl'iakh).** I. M. Korotkin. Leningrad, Izdatel'stvo Sudostroenie, 1981. 216 p. 79 refs. In Russian.

The work describes 200 accidents and disasters of hovercraft and hydrofoil craft of the United States, Great Britain, France, and other fleets which occurred in the 1960s and 1970s as a result of capsizing, storm damage, collisions, fires, explosions, etc. The causes of the accidents, the functioning of various craft systems, and the actions of the crews are examined. Recommendations on the prevention of such accidents are discussed. B.J.

A82-18903 # **Tactical Radar Threat Generator system.** W. T. Harpster and J. L. Gebhart (Emerson Electric Co., St. Louis, MO). In: Military microwaves '80; Proceedings of the Second Conference, London, England, October 22-24, 1980. Sevenoaks, Kent, England, Microwave Exhibitions and Publishers, Ltd., 1981, p. 43-53.

It is pointed out that a military force's survival, and the successful accomplishment of its objective is highly dependent on preconflict training. The success of military training is, in turn, dependent on the accuracy with which the combat environment is duplicated. The combat environment for the crew of an attack aircraft is examined. Realistic training of combat pilots cannot be accomplished unless a typical threat environment is simulated in the target area. A cost effective approach to training involves the procurement of threat emitter equipment which meets certain minimum requirements for effective aircrew training. A suitably low-cost threat simulator is the Tactical Radar Threat Generator (TRTG). The U.S. Army version has become known as 'GRETA' an acronym for Ground Radar Emitter for Training Aviators. Attention is given to TRTG hardware, the digital scan converter, and the scoring equipment. G.R.

A82-18904 # **Design criteria for a miss distance radar.** L. I. Ruffe (Racal-MESL, Ltd., Linlithgow, Scotland). In: Military microwaves '80; Proceedings of the Second Conference, London, England, October 22-24, 1980. Sevenoaks, Kent, England, Microwave Exhibitions and Publishers, Ltd., 1981, p. 54-59. Research supported by the Ministry of Defence (Procurement Executive).

When a missile, fired in connection with development trials or operator training, misses the target, it is most desirable to know by how much it has missed. This miss-distance must be measured without imposing restrictive conditions on the engagement geometry. The design of a Doppler radar system for measuring the miss-distance is considered. The system makes use of the Doppler frequency shift due to the relative velocity between projectile and target to determine the magnitude of the miss-distance. The practical realization of the system measuring concepts is discussed, taking into account aspects of target installation, the antennae, and the ground equipment. The maximum miss-distance which may be determined depends on the size of the projectile. Typical maximum values are 4 m for a 30 mm shell, 11 m for a 114 mm shell, and 15 m for a guided weapon. G.R.

A82-18906 # **Sanctuary radar.** F. L. Fleming (Technology Service Corp., Santa Monica, CA) and N. J. Willis (U.S. Defense Advanced Research Projects Agency, Arlington, VA). In: Military microwaves '80; Proceedings of the Second Conference, London, England, October 22-24, 1980. Sevenoaks, Kent, England, Microwave Exhibitions and Publishers, Ltd., 1981, p. 103-108. Army-USAF-supported research.

This paper describes the Sanctuary bistatic radar test bed and fundamental technical issues addressed in the test program. It outlines the choice of waveform and digital signal processor configuration, which performs both Doppler filtering and pulse compression in the frequency domain. It explains clutter suppression techniques, including those involving real-time software control of the digital processor. Finally, it summarizes flight test objectives and results obtained during initial system tests with the airborne transmitter. (Author)

A82-18908 **Recent developments in military telemetry.** R. G. A. Marzolini (EMI Electronics, Ltd., Feltham, Middx., England). In: Military microwaves '80; Proceedings of the Second Conference, London, England, October 22-24, 1980. Sevenoaks, Kent, England, Microwave Exhibitions and Publishers, Ltd., 1981, p. 123-128.

Developments regarding UK guided weapon telemetry systems following World War II are examined. Analog systems operating in the frequency band from 430 to 450 MHz were replaced in the 1960's by the Type 4650 Variant I and Variant II systems. In the early 1970's, due to the expansion of private mobile radio services, military telemetry moved to new allocations in the frequency band from 1430 to 1450 MHz. The change in frequency operation is to be completed by Jan. 1, 1981. This change in carrier frequency affected the systems which would be allowed to operate in the new band, and one resulting development was the Type 1440 (PAM/FM/FM) system. In parallel with this carrier frequency change the development of digital telemetry in the form of the Type 109 (PCM/FM) system commenced. Attention is given to details regarding carrier frequency, FM transmitters, PCM encoders, standards, and a flight proving trial. G.R.

A82-18911 **Microwave communications to remotely piloted vehicles.** M. R. B. Dunsmore and S. E. Gibbs (Royal Signals and Radar Establishment, Malvern, Worcs., England). In: Military microwaves '80; Proceedings of the Second Conference, London, England, October 22-24, 1980. Sevenoaks, Kent, England, Microwave Exhibitions and Publishers, Ltd., 1981, p. 141-148.

Remotely piloted vehicles (RPVs) rely on two-way communication links to return data from their surveillance sensors to their ground control stations and to receive data for monitor and control operations. The requirements of a data link are examined, and a data link design for meeting these requirements is discussed. It is found that RPV data links are constrained to operate in or above the microwave frequency bands, typically G or J bands. The information (video) bandwidth is considered along with channel bandwidths, the operating range, antenna patterns, receiver sensitivity, and transmitter power. The vulnerability of RPV data links to electronic countermeasures (ECM) is evaluated, taking into account also remotely piloted helicopters. G.R.

A82-18914 # **L-band power generation in the General Electric solid-state radar.** G. B. Sleeper (General Electric Co., Syracuse, NY). In: Military microwaves '80; Proceedings of the Second Conference, London, England, October 22-24, 1980. Sevenoaks, Kent, England, Microwave Exhibitions and Publishers, Ltd., 1981, p. 199-205.

A solid-state, L-band air defense radar is discussed. The considered radar is entirely computer controlled. By handling the energy management problem with a computer in real time, it is possible to exploit fully the high-duty-cycle capability of solid-state power generation. An approach combining computer and solid-state device technologies provides a number of advantages related to high reliability, long operational life, graceful degradation, and low maintenance costs. Attention is given to the array configuration, aspects of array phase calibration, row transmitters, the array transmitter, the power modules, the DC power supply transmit/receive switching, and phase shifting for both transmit and receive. G.R.

A82-18917 **R.F. calibrators for Doppler radars.** T. Billing and P. A. R. Holder (EMI Electronics, Ltd., Wells, Somerset, England). In: Military microwaves '80; Proceedings of the Second Conference, London, England, October 22-24, 1980. Sevenoaks, Kent, England, Microwave Exhibitions and Publishers, Ltd., 1981, p. 245-250. Research supported by the Ministry of Defence (Procurement Executive).

This paper deals with the problem of achieving reliable calibration of Doppler radars. Calibration with a simulator at constant range is examined for two practical cases: in a radar trials situation, where the simulator is placed at a distance for a line-of-sight type calibration; and in the laboratory, where a simulator is connected directly to the radar and where the range delay is simulated. (Author)

A82-18920 # **Automatic controlled terrain following flights.** R. Rode and A. Hessel (Messerschmitt-Bölkow-Blohm GmbH, Munich, West Germany). In: Military microwaves '80; Proceedings of the Second Conference, London, England, October 22-24, 1980. Sevenoaks, Kent, England, Microwave Exhibitions and Publishers, Ltd., 1981, p. 275-280.

Three low-level flying modes are named: terrain-following, terrain-avoidance, and terrain-clearance. Because the terrain avoidance mode is difficult under bad weather conditions and because the terrain-clearance mode is unacceptable with regard to vulnerability, the terrain-following mode is regarded as an acceptable compromise. Block diagrams describing this system are given. It is noted that the system is based on a scanning forward looking radar which, together with other sensors, operates in a closed loop with an automatic flight control system. The radar scans the terrain ahead of the aircraft; the computer then calculates a vertical acceleration based on this information which is then used by the autopilot and flight control system to keep the aircraft on its required flight path. C.R.

A82-18934 # **Octave bandwidth dual polarized antenna.** C. Nicolai, R. Scarpetta, and P. Russo (Selenia S.p.A., Pomezia, Italy). In: Military microwaves '80; Proceedings of the Second Conference, London, England, October 22-24, 1980. Sevenoaks, Kent, England, Microwave Exhibitions and Publishers, Ltd., 1981, p. 417-421.

It is noted that the requirements in the design of ECM antennas become harder to meet for the lower operating microwave frequency band (S or L). A crossed dipole in the short backfire configuration with high performance over more than a 2:1 frequency band is described. Wideband operation is achieved by a proper design of the dipoles and cavity geometry and of the feeding baluns and sleeves. The dipole length and the distance from the cavity are, respectively, about 1/2 and 1/4 of the wavelength at the center frequency. It is noted that radiation patterns optimization and control are possible by varying the sleeves and the back cavity geometry. Good amplitude and phase pattern optimization is achieved with the circular sleeves geometry and the polygonal cavity geometry. C.R.

A82-18936 # **Microwave systems for radar guided missiles.** M. F. Godfrey (Marconi Space and Defence Systems, Ltd., Stanmore, Middx., England). In: Military microwaves '80; Proceedings of the Second Conference, London, England, October 22-24, 1980. Sevenoaks, Kent, England, Microwave Exhibitions and Publishers, Ltd., 1981, p. 433-438.

The importance of the microwave components in radar homing heads is stressed, noting that it is these components which condition the radar signal for the signal-processing unit. The difference between the coherent and incoherent radars used in guided weapons is discussed. Attention is also given to semiactive and active incoherent radars. It is noted that a coherent transmitter must provide mean powers of up to 1 kW, depending on the application, at duty ratios of up to 50% and with pulse repetition rates which may be as high as 500 kHz. The dc to microwave efficiency should be more than 20%. Incoherent transmitters must provide peak powers above 50 kW at duty ratios of 0.1%. C.R.

A82-18937 # **A terminal guidance simulator for evaluation of millimeter wave seekers.** A. J. Witsmeer and K. L. Wismer (Boeing Aerospace Co., Seattle, WA). In: Military microwaves '80; Proceedings of the Second Conference, London, England, October 22-24, 1980. Sevenoaks, Kent, England, Microwave Exhibitions and Publishers, Ltd., 1981, p. 445-451.

A theoretical and physical description is given of a simulator for evaluating passive terminal guidance seekers operating in the millimeter region 10-100 GHz. Attention is also given to the expansion of the present facility into the active regime. It is noted that the chamber may be the only one of its kind in the world. A feature that makes it unique is the use of aluminum foil to reflect the excess microwave energy out of the room through a skylight. In effect, this makes the walls appear cold like the sky background so that the seeker sees only the array with its picture of the target scene. C.R.

A82-18940 # **Airborne measurements with a sensitive high resolution 90 GHz radiometer.** K. Grüner and B. Aumiller (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Hochfrequenztechnik, Oberpfaffenhofen, West Germany). In: Military microwaves '80; Proceedings of the Second Conference, London, England, October 22-24, 1980. Sevenoaks, Kent, England, Microwave Exhibitions and Publishers, Ltd., 1981, p. 473-480.

Design criteria and realized configurations of sensitive, high-resolution airborne 90 GHz radiometer used in low-altitude flights are described. Selected results of the first test measurements are given. The receiver front end comprises an antenna scalar feed horn and a GaAs single-ended Schottky mixer with an integrated first-stage FET-IF-amplifier mounted in an evacuated compartment and cooled to 23 K by a two-stage temperature-controlled helium refrigerator. Among the characteristics are an RF input frequency of 83.9-85.1 and 90.9-92.1 GHz, an IF band of 2.9-4.1 GHz, and a scan angle of plus or minus 14.5 deg. C.R.

A82-18942 # **A study of potentially low cost millimetre-wave radiometric sensors.** S. J. Nightingale and R. N. Bates (Philips Research Laboratories, Redhill, Surrey, England). In: Military microwaves '80; Proceedings of the Second Conference, London, England, October 22-24, 1980. Sevenoaks, Kent, England, Microwave Exhibitions and Publishers, Ltd., 1981, p. 486-491. 7 refs.

Some of the design considerations for a radiometric sensor are examined with a view to developing a compact, lightweight unit which would be cheap to produce. The construction and performance of a 35 GHz Dicke radiometer are described. The r.f. components are made with 'E' plane circuitry, which makes it possible to realize a variety of different transmission structures, for example, finline, microstrip, and coplanar waveguide. It is noted that the r.f. and i.f. circuit techniques discussed here can also be used to make similar units operating at frequencies up to at least 100 GHz. C.R.

A82-18943 **Radiometric measurements at 80 GHz.** S. E. Millard, K. O. Rossiter, and G. R. Selby (EMI Electronics, Ltd., Wells, Somerset, England). In: *Military microwaves '80; Proceedings of the Second Conference, London, England, October 22-24, 1980.* Sevenoaks, Kent, England, Microwave Exhibitions and Publishers, Ltd., 1981, p. 492-497. Research sponsored by the EMI Electronics, Ltd. and Royal Signals and Radar Establishment.

The radiometer system employs the Dicke-switch principle with a 50% duty ratio but also incorporates an additional reference load which can replace the antenna for calibration purposes. Each load is maintained at a certain temperature by immersion in a dewar together with either ice (273 K) or solid CO2 (195 K). It is noted that, in addition, the overall system can be calibrated and the gain checked by fitting small 'black body' cones filled with either ice or solid CO2 over the antenna feed. The measurements made at 81 GHz show acceptable contrasts between a variety of metal targets and characteristic backgrounds for various weather conditions. To the extent that they have been analyzed to date, the measurements confirm that a center frequency in the range 75-90 GHz is acceptable for all-weather operation. They also emphasize the need for both vertical and horizontal polarization measurements to discriminate between metallic and wet, nonmetallic surfaces. C.R.

A82-18975 † **Airport radar systems (Radiolokatsionnye sistemy aeroportov).** L. T. Perevezentsev, A. V. Zelenkov, and V. N. Ogarkov. Moscow, Izdatel'stvo Transport, 1981. 384 p. 27 refs. In Russian.

The design principles of ground-based radar systems for civil aviation are presented along with techniques for implementing these principles and structural and operational characteristics of airport radar systems. Consideration is given to transmitter, receiver, and feed design, and to MTI systems, the primary processing of radar data, the interpretation and processing of secondary radar data, and radar display techniques. B.J.

A82-18998 † **Aircraft electrical equipment - Design and operation (Elektrooborudovanie samoletov - Ustroistvo i ekspluatatsiia).** A. P. Barvinskii and F. G. Kozlova. Moscow, Izdatel'stvo Transport, 1981. 290 p. In Russian.

Design principles and circuit designs are presented for a variety of aircraft electrical systems. Particular consideration is given to ac and dc generators in aircraft power supply systems, and to the electromechanical drive equipment. Various electrical control systems are also examined, including engine starting, fuel control, antiicing, lighting, and fire extinguishing. B.J.

A82-19001 ***Aeromedical evacuation:* Results, analysis, developments; International Aeromedical Evacuation Congress, 1st, Munich, West Germany, September 16-19, 1980, Reports (Die Luftrettung: Ergebnisse, Analysen, Entwicklungen; Internationaler Luftrettungs-Kongress, 1st, Munich, West Germany, September 16-19, 1980, Berichte).** Congress sponsored by the Allgemeiner Deutscher Automobil-Club. Edited by H. H. Atrott. Munich, Allgemeiner Deutscher Automobil-Club, 1981. 503 p. In German and English.

A survey of aeromedical evacuation services throughout the world is provided, taking into account conditions in Switzerland, Austria, France, Norway, Great Britain, Italy, West Germany, Belgium, Sweden, Spain, the United States, Australia, East Africa, South Africa, Argentina, Chile, New Zealand, and Bahrain. Subjects related to organization, legal and financial bases are investigated, giving attention to basic guidelines for a helicopter ambulance service, an air emergency service, a universal system for the identification of emergency vehicles, marketing the hospital-based helicopter system in a free enterprise environment, and limitations and developments of commercial schedule airline flights for the carriage of invalid passengers. Other topics explored are related to aviation medicine, flight guidance and control systems, the training of aeromedical evacuation personnel, and medical and technical requirements for aircraft and equipment. G.R.

A82-19002 **The marketing, organisation and financing of aeromedical evacuation by a motoring organisation.** A. J. Whitaker (British Automobile Association, Basingstoke, Hants., England). In: Aeromedical evacuation: Results, analysis, developments; International Aeromedical Evacuation Congress, 1st, Munich, West Germany, September 16-19, 1980, Reports. Munich, Allgemeiner Deutscher Automobil-Club, 1981, p. 71, 72.

The features and effectiveness of a British automotive club aeromedical insurance plan for travellers in Europe, North Africa, and Turkey are described. The plan is sold through banks, travel agents, and service centers, and the service is provided by an amubulance organization with an aeromedical wing. A central communications base can dispatch emergency air services for transport back to Britain in case of accident or illness, using either small general aviation aircraft, chartered jets, or scheduled air services. M.S.K.

A82-19003 **Survey of aeromedical evacuation in Italy.** C. Manni (Roma, Università Cattolica, Rome, Italy) and G. Ruggieri. In: Aeromedical evacuation: Results, analysis, developments; International Aeromedical Evacuation Congress, 1st, Munich, West Germany, September 16-19, 1980, Reports. Munich, Allgemeiner Deutscher Automobil-Club, 1981, p. 73-75. 6 refs.

Aeromedical rescue efforts in Italy, primarily performed by the Italian Air Force, are outlined. Air rescue is mainly confined to remote locations or small islands, and follows the identification by county authorities of the level of the request, the availability of beds in the nearest hospital, and the ensurance of ground transport from the nearest airfield. The Air Force is responsible for providing personnel and machines, including fixed wing aircraft or helicopters, and readiness requirements are detailed. It is noted that the overlapping of various jurisdictional regions by armed forces, state corps, and governing bodies sometimes results in a redundancy of services arriving for the same rescue mission. The training of Air Force aeromedical personnel for first aid and resuscitation tasks is discussed, and can comprise basic medical actions which justify the cost of airborne rescue. M.S.K.

A82-19004 **The network of civilian air rescue in Germany (Das Netz der zivilen Luftrettung in Deutschland).** G. Kugler (Allgemeiner Deutscher Automobil-Club, Munich, West Germany). In: Aeromedical evacuation: Results, analysis, developments; International Aeromedical Evacuation Congress, 1st, Munich, West Germany, September 16-19, 1980, Reports. Munich, Allgemeiner Deutscher Automobil-Club, 1981, p. 76-79. In German.

For the last 10 years a network of 26 helicopter air rescue stations have been in operation in West Germany, which can reach 80% of the population within 15 minutes. This civilian air rescue system is used to transport physicians to the scene of an accident, transport patients to hospitals or specialized clinics, transport organs, medical equipment or blood, and act as a search vehicle over mountainous land. Since the beginning of the program, 88,000 rescue flights have been completed, with a maximum daily frequency of 15 flights. In addition to the helicopter rescue program, West Germany has an ambulance aircraft service that specializes in flying patients from outlying areas to suitable clinics in the interior of the country for treatment. D.L.G.

A82-19005 **Ambulance helicopter in the Stockholm archipelago.** B. Brismar (Huddinge University Hospital, Huddinge, Sweden) and A. Alveryd. In: Aeromedical evacuation: Results, analysis, developments; International Aeromedical Evacuation Congress, 1st, Munich, West Germany, September 16-19, 1980, Reports. Munich, Allgemeiner Deutscher Automobil-Club, 1981, p. 85-87.

The results of a summer trial program for aeromedical relief of persons in the Swedish archipelago are reported. A Bell 206 helicopter provided room for a pilot, a prone passenger, and a seated passenger. Noting that in no instance was more than one patient transported at a time, the response time from call receipt to chopper arrival was an average of 25 min, and was extended only when the helicopter was otherwise occupied with another call or during night and bad weather conditions. The lack of an on-site, suitable helicopter landing pad at some hospitals forced a transfer of 85% of the patients by surface ambulance to a hospital in other locations. The cost of the helicopter service was about four times the cost of calling an ambulance in Stockholm, and it was found that in only 16% of the calls was a trained physician necessary, with most cases amenable to treatment by a nurse or other paramedic. M.S.K.

A82-19006 **Military assistance to safety and traffic /MAST/.** W. R. Gemma (U.S. Department of Health and Human Services, Office of International Health Affairs, Rockville, MD). In: Aeromedical evacuation: Results, analysis, developments; International Aeromedical Evacuation Congress, 1st, Munich, West Germany, September 16-19, 1980, Reports. Munich, Allgemeiner Deutscher Automobil-Club, 1981, p. 90-94.

The lessons learned and the organizational scheme for the U.S. Military Assistance to Safety and Traffic (MAST) Program are examined. A six-month evaluation of five demonstration sites showed that the use of military personnel and equipment, including helicopters, for emergency medical services is feasible, the military provides round-the-clock readiness, while communities must actively seek to utilize the sources available, and some resistance to MAST use was encountered with local law enforcement agencies. The performance of MAST missions was found to serve as training and mandatory flight time for military personnel, and was employed by civilians only when the available civilian aeromedical services were considered inadequate. Problems of communications involved providing civilian coordinating teams with units compatible with military communications. M.S.K.

A82-19007 **Aerial ambulance service in Australia.** S. Rowley (Sydney Helicopter Rescue Service, Sydney, Australia). In: Aeromedical evacuation: Results, analysis, developments; International Aeromedical Evacuation Congress, 1st, Munich, West Germany, September 16-19, 1980, Reports. Munich, Allgemeiner Deutscher Automobil-Club, 1981, p. 94-99.

The operations of the Royal Doctor Flying Service of Australia, which provides medical services for persons living in the remote regions of the Outback, are described. All the doctors are pilots, and also run daily two-way radio clinics, fly rounds for immunization programs, and accompany emergency aeromedical evacuation teams to transfer seriously ill or injured persons to medical facilities. Surf rescue and other coastal aeromedical functions are enacted by helicopter services, which feature a crew comprising a pilot, a rescue crewman, and a doctor. The services are available to everyone, and no charge is levied on anyone or any community for the services rendered. M.S.K.

A82-19008 **Flying doctor service in East Africa.** A. M. Wood (Flying Doctor Service of Africa, Nairobi, Kenya). In: Aeromedical evacuation: Results, analysis, developments; International Aeromedical Evacuation Congress, 1st, Munich, West Germany, September 16-19, 1980, Reports. Munich, Allgemeiner Deutscher Automobil-Club, 1981, p. 100-103.

The various features of the East Africe Flying Doctor Service are outlined. The service comprises eight aircraft and a radio network of 100 stations, with calls averaging 2200/mo. Over 100 airstrips are provided near medical facilities, and the flying doctor performs a routine six-month circuit, with the emergency calls occurring at any time. Treatment is confined to dealing with the patient on-site wherever possible, due to overcrowded hospitals, the patient's familiarity and tasks at home, and the opportunity to treat other persons while on the visit. A complete operating team travels on each trip, and also a pilot who is frequently from the region and has a commercial pilots' rating. It is noted that the aircraft method provides a service where otherwise there would be none at all. M.S.K.

A82-19009 **Air ambulance systems in the Republic of South Africa.** G. O. F. Lippert. In: Aeromedical evacuation: Results, analysis, developments; International Aeromedical Evacuation Congress, 1st, Munich, West Germany, September 16-19, 1980, Reports. Munich, Allgemeiner Deutscher Automobil-Club, 1981, p. 104-107.

The operations of the three air ambulance systems in South Africa are discussed. The Johannesburg district has the only helicopter ambulance service, and services an area 500 km in radius. A three minute interval exists between call arrival and dispatch with a full medical team on board. The commercial helicopter firms in Cape Town also offer a 300 km radius air ambulance service, while other population centers have fixed-wing services with either voluntary or Red Cross personnel as the medical teams. Military air ambulances are reserved for particular rescue missions, and it is noted that emergency notification is usually accomplished by telephone. M.S.K.

A82-19010 **The situation of air rescue in Argentina (Die Situation der Luftrettung in Argentinien).** K. Liebig (Rappard y Cia, S.A., Buenos Aires, Argentina). In: Aeromedical evacuation: Results, analysis, developments; International Aeromedical Evacuation Congress, 1st, Munich, West Germany, September 16-19, 1980, Reports. Munich, Allgemeiner Deutscher Automobil-Club, 1981, p. 108-110. In German.

Due to the geography of Argentina, air rescue is often the only possible mode of rescue. In case of land catastrophes such as earthquakes, the army will be used to evacuate the elderly, the children and the injured from the area, and fly in medical aid and foodstuffs. Helicopters are often used by the police to rescue people from tall buildings, and water emergencies are taken care of by a special branch of the police who are in charge of the rivers and coasts in the region. Their duties include rescue operations in case of flooding, usually using helicopters. In 1979, the four helicopters in the program flew 320 hours and aided 355 people. D.L.G.

A82-19011 **Aeromedical evacuation in New Zealand.** R. J. Worth. In: Aeromedical evacuation: Results, analysis, developments; International Aeromedical Evacuation Congress, 1st, Munich, West Germany, September 16-19, 1980, Reports.
Munich, Allgemeiner Deutscher Automobil-Club, 1981, p. 120-122.

The operations and integration of military, government, and private air ambulance services in New Zealand are explored. Only one commercial air ambulance helicopter service exists, which logged 40 missions in its first year of operations carrying premature babies, pregnant mothers, burns victims, trauma victims, and patients with head injuries. The helicopter is used for commercial purposes until called on to make a medical emergency call, when a medical supplies unit can be mounted on-board in four minutes. The role of the U.S. Air Force in carrying out rescue missions in Antarctica from the base at Christchurch is reviewed, and a recommendation is made for a central command to coordinate the activities of the U.S. Air Force, the New Zealand Air Force, and the private aeromedical services. M.S.K.

A82-19013 **A comparative study on mechanical vibration and noise during patient transportation.** S. Rowley (Sydney Helicopter Rescue Service, Sydney, Australia). In: Aeromedical evacuation: Results, analysis, developments; International Aeromedical Evacuation Congress, 1st, Munich, West Germany, September 16-19, 1980, Reports. Munich, Allgemeiner Deutscher Automobil-Club, 1981, p. 175-177. 5 refs.

The magnitude of mechanical vibration and noise has been investigated for three different forms of patient transportation: helicopters, fixed-wing aircraft, and road vehicles. The figures obtained for all forms of patient transportation studied are below the level set by international standards, but no conclusive evidence of adverse effects on injured tissue is yet available. It is noted that in the case of the helicopter, where the vibration frequencies (6.5, 13, and 19 Hz) are constant during the entire flight, some components are located in the resonance frequency spectrum of some body organs. It is, however, possible to reduce the magnitude of these critical frequencies more readily than to suppress not only the very low frequencies, but also the displacement of the body occurring both in the fixed-wing aircraft and in the road vehicle. V.L.

A82-19015 **Helicopter secondary applications for neurotraumatic emergencies (Helikopter-Sekundäreinsätze für neurotraumatologische Notfälle).** L. M. Auer (Universitätsklinik für Neurochirurgie, Graz, Austria). In: Aeromedical evacuation: Results, analysis, developments; International Aeromedical Evacuation Congress, 1st, Munich, West Germany, September 16-19, 1980, Reports.
Munich, Allgemeiner Deutscher Automobil-Club, 1981, p. 184-186. In German.

Since the life of patients can depend on minutes in neurological cases, the fastest possible transportation of trained neurological surgeons is very important. Since many mountainous regions in Austria are hours away by car from clinics where patients can receive proper neurological care, a program was developed whereby helicopters can transport neurosurgeons to the patients often within minutes. The system allows the patient to be operated on immediately without being moved, and afterwards the patient can either be flown to a neurological clinic or remain in the original hospital for post-operative care. Results of the program have been good; in 1973-1974 before the program, only 25% of neurotraumatic patients survived, while in 1977-1979 after the application of the program, 58% of the patients survived. D.L.G.

A82-19017 **Helicopters - Night operations (Hubschrauber - Einsätze bei Nacht).** C. Bühler (Schweizerische Rettungsflugwacht, Zurich, Switzerland). In: Aeromedical evacuation: Results, analysis, developments; International Aeromedical Evacuation Congress, 1st, Munich, West Germany, September 16-19, 1980, Reports.
Munich, Allgemeiner Deutscher Automobil-Club, 1981, p. 214-218. In German.

In Switzerland the helicopter is often used to transport accident patients from the south to the university clinics in the north. Pilots are required to make three types of flights: return flights to the homebase, flights to familiar destinations such as hospitals, and flights to unfamiliar destinations such as where first aid is administered. Weather is critical, and bad weather can create delays and additional risk. Accessories are used to improve flying, including obstacle maps, altimeters, night viewing goggles, and projector lamps, and electronic equipment may be used in the future to improve vision. D.L.G.

A82-19018 **Problems pertaining to aeronautical technology in the case of rescue operations with helicopters in mountainous areas (Flugtechnische Probleme beim Bergrettungseinsatz mit Hubschraubern).** B. Klingner (Bundeswehr, Penzing über Landsberg, West Germany). In: Aeromedical evacuation: Results, analysis, developments; International Aeromedical Evacuation Congress, 1st, Munich, West Germany, September 16-19, 1980, Reports.
Munich, Allgemeiner Deutscher Automobil-Club, 1981, p. 219-222. In German.

The use of helicopters for rescue operations in mountainous areas can provide sometimes very great advantages compared to an employment of more conventional means. However, the conditions might be such that a use of helicopters, although urgently needed, is not possible in connection with technological and environmental factors. An investigation is conducted regarding the criteria which have to be taken into account in an evaluation concerning the feasibility of an employment of a helicopter in a specific situation, giving attention to limitations with respect to machines and pilots. Aspects of engine performance are considered along with the helicopter payload, the weather, and a special training of helicopter pilots for flight operations in mountainous areas. G.R.

A82-19019 **The helicopter in rescue operations in high-mountain areas (Der Hubschrauber beim Rettungsdienst im Hochgebirge).** W. Phleps and G. Flora (Innsbruck, Chirurgische Universitätsklinik, Innsbruck, Austria). In: Aeromedical evacuation: Results, analysis, developments; International Aeromedical Evacuation Congress, 1st, Munich, West Germany, September 16-19, 1980, Reports.
Munich, Allgemeiner Deutscher Automobil-Club, 1981, p. 222-229. In German.

The use of helicopters for rescue operations in high-mountain areas is briefly reviewed. It is pointed out that in a number of cases the employment of a helicopter represents the only possibility to effect a rescue. It is estimated that, taking into account only the Alps, considerably more than 100 persons owe their rescue from certain death each year exclusively to the availability of a helicopter. The decision regarding an employment of a helicopter in an area of high mountains is based on three criteria, which are related to the medical aspects involved, considerations regarding the general feasibility of rescue operations, and economic factors. Differences regarding the characteristics of helicopter operations in mountainous areas and in flat country are discussed, and a description is provided of the advantages and drawbacks of the five helicopter types which are most frequently employed in the Alps. G.R.

A82-19020 **Design requirements for modern rescue helicopters (Konstruktive Anforderungen an moderne Rettungshubschrauber /RTH/).** E. Weiland (Messerschmitt-Bölkow-Blohm GmbH, Unternehmensbereich Drehflüger und Verkehr, Munich, West Germany). In: Aeromedical evacuation: Results, analysis, developments; International Aeromedical Evacuation Congress, 1st, Munich, West Germany, September 16-19, 1980, Reports.
Munich, Allgemeiner Deutscher Automobile-Club, 1981, p. 418-436. In German.

The architecture and size of a rescue helicopter is determined by its function as well as the time and space required to successfully complete its mission. A matrix is presented which outlines the various technical requirements of a rescue helicopter and the corresponding design solutions. The resulting architecture includes a helicopter airframe with a large interior cabin for transporting and caring for the sick or injured; a wide door to facilitate loading; a main rotor with at least three blades; a rotor arrangement that provides sufficient ground clearance; the use of gas turbine propulsive units, interior noise attenuation; and additional communication linkages. The weight of the helicopter and the diameter of its rotor must also be determined. As an example, the German BK 117 and BO 105 rescue helicopters are discussed in detail; the necessary mobile and standard equipment and instrumentation for these aircraft are illustrated. J.F.

A82-19021 **Aircraft for secondary long range emergency ambulance flight.** K. J. J. Waldeck and G. B. J. Bramer (Algemeene Nederlandsche Wielrijders Bond, The Hague, Netherlands). In: Aeromedical evacuation; Results, analysis, developments; International Aeromedical Evacuation Congress, 1st, Munich, West Germany, September 16-19, 1980, Reports. Munich, Allgemeiner Deutscher Automobile-Club, 1981, p. 460-463.

The primary aim for medical transport today is mobile intensive treatment and care. Rules and directives for medical assistance in flight must therefore be developed, and an ambulance for long-range emergency flight must be designed. This includes the need for special equipment, such as a floating stretcher, which will protect the body of the patient against accelerations with frequencies, corresponding with the natural frequencies of parts of the body and organs. The Fokker F-27 Friendship turboprop from Holland has been converted into an ambulance aircraft with the primary function of in-flight intensive treatment and care. The helicopter features three compartments for (1) the patient and medical equipment; (2) the medical personnel; and (3) the passengers. The F-27 has a large front cargo door with lift installation and a communication area to maintain radio contact with a ground station for medical purposes. The whole medical system can be loaded into the aircraft on pallets, thus enabling every F-17 fitted with a front cargo door to be converted into an ambulance-aircraft within a short period. J.F.

A82-19061 # **An application of total synthesis to robust coupled design.** M. K. Sain, R. M. Schafer, and K. P. Dudek (Notre Dame, University, Notre Dame, IN). In: Annual Allerton Conference on Communication, Control, and Computing, 18th, Monticello, IL, October 8-10, 1980, Proceedings. Urbana, IL, University of Illinois, 1980, p. 386-395. 10 refs. Contract No. N00014-79-C-0475.

Total synthesis techniques for the control of linear multivariable systems are module theoretic methods aimed at bottom line design, wherein the designer selects at the outset the control action and system response characteristics which will be attained. This selection is made from the class having associated with it the possibility of an internally stable feedback realization. In practice, however, such realizations are normally carried out with decentralized dynamics - or fixed structure. Moreover, they must be achieved in such a way that plant parameter variation does not materially inhibit the nominal filter responses. This paper reports on the extension of the Total Synthesis Problem (TSP) concept to robust feedback realizations of fixed structure. An example from turbojet engine data illustrates the concepts. (Author)

A82-19065 # **The use of adaptive control for helicopter trajectories in search operations.** A. Chacón, M. Azagoury, B. Fernández (Universidad Simón Bolívar, Caracas, Venezuela), R. Padilla, and C. Padilla (Instituto Venezolano de Investigaciones Científicas, Caracas, Venezuela). In: Annual Allerton Conference on Communication, Control, and Computing, 18th, Monticello, IL, October 8-10, 1980, Proceedings. Urbana, IL, University of Illinois, 1980, p. 633-642.

An effective and successful search operation by helicopter requires close tracking of predetermined trajectories defined by the characteristics of the terrain and the prior information available to the search party. We investigate here the design of an adaptive controller such that the helicopter follows a predetermined trajectory in a horizontal plane. A model reference control approach is used. Simulation results are given to illustrate the behavior of the controller. (Author)

A82-19069 # **Broader bandwidth for thin conformal antennas.** K. D. Arkind (Sanders Associates, Inc., Nashua, NH). *Astronautics and Aeronautics,* vol. 20, Jan. 1982, p. 31-33.

Current broadband design technology for thin arrays is described. The ability now exists to analyze array concepts with arbitrary element locations and to use printed circuit antenna concepts, which yields minimum drag on a vehicle surface and reduces the cost of complex array designs. A tee-fed-slot design is described which offers 10-20 times the bandwidths of a similar microstrip counterpart, and is noted to employ layered construction. The array antenna is suggested for applications in ECM environments for radar and communications. M.S.K.

A82-19071 * # **On the track of practical forward-swept wings.** T. J. Hertz, M. H. Shirk (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH), R. H. Ricketts (NASA, Langley Research Center, Hampton, VA), and T. A. Weisshaar (Purdue University, West Lafayette, IN). *Astronautics and Aeronautics,* vol. 20, Jan. 1982, p. 40-52. 30 refs.

Structural laminates which comprise wing-cover skins for forward swept winged aircraft are examined. The laminates are themselves composed of lamina arranged in a symmetrical and unbalanced fashion. The fibers are oriented so that no fiber has a counterpart in the same ply which is at an exact anti-angle to itself. The laminate orientation creates a wash-out in a forward swept wing and alleviates aeroelastic loading. Further discussion is devoted to center-of-pressure movement, flutter behavior, aeroelasticity and aeroelastic divergence, and wind tunnel testing of aerodynamically tailored wings. It is found that rotating the laminate to increase the divergence dynamic pressure decreases strain under aerodynamic loading. Flight tests with three models are reported, and it is concluded that divergence can be avoided by the use of an efficient composite structure. M.S.K.

A82-19195 **A simplified wing procedure in connection with the lifting line theory and the doublet-lattice method (Ein vereinfachtes Tragflächenverfahren in Verbindung mit der Traglinientheorie und der Doublet-Lattice Methode).** R. Dziurzynski and M. Nowak (Polska Akademia Nauk, Instytut Podstawowych Problemow Techniki, Warsaw, Poland). *(Gesellschaft für angewandte Mathematik und Mechanik, Wissenschaftliche Jahrestagung, Berlin, West Germany, Apr. 8-11, 1980.) Zeitschrift für angewandte Mathematik und Mechanik,* vol. 61, Apr. 1981, p. T 145, T 146. In German.

A82-19197 **Use of high conical flow theory for the determination of the pressure distribution on the wave rider and its agreement with experimental results for supersonic flow.** A. Nastase and H. Stahl (Aachen, Rheinisch-Westfälische Technische Hochschule, Aachen, West Germany). *(Gesellschaft für angewandte Mathematik und Mechanik, Wissenschaftliche Jahrestagung, Berlin, West Germany, Apr. 8-11, 1980.) Zeitschrift für angewandte Mathematik und Mechanik,* vol. 61, Apr. 1981, p. T 165-T 168. 13 refs.

The considered wave rider is a delta wing which is designed specifically for hypersonic flight at the cruising Mach number 7. After a flight outside the atmosphere, the wave rider will reenter at supersonic speed. The present investigation is concerned with the theoretical determination of the distribution of the pressure coefficient on the wing surface. The calculation procedure involves the solution of a boundary value problem with respect to the axial disturbance velocity. In the considered case, it is necessary to find the solution of a three-dimensional linearized partial differential equation, taking into account the linearized boundary condition on the wing, or the Mach cone (at the apex of the wave rider), and at infinity. A comparison of the theoretically and experimentally determined values for the pressure distribution shows very good agreement for the entire wing surface. G.R.

A82-19198 **The velocity potential for the harmonically oscillating, rectangular wing with semiinfinite span in nonlinear theory (Das Geschwindigkeitspotential für den harmonisch schwingenden, rechteckigen Flügel halbunendlicher Spannweite in der nichtlinearen Theorie).** S. Turbatu (Centrul National de Fizica, Bucharest, Rumania). *(Gesellschaft für angewandte Mathematik und Mechanik, Wissenschaftliche Jahrestagung, Berlin, West Germany, Apr. 8-11, 1980.) Zeitschrift für angewandte Mathematik und Mechanik,* vol. 61, Apr. 1981, p. T 193-T 195. 9 refs. In German.

A nonlinear potential equation employed by Landahl (1961) is considered. The equation is obtained on the basis of small perturbation theory for conditions near the sonic velocity. The present investigation is concerned with flows for which the free stream Mach number is one. The simplified equation corresponding to the selected condition is solved with the aid of an approach reported by Teipel (1964) and Ruo (1974). The solution procedure makes also use of the parabolic method considered by Oswatitsch and Keune (1955). A boundary value problem is obtained, and solved according to a method reported by Burger (1959). A general formula for the calculation of all desired quantities is derived, and the solution of the problem for the wing is obtained. The formula can be transformed into an expression of linear theory by setting a certain parameter equal to zero. The resulting expression agrees with the solution reported by Turbatu (1964, 1979). G.R.

A82-19201 * # **Ground effect hover characteristics of a large-scale twin tilt-nacelle V/STOL model.** M. R. Dudley, M. D. Falarski (NASA, Ames Research Center, Moffett Field, CA), A. Pisano (U.S. Navy, Naval Air Systems Command, Washington, DC), and W. G. Hill (Grumman Aerospace Corp., Bethpage, NY). *American Institute of Aeronautics and Astronautics and NASA Ames Research Center, V/STOL Conference, Palo Alto, CA, Dec. 7-9, 1981, AIAA Paper 81-2609.* 11 p. 8 refs. Research sponsored by the Grumman Aerospace Corp., U.S. Navy, and NASA.

This paper is a summary of an analysis of the ground-effect characteristics of a large-scale twin-engine, tilt-nacelle V/STOL model. The analysis considers data from the flow field beneath the full-scale model, as well as small-scale model test data, and makes comparisons with jet-ground interactions predicted by a computer code. The data from the large-scale test comprise ground-plane surface temperatures, static pressure distribution and wall-jet total-pressure profiles, fuselage undersurface static pressures, and model forces and moments. The results indicate that the near-field flow is more complex than is indicated by either the small-scale uniform jet studies or the computer predictions. The far-field flow characteristics do show some similarity for these three cases. (Author)

A82-19202 * # **Experimental investigation of a jet inclined to a subsonic crossflow.** K. Aoyagi and P. K. Snyder (NASA, Ames Research Center, Moffett Field, CA). *American Institute of Aeronautics and Astronautics and NASA Ames Research Center, V/STOL Conference, Palo Alto, CA, Dec. 7-9, 1981, AIAA Paper 81-2610.* 15 p. 10 refs.

Experimental investigations have been conducted to determine the surface-pressure distribution on a flat plate and a body of revolution with a jet issuing at a large angle to the free stream and to obtain a better understanding of the entrainment mechanism close to the jet exit by quantitative mean velocity surveys. Pressure data were obtained with a flat plate model at several nozzle injection angles using a single round nozzle. For the body of revolution model, data were obtained with a round jet exhausting perpendicular to the crossflow and with two round jets spaced two to six nozzle diameters apart. Mean velocity measurements were obtained with laser velocimeter surveys near the base of a round jet exhausting normal to a flat plate. For the flat plate model, the pressure field shifts downstream and the entrainment effect decreases with decreasing nozzle injection angle. For the body of revolution model with two jets, the jet-induced effect of the rear jet on the surface-pressure distribution was less than the front jet. The flow regions close to the jet are defined by the laser surveys, but further mean velocity surveys are required to understand the entrainment mechanism. (Author)

A82-19203 * # **Thrust-induced effects on low-speed aerodynamics of fighter aircraft.** D. W. Banks, P. F. Quinto, and J. W. Paulson, Jr. (NASA, Langley Research Center, Subsonic Aerodynamics Branch, Hampton, VA). *American Institute of Aeronautics and Astronautics and NASA Ames Research Center, V/STOL Conference, Palo Alto, CA, Dec. 7-9, 1981, AIAA Paper 81-2612.* 10 p. 10 refs.

The design and technology requirements for STOL fighter aircraft as defined in NASA studies are reviewed. The research has concentrated on advanced high-lift systems using mechanical flaps, methods of obtaining longitudinal trim during the use of thrust vectoring, and thrust reversal to shorten ground roll distances. Several early configurations are described, and investigations of the effect of thrust reversal on the low-speed aerodynamics of the F-15 are detailed. Although the NASA design was a wing-canard configuration, similarities in a Grumman baseline STOL aircraft allowed incorporation of the Grumman nacelle, primary nozzles, spanwise blowing nozzles, and trailing-edge flap systems. M.S.K.

A82-19204 # **Tactical STOL moment balance through innovative configuration technology.** G. J. Eckard, R. C. Sutton (Boeing Military Airplane Co., Seattle, WA), and G. E. Poth (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH). *American Institute of Aeronautics and Astronautics and NASA Ames Research Center, V/STOL Conference, Palo Alto, CA, Dec. 7-9, 1981, AIAA Paper 81-2615.* 16 p.

Innovative and conventional thrust vectoring moment balance mechanisms, as applied to advanced tactical fighters, are examined. The innovative mechanisms include thrust line translation, life line translation, and auxiliary power control; the conventional mechanisms under investigation are horizontal tails, canards, and variable sweep wings. These mechanisms are tested for their ability to provide negative static margins for landing approach or relocation of the vectored thrust line nearer the aircraft's center of gravity. The net pitching moment due to wing, flaps, and vectored thrust lift would then be small, making possible beneficial trim forces from small trimming devices. These innovative mechanisms are, however, possibly heavy and must be evaluated on their complexity, reliability, maintainability, and STOL capabilities. Several candidate fighter configurations are compared and evaluated. J.F.

A82-19205 # **Application of thrust vectoring for STOL.** P. D. Whitten, R. W. Woodrey, and J. E. Hames (General Dynamics Corp., Fort Worth, TX). *American Institute of Aeronautics and Astronautics and NASA Ames Research Center, V/STOL Conference, Palo Alto, CA, Dec. 7-9, 1981, AIAA Paper 81-2616.* 13 p. 12 refs.

Studies of generic aircraft configurations to determine the payoff of thrust vectoring for direct lift during STOL landings and takeoff and for control power augmentation during weapons-delivery maneuvers are described. Results show that for a nominal 1000-foot landing distance, direct-lift benefits are small, but significant improvements in control power augmentation contribute to payoffs in takeoff distance and recovery from roll-pitch-coupling-induced departures at high angles of attack. (Author)

A82-19206 # **STOL capability impact on advanced tactical aircraft design.** R. E. Krepski (Grumman Aerospace Corp., Bethpage, NY) and R. E. Hudson, Jr. (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH). *American Institute of Aeronautics and Astronautics and NASA Ames Research Center, V/STOL Conference, Palo Alto, CA, Dec. 7-9, 1981, AIAA Paper 81-2617.* 9 p.

The design and technical issues affecting supersonic STOL development as an airbase attack fighter are discussed. An Air Force study has indicated that, from a weight and cost standpoint, the preferred directions will include two-dimensional nozzles with vectoring and thrust reversing capability. Take-off and landing requirements would determine other design features, and the use of a jump strut to enable landing maneuvers to be made at pitch angles which would normally drag the tail is detailed. The addition of a tip-mounted reaction control system is foreseen as necessary for roll control at the low aerodynamic speeds of STOL landing. A severe 700 ft landing distance design is outlined, and includes a lifting engine with bleed-air features to feed the reaction control system. M.S.K.

A82-19207 * # **Analysis of data from a wind tunnel investigation of a large-scale model of a highly maneuverable supersonic V/STOL fighter - STOL configuration.** M. D. Falarski, M. D. Dudley (NASA, Ames Research Center, Moffett Field, CA), and G. Howell (General Dynamics Corp., Fort Worth, TX). *American Institute of Aeronautics and Astronautics and NASA Ames Research Center, V/STOL Conference, Palo Alto, CA, Dec. 7-9, 1981, AIAA Paper 81-2620.* 21 p. 13 refs.

The surface pressure and thermal characteristics of a large-scale model of a highly maneuverable supersonic fighter with STOL capability are described. The 7.28 m span model is powered by two J-97 turbojets, operated at 9340 N thrust. It combines upper-surface and spanwise blowing to augment the lift characteristics over a wide angle-of-attack range. The most significant feature of the fighter's flow field is the leading edge vortex that forms at low alphas, grows stronger, and moves inboard as alpha is increased. Upper surface blowing enhanced the lift on the wing in both stalled and unstalled areas significantly, while generating only a modest aft shift in the center of pressure. Lift gains were greatest at high alphas and with the flap deflected. Spanwise blowing was most significant at angles-of-attack greater than 8 deg, when the jet strengthened the vortex. The 1100 F spanwise blowing jet mixed very rapidly with the wing flow field, creating a maximum temperature rise of only 300-350 F. A comparison of small-scale and large-scale model wing pressure characteristics showed similar trends created by upper surface blowing, while spanwise blowing characteristics differed considerably. Force data correlated well with semi-empirical predictions for gross thrust coefficients less than 1.0. J.F.

A82-19208 * # **Large-scale wind tunnel tests of a sting-supported V/STOL fighter model at high angles of attack.** F. Stoll (NASA, Ames Research Center, Helicopter and Powered Lift Technology Div., Moffett Field, CA) and E. A. Minter (Vought Corp., Dallas, TX). *American Institute of Aeronautics and Astronautics and NASA Ames Research Center, V/STOL Conference, Palo Alto, CA, Dec. 7-9, 1981, AIAA Paper 81-2621.* 12 p. 6 refs.

A new sting model support has been developed for the NASA/Ames 40- by 80-Foot Wind Tunnel. This addition to the facility permits testing of relatively large models to large angles of attack or angles of yaw depending on model orientation. An initial test on the sting is described. This test used a 0.4-scale powered V/STOL model designed for testing at angles of attack to 90 deg and greater. A method for correcting wake blockage was developed and applied to the force and moment data. Samples of this data and results of surface-pressure measurements are presented. (Author)

A82-19209 * # **Quiet Short-Haul Research Aircraft - The first 3 years of flight research.** J. A. Cochrane, D. W. Riddle, and V. C. Stevens (NASA, Ames Research Center, Moffett Field, CA). *American Institute of Aeronautics and Astronautics and NASA Ames Research Center, V/STOL Conference, Palo Alto, CA, Dec. 7-9, 1981, AIAA Paper 81-2625.* 18 p. 9 refs.

NASAs first three years of flight research in an investigation of terminal area flight operation with the Quiet Short-Haul Research Aircraft (QSRA) are presented. An initial flight and modification program was devoted to improving the capabilities of the QSRA and measuring its performance. Later programs included a joint program with the US Navy, a guest pilot program involving 23 pilots from 16 organizations, and a program to measure benefits of propulsive-lift to CTOL aircraft. Development flight research, complemented by the aircraft modification program, has resulted in improvements in the maximum lift coefficient of more than two units, and has greatly improved flight characteristics and handling qualities. D.L.G.

A82-19210 * # **Low speed testing of the inlets designed for a tandem-fan V/STOL nacelle.** R. C. Williams (NASA, Lewis Research Center, Cleveland, OH) and A. H. Ybarra (Vought Corp., Dallas, TX). *American Institute of Aeronautics and Astronautics and NASA Ames Research Center, V/STOL Conference, Palo Alto, CA, Dec. 7-9, 1981, AIAA Paper 81-2627.* 12 p. 5 refs.

An approximately 0.25 scale model of a tandem fan nacelle, designed for a subsonic V/STOL aircraft, was tested in a Lewis wind tunnel. Model variables included long and short aft inlet cowls and the addition of exterior strakes to the short inlet cowl. Inlet pressure recoveries and distortion were measured at pitch angles to 40 deg and at combinations of pitch and yaw to 30 deg. Airspeeds covered a range to 135 knots (69 m/sec). The short aft inlet with added strakes had the best aerodynamic performance and is considered suitable for the intended V/STOL application. (Author)

A82-19211 * # **Application of thrusting ejectors to tactical aircraft having vertical lift and short-field capability.** D. G. Koenig, F. Stoll, and K. Aoyagi (NASA, Ames Research Center, Moffett Field, CA). *American Institute of Aeronautics and Astronautics and NASA Ames Research Center, V/STOL Conference, Palo Alto, CA, Dec. 7-9, 1981, AIAA Paper 81-2629.* 23 p. 41 refs.

The status of ejector development in terms of application to V/STOL aircraft is reported in three categories: aircraft systems and ejector concepts; ejector performance including prediction techniques and experimental data base available; and, integration of the ejector with complete aircraft configurations. Available prediction techniques are reviewed and performance of three ejector designs with vertical lift capability is summarized. Applications of the 'fuselage' and 'short diffuser' ejectors to fighter aircraft are related to current and planned research programs. Recommendations are listed for effort needed to evaluate installed performance. (Author)

A82-19212 * # **Airframe effects on top-mounted inlet systems for VSTOL fighter aircraft.** D. B. Smeltzer, W. P. Nelms, and T. L. Williams (NASA, Ames Research Center, Moffett Field, CA). *American Institute of Aeronautics and Astronautics and NASA Ames Research Center, V/STOL Conference, Palo Alto, CA, Dec. 7-9, 1981, AIAA Paper 81-2631.* 10 p. 8 refs.

Inlet flow-field and compressor-face performance data were obtained for a 0.095-scale model of a VSTOL fighter-attack aircraft configuration with twin top-mounted inlets. Tests were conducted at Mach numbers from 0.6 to 2.0 and at angles of attack and sideslip up to 27 deg and 12 deg, respectively. The effects of inlet location, wing leading-edge extension planform area, canopy-dorsal integration, and variable incidence canards were determined. The results show that distortion at the compressor face when maneuvering is relatively low (20% or less) at Mach numbers up to 0.9. However, at Mach numbers of 1.2 and above, maneuverability may be restricted because of high distortion or low pressure recovery (80% or less) or both. (Author)

A82-19213 * # **Thrust modulation methods for a subsonic V/STOL aircraft.** R. R. Woollett (NASA, Lewis Research Center, Cleveland, OH). *American Institute of Aeronautics and Astronautics and NASA Ames Research Center, V/STOL Conference, Palo Alto, CA, Dec. 7-9, 1981, AIAA Paper 81-2633.* 17 p.

Attention is given to four techniques for attaining thrust modulation, namely (1) varying the engine rotational speed; (2) varying the fan nozzle exit area; (3) changing the thrust of the propulsion system by using a variable pitch rotor; and (4) changing the thrust by means of variable inlet guide vanes. The thrust modulation range, thrust level, and blade stresses are examined for each of the thrust modulation systems. Results are shown at the high angles of attack associated with tilt-nacelle V/STOL aircraft. Finally, the interrelationship between the inlet and the thrust modulation system is illustrated for two inlet types. C.R.

A82-19214 * # **Comparison of two parallel/series flow turbofan propulsion concepts for supersonic V/STOL.** R. W. Luidens, G. E. Turney, and J. Allen (NASA, Lewis Research Center, Cleveland, OH). *American Institute of Aeronautics and Astronautics and NASA Ames Research Center, V/STOL Conference, Palo Alto, CA, Dec. 7-9, 1981, AIAA Paper 81-2637.* 15 p. 5 refs.

The thrust, specific fuel consumption, and relative merits of the tandem fan and the dual reverse flow front fan propulsion systems for a supersonic V/STOL aircraft are discussed. Consideration is given to: fan pressure ratio, fan air burning, and variable core supercharging. The special propulsion system components required are described, namely: the reflecting front inlet/nozzle, the aft subsonic inlet, the reverse pitch fan, the variable core supercharger and the low pressure forward burner. The potential benefits for these unconventional systems are indicated. (Author)

A82-19215 # **VTOL as it applies to resource development in the Canadian north.** R. N. Lightfoot (UMA Group, Edmonton, Alberta, Canada). *American Institute of Aeronautics and Astronautics and NASA Ames Research Center, V/STOL Conference, Palo Alto, CA, Dec. 7-9, 1981, AIAA Paper 81-2640.* 18 p. 58 refs.

It is pointed out that, for many of the natural resource development projects planned in Canada between now and the end of the century, it may be necessary for the work force to commute to the site by air. Examples of successful operations, including those involving VTOL, are given. A computer program developed for determining the least expensive type of aircraft for commuting to remote projects is described. It is noted that the program can select both fixed-wing and helicopter aircraft types for a specific project, employing such variables as the size and shift schedules of the work force and the commuting distance. Capital and operating costs of existing and proposed aircraft types, as well as groundside infrastructure operations and maintenance costs, are compared for competing aircraft. C.R.

A82-19216 * # Concept definition and aerodynamic technology studies for single-engine V/STOL fighter/attack aircraft. W. P. Nelms and D. A. Durston (NASA, Ames Research Center, Aircraft Aerodynamics Branch, Moffett Field, CA). *American Institute of Aeronautics and Astronautics and NASA Ames Research Center, V/STOL Conference, Palo Alto, CA, Dec. 7-9, 1981, AIAA Paper 81-2647.* 28 p. 15 refs.

The results obtained in the early stages of a research program to develop aerodynamic technology for single-engine V/STOL fighter/attack aircraft projected for the post-1990 period are summarized. This program includes industry studies jointly sponsored by NASA and the Navy. Four contractors have identified promising concepts featuring a variety of approaches for providing propulsive lift. Vertical takeoff gross weights range from about 10,000 to 13,600 kg (22,000 to 30,000 lb). The aircraft have supersonic capability, are highly maneuverable, and have significant short takeoff overload capability. The contractors have estimated the aerodynamics and identified aerodynamic uncertainties associated with their concepts. Wind-tunnel research programs will be formulated to investigate these uncertainties. A description of the concepts is emphasized. (Author)

A82-19217 # Sea based support aircraft alternatives. R. T. Priestley and A. R. Yackle (Lockheed-California Co., Burbank, CA). *American Institute of Aeronautics and Astronautics and NASA Ames Research Center, V/STOL Conference, Palo Alto, CA, Dec. 7-9, 1981, AIAA Paper 81-2649.* 10 p. 5 refs.

Multi-mission, CTOL, STOL and V/STOL aircraft concepts were sized for the Navy ASW/ASUW missions and comparatively evaluated. Initially, technology levels in the areas of lift, control systems, propulsion, advanced materials and avionics were established for the early 1990's. The aircraft were compared to determine the impact of multi-mission requirements, operational considerations, chiefly takeoff mode, as well as the technology advancements. Results presented include performance envelopes, weight statements, growth factors, impact of technology on weight reduction and the impact of design constraints. (Author)

A82-19218 # Design features of a sea-based multipurpose V/STOL, STOVL, and STOL aircraft in a support role for the U.S. Navy. G. W. Bradfield (General Dynamics Corp., Fort Worth, TX). *American Institute of Aeronautics and Astronautics and NASA Ames Research Center, V/STOL Conference, Palo Alto, CA, Dec. 7-9, 1981, AIAA Paper 81-2650.* 9 p.

Design features and certain performance data are outlined for three different basic airframes. The heart of the design is a powered lift system known formally as the Advanced Blown Lift Enhancement system. A summary of the results of both powered-model wind tunnel tests of the airplane and of static tests of the vectoring-nozzle system is given to indicate the rather high degree of thrust vectoring efficiency and powered lift enhancement attained. C.R.

A82-19219 # Application of the ABC helicopter to the emergency medical service role. L. S. Levine (United Technologies Corp., Sikorsky Aircraft Div., Stratford, CT). *American Institute of Aeronautics and Astronautics and NASA Ames Research Center, V/STOL Conference, Palo Alto, CA, Dec. 7-9, 1981, AIAA Paper 81-2653.* 18 p. 23 refs.

Attention is called to the use of helicopters in transporting the sick and injured to medical facilities. It is noted that the helicopter's speed of response and delivery increases patient survival rates and may reduce the cost of medical care and its burden on society. Among the vehicle characteristics desired for this use are a cruising speed of 200 knots, a single engine hover capability at 10,000 ft, and an absence of a tail rotor. Three designs for helicopters incorporating such new technologies as digital/optical control systems, all composite air-frames, and third-generation airfoils are presented. A sensitivity analysis is conducted to show the effect of design speed, mission radius, and single engine hover capability on vehicle weight, fuel consumption, operating costs, and productivity. C.R.

A82-19220 * # Analysis of selected VTOL concepts for a civil transportation mission. S. B. Wilson, III, J. V. Bowles, and J. D. Foster (NASA, Ames Research Center, Moffett Field, CA). *American Institute of Aeronautics and Astronautics and NASA Ames Research Center, V/STOL Conference, Palo Alto, CA, Dec. 7-9, 1981, AIAA Paper 81-2655.* 19 p. 15 refs.

As part of defining the needs and technology requirements for VTOL aircraft research and development, the objective of this paper is to study the application of two tilt propulsion concept VTOL aircraft to the business/executive transport mission. The two concepts selected for study are the tilt jet concept utilizing rotating turbofan engines for both vertical lift and cruise thrust, and the tilt rotor concept using relatively low disc loading propellers for hover and cruise. Overall mission costs, including the time-value cost of the executives, was computed for a selected range of mission distances, up to the design mission range of 750 nm (1400 km). The total trip cost was also compared to that of a conventional helicopter/business jet combination for a typical executive transport mission. (Author)

A82-19221 * # A real time Pegasus propulsion system model for VSTOL piloted simulation evaluation. J. R. Mihaloew (NASA, Lewis Research Center, Cleveland, OH), S. P. Roth, and R. Creekmore (United Technologies Corp., Government Products Div., West Palm Beach, FL). *American Institute of Aeronautics and Astronautics and NASA Ames Research Center, V/STOL Conference, Palo Alto, CA, Dec. 7-9, 1981, AIAA Paper 81-2663.* 18 p. 6 refs.

A Pegasus-Harrier propulsion system is selected as a baseline for developing mathematical modeling and simulation techniques for VSTOL. Initially, static and dynamic propulsion system characteristics are modeled in detail to form a nonlinear aerothermodynamic digital computer simulation of a Pegasus engine. From this high fidelity simulation, a real-time propulsion model is formulated by applying a piecewise linear state variable methodology. A hydromechanical and water injection control system is also simulated. It is noted that the real-time dynamic model includes the detail and flexibility required for evaluating critical control parameters and propulsion component limits over a limited flight envelope. C.R.

A82-19234 Utilization of hybrid computational equipment for the simulation of parachute system flight. W. H. Curry and P. R. Schatzle (Sandia National Laboratory, Albuquerque, NM). In: Summer Computer Simulation Conference, Washington, DC, July 15-17, 1981, Proceedings. Arlington, VA, AFIPS Press, 1981, p. 143-147. 5 refs. Research supported by the U.S. Department of Energy.

Some computational programs which ordinarily would be run on large-scale, all-digital central computing equipment could also be implemented on hybrid computing equipment located in dedicated facilities such as, for example, aerospace flight simulation laboratories. Advantages would be cost-effective use of equipment and, in many cases, shorter run time. A description is presented of the utilization of a hybrid computer for parachute system flight simulation, taking into account some typical results. The described simulations were programmed for hybrid computer facilities which include fully expanded AD/FIVE analog computers interfaced to a PDP11/60 digital computer with a 64-kiloword core and two 2.5 megaword disks. G.R.

A82-19244 KC-135 avionics modernization hot bench - An evaluation of requirements and design for the future. S. J. Cristiani (USAF, Aeronautical Systems Div., Wright-Patterson AFB, OH). In: Summer Computer Simulation Conference, Washington, DC, July 15-17, 1981, Proceedings. Arlington, VA, AFIPS Press, 1981, p. 338-340.

The U.S. Air Force has been extending the operational capabilities and useful life of its KC-135 air refueling fleet through a series of improvements. In order to evaluate various options for avionics system design, projects were initiated with the Directorates of Avionics Engineering (ENA) and Equipment Engineering (ENE). Attention is given to the development of the Avionics Modernization Hot Bench (AMHB). This effort is providing the technical data base for near term KC-135 avionic updates and for charting the long-term roadmap for future updates. The Hot Bench consists of a mix of actual avionics hardware (e.g., computers, displays) and software simulation of certain subsystems. The hot bench is a well known development, test, and integration tool for real-time avionics systems. The simulation software portion of the Hot Bench is discussed. G.R.

A82-19245 **Radar environment simulation for software test.** W. D. Horner (Westinghouse Defense and Electronic Systems Center, Baltimore, MD). In: Summer Computer Simulation Conference, Washington, DC, July 15-17, 1981, Proceedings. Arlington, VA, AFIPS Press, 1981, p. 341-343.

Real-time radar environment simulations are used to speed up the software integration and debug phase of radar system development. The entire radar environment can be simulated for the operational flight program (OFP) resident within the fire control radar computer (RC) by physically connecting the RC to a simulation support computer through special purpose hardware interfaces. A description is provided of some of the capabilities of a radar environment simulation used in conjunction with actual embedded radar computer hardware. The real power of the simulation lies in its organization which makes it possible to make use of the hardware freeze capability, within the embedded computer. G.R.

A82-19253 **A fuel control system designers approach to gas turbine engine computer model validation.** R. M. Evans (Aviation Electric, Ltd., Montreal, Canada). In: Summer Computer Simulation Conference, Washington, DC, July 15-17, 1981, Proceedings. Arlington, VA, AFIPS Press, 1981, p. 532-537. Department of Industry, Trade and Commerce Contract No. 9ST79-00058.

A hybrid computer model of a gas turbine driving a helicopter rotor system is assembled and shown to be an accurate simulation in both steady state and transient modes of operation when compared to actual engine data. A fuel controller is designed, which employs innovative control mode concepts using the engine model to define the control mode concepts using the engine model to define the control mode parameters. The basic structure of the model is shown to be sound and applicable to other types of gas turbines. D.L.G.

A82-19256 **SIMATR - An air battle simulation of the USAF Tactical Air Control System /TACS/ with Advanced Tactical Radars.** J. Golub, D. M. Greeley, and B. B. Levy (RCA, Missile and Surface Radar Div., Moorestown, NJ). In: Summer Computer Simulation Conference, Washington, DC, July 15-17, 1981, Proceedings. Arlington, VA, AFIPS Press, 1981, p. 636-641.

The objective of SIMATR (Simulation of Integrated Multiple Advanced Tactical Radars) is to demonstrate the value of a network of Advanced Tactical Radars (ATRs) in an air battle through the increased effectiveness of the interceptors in repulsing the attack. This increased effectiveness is attained by directly controlling and designating the airborne interceptor radar to provide the interceptor a relatively free and unanswered first shot of an air-to-air weapon. The basic SIMATR operation is described, and an example is provided of defensive force reaction to a massive enemy air attack. System enhancements that may further expand its capabilities and increase its effectiveness are discussed. C.R.

A82-19259 **Simulation of advanced cockpits.** J. M. Reising (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, OH) and L. Hitchcock (FAA, Technical Center, Atlantic City, NJ). In: Summer Computer Simulation Conference, Washington, DC, July 15-17, 1981, Proceedings. Arlington, VA, AFIPS Press, 1981, p. 662-665. 5 refs.

The development of advanced digital graphics and displays which utilize the capabilities of full-color, computer generated pictures is described. The transition is being made from electromechanical displays and associated numerical formats to electro-optical displays which employ advanced symbols and special algorithms for real-time projection. Pictorial formats provide intuitive, simple representations of how the aircraft is performing, its situation relative to other traffic, the presence of ground obstacles, and emergencies and remedial procedures. New formats are recommended to be screened in a two stage evaluation involving mock-ups and simulators, and are subjected to pilot scrutiny to determine acceptability. The digital Synthesis Facility is described, including the use of an A-7 cockpit and a PDP-11/50 computer system for real-time simulation of A-7 flight. M.S.K.

A82-19260 * **Real-Time Simulation Computation System.** J. L. Fetter (NASA, Ames Research Center, Moffett Field, CA). In: Summer Computer Simulation Conference, Washington, DC, July 15-17, 1981, Proceedings. Arlington, VA, AFIPS Press, 1981, p. 666-670. 9 refs.

The Real-Time Simulation Computation System, which will provide the flexibility necessary for operation in the research environment at the Ames Research Center is discussed. Designing the system with common subcomponents and using modular construction techniques enhances expandability and maintainability qualities. The 10-MHz series transmission scheme is the basis of the Input/Output Unit System and is the driving force providing the system flexibility. Error checking and detection performed on the transmitted data provide reliability measurements and assurances that accurate data are received at the simulators. D.L.G.

A82-19263 # **Experience with flight simulators - Training effectiveness-future developments.** J. F. Smith (USAF, Human Resources Laboratory, Williams AFB, AZ). *Deutsche Gesellschaft für Luft- und Raumfahrt, Symposium über Schulung mit Flug- und Taktiksimulatoren, Cologne, West Germany, May 20, 21, 1981, Paper 81-110.* 12 p.

The progress, development, and effectiveness of flight simulators are examined from the introduction of the Link trainer to predictions of future directions and capabilities. The first six simulators were delivered in 1934 and by WW II congressional reports asserted that armed service savings in manhours and expenses were in millions of hours and hundreds of millions of dollars. Electronic simulation began after WW II, and with the arrival of jet aircraft, simulators were used for instrument and procedures training, as well as weaponry and refueling operations. Visual representations were added in the 1970's, along with low-level flight cuing, manual reversion problems, and remote operation of a simulator from different bases. Recommendations are provided for optimized use of present simulators, and the employment of simulators as testing grounds for pilots, for total environment simulation, and the development of part-task trainer systems in the future are discussed. M.S.K.

A82-19264 # **Cost efficiency versus objective fidelity in flight simulation (Kosteneffektivität gegenüber objektivem Realismus bei der Flugsimulation).** G. Dörfel and H. Distelmaier (Forschungsinstitut für Anthropotechnik, Wachtberg-Werthoven, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Symposium über Schulung mit Flug- und Taktiksimulatoren, Cologne, West Germany, May 20, 21, 1981, Paper 81-104.* 15 p. 8 refs. In German.

The effect of the objective fidelity level on the simulation cost is considered, taking into account relative cost as a function of motion fidelity and visual scene fidelity levels. Cost considerations make it necessary to conduct an investigation regarding the degree to which an achievement of objective fidelity is desirable for flight simulation processes. It has to be taken into account that the simulator is not an aircraft copy, but any educational device employed to obtain a certain objective regarding the training of a pilot. A study is required regarding the approaches needed to achieve this objective, taking into account the extent of the information which has to be presented and the effect of the various cues on the pilot and his performance. Previous investigations show that subjective fidelity can help to achieve, at a lower cost, training results of the same quality as objective fidelity. These conclusions apply to full-mission simulators and to part-time training devices. G.R.

A82-19265 # **Properties of the new flight and tactics simulators (Eigenschaften der neuen Flug- und Taktiksimulatoren).** H.-J. Balke (Bundesamt für Wehrtechnik und Beschaffung, Koblenz, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Symposium über Schulung mit Flug- und Taktiksimulatoren, Cologne, West Germany, May 20, 21, 1981, Paper 81-106.* 17 p. In German.

In the 1970s, the Armed Forces of the Federal Republic of Germany have placed orders for many simulators, which are currently being used or which will be received in the next few years. All new simulators employ exclusively digital computers. The combined use of display and computer makes the simulator an efficient training device. A pilot can draw conclusions regarding the flight conditions of the aircraft on the basis of the aircraft motions perceived by him. Facilities are provided which make it possible for the pilot to practice such a utilization of aircraft motions in the simulator. The employed kinematic system performs motion processes involving 6 degrees of freedom. The G-seat in connection with the G-suit can convey to the pilot the impression that he is flying at accelerations greater than 1 g. Attention is also given to equipment used to make the aid of the instructor more effective, aspects of radar simulation, and the simulation of electronic warfare situations. G.R.

A82-19266 # **Procurement of the new flight and tactics simulators - Experience, problems, meaning (Beschaffung der neuen Flug- und Taktiksimulatoren - Erfahrungen, Probleme, Sinn).** H.-J. Balke (Bundesamt für Wehrtechnik und Beschaffung, Koblenz, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Symposium über Schulung mit Flug- und Taktiksimulatoren, Cologne, West Germany, May 20, 21, 1981, Paper 81-095.* 8 p. In German.

The stationary flight and tactics simulator is used for the training of flight crews. An aircraft cockpit is employed, while electronic computers simulate the behavior of the aircraft, the characteristics of the aircraft equipment, and the operation of the engine. A number of similar appearing names are employed for simulators and other training devices. It is, therefore, sometimes difficult to distinguish between training devices for ground personnel and the simulators for flight crews. A description of the meaning of the various terms employed in this connection is provided as an aid for the appropriate identification of a device. Attention is given to market considerations regarding the purchase of simulators, details concerning the simulator procurement process, and the benefits obtained by an employment of flight and tactics simulators. G.R.

A82-19267 # **Requirements regarding digital external view systems for full mission flight and tactics simulators (Anforderungen an Digitale Aussensichtsysteme für Full Mission Flug- und Taktiksimulatoren).** P. Güldenpfennig (Messerschmitt-Bölkow-Blohm GmbH, Ottobrunn, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Symposium über Schulung mit Flug- und Taktiksimulatoren, Cologne, West Germany, May 20, 21, 1981, Paper 81-100.* 14 p. In German.

During the time period from 1975 to 1977 a computer-generated image (CGI) system for the training simulator Tornado was developed by an aerospace company in West Germany. A school for the study of weapon systems, four squadrons of the German Air Force, and two squadrons of the German Navy were equipped with flight and tactics simulators for the training of Tornado crews. The principal combat objectives for the Tornado aircraft are related to the performance of battlefield interdiction and strike missions. A CGI system prototype is considered along with an evaluation of the CGI system prototype by pilots of the German Air Force and Navy. The results of the evaluation are discussed, taking into account each of the various types of operation to be performed with the aircraft. The evaluation led to the formulation of requirements for new technical system parameters. The specified requirements are related to an enhancement of the data base storage capacity, image improvement, improved resolution, and the employment of texturing and curved shading. G.R.

A82-19268 # **The procurement of flight simulators at the German Lufthansa (Die Beschaffung von Flugsimulatoren bei der Deutschen Lufthansa).** W.-D. Hass (Deutsche Lufthansa AG, Frankfurt am Main, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Symposium über Schulung mit Flug- und Taktiksimulatoren, Cologne, West Germany, May 20, 21, 1981, Paper 81-093.* 10 p. In German.

Flight simulators have become indispensable for the training of airline pilots. Questions regarding the requirements for flight simulators arise, therefore, in connection with the introduction of new aircraft types or the enlargement of the fleet of existing aircraft types. Decisions have to be made concerning the placing of an order for a simulator or the purchase of simulator time on devices of the aircraft manufacturer or other companies. It is advisable to specify in the contract covering the purchase of the aircraft that the aircraft manufacturer has to provide data and components to a flight simulator producer. With respect to the Lufthansa, during the last 15 years there was almost always a relationship between the orders for an aircraft and a simulator. Price and delivery information from simulator manufacturers is obtained as soon as the negotiations regarding the purchase of aircraft appear to lead to a concrete agreement. Attention is given to procurement specifications, evaluation criteria, and a point system for an evaluation. G.R.

A82-19269 # **Flight simulation consoles, aid or obstruction - Objective evaluation of control consoles of modern flight and tactics simulators (Flugsimulatorbedienkonsolen, Hilfe oder Behinderung - Objektive Bewertung von Bedienkonsolen moderner Flug- und Taktiksimulatoren).** B. Heger, A. L. Lippay, M. McKinnon, A. Del Mar, and R. Glass (CAE Electronics GmbH, Stolberg, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Symposium über Schulung mit Flug- und Taktiksimulatoren, Cologne, West Germany, May 20, 21, 1981, Paper 81-097.* 24 p. In German.

An investigation was conducted with the objective to develop a model for the evaluation of control consoles at training simulators, taking into account the function of the console as human-machine interface. The obtained information is to be used in connection with the development of new control consoles. The investigation made use of System Analysis by Integrated Network of Tasks (SAINT) to analyze the operational stress to which an instructor is subjected during the training. The tasks of the instructor were divided with respect to typical activity modules. Each task could be assigned to any arbitrary control device. The described approach makes it possible to determine the time required for the performance of each task. The number of tasks performed or omitted in connction with a lack of time can be obtained along with the causes for an overload. The results obtained indicate various nonoptimal conditions, which are related to existing design characteristics and an inappropriate division of tasks between man and machine. G.R.

A82-19270 # **Data base generation for digital external view systems (Datenbasisgenerierung für digitale Aussensicht-systeme).** U. List (Bundesamt für Wehrtechnik und Beschaffung, Koblenz, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Symposium über Schulung mit Flug- und Taktiksimulatoren, Cologne, West Germany, May 20, 21, 1981, Paper 81-101.* 14 p. 6 refs. In German.

Flight simulators make increasing use of systems which provide the pilot with a computer-generated image in simulation of the external scene which the pilot would perceive from the cockpit of the aircraft. Realistic impressions of motion are conveyed. The degree of realism achieved in the image is essentially determined by the processing capacity of the employed system. The realism of representation could be improved in connection with advances in electronics and automatic data processing made during the last few years. A computer-generated image system prototype is discussed along with the data base generation system (DBGS) used with it. Attention is given to the DBGS hardware configuration, the automatic transformation procedure, aspects of interactive processing, and questions of data base verification. The DBGS uses as a basis for its operation magnetic tapes with topographic information along with maps, aerial photographs, and other photographs. G.R.

A82-19271 # **Official recognition and the significance of simulators for safe flight operations (Die behördliche Anerkennung und der Stellenwert von Simulatoren für den sicheren Flugbetrieb).** G. Voss (Luftfahrt-Bundesamt, Braunschweig, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Symposium über Schulung mit Flug- und Taktiksimulatoren, Cologne, West Germany, May 20, 21, 1981, Paper 81-094.* 8 p. In German.

The evolution of the flight simulator since its first introduction in the 1950s is considered. It is pointed out that the performance of modern flight simulators exceeds greatly the requirements for simulators described in the original definition of the International Civil Aviation Organization. The possibilities provided by the simulators for a replacement of flight training led to regulations by the appropriate authorities in the various countries regarding the use of flight simulators in training leading to the licensing of pilots. Attention is also given to the procedures to be followed for the testing of simulators to obtain official recognition. Test guides and, perhaps, even simulator self-test processes developed by the simulator industry would make it possible to reduce the time and work required in conducting the initial admission tests for simulators and the required follow-up tests. Improvements in simulation are discussed which would make the simulator even more efficient. G.R.

A82-19272 # **Simulation of modern radar installations in full-mission flight and tactics simulators (Simulation moderner Radaranlagen in Full-Mission-Flug- und Taktiksimulatoren).** H. G. Werner (Messerschmitt-Bölkow-Blohm GmbH, Ottobrun, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Symposium über Schulung mit Flug- und Taktiksimulatoren, Cologne, West Germany, May 20, 21, 1981, Paper 81-103.* 17 p. In German.

The correct use of the radar systems represents one of the most important functions of the crew of modern bomber aircraft. The simulation of radar display and radars signals for other systems comprises, therefore, an essential part of the work load of the simulators. Terrain profiles are produced with the aid of a digital terrain data base, taking into account suitable antenna models, and the aircraft parameters. The terrain profiles provide the basis for the derivation of the radar echo data. The main function of the Multi-Role Combat Aircraft (MRCA) radar simulation is the generation of a realistic radar display video signal for the Ground Mapping Radar (GMR) and the Terrain Following Radar (TFR). A description is provided of design and functions of the Digital Radar Land Mass Simulator (DRLMS) of the MRCA Operational Flight and Tactics Simulator (OFTS). G.R.

A82-19273 # **Training in the flight and tactics simulator of the Navy Flight Squadron 3 'Graf Zeppelin' (Ausbildung im Flug- und Taktiksimulator des Marinefliegergeschwader 3 'Graf Zeppelin').** J. Zielke. *Deutsche Gesellschaft für Luft- und Raumfahrt, Symposium über Schulung mit Flug- und Taktiksimulatoren, Cologne, West Germany, May 20, 21, 1981, Paper 81-109.* 11 p. In German.

The squadron has 14 antisubmarine warfare aircraft of the type Breguet 1150. The aircraft represents a NATO development, which is also employed by the French, Dutch, and Italian navies. In tactical combat missions the aircraft is employed with a crew of twelve men. The considered training device has been designed for the simulation of antisubmarine warfare situations. The simulation operations are essentially related to tactical basic and advanced training of the crew, the testing of new tactical procedures, and a participation in the tactical combat training program. The use of the simulator made it possible to reduce substantially the time required for actual flight training. The employment of the simulator makes it feasible to represent realistic combat situations which can generally not be economically provided by other means. G.R.

A82-19274 # **Report covering experience obtained at the German Lufthansa with respect to training involving the use of flight simulators (Erfahrungsbericht aus der Schulung mit Flugsimulatoren bei der Deutschen Lufthansa).** G. Wendt (Deutsche Lufthansa AG, Cologne, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Symposium über Schulung mit Flug- und Taktiksimulatoren, Cologne, West Germany, May 20, 21, 1981, Paper.* 17 p. In German.

The use of flight simulators in the basic training of flight crews is steadily increasing. Basically, the reasons for this trend can be divided into three categories, which are related to aspects of safety, efficiency, and economics. Safety is probably the most important factor. The rate of accidents involving the death of persons was found to be nine times higher for training flights than for regular airline flights. Another advantage of training with a simulator is the possibility to provide many abnormal and emergency situations which, in connection with safety considerations, cannot be reproduced in an aircraft. A training involving the use of a simulator is consequently much more realistic and, therefore, more efficient than the training in an aircraft. Advantages of simulator training related to economics become increasingly important with rising fuel costs. G.R.

A82-19300 **Flexibility is offered by XV-15 tilt-rotor concept.** R. R. Ropelewski. *Aviation Week and Space Technology,* vol. 116, Jan. 11, 1982, p. 74-76, 78, 83, 85.

The flight profile flexibility, low pilot work load and relatively low noise and vibration levels for which the XV-15 tilt-rotor VLOL experimental aircraft was designed are confirmed by flight tests. The aircraft uses two three-blade, 25 ft diameter rotors powered by two 1550 shp turboshaft engines for both vertical lift and forward thrust, thereby combining rotary wing and fixed wing aircraft operational capabilities. Attention is given to the 'conversion corridor', or difference between wing stall speed and rotor overstress speed at any given angle of wingtip nacelle tilt angle. With a normal rate of nacelle conversion of 7.8 deg/sec, the nacelles can translate through the full 95 deg of rotation from horizontal to vertical flight in 12-13 sec. It is noted that the dual flight capability of the XV-15 has not called for the introduction of many new flight instruments into the cockpit. O.C.

A82-19305 * # **Analytical prediction of aerospace vehicle vibration environments.** J. F. Wilby and A. G. Piersol (Bolt Beranek and Newman, Inc., Canoga Park, CA). *American Society of Mechanical Engineers, Design Engineering Technical Conference, Hartford, CT, Sept. 20-23, 1981, Paper 81-DET-29.* 10 p. 11 refs. Members, $2.00; nonmembers, $4.00. Contracts No. NAS5-22832; No. NAS9-15231; No. NAS1-14611; No. NAS1-15426.

Considerable attention has been given recently to the formulation and validation of analytical models for the prediction of aerospace vehicle vibration response to acoustic and fluctuating pressures. This paper summarizes the development of such analytical models for two applications, (1) structural vibrations of the Space Shuttle orbiter vehicle due to broadband rocket noise and aerodynamic boundary layer turbulence, and (2) structural vibrations of general aviation aircraft due to discrete frequency propeller and reciprocating engine exhaust noise. In both cases, the spatial exterior excitations are convected pressure fields which are described on the basis of measured cross spectra (coherence and phase) information. Structural modal data are obtained from analytical predictions, and structural responses to appropriate excitation fields are calculated. The results are compared with test data, and the strengths and weaknesses of the analytical models are assessed. (Author)

A82-19306 # **Modal analysis using helicopter dynamic test data.** N. Giansante (Kaman Aerospace Corp., Bloomfield, CT) and N. Calapodas (U.S. Army, Applied Technology Laboratory, Fort Eustis, VA). *American Society of Mechanical Engineers, Design Engineering Technical Conference, Hartford, CT, Sept. 20-23, 1981, Paper 81-DET-30.* 9 p. Members, $2.00; nonmembers, $4.00. Army-supported research.

A description is presented of experimental techniques for dynamic test data acquisition and analytical procedures for performing modal analysis. Modal analysis was applied to data acquired from dynamic test of the AH-IG helicopter airframe. Application of the methodology allowed accurate definition of the structure's natural frequencies, generalized modal parameters and complex mode shapes. The AH-IG airframe exhibits complex modes because of the nonproportional distribution of damping resulting from elastomeric isolators and nonstructural access panels on the helicopter. Underlying the technique of modal testing is the principle of the linear decomposition of structural dynamic response into contributions from the natural modes occuring within a specified frequency interval. A measure of the success of a modal analysis technique is the ability to duplicate analytically the measured frequency response data for a given frequency range using the modal parameters extracted from the dynamic test results. In the subject program the dynamic response of the AH-IG was accurately synthesized over a continuous frequency interval attesting to the success both of the experimental and analytical techniques utilized. (Author)

A82-19307 # **Dynamic response of blades and vanes to wakes in axial turbomachinery.** R. N. Tadros and M. Botman (Pratt and Whitney Aircraft of Canada, Ltd., Longueil, Quebec, Canada). *American Society of Mechanical Engineers, Design Engineering Technical Conference, Hartford, CT, Sept. 20-23, 1981, Paper 81-DET-33.* 8 p. 17 refs. Members, $2.00; nonmembers, $4.00.

A numerical method is presented which allows the calculation of vibratory stresses in blades and vanes of axial turbines and compressors. The viscous wakes of the cascaded stages are defined by means of thin airfoil theory. The flow is incompressible and the cascades have low solidity. The attention is confined to the case of a single stator row upstream of a single blade row. An existing beam-type program is used to calculate structural natural frequencies and modal shapes. Structural and aerodynamic quantities are combined in a Lagrangian formulation in terms of generalized coordinates. The solution of the equations of motion results in generalized displacements and vibratory stresses. Theoretical results for a compressor turbine blade show the effects of some design parameters on the blade vibratory response. The vibratory stress obtained in a strain gauge test indicates a reasonable agreement. (Author)

A82-19310 # **Balancing of flexible rotors by the complex modal method.** S. Saito and T. Azuma (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan). *American Society of Mechanical Engineers, Design Engineering Technical Conference, Hartford, CT, Sept. 20-23, 1981, Paper 81-DET-46.* 7 p. 22 refs. Members, $2.00; nonmembers, $4.00.

A new calculation method of the modal unbalance response for general flexible rotors in fluid film bearings has been developed by introducing the concept of modal exciting force vector into the usual complex modal method, and the physical meaning of the damping ratio at a critical speed is discussed. Next, application of this method, that correction weights can be determined in only one trial operation, is reported, and positions to measure vibration and to correct unbalance weight are discussed on the basis of the right eigenvector and the exciting factor mode, respectively. Lastly, it is shown by experiments that the proposed balancing method is of use for actual rotors. (Author)

A82-19311 # **Application of the principle of reciprocity to flexible rotor balancing.** M. S. Darlow and A. J. Smalley (Southwest Research Institute, San Antonio, TX). *American Society of Mechanical Engineers, Design Engineering Technical Conference, Hartford, CT, Sept. 20-23, 1981, Paper 81-DET-49.* 5 p. 7 refs. Members, $2.00; nonmembers, $4.00. Research sponsored by the Mechanical Technology, Inc.

A series of numerical and experimental studies have been conducted to investigate the validity of the principle of reciprocity for real rotordynamic systems in the presence of damping, gyroscopic, and cross-coupling bearing effects. All of the results are found to be consistent with the principle of reciprocity. It is pointed out that by using the principle of reciprocity it is possible to substantially reduce the number of trial mass runs required for influence coefficient balancing or for the unified balancing approach, a recently developed procedure for balancing flexible rotors. V.L.

A82-19314 # **Optimum journal bearing parameters for minimum rotor unbalance response in synchronous whirl.** R. B. Bhat, T. S. Sankar (Concordia University, Montreal, Canada), and J. S. Rao. *American Society of Mechanical Engineers, Design Engineering Technical Conference, Hartford, CT, Sept. 20-23, 1981, Paper 81-DET-55.* 6 p. 12 refs. Members, $2.00; nonmembers, $4.00. Natural Sciences and Engineering Research Council of Canada Grant No. A-7104.

The unbalance response of a Jeffcott-type rotor is analyzed with reference to the contributions of hydrodynamic bearing parameters including the bearing diameter, clearance, and the oil viscosity. Optimization of the bearing parameters is carried out using the method of feasible directions. It is shown that by using a four-shoe tilting pad type bearing with a L/D of 0.5, the maximum unbalance response of the original rotor studied can be reduced by 55%. V.L.

A82-19326 # **Development of a correlated finite element dynamic model of a complete aero engine.** R. A. Bellamy, J. C. Bennett, and S. T. Elston (Rolls-Royce, Ltd., Derby, England). *American Society of Mechanical Engineers, Design Engineering Technical Conference, Hartford, CT, Sept. 20-23, 1981, Paper 81-DET-74.* 8 p. 5 refs. Members, $2.00; nonmembers, $4.00.

This paper presents a particular case study in which a complete RB 211-524 engine carcass and nacelle was modelled using the Rolls-Royce finite element system. This structure was also vibration tested in the laboratory using two independent modal analysis systems. Close correlation between theory and experiment is demonstrated, which gives confidence in the finite element method for prediction of the dynamic properties of a real engineering structure. It also demonstrates that commercial modal analysis systems can measure the dynamic characteristics of such structures with sufficient quality to validate the theoretical models. (Author)

A82-19332 # **Prediction of aircraft interior noise using the statistical energy analysis method.** V. R. Miller (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, OH) and L. L. Faulkner (Battelle-Columbus Laboratories, Columbus, OH). *American Society of Mechanical Engineers, Design Engineering Technical Conference, Hartford, CT, Sept. 20-23, 1981, Paper 81-DET-102.* 9 p. 18 refs. Members, $2.00; nonmembers, $4.00.

An analytical model is developed to predict the transmission of noise into an airplane interior through the fuselage sidewall by the statistical energy analysis (SEA) method. The fuselage structure is represented as a series of curved, isotropic plates, the isotropic representation resulting from the effects of smearing out the stiffeners. Other complicating effects such as pressurization, acoustic transmission through windows or seal leaks, and aerodynamic excitation are excluded in this effort but could be modeled by these same methods. Evaluation of the model was made using measured full scale acoustic data from both an adhesively bonded and a mechanically fastened airplane fuselage structure. Reasonably good agreement was obtained between predicted and measured levels in the higher frequencies. Predicted levels were shown to be sensitive to the value chosen for structural loss factor. Comparisons were also made with the measured data with an estimation procedure reported in the literature. (Author)

A82-19333 # **A CAD/CAM graphics system with relative datums and tolerances.** J. P. Memery, W. R. Marler, and J. D. Lancaster (United Technologies Corp., Pratt and Whitney Aircraft Group, East Hartford, CT). *American Society of Mechanical Engineers, Design Engineering Technical Conference, Hartford, CT, Sept. 20-23, 1981, Paper 81-DET-108.* 6 p. 10 refs. Members, $2.00; nonmembers, $4.00.

An interactive graphic design system for turned parts in use at Pratt & Whitney Aircraft is described. This CAD/CAM system is capable of capturing relative datums and tolerances required for the manufacture and inspection of these parts. Tolerance capacity allows application of the system to broaching, a process which is commonly used to produce the parts. In the CAD/CAM system, turned parts and bladed disk attachment cross-section profiles are created in the computer. The required position of the attachment root can be calculated to minimize moments created by centrifugal force and air loads on the airfoil. The leakage area between the blade root and the disk slot can be computed, and the weight of the finished part estimated. The computer description is stored in the CAD/CAM data base and identified on the engineering drawing. More than 20 design and manufacturing application modules are currently in place as part of the Pratt & Whitney Aircraft CAD/CAM system. J.F.

A82-19337 * # **Aeroelastic characteristics of a cascade of mistuned blades in subsonic and supersonic flows.** R. E. Kielb (NASA, Lewis Research Center, Structural Dynamics Section, Cleveland, OH) and K. R. V. Kaza (NASA, Lewis Research Center, Cleveland; Toledo, University, Toledo, OH). *American Society of Mechanical Engineers, Design Engineering Technical Conference, Hartford, CT, Sept. 20-23, 1981, Paper 81-DET-122.* 12 p. 19 refs. Members, $2.00; nonmembers, $4.00.

An investigation of the effects of mistuning on flutter and forced response of a cascade in subsonic and supersonic flows is presented. The aerodynamic and structural coupling between the bending and torsional motions and the aerodynamic coupling between the blades are included. It is shown that frequency mistuning always has a beneficial effect on flutter. Additionally, the results indicate that frequency mistuning may have either a beneficial or an adverse effect on forced response, depending on the engine order of the excitation and Mach number. (Author)

A82-19338 # **Natural frequencies of rotating bladed discs using clamped-free blade modes.** S. J. Wildheim (Stal-Laval Turbin AB, Finspang, Sweden). *American Society of Mechanical Engineers, Design Engineering Technical Conference, Hartford, CT, Sept. 20-23, 1981, Paper 81-DET-124.* 11 p. 16 refs. Members, $2.00; nonmembers, $4.00.

A method for calculating the natural frequencies of practical bladed disk assemblies is described, which is based on a dynamic substructuring technique. The cut-of-plane vibrations of the rotating prestressed disk are described by receptances, while the blade dynamics are described by the clamped-free modes. A blade dynamic stiffness matrix of order 4 + 10I, (where I is the number of lacing wires), is formed directly from the blade modal data in the interface displacements between the disk and the blades and between the blades and the lacing wires. The lacing-wires are treated as elastic and massless. The sign-count method and bisection are used to locate the eigenvalues. The method presents no numerical difficulties and is automatic as well as efficient. J.F.

A82-19340 # **On the formulation of coupled/uncoupled dynamics analyses of blade-disc assemblies.** P. S. Kuo (Avco Corp., Avco Lycoming Stratford Div., Stratford, CT). *American Society of Mechanical Engineers, Design Engineering Technical Conference, Hartford, CT, Sept. 20-23, 1981, Paper 81-DET-126.* 9 p. 6 refs. Members, $2.00; nonmembers, $4.00.

The interaction between the blades and their attachments on a flexible rotor-disc assembly may induce potential vibration problems. Coupled blade-disc resonance, the dissimilar behavior of blade groups, and the uncoupled blade or disc natural frequencies must be evaluated. To satisfy all of the requirements and at the same time reduce the complexity of the analysis, an efficient analytical formulation of a combined blade-disc segment model using finite element rotational symmetry techniques was developed. The capability of the technique, as demonstrated, using a plate-element model, includes computer plots of the blade and disc normalized modal deformations in consecutive segments at the respective natural frequencies. The results are discussed and verified by fundamental vibration theory. Various finite element models of blades and discs are also presented to clarify the modeling procedure. The method is shown to be a cost-effective tool that readily lends itself to daily routine use. (Author)

A82-19342 # **Optimal shape design of turbine blades.** J. P. Queau and P. Trompette (Lyon, Institut National des Sciences Appliquées, Villeurbanne, Rhône, France). *American Society of Mechanical Engineers, Design Engineering Technical Conference, Hartford, CT, Sept. 20-23, 1981, Paper 81-DET-128.* 6 p. 10 refs. Members, $2.00; nonmembers, $4.00.

This paper attempts to present a general engineering method for minimizing the weight of rotating turbine blades in optimizing the cross section shapes. The constraints originate from either aerodynamic or solid mechanic specifications. As the problem is reformated after a first F.E. analysis, the optimization process is quite inexpensive. A large variety of compressor or turbine rotating blades can be designed by this method which uses the variables selected by the aerodynamicists and leads to continuous optimal profiles. (Author)

A82-19343 # **Investigation of vibration of shrouded turbine blades.** J. Wachter and H. Wolfs (Stuttgart, Universität, Stuttgart, West Germany). *American Society of Mechanical Engineers, Design Engineering Technical Conference, Hartford, CT, Sept. 20-23, 1981, Paper 81-DET-129.* 5 p. 6 refs. Members, $2.00; nonmembers, $4.00.

The grouping of cantilever blades by means of shrouding (bands, plates or damping wires) results in a new vibratory system the theoretical and experimental analysis of which would pose a variety of problems. In order to find some improved approach of numeric predictive computation we must carry out experimental analyses while varying systematically some of the influencing parameters. This paper discusses some static parameter analyses of model blades of simplified geometry. The results obtained are compared with numeric calculations by the finite elements method. (Author)

A82-19344 # **A practical approach to systems mode analysis.** P. W. Spence (General Electric Co., Aircraft Engine Group, Lynn, MA). *American Society of Mechanical Engineers, Design Engineering Technical Conference, Hartford, CT, Sept. 20-23, 1981, Paper 81-DET-130.* 8 p. 5 refs. Members, $2.00; nonmembers, $4.00.

A simplified methodology is presented for the analysis of disc-blade-shroud assemblies to obtain system mode frequencies and stress and load distributions in the blades. The method uses the cantilever vibration characteristics of the blades with a travelling wave solution applied to the shroud boundary conditions. Theoretical and experimental results are compared and some design criteria are indicated for frequency tuning to meet design objectives. (Author)

A82-19347 # **An investigation of dual mode phenomena in a mistuned bladed-disk.** W. Q. Stange and J. C. MacBain (USAF, Aero Propulsion Laboratory, Wright-Patterson AFB, OH). *American Society of Mechanical Engineers, Design Engineering Technical Conference, Hartford, CT, Sept. 20-23, 1981, Paper 81-DET-133.* 12 p. 5 refs. Members, $2.00; nonmembers, $4.00.

This paper presents the results of an investigation addressing the effects of mistuning on the lower modes of vibration of a simple bladed-disk model. The phenomena of dual modes, also known as mode splitting, is studied using holographic interferometry and strain gage measurements under nonrotating and rotating conditions. Resonant amplitudes, mode shapes, and natural frequencies of the disk model were determined, without deliberately mistuning the disk. The tests were then repeated with the disk deliberately mistuned to varying degrees, paying particular attention to the second diameter (2N) dual modes. Additionally, tests were conducted on the disk at a rotational speed of 2000 rpm, in an effort to gain insight as to the vibratory characteristics of the disk under rotating conditions. (Author)

A82-19348 # **Measurement of the influence of flow distortions on the blade vibration amplitude in an air turbine.** J. Beckmann and J. Wachter (Stuttgart, Universität, Stuttgart, West Germany). *American Society of Mechanical Engineers, Design Engineering Technical Conference, Hartford, CT, Sept. 20-23, 1981, Paper 81-DET-135.* 9 p. 6 refs. Members, $2.00; nonmembers, $4.00.

Experimental investigations in an air turbine are carried out to determine the influence of exciting forces due to flow distortions on the vibration amplitudes of a rotating bladed disk. Flow distortions are simulated at different operating points by changing the outlet angle of the guide vanes. The dynamic signals like blade vibrations and fluctuating pressures are measured, transmitted by a five channel telemetry system, stored on a multitrack tape and subsequently analyzed by a real-time analyzer and a computer comparing amplitude and phase shift. (Author)

A82-19349 # **A parametric study of dynamic response of a discrete model of turbomachinery bladed disk.** A. Muszynska (Dayton, University, Dayton, OH) and D. I. G. Jones (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH). *American Society of Mechanical Engineers, Design Engineering Technical Conference, Hartford, CT, Sept. 20-23, 1981, Paper 81-DET-137.* 12 p. 8 refs. Members, $2.00; nonmembers, $4.00.

A model consisting of n five-degree-of-freedom subsystems has been developed to characterize some of the mechanical response features of a bladed disk system, including four modes of each blade, n bending modes of the disk, blade-to-blade and blade-to-ground Coulomb friction, structural damping, blade-to-blade mistuning, and various types of excitation. The equations of motion and method of solution are described, and numerical results illustrate some of the interesting effects of various levels of frictional damping on tuned and mistuned systems, which may shed light on some aspects of damped system design and performance. (Author)

A82-19351 # **Application of structural optimization technique to reduce the external vibrations of a gas-turbine engine.** H. Bedrossian and R. Phoenix (Avco Corp., Avco Lycoming Stratford Div., Stratford, CT). *American Society of Mechanical Engineers, Design Engineering Technical Conference, Hartford, CT, Sept. 20-23, 1981, Paper 81-DET-143.* 8 p. Members, $2.00; nonmembers, $4.00.

The development of a structural and dynamics finite element model of a complete gas-turbine engine was achieved using the resources of the Integrated Turbine Analysis System, an in-house research program. This system employed interactive graphics and an engineering database to generate a NASTRAN dynamic model of the subject engine. A normal modes analysis identified the natural frequencies and associated mode shapes for the engine structure within its operating range. A forced-response analysis due to the steady-state sinusoidal load of rotor unbalanced was obtained. Results were found to be in good agreement with typical vibration records obtained in a production test cell. The forced response strain energy method was utilized to identify the structural elements primarily contributing to the response. The effect of component stiffness on engine vibration levels and the recommended design modification to reduce these levels, was established. (Author)

A82-19521 # **Analysis and tolerance study of an array antenna for a new generation of secondary radars.** M. Di Fausto, A. Saitto (Selenia S.p.A., Rome, Italy), and G. Pelosi (Roma, Università, Rome, Italy). In: European Microwave Conference, 10th, Warsaw, Poland, September 8-12, 1980, Proceedings.
Sevenoaks, Kent, England, Microwave Exhibitions and Publishers, Ltd., 1981, p. 144-148. 11 refs.

An open array antenna is analyzed considering performance and tolerances with respect to the specifications given by Eurocontrol and FAA. Computed results and parametric charts are presented. The analytical methods used are briefly described. Some considerations on the choice of the radiating element (slot or dipole) are given with respect to the desired performance. (Author)

A82-19552 # **Leaky wave antenna using an inverted strip dielectric waveguide.** R. Crampagne, L. Padellec, and A. Sarremejean (ONERA, Centre d'Etudes et de Recherches de Toulouse, Toulouse, France). In: European Microwave Conference, 10th, Warsaw, Poland, September 8-12, 1980, Proceedings. Sevenoaks, Kent, England, Microwave Exhibitions and Publishers, Ltd., 1981, p. 474-479. 5 refs.

Experimental results on a leaky wave antenna built from an inverted strip dielectric waveguide are presented, the frequency ranging from 64 to 74 GHz. The frequency scanning for beams inclined backward is investigated, along with the variations of gain and 3 dB beamwidth. An approximate analysis is proposed for calculating the main lobe angle and the radiating space harmonic's amplitude. Comparison between experimental and theoretical results shows that the angle's value (for inclined beams) is very sensitive to machining tolerance. Several approximate theoretical methods are proposed for determining the main lobe angle. C.R.

A82-19621 **Trends in aviation fuels and lubricants; Proceedings of the West Coast International Meeting, Seattle, WA, August 3-6, 1981.** Meeting sponsored by the Society of Automotive Engineers. Warrendale, PA, Society of Automotive Engineers, Inc. (SAE Proceedings SP-492), 1981. 65 p. $9.00.

Trends in aviation fuels and lubricants are reviewed in a historical aspect and with reference to recent measurements which can provide projections for anticipated trends in the near future. Topics discussed include a short history of aviation gasoline development covering the period 1903-1980; a history of aircraft piston engine lubricants; aviation turbine fuel properties and their trends; and finally, the history of aviation turbine lubricants. V.L.

A82-19622 **A history of aircraft piston engine lubricants.** R. V. Kerley. In: Trends in aviation fuels and lubricants; Proceedings of the West Coast International Meeting, Seattle, WA, August 3-6, 1981. Warrendale, Pa, Society of Automotive Engineers, Inc., 1981, p. 15-42. 50 refs.

This paper is a review of the literature covering the history of the use of lubricants. The uses of oils derived from animals, vegetables and minerals are placed in perspective from ancient times to the Wright Brothers' flight in 1903. After that period, the discussion is confined largely to the lubrication of aircraft piston engines. The paper attempts to explain the preference for castor oil in European and British engines and the more general, but by no means exclusive, use of petroleum-based mineral oils in the United States. The background for the continued, and often controversial use of straight mineral oil, some of the additives used, tests of synthetic oil in winter use, and oil reclamation are reviewed through World War II until 1963 when lubricating oils containing ashless additives became the predominant products. (Author)

A82-19623 * **Aviation turbine fuel properties and their trends.** R. Friedman (NASA, Lewis Research Center, Cleveland, OH). In: Trends in aviation fuels and lubricants; Proceedings of the West Coast International Meeting, Seattle, WA, August 3-6, 1981. Warrendale, PA, Society of Automotive Engineers, Inc., 1981, p. 43-54. 16 refs.

This paper is an examination of published Jet A inspection data covering selected property distributions, averages, and trends for the period from 1969 to 1979. Yearly median values of aromatics, mercaptan sulfur content, 10-percent distillation temperature, smoke point, and freezing point are changing with time, approaching their specification limit values, particularly in the last three years. A near-specification property is defined as one within a stated tolerance band around the specification limit. On this basis, most fuel samples have one to three near-specification properties, the most common being aromatics, smoke point, and freezing point. (Author)

A82-19624 **The history of aviation turbine lubricants.** R. Knipple and J. Thich (Royal Lubricants Co., Inc., East Hanover, NJ). In: Trends in aviation fuels and lubricants; Proceedings of the West Coast International Meeting, Seattle, WA, August 3-6, 1981. Warrendale, PA, Society of Automotive Engineers, Inc., 1981, p. 55-63. 24 refs.

Condensed in this report are the salient points of the forty year history of the development of the gas turbine engine, its associated aircraft and the various lubricants used. Tables are included comparing some of the important specification properties of many of these fluids, both petroleum and synthetics. An explanation is incorporated outlining the reasons synthetics perform well in the turbine engine environment. A genealogical chart detailing the various dates on which lubricant specifications or important changes were issued is provided. There are indications that some commercially available lubricants are being stressed to the limits of the fluids capabilities. Any new engine designs, therefore, may require entirely new lubricants and/or new lubrication systems. (Author)

A82-19649 # **The significance of electronics for air traffic control at the present time and in the future (Die Bedeutung der Elektronik für die Flugsicherung in Gegenwart und Zukunft).** K. Platz (Bundesanstalt für Flugsicherung, Frankfurt am Main, West Germany). *Luft- und Raumfahrt,* vol. 2, 4th Quarter, 1981, p. 109-112, 114-116. In German.

It is pointed out that the current Air Traffic Control (ATC) system is the result of an evolutionary development process, taking place during the last thirty years. The ATC system can perform its tasks only by making use of the advances made in the area of electronics. The system aids provided for the air traffic controller must be continuously improved in connection with the adaptation of ATC to aircraft-related technological advances. Improved ACT procedures make it also possible to enhance the control capacity of the system in response to increases in the volume of air traffic. Attention is given to the technical system of ATC, future developments on the international level, and technological possibilities for future ATC systems. The use of an onboard computer is considered along with traffic flow control, a European flight-plan data bank, the telecommunication network for aviation, an enlarged radar system, data transmission, new data-display methods, and the cost of ATC. G.R.

A82-19733 # **Technical evaluation report of the AGARD Fluid Dynamics Panel Symposium on computation of viscous-inviscid interactions (Rapport d'evaluation technique du Symposium organisé par la Commission de Dynamique des Fluides de l'AGARD sur le calcul de l'interaction fluide-parfait-fluide visqueux).** J. C. Le Balleur (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *(Association Aéronautique et Astronomique de France, Colloque d'Aérodynamique Appliquée, 18th, Poitiers, France, Nov. 18-20, 1981.) ONERA, TP* no. 1981-116, 1981. 9 p. 31 refs. In French.

The symposium surveys the status of current research in computational aerodynamics based on methods solving a viscous-inviscid interaction problem. In spite of limitation in the models or numerical techniques for shock wave boundary layer interaction or trailing edge problems, the situation is well advanced in unseparated, steady two-dimensional flow, with the potential approximation for the inviscid part. Progress has advanced in the computation of separations, based on strong interaction models. It would be fruitful to make use of the complete Euler equations in transonic flow. Progress toward strong interaction methods is much less advanced in unsteady or three-dimensional flow, but seems likely. The development of strong interaction methods, highly connected with that of inviscid and Navier-Stokes numerical techniques, appears as mandatory to having access to practical application needs. (Author)

A82-19737 # **A progress report on the European Transonic Wind Tunnel Project (Le Projet de Soufflerie Transsonique euro-**

péenne ETW - Etat actuel). J. P. Morel (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *(Association Aéronautique et Astronomique de France, Colloque d'Aérodynamique Appliquée, 18th, Poitiers, France, Nov. 18-20, 1981.) ONERA, TP* no. 1981-121, 1981. 24 p. 5 refs. In French.

An interim report on the design for a European Transonic Wind Tunnel, being built by the cooperative efforts of West Germany, Britain, and the Low Countries is presented, and details of the partially completed prototype wind tunnel are provided. The ETW will be a cryogenic, nitrogen gas installation for examining flows at high Reynolds numbers, and consultations are continuing with NASA on the cryogenic technology. The full test channel will have a 2.4 x 2 sq m cross section, with a pressure variance between 1.25-4.5 bars. Temperatures will range from 120-168 K at Mach numbers up to 1.7, and equipment altering the incidence angle of test models at a rate of four deg/sec is intended. A pilot ETW is under construction, with a cross-section of 0.27-0.23 m, and is being used to verify the aerodynamic performance of the flow circuit, the responses to Mach number, pressure, and temperature, and the control circuits. M.S.K.

A82-19738 # **Aerodynamics of a transport aircraft-type wing-fuselage assembly (Aérodynamique d'un ensemble voilure-fuselage du type 'Avion de transport').** V. Schmitt (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *(Association Aéronautique et Astronautique de France, Colloque d'Aérodynamique Appliquée, 18th, Poitiers, France, Nov. 18-20, 1981.) ONERA, TP* no. 1981-122, 1981. 24 p. 19 refs. In French.

This study, carried out at ONERA, is based on the DFVLR-F4 wing-body combination. The 1/38 model is formed by a 9.5 aspect ratio transonic wing and an Airbus A 310 fuselage. After a description of the F4 wing geometrical characteristics, main experimental results obtained in the S2MA wind tunnel are discussed. Both wing-fuselage interferences and viscous effects, which are important on the wing due to a high rear loading, are investigated. In order to do that three-dimensional calculations are performed; an attempt is made to find their limitations. (Author)

A82-19740 # **Three-dimensional calculation of the flow in helicopter air intakes (Calculs tridimensionnels de l'écoulement dans les prises d'air d'hélicoptères).** B. Boizard (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *(Association Aéronautique et Astronautique de France, Colloque d'Aérodynamique Appliquée, 18th, Poitiers, France, Nov. 18-20, 1981.) ONERA, TP* no. 1981-124, 1981. 14 p. In French. Research supported by the Direction des Recherches, Etudes et Techniques.

The results of an ONERA-initiated investigation to optimize the efficiency of helicopter air intakes and minimize the aerodynamic drag are reported. A method of singularities was used to study the internal flow in the air intakes, with the flow considered as incompressible and the air as an ideal fluid. The walls of the intake were discretized into quadrilateral facets for solution of a series of linear equations in a computer. The velocity fields induced by the facets were obtained for the intensities of the calculated doublets. The air intake during hovering and acceleration are modeled for two existing aircraft, and the necessity of accounting for viscous effects in future programs is indicated. M.S.K.

A82-19784 * # **Control law development for a close-coupled canard, relaxed static stability fighter.** R. W. Klein, M. Lapins, R. P. Martorella, and M. Sturm (Grumman Aerospace Corp., Bethpage, NY). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0180.* 20 p. Contract No. NAS1-16636.

The performance benefits to be gained from relaxed static stability (RSS) are illustrated for M = 0.9 and M = 2.0 flight conditions. The longitudinal, directional, and lateral control system structure is developed. The effect of static margin, bandwidth, and canard-wing interaction on canard rate requirements is analyzed. Control and maneuver limiter functions are developed and implemented about all three axes; simulation results strikingly demonstrate the concomitant improvement in energy management and improved resistance to departure and spin. C.R.

A82-19786 * # **An analytical technique for the analysis of airplane spin entry and recovery.** L. W. Taylor, Jr. and G. K. Miller, Jr. (NASA, Langley Research Center, Flight Dynamics and Control Div., Hampton, VA). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0243.* 9 p. 10 refs.

The dynamic equations of motion for a spinning airplane are simplified to facilitate the analysis of spin entry and recovery maneuvers. Solutions of a nonlinear, first order equation for spin rate enable calculation of spin entry and recovery times and control required for recovery. The analysis is applied to a light airplane for which both aerodynamic data, rotory balance wind tunnel tests, and spin flight test data have been obtained. A comparison of predicted and actual transient spin responses is made which supports the validity of the analytical approach taken but which also illustrates the difficulty in obtaining accurate aerodynamic data for spinning airplanes. Certain normalized parameters of the reduced state spin equation suggest criteria for assessing the transient spin characteristics of light airplanes. (Author)

A82-19791 # **The sooting tendency of fuels containing polycyclic aromatics in a research combustor.** D. W. Naegeli, L. G. Dodge, and C. A. Moses (Southwest Research Institute, San Antonio, TX). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0299.* 11 p. 21 refs.

An investigation regarding soot formation has been conducted for a variety of jet fuels, taking into account a wide range of combustor conditions covering the operating envelopes of many gas turbine engines. The results demonstrate that the dominant soot formation mechanisms in gas turbine engines are dependent on operating conditions. There are evidently a number of competing soot formation and oxidation steps whose relative importance varies with inlet air temperature, reference velocity, and fuel/air ratio. Under some operating conditions the sooting tendency is significantly affected by polycyclic aromatics including tetralin, but the H/C ratio is the principal correlating parameter. At high power conditions where soot formation is of greatest concern, the fuel/air ratio of most engines is high (0.02), and there is little sensitivity to polycyclics. G.R.

A82-19796 * # **Experimental studies of the Eppler 61 airfoil at low Reynolds numbers.** T. F. Burns and T. J. Mueller (Notre Dame, University, Notre Dame, IN). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0345.* 12 p. 15 refs. Research sponsored by the University of Notre Dame; Grant No. NsG-1419.

The results of an experimental study to document the effects of separation and transition on the performance of an airfoil designed for low Reynolds number operation are presented. Lift, drag and flow visualization data were obtained for the Eppler 61 airfoil section for chord Reynolds numbers from about 30,000 to over 200,000. Smoke flow visualization was employed to document the boundary layer behavior and was correlated with the Eppler airfoil design and analysis computer program. Laminar separation, transition and turbulent reattachment had significant effects on the performance of this airfoil. (Author)

A82-19797 * # **Numerical solution of three-dimensional unsteady transonic flow over wings including inviscid/viscous interactions.** D. P. Rizzetta and C. J. Borland (Boeing Military Airplane Co., Seattle, WA). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0352.* 37 p. 30 refs. Contract No. NAS2-10762.

A method is presented for computing the unsteady three-dimensional transonic flowfield about twin wings of arbitrary planform and section geometry including the effects of inviscid/viscous interaction. Dominant effects of the shock-boundary-layer interaction are accounted for by a simple empirically defined model, while viscous regions adjacent to the wing surface and along the trailing wake are described by a set of integral equations appropriate for two-dimensional turbulent flows. The validity of the proposed method is verified by comparison with steady three-dimensional experimental data and a solution of more exact equations for a typical transport wing configuration. V.L.

A82-19798 * # **Unsteady lifting-line theory with applications.** A. R. Ahmadi (Bolt Beranek and Newman, Inc., Cambridge, MA) and S. E. Widnall (MIT, Cambridge, MA). *American Institute of*

Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0354. 21 p. 32 refs. Research supported by the Bolt Beranek and Newman, Inc.; Grant No. NGR-22-009-818.

Unsteady lifting-line theory is developed for a flexible unswept wing of large aspect ratio oscillating at low frequency in inviscid incompressible flow. The theory is formulated in terms of the acceleration potential and treated by the method of matched asymptotic expansions. The wing displacements are prescribed and the pressure field, airloads, and unsteady induced downwash are obtained in closed form. Sample numerical calculations are presented. The present work identifies and resolves errors in the unsteady lifting-line theory of James and points out a limitation in that of Van Holten. Comparison of the results of Reissner's approximate unsteady lifting-surface theory with those of the present work shows favorable agreement. The present work thus provides some formal justification for Reissner's ad hoc theory. For engineering purposes, the region of applicability of the theory in the reduced frequency-aspect ratio domain is identified approximately and found to cover most cases of practical interest. (Author)

A82-19801 # Real gas flows over complex geometries at moderate angles of attack. S. Swaminathan, C. H. Lewis (Virginia Polytechnic Institute and State University, Blacksburg, VA), and M. D. Kim. *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0392.* 22 p. 12 refs.

Numerical simulation of supersonic and hypersonic flows over arbitrary geometries at moderate angles of attack is presented in this paper. The different geometries considered for analysis include a slab delta wing, a sphere-cone-cylinder-flare, a blunt-nosed inlet and a 7-degree half-angle sphere-cone. The three-dimensional flowfields over these geometries are analyzed by a parabolized Navier-Stokes code (HYTAC) and a new viscous shock-layer code (VSLET), and the results are compared. Both laminar and turbulent flowfield results for both perfect gas and equilibrium air are presented. In general the surface pressure distributions are in good agreement whereas the heat-transfer results differ depending on the differencing scheme used in the calculation of gradients and turbulent modelling. Aerodynamic force and moment coefficients are presented for some typical cases. Computing times for various test cases are presented. (Author)

A82-19810 † Aerodynamic characteristics of waveriders at subsonic flight speeds (Aerodinamicheskie kharakteristiki Lambda-kryl'ev na dozvukovykh skorostiakh poleta). V. I. Voronin and A. I. Shvets. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza,* Nov.-Dec. 1981, p. 104-109. 10 refs. In Russian.

Theoretical and experimental results are presented on the aerodynamic characteristics of two series of waverider models, differing in dihedral angle and sweep angle. The method of discrete vortices was used to analyze the characteristics of thin triangular-platform waveriders. Theoretical results were compared with experimental data on thin waveriders with a relative thickness up to 3%; wind tunnel tests were carried out in the 0.4-0.8 Mach number range. B.J.

A82-19813 † Analysis of an ideal-fluid flow past a finite-thickness wing (Raschet obtekaniia kryla konechnoi tolshchiny ideal'noi zhidkost'iu). A. A. Zaitsev and A. D. Khamzaev. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza,* Nov.-Dec. 1981, p. 124-131. 12 refs. In Russian.

A numerical analysis of potential flow past a finite-span wing is carried out using a piecewise-linear approximation of the unknown functions with respect to wing span. In the nonlinear problem the vortex sheet is represented as vortex threads, while in the linear problem it is represented as vortex threads and as a vortex surface. An aerodynamic analysis of swept-wings of finite thickness is presented, and theoretical results are compared with experimental data. B.J.

A82-19814 † The design of compact asymmetric maximum-thrust nozzles for a given lift force (O postroenii kompaktnykh nesimmetrichnykh sopl maksimal'noi tiagi pri zadannoi pod'emnoi sile). A. I. Rylov. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza,* Nov.-Dec. 1981, p. 132-136. 7 refs. In Russian.

Kraiko's (1979) indeterminate-control-contour method is used to solve the variational design problem for an asymmetric supersonic plane maximum-thrust nozzle for a given lift force and given size constraints. It is shown that the present problem is equivalent to the maximum thrust problem (with the absence of the lift-force constraint) in a coordinate system that differs from the original system by a certain angle of rotation. Numerical calculations are presented which illustrate the influence of the lift force on nozzle geometry and thrust. B.J.

A82-19858 X-band vs C-band aircraft radar - The relative effects of beamwidth and attenuation in severe storm situations. P. H. Hildebrand, R. A. Oye, and R. E. Carbone (National Center for Atmospheric Research, Boulder, CO). *Journal of Applied Meteorology,* vol. 20, Nov. 1981, p. 1353-1361. 21 refs. U.S. Bureau of Reclamation Contract No. 7-07-83-V001; NSF Grant No. ATM-78-27420.

A simulation of X-band and C-band radar is given, with consideration of the effects of attenuation and beamwidth on measurements of radar equivalent reflectivity factor. Two tornadic storms were examined, to determine the ability of radar to adequately show a safe path through a storm. Historical data were acquired and attenuated for the radar wavelength chosen, filtered in azimuth, elevation, and range desired according to the radar beamwidth and pulse depth desired, and filtered in threshold on the basis of received power in order to approximate the simulated radar sensitivity. It was found that X-band radar can provide incorrect information in severe convective storms, while C-band radar is more accurate in severe storm penetration, especially with sampling at 1/3-1/4 beamwidth intervals. The results are noted to hold significance for both operational and research airborne radar use. M.S.K.

A82-19928 † Automated calculation of the stressed state of shell systems under asymmetrical mechanical and thermal loading (Ob avtomatizatsii rascheta napriazhennogo sostoianiia obolochechnykh sistem pri nesimmetrichnykh silovykh i teplovykh vozdeistviiakh). Ia. M. Grigorenko, G. I. Genkin, N. D. Draigor, E. T. Fedorova, and V. N. Khoroshilov (Akademiia Nauk Ukrainskoi SSR, Institut Mekhaniki, Kiev, Ukrainian SSR). *Prikladnaia Mekhanika,* vol. 17, Dec. 1981, p. 49-56. In Russian.

Problems related to the computer calculation of the strength of structural elements of aircraft engines are presented. The engines are considered to be elastic systems, composed of various shells of revolution, which are under the effects of non-axisymmetrical mechanical and thermal loads, as well as boundary forces and moments. The calculated values are found to be in good agreement with experimental results. J.F.

A82-19947 Consequences of American airline deregulation Legislative theory in a concrete example (Auswirkungen der amerikanischen Airline Deregulations - Gesetzgebungslehre an einem konkreten Beispiel). R. H. Weber. *Zeitschrift für Luft- und Weltraumrecht,* vol. 30, Dec. 1981, p. 333-348. 52 refs. In German.

The Airline Deregulation Act of 1978 is discussed in terms of its impact on American and international air commerce. Major advantages and disadvantages are presented, including a lower cost of flying for the consumer and efficient and profitable air route structures on the one hand and the reduction of safety standards and the creation of operational and financial instability for airlines on the other. Consequences of deregulation in the American market include the establishment of a tariff, a reduction of service for smaller airports, and an increase in small commuter aircraft which run a greater accident risk, especially at take-off and landing. The impact of the tariff on international air traffic is discussed, and a comprehensive evaluation of the Deregulation Act is given. It is concluded that innovation in the airline industry will play a larger role due to increased competition resulting from the deregulation. D.L.G.

A82-19958 # Subsonic and transonic roll damping measurements on Basic Finner. H. S. Murthy (National Aeronautical Laboratory, Bangalore, India). *Journal of Spacecraft and Rockets,* vol. 19, Jan.-Feb. 1982, p. 86, 87. 7 refs. Research sponsored by the Indian Space Research Organization.

Wind tunnel roll damping data on the Basic Finner are presented for subsonic speeds up to Mach 3. Rolling moment coefficients were obtained with a 5% accuracy in the transonic regime and to within 3% at supersonic speeds. A drop in roll damping in the transonic region is attributed to the occurrence of a shock wave on the fin causing a drop in fin lift. The measured roll rate coefficient was found to be invariant with the roll rate at all Mach speeds at zero angle of incidence, in contrast to previous tests in which the roll rate constant remained invariant with the rate only in supersonic regimes. M.S.K.

A82-19966 # **Fuel property effects on radiation intensities in a gas turbine combustor.** J. A. Clark (Ohio State University, Columbus, OH). *AIAA Journal,* vol. 20, Feb. 1982, p. 274-281. 20 refs.

The effect of fuel properties on primary zone radiation intensities in gas turbine combustors is examined. This study concludes that there is a strong empirical relationship between the primary zone radiation intensity and two fuel properties - percent hydrogen and percent polycyclic aromaticity. These two properties are combined in a single parameter called 'effective hydrogen content,' which is then used to correlate radiation intensities from seven different fuels burning under a variety of operating conditions. The explanation for the empirical relationship is that effective hydrogen content is a measure of the soot-forming tendency of a fuel. (Author)

A82-19970 **Ground reflection effects in aircraft noise measurements (Bodenreflexionseffekte bei Fluglärmessungen).** W. M. Dobrzynski (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Abteilung Technische Akustik, Braunschweig, West Germany). *Zeitschrift für Flugwissenschaften und Weltraumforschung,* vol. 5, Nov.-Dec. 1981, p. 367-374. 6 refs. In German.

Aircraft noise measurements were carried out for the certification of propeller aircraft (weighing no more than 5.7 tons), and the maximum A-weighted flyover noise level was determined as a coefficient of measure. Since the flyover signal is known to be affected by ground reflection interference experimental and theoretical methods were used to determine the extent to which these effects can also change the maximum A-weighted flyover noise level. Measurements were made by microphones on several aircraft at 1.2 m in altitude; a second microphone was placed on the ground as a reference. Calculations and measurement results show that, depending on the propeller rotational speed and blade number, level differences of up to 3 dB(A) can be obtained between unaffected signals plus signals affected by reflection interference. J.F.

A82-20054 **Ultrasonic method for flow field measurement in wind tunnel tests.** R. H. Engler, D. W. Schmidt, W. J. Wagner, and B. Weitemeier (Max-Planck-Institut für Strömungsforschung; Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Göttingen, West Germany). *Acoustical Society of America, Journal,* vol. 71, Jan. 1982, p. 42-50. 14 refs.

An ultrasonic measuring system suitable for rapid and nondisturbing measurements of the flowfield around models in wind tunnels is presented. The shift in two sound beams propagating parallel to one another when crossing a vortex is modeled, and the velocity field traversed is defined. The running times of the sound beams are used to determine the circulation of the vortex under test directly from a derived curve. Condensor microphones emit the sound pulses, which are received by similar apparatus for processing by computer. Examples are provided for a single vortex, for the influence of a spoiler, and for tip vortices behind an oscillating blade. Future developments in the system which include using an array of up to 18 ultrasonic microphones to eliminate mechanical shifting of the model are indicated. M.S.K.

A82-20058 **Comparison of aircraft and ground vehicle noise levels in front and backyards of residences.** J. C. Ortega (Paul S. Veneklasen and Associates, Santa Monica, CA) and K. D. Kryter (SRI International, Menlo Park, CA). *Acoustical Society of America, Journal,* vol. 71, Jan. 1982, p. 216, 217.

Measurements and measurement techniques for comparing front and backyard noise levels for aircraft and surface vehicle noises are presented. Microphones in the front and back of a house were used to gather sounds from aircraft taking off, a manual shift small vehicle pulling in and out of the driveway, and a garbage collection truck making its rounds past the front of the house. Two residences were monitored, and the tapes were analyzed for maximum A-weighted noise levels. The reduction for surface vehicle noise traveling from front-to-back of the house ranged from 17-21 dBA, while no significant difference was found for the aircraft noise. M.S.K.

A82-20128 **Design of the composite spar-wingskin joint.** R. D. Cope and R. B. Pipes (Delaware, University, Newark, DE). *Composites,* vol. 13, Jan. 1982, p. 47-53. Contract No. F33615-77-C-3132.

A variety of composite spar-wingskin joint concepts have been investigated to optimize out-of-plane strength while still providing low weight and ease of fabrication. The spar-wingskin configuration consists of a thin spar which overlaps and is co-cured perpendicular to a thick wingskin. Investigation parameters were the joint geometry in the immediate vicinity of the base of the spar, and the spar-to-spar spacing. It was found that by varying the overlap geometry and decreasing the interspar spacing a significant increase in out-of-plane strength could be realized. A theoretical analysis was made by the extended use of the finite element technique. Joint strength was predicted through the application of Tsai-Wu, maximum stress and maximum shear failure criteria. These results were verified by comparison to experimental results in which all significant concepts were fabricated and tested. (Author)

A82-20137 **The prospects for liquid hydrogen fueled aircraft.** G. D. Brewer (Lockheed-California Co., Burbank, CA). *International Journal of Hydrogen Energy,* vol. 7, no. 1, 1982, p. 21-41. 12 refs.

It is pointed out that an alternative fuel for transport aircraft must be either producible or available anywhere in the world. It is contended that this requirement can be met by liquid hydrogen because it can be produced from water using any locally available energy source. It is not dependent on the availability of fossil resources. With conventional production technologies, LH2 may cost more per unit energy than hydrocarbon alternatives. Because of the weight advantage, however, aircraft using LH2 will be more efficient and their direct operating costs will be competitive. It is shown that, with advanced technologies, LH2 can provide cost and energy advantages. A plan to develop LH2 technology on an international basis is proposed. C.R.

A82-20172 **New life for an 'old' body - Vienna's master plan for revitalization.** R. Schano. *Airport Forum,* vol. 11, June 1981, p. 27, 28, 30, 32.

Details of a new master plan for the Vienna airport are presented, noting the departure from a piece-by-piece add-on system to meet new demands. The plan was developed to anticipate the needs and services for an increase of one million passengers/yr every five years until the year 2000. A decision was reached to expand the existing terminal, making more efficient use of available space. The two legs of the V-shaped runways will be extended and equipped for Cat 3, all-weather conditions, sufficient for the 230,000 projected aircraft movements which prodded the expansion. The phased improvements will be undertaken while the airport continues normal operations, and will at some point involve ferrying passengers to parked aircraft by wide-bodied buses. A doubling of the ramp area is also planned. M.S.K.

A82-20221 **Movement in Category III conditions.** P. J. Hunt (British Airways, Hounslow, Middx., England). *Aircraft Engineering,* vol. 53, Dec. 1981, p. 14-17.

All-weather operations are defined and discussed for the London Heathrow Airport. The decision height and the runway visual range are the critical parameters for choosing the operational conditions and the category. To make a landing with 100 m visibility and a decision height of 10-20 ft, a fully automatic landing system is required and must operate fully linked with an ILS localizer on the ground. Traffic is cleared of the sensitive landing corridor to maintain clean signals to the incoming craft just before touchdown.

The distance at Heathrow is set at 135 m, and it is noted that the procedures reduce the rate of arrivals by only one/hour. A surface radar is employed to maintain surveillance over ground traffic and control the patterns, mainly through a controllable taxiway centerline, stop-bar lights, and a flashing red Category 2/3 holding point marker. M.S.K.

A82-20222 **Ground movement control and guidance - Cat. 3 operations experience in Air Inter.** Mr. Roland-Billecart (Air Inter, Paray-Vieille-Poste, Essonne, France). *Aircraft Engineering,* vol. 53, Dec. 1981, p. 17-19.

A82-20266 **Pressure dependence of jet noise and silencing of blow-offs.** D.-Y. Maa and P.-Z. Li (Chinese Academy of Sciences, Acoustics Institute, Beijing, People's Republic of China). *Noise Control Engineering,* vol. 17, Nov.-Dec. 1981, p. 104-112. 13 refs.

Improvements in methods of jet noise prediction and reduction are discussed. Measurements were performed on a cold-air jet exiting through convergent nozzles of varying diameters, and on superheated jet streams at an oil refinery. A critical value was determined for the stagnation pressure, beyond which the jet becomes choked and shock-cell noise occurs along with turbulent noise. The turbulent noise was isolated by making the lip of the jet irregular, then measuring the A-weighted sound level. Blow-down studies were also made of the shock-cell noise, which was found to happen above the frequency peak of the turbulent noise. The interaction of microjets grouped together is considered, noting that a form of the Coanda effect causes the formation of a single jet. A micropore muffler is presented, which consists of a pipe drilled with many holes, and a diffuse-muffler is mentioned, which contains randomly distributed holes internally to dampen the noise emission. M.S.K.

A82-20276 **Computer graphics for quality assurance.** V. W. Gott (Northrop Corp., Aircraft Div., Hawthorne, CA). *IEEE Computer Graphics and Applications,* vol. 2, Jan. 1982, p. 39-41, 43, 44.

The use of CAD/CAM for quality assurance at Northrop is examined. The use of on-line and library computer graphics systems by the quality assurance personnel enabled the programming of lofting for at-will retrieval. The data is used to inspect master tools check features, castings, forgings, parts with basic moldline features, drawings, and tool design drawings. Lofting requests are made if the files are found to have inadequacies, and quality assurance findings are returned to the requester in hard copy form. Continuous updating of the system is reviewed, and the relevant data for cataloguing and identifying parts and parts surfaces are outlined. A reduction of time spent in inspections of 400% has been achieved with the system. M.S.K.

A82-20277 **Graphics in numerical control - The user's challenge.** J. H. Mabry (Rockwell International Corp., Tulsa, OK). *IEEE Computer Graphics and Applications,* vol. 2, Jan. 1982, p. 45-49.

The use of computer graphics to develop numerical control programs for the aerospace industry, particularly for parts for the Boeing 757, is explored. The user's understanding of the command structure of the graphics system was found to be the critical element in increasing productivity with the CAD/CAM systems. Other productivity gains were obtained by programming commonalities, reviewing the processing requirements to identify the command stream, elimination of operator response where possible, and menu or software revision early in the task. M.S.K.

A82-20278 **The future of integrated CAD/CAM systems - The Boeing perspective.** W. Beeby (Boeing Commercial Airplane Co., Engineering Div., Seattle, WA). *IEEE Computer Graphics and Applications,* vol. 2, Jan. 1982, p. 51, 52, 54-56.

The operations and upgrading of the interactive CAD/CAM system at Boeing for the design and manufacture of aircraft are discussed. The introduction of the system allowed engineering drawings to be used by manufacturing personnel without necessitating face-to-face contact, and the inclusion of lofting diagrams permitted the designers and builders to talk through the system to define changes. An upgrading to three-dimensional representation to enhance the engineering and manufacturing sections of the system is outlined, with stress upon the use of a shared data base. Critical areas of the system are listed as data management, which delineates the product definition data and planning and control data; a geometry engine for manipulating and evaluating the image data; and the communications processing network, which facilitates the rapid transfer of data between any discipline in the plant. M.S.K.

A82-20291 * # **Dilution jet behavior in the turn section of a reverse flow combustor.** S. M. Riddlebaugh (NASA, Lewis Research Center, Cleveland, OH), I. Greber (Case Western Reserve University, Cleveland, OH), and A. Lipshitz. *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0192.* 13 p.

Measurements of the temperature field produced by a single jet and a row of dilution jets issued into a reverse flow combustor are presented. The temperature measurements are presented in the form of consecutive normalized temperature profiles, and jet trajectories. Single jet trajectories were swept toward the inner wall of the turn, whether injection was from the inner or outer wall. This behavior is explained by the radially inward velocity component necessary to support irrotational flow through the turn. Comparison between experimental results and model calculations showed poor agreement due to the model's not including the radial velocity component. A widely spaced row of jets produced trajectories similar to single jets at similar test conditions, but as spacing ratio was reduced, penetration was reduced to the point where the dilution jet flow attached to the wall. (Author)

A82-20293 * # **An experimental study of separated flow on a finite wing.** A. E. Winkelmann (Maryland, University, College Park, MD). *American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Albuquerque, NM, Aug. 19-21, 1981, Paper 81-1882.* 21 p. 9 refs. Grant No. NsG-1570.

The flow field associated with the formation of a mushroom shaped trailing edge stall cell on a low-aspect-ratio (AR = 4.0) wing was investigated in a series of low speed wind tunnel tests (Reynolds number based on 15.2 cm chord = 480,000). Flow field surveys of the separation bubble and wake of a partially stalled and fully stalled wing were completed using a hot-wire probe, a split-film probe, and a directional sensitive pressure probe. A new color video display technique was developed to display the flow field survey data. Photographs were obtained of surface oil flow patterns and smoke flow visualization. (Author)

A82-20294 # **Digital avionics - Advances in maintenance designs.** D. W. Mineck (Rockwell International Corp., Collins Air Transport Div., Cedar Rapids, IA). In: Digital Avionics Systems Conference, 4th, St. Louis, MO, November 17-19, 1981, Collection of Technical Papers. Conference sponsored by the American Institute of Aeronautics and Astronautics and Institute of Electrical and Electronics Engineers. New York, American Institute of Aeronautics and Astronautics, 1981. 11 p. (AIAA 81-2240)

It is shown that the performance benefits of advanced digital avionics systems can only be realized through the refinement of maintenance techniques. Digital technology permits the cost-effective application of line replaceable unit (LRU) level testing, centralized avionics system monitoring, and fault isolation. It is expected that maintenance designs under development will further reduce costs, and ensure that performance benefits are consistently achieved through high availability. Automatic and interactive ground testing can be realized through the application of maintenance oriented ground rules throughout avionics systems' design and development process, including on-aircraft maintenance of in-flight fault storage and in-flight fault consolidation. In this way, carry-on equipment will be virtually eliminated. O.C.

A82-20296 * # **Piloted simulation of an on-board trajectory optimization algorithm.** D. B. Price (NASA, Langley Research Center, Hampton, VA), A. J. Calise, and D. D. Moerder (Drexel University, Philadelphia, PA). *AIChE, ASME, IEEE, and ISA, Joint Automatic Control Conference, University of Virginia, Charlottesville, VA, June 17-19, 1981, Paper.* 28 p.

This paper will describe a real time piloted simulation of algorithms designed for on-board computation of time-optimal intercept trajectories for an F-8 aircraft. The algorithms, which were derived using singular perturbation theory, generate commands that are displayed to the pilot on flight director needles on the 8-ball. By flying the airplane so as to zero the horizontal and vertical needles, the pilot flies an approximation to a time-optimal intercept trajectory. The various display and computation modes that are available will be described and results will be presented illustrating the performance of the algorithms with a pilot in the loop. (Author)

A82-20297 * # **Development of a digital integrated automatic landing system /DIALS/ for steep approach and landing.** N. Halyo (Information and Control Systems, Inc., Hampton, VA) and R. M. Hueschen (NASA, Langley Research Center, Hampton, VA). *AIChE, ASME, IEEE, and ISA, Joint Automatic Control Conference, University of Virginia, Charlottesville, VA, June 17-19, 1981, Paper*, 10 p. 12 refs. Contracts No. NAS1-15116; No. NAS1-12754.

This paper describes the development of a three-dimensional digital integrated automatic landing system (DIALS) for a small commercial jet transport. The system uses the Microwave Landing System (MLS), body-mounted accelerometers, as well as on-board sensors usually available on commercial aircraft, but does not require inertial platforms. The system development uses modern digital control techniques. The phases of flight considered are the localizer and glideslope capture, which may be performed simultaneously or sequentially, localizer and glideslope track (hold), crab/decrab, and flare to touchdown. The system captures, tracks and flares from steep glideslopes (2.5 - 5.5 deg) selected prior to glideslope capture. The results of a nonlinear simulation are presented. (Author)

A82-20298 # **Endwall boundary layer flows and losses in an axial turbine stage.** I. H. Hunter (Shell Research, Ltd., Thornton Research Centre, Chester, Ches., England). *(American Society of Mechanical Engineers, International Gas Turbine Conference and Products Show, Houston, TX, Mar. 9-12, 1981.) ASME, Transactions, Journal of Engineering for Power*, vol. 104, Jan. 1982, p. 184-193. 12 refs. Research supported by the Central Electricity Generating Board.

In order to gain an insight into boundary layer phenomena in axial flow turbines, experimental studies were carried out on a large-scale, low speed, single stage machine. Low and high frequency instrumentation supplemented by flow visualizations were used to determine the details of the flows and losses in the stator and rotor blade rows. Measurements of the turbine stator flows, which were obtained at two different inlet wall boundary layer thicknesses, were generally consistent with typical linear cascade observations. A major difference concerned the presence of appreciable radially directed flow. Hot-wire anemometry measurements at the turbine rotor exit, revealed strong secondary flows at the high turning hub section. The flow pattern was seen to be influenced by the spacing between the two rows of blades and by the rotor's instantaneous position with respect to the periodic flow field arising from the upstream stator row. (Author)

A82-20299 # **Boundary layer transition and separation on a compressor rotor airfoil.** R. P. Dring (United Technologies Research Center, East Hartford, CT). *ASME, Transactions, Journal of Engineering for Power*, vol. 104, Jan. 1982, p. 251-253.

Boundary layer calculations based on potential flow comparisons and comparisons with surface flow visualizations are presented for locating the boundary layer transition and separation. The flow at the midspan of a multistage compressor was studied using Ozalid paper on the blades in an ammonia flow with operational conditions. A turbulent boundary layer calculation showed separation close to the trailing edge, while actual observations showed attachment at the trailing edge. The visualization technique using Ozalid paper on compressor rotors is judged to be effective in studying boundary layer transition where centrifugal and Coriolis forces cause boundary layer skewing, and allows two-dimensional boundary layer analysis for predictions of the locations of transition and separation in the design of compressor airfoils. M.S.K.

A82-20407 **Mapping in tropical forests - A new approach using the laser APR.** H. Arp, J. C. Griesbach (TRANARG CA, Caracas, Venezuela), and J. P. Burns. *Photogrammetric Engineering and Remote Sensing*, vol. 48, Jan. 1982, p. 91-100. 7 refs.

Novel techniques involving the Laser Airborne Profile Recorder (Laser APR) have been developed as a solution to the problem of topographic mapping in dense tropical forests. The narrow laser beam used is able not only to record profiles of the tree canopy, but penetrate through small openings to ground level. Tree heights are then determined by comparing recorded profiles. The system is applied to the mapping of the Rio Caura reservoir site in southern Venezuela, where topographic maps showing 5-10 m contours of the 800 sq km area were completed in five months by means of Laser APR flights at 1.5 km intervals. A special, three-channel Autotape, mounted on a helicopter, was used in photogrammetric control location by trilateration from ground stations to the hovering aircraft. Many Laser APR-derived elevations were identified on the existing, 1:50,000-scale photography used for the mapping. O.C.

A82-20447 * # **Structure and variability of the Alboran Sea frontal system.** R. E. Cheney (NASA, Goddard Space Flight Center, Greenbelt, MD) and R. A. Doblar (U.S. Navy, Naval Ocean Research and Development Activity, Bay St. Louis, MS). *Journal of Geophysical Research*, vol. 87, Jan. 20, 1982, p. 585-594. 8 refs. Navy-sponsored research.

A distinct oceanic front coinciding with the jet of incoming North Atlantic water, and an associated anticyclonic gyre in the western half of the basin, were observed during a ship and aircraft survey of the physical characteristics of the Alboran Sea in the western Mediterranean in October 1977. The front was confined to the upper 200 m and was a continuous feature, extending from the Strait of Gibraltar 500 km eastward to the prime meridian. It is noted that in ten days between two surveys, the center of the gyre shifted 50 km westward. This variability of the anticyclonic gyre may correspond to changes of North Atlantic inflow strength, as inferred by local wind and the average atmospheric pressure over the western Mediterranean. O.C.

A82-20506 **Methods and models for predicting fatigue crack growth under random loading.** Edited by J. B. Chang (Rockwell International Corp., North American Aircraft Div., Los Angeles, CA) and C. M. Hudson (NASA, Langley Research Center, Hampton, VA). Philadelphia, PA, American Society for Testing and Materials (ASTM Special Technical Publication, No. 748), 1981. 145 p. $16.50.

Papers are presented in the volume summarizing the baseline data, methodology, procedures, and results of a round-robin analysis which was conducted to predict the fatigue crack growth in 2219-T851 aluminum center-cracked specimens subjected to flight loading in random cycle-by-cycle format. The objective of the analysis was to assess whether data from constant-amplitude fatigue crack growth tests on center-cracked specimens can be used to predict fatigue crack growth lives under random loading. The following approaches are discussed in detail: a root-mean-square approach, a crack-closure model, a multi-parameter yield zone model, and a load-interaction model. V.L.

A82-20509 * **A crack-closure model for predicting fatigue crack growth under aircraft spectrum loading.** J. C. Newman, Jr. (NASA, Langley Research Center, Hampton, VA). In: Methods and models for predicting fatigue crack growth under random loading. Philadelphia, PA, American Society for Testing and Materials, 1981, p. 53-84. 20 refs.

The present paper is concerned with the development and application of an analytical model of cyclic crack growth that includes the effects of crack closure. The model was based on a concept like the Dugdale model, but was modified to leave plastically deformed material in the wake of the advancing crack tip. The model was used to correlate crack growth rates under constant-amplitude loading and to predict crack growth under aircraft spectrum loading on 2219-T851 aluminum alloy plate material. The predicted crack growth lives agreed well with experimental data. The ratio of predicted-to-experimental lives ranged from 0.66 to 1.48. (Author)

A82-20510 * **Multi-parameter yield zone model for predicting spectrum crack growth.** W. S. Johnson (NASA, Langley Research Center, Hampton, VA). In: Methods and models for predicting fatigue crack growth under random loading. Philadelphia, PA, American Society for Testing and Materials, 1981, p. 85-102. 24 refs.

A phenomenological load interaction model referred to as the Multi-Parameter Yield Zone model is presented which accounts for crack growth retardation caused by previous overloads, acceleration due to current overloads, and underload effects. In the present model, load interaction effects are calculated utilizing a residual stress intensity concept. Crack growth retardation and acceleration are accounted for by decreasing or increasing, respectively, the effective stress ratio used in a modified Forman's (1967) crack growth equation. Results of spectrum crack growth predictions for 2219-T851 aluminum are presented. V.L.

A82-20511 **Crack growth behavior of center-cracked panels under random spectrum loading.** J. L. Rudd and R. M. Engle, Jr. (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH). In: Methods and models for predicting fatigue crack growth under random loading. Philadelphia, PA, American Society for Testing and Materials, 1981, p. 103-114. 8 refs.

A study was carried out to assess the validity of using constant-amplitude fatigue crack growth rate data for center-cracked panels to predict the crack growth behavior of center-cracked panels subjected to random flight-by-flight spectrum loading. Analytical/experimental correlations and an evaluation of the sensitivity of the correlations to the overload shut-off ratio and threshold maximum stress-intensity factor used in the analyses are presented. It is concluded that the crack growth behavior of center-cracked panels subjected to random flight-by-flight loading can be accurately predicted from center-cracked panel constant-amplitude fatigue crack growth rate data. V.L.

A82-20512 **Random spectrum fatigue crack life predictions with or without considering load interactions.** J. B. Chang, M. Szamossi, and K.-W. Liu (Rockwell International Corp., North American Aircraft Div., Los Angeles, CA). In: Methods and models for predicting fatigue crack growth under random loading. Philadelphia, PA, American Society for Testing and Materials, 1981, p. 115-132. 14 refs. Contract No. F33615-77-C-3121.

Constant-amplitude fatigue crack growth rate data for 2219-T851 aluminum center-cracked tension specimens have been used to predict fatigue crack lives under random spectrum loading with and without considering load interaction. When the load interaction effects are not considered, the predictions are shown to be conservative for those spectra consisting of predominant tensile overload cycles, whereas for spectra consisting of predominant tension-compression cycles, unconservative predictions will result. A range-pair counting procedure that properly counts the cycles in a random spectrum improves crack growth predictions. The crack growth analysis methodology and computation procedures are discussed in detail. V.L.

A82-20513 **Energy management and its impact on avionics; Proceedings of the Symposium, London, England, March 19, 1981.** Symposium sponsored by the Royal Aeronautical Society. London, Royal Aeronautical Society, 1981. 77 p.

Topics discussed include design possibilities for improved fuel efficiency of civil transport aircraft, energy management in military combat aircraft, and the control of aircraft gas turbines for fuel economy. Particular attention is given to the impact of increasing cost upon the design of avionic fuel management systems and the operational and performance aspects of fuel management in civil aircraft. Consideration is also given to the FS2 Bedford Civil Flight Research Program as well as current and future developments in thrust management. J.F.

A82-20514 **Design possibilities for improved fuel efficiency of civil transport aircraft.** D. H. Jagger (Airbus Industrie, Blagnac, Haute-Garonne, France). In: Energy management and its impact on avionics; Proceedings of the Symposium, London, England, March 19, 1981. London, Royal Aeronautical Society, 1981. 9 p.

The possible application and potential benefits of various technical advances in aerodynamics, structures, and propulsion for the reduction of fuel usage in future Airbus aircraft are discussed. In particular, technical comparisons and tradeoffs in terms of fuel economy are considered for a hypothetical medium-range project aircraft of the 1980's. Improvements in fuel used per passenger at 1,000 n.m. range over two successive periods of 20 years are estimated. A breakdown of the objectives, time-scales, and costs of of a turbine blade, were preheated and cooled by jets from different impingement tubes at various flow rates and distances. The lumped capacity method was used to determine the cooling rate of the aluminum specimen. The mean heat transfer coefficients were calculated and correlated with dimensionless parameters. The results of the Nusselt numbers obtained from experiments were consistent with those calculated from the recommended formula. Furthermore, these results were compared with the correlations of Metzger and those of Ravuni and Tabakoff, and it was concluded that the formula proposed by this paper was more reasonable. (Author)

A82-20515 **Energy management in military combat aircraft.** J. W. Lyons (British Aerospace Public, Ltd., Co., Aircraft Group, Brough, Humberside, England). In: Energy management and its impact on avionics; Proceedings of the Symposium, London, England, March 19, 1981. London, Royal Aeronautical Society, 1981. 6 p. 5 refs.

Energy management is important not only for fuel economy, but for efficient three-dimensional maneuvering capabilities as well. The principles of several new techniques for energy efficient three-dimensional maneuvers in combat aircraft are discussed. Efficient turbofan engines have been adopted which are electronically controlled for achieving precise thrust settings within engine limits. Engine bleed can be better controlled, and hydraulic pressure control, resulting in reduced mechanical offtakes from the engine, is now possible using microprocessors. Self-healing systems can be used in the battlefield scenario, and advanced display concepts are being employed to make better use of available maneuver energy. These techniques individually result in greater efficiency, but together they provide significant synergistic improvements. J.F.

A82-20516 **The control of aircraft gas turbines for fuel economy.** D. J. Lee (Rolls-Royce, Ltd., Bristol, England). In: Energy management and its impact on avionics; Proceedings of the Symposium, London, England, March 19, 1981. London, Royal Aeronautical Society, 1981. 7 p.

Electronic controls are important to the fuel efficient aircraft of the future as sophisticated fly by wire controls, flight management systems, and complex ATC navigation systems. The functions obtainable using electronic controls are often more complex and more flexible than those produced with hydromechanical systems. They provide greater accuracy in staying within temperature and stress limitations, as well as increased fuel economy. Electronic engine control is also very cost effective over the life of the unit and has the benefit of reducing the pilot workload. Microprocessors have made the use of digital technology for engine control more popular; the benefits of digital control may be seen in terms of improved accuracy, fault diagnostics and tolerance, fuel-type variations, system complexity, and airframe integration. Finally, engine health monitoring systems are used for the programmed maintenance of mechanical parts of gas turbines. J.F.

A82-20517 **The impact of increasing energy costs upon the design philosophy of avionic fuel management systems.** P. R. Thrift (Smiths Industries Aerospace and Defence Systems Co., London, England). In: Energy management and its impact on avionics; Proceedings of the Symposium, London, England, March 19, 1981. London, Royal Aeronautical Society, 1981. 9 p.

Parameters of fuel quantity remaining and rate-of-usage are determinate factors in the operational range of any aircraft. Methods for designing engines with lower fuel consumption, and airframes with lower drag coefficients to minimize the mass of fuel to be carried are being investigated. Operating costs may be reduced by using unused portions of fuel as dynamic balast to control the center of gravity throughout a flight profile. Fuel consumption can also be reduced by control of the aircraft's complete flight envelope. Strategies for measuring fuel mass and determining fuel density are discussed. Means of improving the twin concentric circular cross section transducers are discussed, and the production of a fault tolerant system by the incorporation of two computer systems is described. Finally, the use of microprocessors to control the center of gravity and to detect fuel leaks is discussed. J.F.

A82-20518 **Operational and performance aspects of fuel management in civil aircraft.** H. P. K. Dibley (British Airways, Hounslow, Middx., England). In: Energy management and its impact on avionics; Proceedings of the Symposium, London, England, March 19, 1981. London, Royal Aeronautical Society, 1981. 13 p.

In order to carry maximum payload at minimum cost, an airline must find means of optimizing fuel purchasing, pre-flight planning, and in-flight procedures. Accurate forecasting and monitoring of fuel costs is needed to obtain adequate fuel supplies at the best price, to maximize uplift at cheap stations, and to show the effect of outages of uplift stations. Pre-flight planning is used to determine the route for minimum fuel consumption and to calculate the maximum take-off weight. Minimization of fuel consumption during flight can be achieved by (1) presentation of optimum climb, cruise and descent information; (2) flight management systems coupled to the autopilot; (3) optimizing the use of engine climb derate; (4) improving navigational accuracy; (5) presentation of more navigation parameters to the pilot; (6) vertical navigation; and (7) minimizing noise and fuel consumption on approach. J.F.

A82-20519 **The FS2 RAE Bedford civil flight research programme.** R. W. Jones and R. C. Rawlings (Royal Aircraft Establishment, Bedford, England). In: Energy management and its impact on avionics; Proceedings of the Symposium, London, England, March 19, 1981. London, Royal Aeronautical Society, 1981. 11 p. 12 refs.

The RAE/FS2 Bedford Civil Avionics Flight Research Program is aimed at studying the individual component systems for flight control, navigation, display, and flight management and at integrating these systems for optimum air traffic control (ATC). Modern equipment can provide accurate automatic navigation in four dimensions, and electronic displays can improve methods of displaying information to the flight crew as well as improve interaction between pilot/ATC and automatic navigation systems. Radar monitoring will be needed to ensure the meeting of safety standards, and monopulse SSR will provide an improved method of tracking and identifying aircraft. More use will be made of high level stacking to provide the airspace necessary to handle more aircraft and to reduce fuel wastage. The ADSEL/DABS system reduces garbling and provides a suitable data link to pass ATC requirements and wind data to the aircraft as well as aircraft derived parameters to the ATC. J.F.

A82-20520 **Thrust management - Current achievements and future developments.** J. L. Weston (Smiths Industries Aerospace and Defence Systems Co., Cheltenham, Glos., England). In: Energy management and its impact on avionics; Proceedings of the Symposium, London, England, March 19, 1981. London, Royal Aeronautical Society, 1981. 12 p.

A system architecture has been developed to provide a fuel efficient full-flight regime auto-throttle system and a second generation flight management computer system. The auto-throttle system is capable of controlling the engine throttle levers from before take-off until touchdown as well as providing command signals to the aircraft flight director system. The operation modes of the system include take-off, climb, cruise, descent, maximum continuous thrust, hold, approach and go-around. The flight management computer system is responsible for the overall operation of the aircraft between the take-off location and the destination point. Its eight major functions are (1) flight planning; (2) navigation; (3) control of VOR/DME receivers; (4) lateral guidance; (5) vertical path optimization; (6) vertical guidance; (7) look ahead information; and (8) provision of information to support the electronic flight instrument system. J.F.

A82-20521 **Pactec V - Plastics technology advances/1980 update; Proceedings of the Fifth Annual Pacific Technical Conference, Los Angeles, CA, February 26-28, 1980. Volume 3.** Conference sponsored by the Society of Plastics Engineers. Greenwich, CT, Society of Plastics Engineers, Inc.; El Segundo, CA, Technology Conferences, 1981. 257 p. $17.50.

The latest contributions to the scientific and engineering knowledge of plastics are discussed under the headings of reinforced plastics and composites, structural foams, and plastics in building. Papers presented include: conductive prepregs for lightning strike protection of aircraft, fatigue behavior of selected nonwoven fiber composites for helicopter rotor blades, conductive plastics for EMI shielding, recent advances in plastic concrete, and thermoplastics in solar energy. V.L.

A82-20523 **Conductive prepregs for lightning strike protection on aircraft.** G. L. Patz (Hexcel Corp., Dublin, CA). In: Pactec V - Plastics technology advances/1980 update; Proceedings of the Fifth Annual Pacific Technical Conference, Los Angeles, CA, February 26-28, 1980. Volume 3. Greenwich, CT, Society of Plastics Engineers, Inc.; El Segundo, CA, Technology Conferences, 1981, p. 15-22.

A prepreg system has been developed which is capable of dissipating a full 200,000 amp lightning strike. The prepreg system is based on an E-glass fiber which has a continuous uniform coating of pure aluminum chemically bonded to the glass filament. Simulated lightning tests of a series of aircraft-skin-type sandwich panels on which the new prepreg was used as a surface ply over graphite, Kevlar, and glass prepreg systems have shown that the tested material is capable of conducting lightning currents without undue structural damage. Preliminary testing has also shown that there is no appreciable galvanic cell interaction between the outer ply and the graphite substructure. V.L.

A82-20524 **Fatigue behavior of selected non-woven fiber composites for helicopter rotor blades.** J. W. Davis and G. J. Sundsrud (3M Co., Structural Products Dept., St. Paul, MN). In: Pactec V - Plastics technology advances/1980 update; Proceedings of the Fifth Annual Pacific Technical Conference, Los Angeles, CA, February 26-28, 1980. Volume 3. Greenwich, CT, Society of Plastics Engineers, Inc.; El Segundo, CA, Technology Conferences, 1981, p. 23-38.

A number of variables characterizing nonwoven glass-reinforced composites used for propeller and rotor blade structures have been studied in order to determine which of the many raw material variables could contribute to improving the fatigue properties of the composite. The properties investigated included variations in resin, glass type, glass supplier, glass finish, glass monofilament diameter, and fiber bundle size. Both unidirectional and 45-degree orientations were used in tensile fatigue tests. The study has produced a series of thirty-one alternating stress vs cycle to failure curves for the raw material variables investigated. V.L.

A82-20526 **Experience and needs of civil and military flight simulator users; Proceedings of the Flight Simulation Symposium, London, England, April 7, 8, 1981.** Symposium sponsored by the Royal Aeronautical Society. London, Royal Aeronautical Society, 1981. 116 p.

The state-of-the-art in flight simulator trainers is examined, with consideration given to both commercial and military uses of simulators. Training with simulators by the RAF, the French Air Force, and the USAF is explored, and attention is paid to commercial pilot training for airlines and in general aviation aircraft. Specific mention is made of simulators for crew member training for the Nimrod helicopter and for the B-52 bomber. The employment of simulators by aircraft manufacturers is discussed, including the automation of in-flight simulation of data handling and validation testing of the simulator programs. The effects of simulators on advanced aircraft technology is explored, as are advances in simulation, in visual representation technology, and the direction of civil simulation, particularly for the case of satisfying FAA Phase III requirements. M.S.K.

A82-20527 **The simulator and the airline pilot.** G. T. Lavery (British Air Line Pilots Association, Hayes, Middx., England). In: Experience and needs of civil and military flight simulator users; Proceedings of the Flight Simulation Symposium, London, England, April 7, 8, 1981. London, Royal Aeronautical Society, 1981. 6 p.

The purposes, a summary, and future goals of pilot simulator training techniques are reviewed. Simulators eliminate the expense of flying an actual aircraft for many hazardous operating experiences, can be used regardless of weather conditions, allows repetitive exposure to abnormal situations, and allows the instructor to be close-at-hand. Simulators are noted to often lack fidelity in terms of power applications and yaw, magnitude of response to configuration changes and drag changes, instrument reproduction, visual system response, and accurate aircraft cabin noises. Persisting problems are stressed as down-time for the simulators, lack of use of simulators for practice instead of as a testing tool only, and lack of authentic parts in the cockpit. Future necessities for actual zero-flight time training are outlined, and methods for training for flying different types of aircraft to maximize shifts of trained abilities are suggested. M.S.K.

A82-20528 **The use of flight simulators in l'Armée de l'Air.** F. Lemarchal (Ministère de la Défense, Etat-Major de l'Armée de l'Air, Paris, France). In: Experience and needs of civil and military flight simulator users; Proceedings of the Flight Simulation Symposium, London, England, April 7, 8, 1981.
London, Royal Aeronautical Society, 1981. 3 p.

Various aspects of the use of flight simulators by the French air force are examined, noting a decrease in fuel expenditures by use of the trainers. Proficient control of the aircraft is considered essential to making maximum use of other sophisticated instrumentation such as advanced radars and missile store indicators. Flying time is eliminated during take-off and runway circuit training, and human factor accident rates are decreased by exposing the pilots to critical situations, as well as recovery procedures, before actual flying begins. The deployment of simulators among service divisions is outlined, and current programs in operation are described. Finally, the French air force combat simulator is discussed, including its advantages for repetitive exposure, adjustments in the flight envelope to fit the students' abilities, and comprehensive instrumentation replication. M.S.K.

A82-20530 **The aircraft manufacturer's needs as a simulator user.** J. W. Martz (Boeing Commercial Airplane Co., Renton, WA). In: Experience and needs of civil and military flight simulator users; Proceedings of the Flight Simulation Symposium, London, England, April 7, 8, 1981. London, Royal Aeronautical Society, 1981. 6 p.

The use of flight simulators by the aerospace industry is examined. Aircraft manufacturers use engineering and flight training simulators, and also test facilities and equipment rigs for each developmental phase of a craft. The test facilities include wind tunnels, a system integration test facility, cabin air supply mock-up, engineering mock-ups, etc. Actual flight simulators are divided into one unit for acquainting the pilot with primary instrumentation and the electro-hydraulic force feel, another with the electro-hydraulic system and a three degrees-of-freedom motion base, and other units for differing numbers of crew members, all equipped with digital avionics and systems integration. Boeing is noted to be preparing simulators with six degrees of freedom for simulation of flight conditions on the 727, 737, 757, and 767 aircraft, with training curricula available for pilots having anywhere from 300 to 20,000 hr of experience. M.S.K.

A82-20531 **ASW and weapon system simulation with reference to the Nimrod MR Mk2 maritime crew trainer.** K. Wells (Marconi Space and Defense Systems, Ltd., Stanmore, Middx., England). In: Experience and needs of civil and military flight simulator users; Proceedings of the Flight Simulation Symposium, London, England, April 7, 8, 1981. London, Royal Aeronautical Society, 1981. 5 p.

The features and operational characteristics of the Mk 1 and Mk 2 training simulators for the Nimrod helicopter crew members are described. The Maritime Crew Trainer (MCT) for the Mk 1 system fully simulates sonar, ESM, radar, MAD, communications, routine and tactical navigation, and weapons management. Crew members are supplied with alphanumeric displays and a keyboard, and the instructor can direct a full range of targets, operational conditions, and instrument faults. Improvements to the Mk 2 facility include digital provisions for ASW operations, navigational interlinks with the sonar and radar system, and weapons systems management. Further additions in sonar and radar target, environmental, sonobuoy, and receiver-transmitter simulation are outlined, and a recommendation is given that simulators be designed with same requirements as the aircraft they simulate. M.S.K.

A82-20532 **Automation in flight simulation of data handling and validation testing.** J. Shlien (CAE Electronics, Ltd., Montreal, Canada). In: Experience and needs of civil and military flight simulator users; Proceedings of the Flight Simulation Symposium, London, England, April 7, 8, 1981.
London, Royal Aeronautical Society, 1981. 11 p.

The use of automated simulation devices to effect heightened fidelity in the transfer of actual operational aircraft parameters to training simulators is discussed. The automated hardware use digital processing, allowing consideration of large volume data points of lateral to longitudinal cross-coupling, complicated surface interference effects, ground effects, engine interference effects, and downwash effects. System inputs comprise a library listing of all breakpoints to be used, correlation of function to corresponding function, and the manufacturers' data points. There is no loss of data resolution, updates can be rapidly incorporated, and a direct traceability exists between the manufacturer's data and the simulator's files. FORTRAN is noted as the accepted software checking language, and the use of automated simulator six degree-of-freedom hardware is stressed as having released the instructor from having to verify the simulator program and allowed concentration on presenting actual critical flying conditions to the trainee. M.S.K.

A82-20533 **The effects on simulators of advances in aircraft technology.** J. Baradat (Thomson - CSF, Division Simulateurs, Trappes, Yvelines, France). In: Experience and needs of civil and military flight simulator users; Proceedings of the Flight Simulation Symposium, London, England, April 7, 8, 1981.
London, Royal Aeronautical Society, 1981. 5 p.

Advances in flight technology which impinge on the design of flight simulators are discussed. The increase in control surfaces, automated flying modes, and digital avionics displays have increased the magnitude and complexity of the software data necessary for high-fidelity simulation. The characteristics of the transfer circuits are adapted to the aircraft equipment input-output characteristics, and simulators are required to provide freeze-frame capability, repetition of important flight phases, and time acceleration or jumps. The use of either common bus or arborescent architecture for the data processing is outlined, and attention is given to software updates, particularly for the autopilot, and the choice of software, specifically when a necessity arises for a manufacturer to yield aircraft software to the simulator manufacturer. M.S.K.

A82-20535 **Advanced simulation.** C. H. Huettner (FAA, Office of Flight Operations, Washington, DC). In: Experience and needs of civil and military flight simulator users; Proceedings of the Flight Simulation Symposium, London, England, April 7, 8, 1981.
London, Royal Aeronautical Society, 1981. 6 p.

The Advanced Simulation Rule, the guidance implementing the Rule, the FAA National Simulator Evaluation Team, the status of other simulator evaluation activities, and future FAA simulator activities are discussed. The Phase II certification occurred in January 1981, and signalled the incorporation of realistic three-dimensional windshear dynamics, stopping and directional control forces for various runway conditions, braking dynamics, six degrees-of-freedom simulation, operational navigation, and aircraft cabin noise fidelity into pilot training simulators. Further cloud and lighting advances are described, and Phase III requirements are mentioned as including varying light and visual representations, weather anomalies, realistic colors, and weather radar. FAA circular 121-14C is outlined, the manner of using Phase I equipment to gain Phase II certification, and the functions of the nine FAA simulator evaluations specialists are examined. M.S.K.

A82-20536 **A European airline's future simulator requirements.** J. Meier (Swissair AG, Zurich, Switzerland). In: Experience and needs of civil and military flight simulator users; Proceedings of the Flight Simulation Symposium, London, England, April 7, 8, 1981. London, Royal Aeronautical Society, 1981. 13 p.

The features and operations of the Swissair DC-9-81 simulator are reviewed, and the Phase I, II, and III FAA requirements for simulators are discussed. The simulator software has been upgraded in the DC-9-81 to include ground reactions and handling, brake and antiskid modeling, ground proximity, atmospheric simulation, FORTRAN programming, and an improved motion program. Control feel and force have also been added to express the mass of control components, the dead band, breakout forces, autopilot forces, trim, aerodynamic forces and surface blow back, and 200 types of malfunction. Simulator hardware changes to upgrade the computer, the motion simulation, control loading, sound, and visual fidelity are examined. Finally, actual implementation of the Phase II regulations are discussed, noting that the goal is to make the training simulation experience more thorough than will actually be encountered in flight. M.S.K.

A82-20537 **An independent view of where civil simulation should be headed.** J. A. Carrodus (Cathay Pacific Airways, Ltd., Hong Kong). In: Experience and needs of civil and military flight simulator users; Proceedings of the Flight Simulation Symposium, London, England, April 7, 8, 1981. London, Royal Aeronautical Society, 1981. 5 p.

Deficiencies in the optimal use of simulators are discussed and suggestions for improvements in the use of simulators are offered. The inadequacies in validation documents for testing the fidelity of one variable factor against another in a dynamic program are examined, and a remedy is found in obtaining validation data from the aircraft manufacturer. Recommendations are also offered that simulator construction be given the same lead time as the aircraft they simulate, while manufacturers should also supply qualified pilots who can validate the simulator programs for conditions outside of the normal flight envelope. Error checking is emphasized, as are buffet and motion realism, sound reproduction fidelity, meeting development schedules, and provisions for automatic testing. Finally, maintenance in simulators is reviewed, along with government oversight agencies to uphold the integrity of simulator training. M.S.K.

A82-20540 **Helicopter transmissions; Proceedings of the Symposium, London, England, February 6, 1980.** Symposium sponsored by the Royal Aeronautical Society. London, Royal Aeronautical Society, 1980. 99 p.

Topics discussed include the airworthiness of helicopter transmissions, the application of condition monitoring, and the minimum-cost performance monitoring of turboshaft engines. Consideration is also given to single-shot diagnostics, helicopter transmission philosophy, and on-site vibration measurement, dynamic tracking and balancing. J.F.

A82-20541 # **Airworthiness of helicopter transmissions.** P. D. Vinall (Civil Aviation Authority, London, England). In: Helicopter transmissions; Proceedings of the Symposium, London, England, February 6, 1980. London, Royal Aeronautical Society, 1980. 30 p.

The fatal accident rates caused by the rotor and transmission systems of rotorcraft are almost an order of magnitude worse than those of fixed-wing aircraft. This is in part due to the single load path characteristics of the vehicle. Redundancy in the transmission system would mean, however, a change in the current design practice and the possible disadvantages of increased weight and complexity. The standards achieved on rotorcraft transmissions bear comparison with experience on similar dynamic components in turboprop engines. Safety considerations are of greater significance in a helicopter, however, and these aircraft should have higher standards for airworthiness. It is suggested that there be manufacturing control of critical parts for rotorcraft, and that transmissions not be used as a source of power for accessory functions which might reduce the integrity and reliability of the transmissions. Better diagnostic aids should also be established, including an in-flight indicator of transmission condition and a periodic vibrographic oil and sonic analysis. J.B.

A82-20542 # **The application of condition monitoring.** A. T. Dalton (Civil Aviation Authority, London, England). In: Helicopter transmissions; Proceedings of the Symposium, London, England, February 6, 1980. London, Royal Aeronautical Society, 1980. 14 p.

The development in the application and management of in-service maintenance of commercial helicopters has lagged the advancements in design and operation. The Primary Maintenance Process is discussed in detail, emphasizing its three primary maintenance processes: (1) hard time maintenance for known deterioration; (2) on-condition inspection at regular intervals; and (3) condition monitoring, which relies on in-service information analysis. The primary processes (1 and 2) are applied in detail to each item of a helicopter, after which condition monitoring (3) is used as a secondary surveillance activity for engineering management. It is maintained that formalized application of condition monitoring to safely develop maintenance tasks will reduce costs and promote deregulation by delegation of certain activities to the helicopter operator under controlled program conditions. J.F.

A82-20543 # **Quick learning diagnostics.** R. M. Stewart (Southampton, University, Southampton, England). In: Helicopter transmissions; Proceedings of the Symposium, London, England, February 6, 1980. London, Royal Aeronautical Society, 1980. 14 p.

Single-shot diagnostics implies the ability to judge the state or condition of a component on the basis of one measurement and without reliance on past history. Vibration patterns that signal the existence of a fault and the nondimensional numbers to encode them are found; use of both patterns and numbers reduces the data storage requirement, since the diagnosis is independent of past history, machine speed/load and monitoring position. Noise reduction and multiple techniques are developed to permit inspection of more complex machines. Single-shot diagnostics was used to monitor the vibrations of a gear box and a rolling contact bearing. In the former, the pattern recognition procedure resulted in the production of a true nondimensional number; in the latter, mere detection of the pattern was considered sufficient. Both cases required a great deal of computation, first during the primary phase of signal averaging or power spectrum analysis, and then in the secondary phase of reducing the complicated primary signature to a simple statement: acceptable or unacceptable. J.F.

A82-20544 # **Minimum cost performance monitoring of turboshaft engines.** H. I. H. Saravanamuttoo (Carleton University, Ottawa, Canada). In: Helicopter transmissions; Proceedings of the Symposium, London, England, February 6, 1980. London, Royal Aeronautical Society, 1980. 13 p.

A low-cost Engine Health Monitoring system for turboshaft engines is presented, which is suitable for use by small operators who do not have access to computing facilities. Two approaches are discussed, Gas Path Analysis (GPA) and Trend Analysis, according to which measurements are made of the power fuel flow, inlet conditions, pressure levels, and temperatures. GPA is shown to be the more powerful method, but requires extra instrumentation. Fuel flow errors can be detected either by a large increase in airflow or an increase in turbine efficiency. Fuel flow proved to be the most critical measurement (a 1% error gave a 1.4% error in airflow, whereas a 1% error in power only gave a 0.4% error in airflow). This lower sensitivity to power errors results since GPA deduces the airflow from the gross power developed by both turbines, and power absorbed by the compressor is usually greater than that absorbed by the rotor. Trend Analysis, on the other hand, requires no extra instrumentation, but when applied with good judgement, can indicate troubles before they become critical. J.F.

A82-20545 # **On-site vibration measurement, dynamic tracking and balancing.** N. E. Trigg (Helitune, Ltd., Fleet, Hants., England). In: Helicopter transmissions; Proceedings of the Symposium, London, England, February 6, 1980. London, Royal Aeronautical Society, 1980. 10 p.

Undetected vibration can severely damage expensive and often unobtainable major components, resulting in lengthy, costly, and untimely overhauls. Old and new methods of vibration analysis and tracking are compared, and the various techniques and equipment used by these methods are discussed: flag tracking, hand-held vibrograph, the Scientific Atlanta Vibration Signature Analyzer. The latter instrument provides a hard copy of vibration signatures recorded in the vertical, lateral, and fore and aft planes; by relating the peaks of the signatures to a vibration order sheet, the sources of vibration can be found and sharply reduced. Out-of-track and out-of-balance conditions in the main and tail rotors can be pin-pointed with accuracy and eliminated. The future will involve microprocessors to interpret the data more rapidly and give instructions for speedy tuning. J.F.

A82-20546 # **Helicopter transmission philosophy - The way ahead.** B. A. Shotter (Westland Helicopters, Ltd., Yeovil, Somerset, England). In: Helicopter transmissions; Proceedings of the Symposium, London, England, February 6, 1980.
London, Royal Aeronautical Society, 1980. 10 p.

Factors influencing the design of a helicopter transmission system are discussed. The power and speed of the slowest output are of primary importance since these define the maximum torques where the highest weights are likely to be found. The physical arrangement of the aircraft usually demands that the engine axis be near-horizontal, while the main rotor axis be near-vertical; one stage of gearing will therefore be concerned with changing the rotation axis. The physical form of the system is also influenced by the rotor control principles and the nature of the forces emanating from the rotor. The system should also have a light weight, high reliability, a minimum amount of maintenance, and a long life. Improvements in materials can contribute to a consistent performance, and a simple system, based on a large number of units of the same design, will make the unit more problem-free. J.F.

A82-20551 **Airships and their maritime applications; Proceedings of the Symposium, London, England, March 10, 1981.** Symposium sponsored by the Royal Aeronautical Society, Royal Institution of Naval Architects, and Airship Association. London, Royal Aeronautical Society, 1981. 114 p.

After giving an historical account of the development of rigid and non-rigid airship design, the conference covers the application of airships to offshore military and economic activities such as those defined by the Third U.N. Conference on the Law of the Sea, the incorporation of modern technologies into maritime patrol airships, comparisons of airships and conventional aircraft in maritime roles off the Japanese Archipelago, and possibile military roles for airships of various designs in the Royal Navy. Consideration is also given the airworthiness of airships under severe flight conditions, the design of a surveillance airship for duty in the area of New Zealand, and the design characteristics and operational capabilities of the Skyship 500 airship. O.C.

A82-20552 **An introduction to the airship.** E. Mowforth (Airfloat Transport, Ltd., Guildford, Surrey, England). In: Airships and their maritime applications; Proceedings of the Symposium, London, England, March 10, 1981. London, Royal Aeronautical Society, 1981. 8 p.

This paper seeks to indicate some of the principal design parameters and operational characteristics of the airship, making particular reference to those features relevant to maritime applications. The greater part of the presentation is devoted to the traditional airship geometry, typified historically by for example the Goodyear 'blimps' and the Hindenburg'; structural categories for this form will first be described, leading to a survey of selected operational aspects, a brief historical account of the use of airships in a maritime context, and some comments on the performance to be expected from the conventional configuration. The paper will then conclude with a short look at some of the modern proposals deviating from the traditional concept, particularly at 'hybrid' designs. (Author)

A82-20553 **Offshore uses of the airship.** M. B. F. Ranken (Aquamarine International /Fisheries and Ocean Development/, Ltd., London, England). In: Airships and their maritime applications; Proceedings of the Symposium, London, England, March 10, 1981. London, Royal Aeronautical Society, 1981. 12 p. 42 refs.

An assessment is made of the application of airships to the maritime surveillance tasks made neccessary by the definition of exclusive economic zones (EEZs) for coastal states by the Third U.N. Conference on the Law of the Sea. It is suggested that the fuel economy, long mission durations, and large horizon for radar use make airships attractive tools in the implementation of surveillance within the EEZs. Attention is given the construction, operation and crew training cost advantages of airships, the ease with which avionics and specialized electronic surveillance equipment can be accomodated in an airship gondola, and the all-weather operational capabilities of modern airships. O.C.

A82-20554 **Studies of modern technology airships for maritime patrol applications.** D. B. Bailey (U.S. Naval Material Command, Naval Air Development Center, Warminster, PA), K. E. Williams, and L. J. Nivert (U.S. Coast Guard, Washington, DC). In: Airships and their maritime applications; Proceedings of the Symposium, London, England, March 10, 1981. London, Royal Aeronautical Society, 1981. 12 p. 24 refs.

The energy efficiency of airships has prompted the reexamination of their capabilities in maritime patrol roles, in light of competition from hydrofoil, surface effect, and small waterplane area ship designs. Based on the past performance of airships and the incorporation of modern technology for propulsion, structures, materials and flight controls, it is assumed that the new airships would be capable of hover, VTOL operation, a 90-knot maximum speed, sensor and vessel towing, and all-weather flight. The lifting gas considered is 95% pure helium. Studies concerning vehicle sizing, estimated life cycle costs, and vehicle case studies are invoked by conclusions which recommend that (1) airship flight demonstrations be conducted for technical and operational validation, and (2) that analyses be conducted of such operational and logistic factors as crew training, maintenance, basing and utilization. O.C.

A82-20555 **The airship - Its application and promotional activity.** K. Iinuma (Japan Buoyant Flight Association, Japan). In: Airships and their maritime applications; Proceedings of the Symposium, London, England, March 10, 1981. London, Royal Aeronautical Society, 1981. 7 p.

The opportunities for airship operation in the Japanese Archipelago are assessed, with a view toward more economical fulfilment of territorial waters control and maritime surveillance requirements than present YS-11 and 737 conventional aircraft. Attention is given the use of airships in traffic between the main islands and small outlying islands. The airship design assumed in all comparisons and estimates is a four-rotor, helistat-type craft incorporating a buoyant hull with vectorable, helicopter-like propellers. O.C.

A82-20556 **The uses of airships in the Royal Navy.** B. Shaw (Ministry of Defence /Navy/, London, England). In: Airships and their maritime applications; Proceedings of the Symposium, London, England, March 10, 1981. London, Royal Aeronautical Society, 1981. 6 p. 7 refs.

An assessment is given of the operational capabilities offered by airships incorporating new materials and novel design concepts, in the context of the NATO roles to which the British Navy is commited in the North Atlantic. In addition to considering ASW, mine warfare, flying command communications center and RPV-carrying functions, attention is given to the structural design of an airship whose service altitude would be 15,000 ft. The structural configuration consists of a carbon fiber-reinforced plastic central beam, which would support the hull envelope by means of circular frames attached to the beam by radial wires. Design suggestions are also made for a low-level airship with four vectorable rotors. Emphasis is placed on the advantages of airships in the airborne early warning role and in the role of logistics support for ships at sea. O.C.

A82-20557 **Airworthiness of airships.** E. J. Niedermayer (Civil Aviation Authority, London, England). In: Airships and their maritime applications; Proceedings of the Symposium, London, England, March 10, 1981. London, Royal Aeronautical Society, 1981. 6 p.

Criteria under consideration by the British Civil Aviation Authority with a view of establishing airship airworthiness and safety requirements for certification of future commercial designs are presented. Emphasis is put on the airship hull's ability to withstand storm-strength gust conditions, and of the control surfaces' ability to establish sufficient stability under those conditions. It is noted that the velocities of up- and down-drafts in the center of a severe thunderstorm may reach 3000 ft/min at the 3000 ft altitudes at which airships traditionally cruise. Attention is also given to the free-balloon condition that results from total engine failure, and to the establishment of operational limitations concerning maximum rates of climb and descent, minimum turn radii, and minimum cleareance space for take-off and landing. O.C.

A82-20558 **A surveillance airship for the New Zealand environment.** P. W. C. Monk (Airship Industries, Ltd., Isle of Man, England). In: Airships and their maritime applications; Proceedings of the Symposium, London, England, March 10, 1981. London, Royal Aeronautical Society, 1981. 31 p.

A description is presented of a small, non-rigid airship, which may be fueled by a combination of natural gas and liquid petroleum gas, intended to meet the territorial waters patrol requirements that have arisen through the imposition of a 200-mile economic zone around the islands of New Zealand. The non-metallic airship hull is suited for the installation of a 12-ft wide radar antenna, which will at an altitude of 4000 ft detect 11,000 sq ft targets at 100 n.mi. Attention is given to the structural design of the Kevlar-cloth hull, and to the management of thrust between a reciprocating powerplant for stationkeeping and two turboprop engines for 90-knot dash speeds. Performance projections are given for (1) combined weight of power units and fuel vs. range, (2) search capability vs. target area, (3) time on station at 40 knots and 4000 ft, (4) static stability, (5) speed as a percentage of engine power, and (6) lift derived from the hull at varying angles of attack and from the vectoring of the turboprop engines. O.C.

A82-20559 **Skyship 500 - The development of a modern production airship.** R. Munk (Airship Industries, Ltd., London, England). In: Airships and their maritime applications; Proceedings of the Symposium, London, England, March 10, 1981. London, Royal Aeronautical Society, 1981. 11 p.

A description is presented of the structure, systems, performance capabilities and possible missions of the Skyship 500 and 600 non-rigid airships. Hull envelope construction is unusual in that it combines a single-ply fabric with the use of longitudinal fabric panels in which the warp of the fabric also runs longitudinally rather than transversely, as has been the case traditionally. Collapsible ballonets are used fore and aft, and helium is employed as the lift gas. The gondola is constructed from Kevlar-reinforced epoxy, and incorporates vectorable ducted propellers driven by reciprocating engines on each side. A production-costs breakdown is given for all structural components and systems, and disposable-load figures under two assumed lift volumes are provided. The suitability of the craft is considered for maritime surveillance, ASW and mine sweeping roles. O.C.

A82-20560 **Design for military aircraft operability; Proceedings of the Symposium, London, England, February 7, 1980.** Symposium sponsored by the Royal Aeronautical Society. London, Royal Aeronautical Society, 1981. 58 p.

Topics related to the design, maintenance, operability, and reliability of combat aircraft for the RAF are discussed. Specific attention is paid to front-line maintenance requirements, including the reduction of the numbers of necessary on-hand parts and the turnaround time. Management methods for reliability and maintenance are reviewed, as are particular aircraft design features which enhance operability, such as in the avionics systems. The interface between the procurement agencies, the manufacturers, the design teams, and the end users is explored, noting the effectiveness of contracts with specified reliability and MTBF requirements, and the techniques of producing combat-ready aircraft during peacetime conditions are outlined. M.S.K.

A82-20561 **Design for operability of military aircraft RAF engineering experience and requirements. I - Thoughts of a squadron engineer.** B. Robson (RAF, London, England). In: Design for military aircraft operability; Proceedings of the Symposium, London, England, February 7, 1980. London, Royal Aeronautical Society, 1981. 5 p.

Factors which contribute to aircraft reliability are examined, with emphasis on first-line maintenance requirements. Mobility requirements are met by reducing the total amount of equipment that must be brought to the point of use, while on-board electronic systems checks, redundancy, and the ease of repairability are essential to reducing the amount of spares necessary on-hand. Reliability can be considered in terms of ease of repair external to combat damage, and resistance to foreign object damage, in addition to fault diagnosis procedures to save time in identifying defective components. Maintainability is discussed in terms of cost, manpower, time and equipment, and impinges on the efficiency of turnaround time. It is noted that the standardization of parts and tools have significantly aided the reduction of repair time for various aircraft. M.S.K.

A82-20562 # **Aircraft operability - RAF engineering experience and requirements. II.** D. Williams (RAF, London, England). In: Design for military aircraft operability; Proceedings of the Symposium, London, England, February 7, 1980. London, Royal Aeronautical Society, 1981. 6 p.

The procurement cycle, engineering information, and day-to-day nominal operational procedures of combat aircraft maintenance are reviewed to form a basis for requirements for reliability and maintenance. The procurement cycle is outlined, with emphasis on development costs and production costs and timescales. Engineering data are gathered to predict the expected extent and time of repair of nominal breakdowns and operational damage. Specifications for MTBF are promulgated, and plans are defined for ground service testing, built-in test equipment, automatic test equipment, and all factors which consume time before readiness. All necessary components, times, and teams necessary to fulfill maintenance requirements are detailed, and definitions of reliability are set down. Emphasis is placed on tying reliability and maintenance requirements to contractual guarantees. M.S.K.

A82-20563 # ***Aircraft design for operability.*** H. A. G. Waugh (British Aerospace Public, Ltd., Co., Kingston-on-Thames, Surrey, England). In: Design for military aircraft operability; Proceedings of the Symposium, London, England, February 7, 1980. London, Royal Aeronautical Society, 1981. 4 p.

The design of fighter aircraft is examined for modifications necessary in the design process to obtain maximum operability. Noting that aircraft are growing larger and requiring greater thrust, the tendency of organizations to resist change where change is needed is emphasized. Contractual guarantees for reliability and maintenance, performance standards, price, and fixed schedules created a perception of the necessity for changes to occur early in the design process. Changing standards in the middle of the design process also added to the workload and affected the level of understanding between the user and the manufacturer. Continued communications between the procurement agency, the end users, and the manufacturing team is stressed as necessary to achieving the cost, reliability and maintenance, and performance goals for new aircraft. M.S.K.

A82-20564 # **Operability of military aircraft - Avionic design aspects.** D. I. Jackson and G. Belcher (Marconi Avionics, Ltd., Rochester, Kent, England). In: Design for military aircraft operability; Proceedings of the Symposium, London, England, February 7, 1980. London, Royal Aeronautical Society, 1981. 6 p.

The design, operability, reliability, and maintenance of avionics computers are discussed, with emphasis on ensuring availability in a combat environment. The characteristic accuracy and complexity of modern digital avionics systems are described in terms of an existing autopilot computer, a stability augmentation computer, and two separate display computers. The computers weigh from 25-38 lb, have from 1850-5000 components, draw from 120-180 W, and feature from 240-2600 internal and external connections, with MTBF ranging from 500-2000 hr. Cooling is accomplished through either cold wall or air blown methods, with the high density electronics mounted on module cards for ease of replacement and enhanced cooling. Increasing use of LSI expands the computing power, lowers the power requirements, and offers the potential for higher reliability. A schematic is provided of a reconfigurable system, and an impetus for standard computer languages is noted. M.S.K.

A82-20565 # **Operability of military aircraft - Some design and cost trends.** J. Fletcher and M. S. Wooding (British Aerospace Public, Ltd., Co., Warton Div., Preston, Lancs., England). In: Design for military aircraft operability; Proceedings of the Symposium, London, England, February 7, 1980. London, Royal Aeronautical Society, 1981. 10 p.

Trends, trade-offs, and variabilities in the maintainability, reliability, and survivability of combat aircraft in peacetime conditions are examined. The assurance of quality control before delivery is stressed, while changing components demands are noted to affect the economic continuity of small subcontractor investments in production equipment. A constant feedback is recommended between user operating experience, procurements demands, and designers to support the achievement of performance requirements and reliability, i.e. MTBF. Early, thorough testing of all new components are considered as essential before implementation in aircraft, although the up-front expense is greater. The choice of aircraft stores to minimize weight and size is discussed, along with the placement of arterial passageways to ensure survivability in the case of a strike by employing dispersed pathways and shielding. M.S.K.

A82-20570 **Modelling of target radar scattering with application to guidance simulation.** S. C. Woolcock (EMI Electronics, Ltd., Wells, Somerset, England). In: Trends in missile guidance design concepts; Proceedings of the Symposium, London, England, January 14, 1981. London, Royal Aeronautical Society, 1981. 30 p. 5 refs.

The complexity of the receivable scattering of radar signals from man-made targets is described, and the parameters which have the greatest influence on guidance are outlined. Target-phase fronts are complicated by multireflector scattering returning from complex surfaces, and angular glint occurs when the received return signal is imbedded in the field of several interference signals from reflective surfaces of the perceived target. Ground-based radars experience fluctuations due to polarization or frequency changes in the transmitted signal, range and aspect changes, environmental influences, and depolarization of scattering. Further discussion is devoted to air-to-air guidance systems radar problems, and features of reflective surfaces of typical targets are examined. Finally, the analytic modelling of underwater and guidance radars, as well as radar performance parameters, is presented, along with experimental techniques. M.S.K.

A82-20586 **MLS flare low elevation angle guidance considerations.** R. J. Kelly and E. F. C. LaBerge (Bendix Corp., Communications Div., Baltimore, MD). In: NTC '80; National Telecommunications Conference, Houston, TX, November 30-December 4, 1980, Conference Record. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 11.1.1-11.1.5. 6 refs.

Aircraft executing an automatic flare maneuever require vertical guidance information to the autopilot at very low altitudes just prior to touchdown. MLS provides the vertical guidance by combining, in the aircraft flare computer, flare elevation angle information with distance measured by DME to determine aircraft height above the runway. This paper addresses the system design considerations for the flare maneuver guidance, giving attention to accuracy requirements, error sources, antenna design considerations, the airborne signal processor, simulation studies, receiver bench tests, and field tests. Since MLS flare guidance accuracy requirements in the presence of ground multipath exceed that provided by the natural resolution of the scanning beam, it is demonstrated that, by using single edge processing and selected antenna height, a + or - 2-foot flare guidance accuracy can be achieved over the touchdown zone. B.J.

A82-20588 **Experimental measurement of the low angle terrain scattering interference environment.** J. E. Evans and D. F. Sun (MIT, Lexington, MA). In: NTC '80; National Telecommunications Conference, Houston, TX, November 30-December 4, 1980, Conference Record. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 11.3.1-11.3.5. 17 refs. FAA-sponsored research.

The paper presents the results of an experimental study whose aim was to obtain a better quantitative understanding of low angle microwave propagation phenomena needed to assess the potential for improved elevation tracking performance. The experimental data were obtained with a 26-lambda L-band array and a 57-lambda C-band array at a variety of sites in eastern Massachusetts with vegetated and/or rolling terrain. The data were analyzed using the maximum likelihood and maximum entropy methods. It is found that these modern spectral estimation methods, especially the maximum entropy method, can be effectively used for ground reflection elevation multipath characterization. The angular spectra observed to date can be qualitatively and quantitatively predicted by a model based on specular reflections from tilted flat plates. B.J.

A82-20589 **Comparison of various elevation angle estimation techniques.** J. E. Evans and D. F. Sun (MIT, Lexington, MA). In: NTC '80; National Telecommunications Conference, Houston, TX, November 30-December 4, 1980, Conference Record. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 11.4.1-11.4.5. 8 refs. FAA-sponsored research.

Distributions of multipath scattered power are used to compare several elevation angle estimation techniques: (1) conventional monopulse (CM); (2) off-boresight monopulse (OBM); (3) double null monopulse (DNM); (4) single edge processing (SEP) as used for flare processing in the MLS; and (5) a maximum entropy (ME) technique based estimator. The techniques were applied to several identical data sets, both synthetic and field measured. It is found that the ME technique appeared to yield the best performance if a sufficient number of sensor samples was available. The DNM and SEP appeared to work much better than the CM or OBM for the synthetic data cases. However, in the field measurement results, the DNM and OBM appeared to give similar performance and the SEP performed notably poorer than the other techniques. B.J.

A82-20590 **Tracking of low-altitude targets by a combined X/Ka-band radar system.** L. J. Klaver (Hollandse Signaalapparaten, Hengelo, Netherlands). In: NTC '80; National Telecommunications Conference, Houston, TX, November 30-December 4, 1980, Conference Record. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 11.5.1-11.5.5. 6 refs.

A historical account is given of how SIGNAAL arrived at a solution to the problem of tracking low-flying targets by a combined X/Ka-band radar system, while suppressing the image effect. In this system, target detection is performed by a normal search radar, and acquisition by the X-band tracking radar. With sufficient video quality, target tracking occurs in the Ka-band. B.J.

A82-20601 # **NAVSTAR global positioning systems.** J. Reynolds and T. McCabe (USAF, Space Div., Los Angeles Air Force Station, CA). In: NTC '80; National Telecommunications Conference, Houston, TX, November 30-December 4, 1980, Conference Record. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 21.1.1-21.1.6.

A NAVSTAR system overview is presented. Consideration is then given to concept validation results, Phase I test results, full scale engineering development, test planning, Phase III production and deployment, and applications. B.J.

A82-20615 # **Laser communications via an atmospheric link.** R. S. Mason (USAF, Space Div., Los Angeles Air Force Station, CA). In: NTC '80; National Telecommunications Conference, Houston, TX, November 30-December 4, 1980, Conference Record. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 27.1.1-27.1.9. 9 refs.

It is pointed out that interest in communications by laser over either an atmospheric or free space link has existed in the Air Force since the early 70's. The Laser Communications (LaserCom) program is currently in a test and demonstration phase. The Airborne Flight Test System (AFTS) developed in connection with LaserCom is discussed. The transmitter terminal is on board a modified C-135 aircraft. The receiver terminal is located on the ground. The demonstration range is up to 100 km in an altitude window of 33,000-37,000 ft. The airborne laser is a Nd:YAG which operates pulsed, mode-locked, and frequency doubled. The operating wavelength is 5320 A. Typical output power is 150 mW, linearly polarized. The pump source is a potassium arc-type lamp, driven at 250 W. The lamp is recognized as the limiting lifetime component of the system. G.R.

A82-20656 **Land navigation with a low cost GPS receiver.** K. P. Yiu, R. Eschenbach, and F. Lee (Hewlett-Packard Laboratories, Palo Alto, CA). In: NTC '80; National Telecommunications Conference, Houston, TX, November 30-December 4, 1980, Conference Record. Volume 3. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 55.3.1-55.3.7. 5 refs.

The Navstar Global Positioning System (GPS) is a satellite-based radio navigation system that will provide extremely accurate three-dimensional position fixes and timing information to properly equipped users anywhere on or near the earth. Civil applications of GPS are mostly limited to either air or marine navigation. In 1977, an investigation was initiated with the objective to prove the feasibility of land navigation with a low cost, single channel, single frequency GPS receiver based on the C/A code only. A GPS receiver was built and static and dynamic tests were conducted. An accuracy of 20 meters was obtained. It was found that the low-cost navigation algorithms used provide adequate and acceptable performance for land navigation. The receiver performance has been excellent even under the adverse environments, such as downtown San Francisco and San Francisco International Airport. G.R.

A82-20672 **The influence of technology advances on integrated CNI avionics.** R. A. Reilly and C. R. Ward (ITT, ITT Avionics Div., Nutley, NJ). In: NTC '80; National Telecommunications Conference, Houston, TX, November 30-December 4, 1980, Conference Record. Volume 3. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 61.3.1-61.3.6.

Attention is given to an integrated communication, navigation, and identification avionics (ICNIA) architecture which represents an attempt to overcome current-day tactical avionics problems in a highly cost effective manner. This architecture uses a wideband, agile, programmable transversal filter, as a key element of the design. The use of such a device as a preselector filter reduces the input bandwidth from approximately 400 MHz to 5 MHz, which is the spectrum bandwidth of a Joint Tactical Information Distribution System (JTIDS) pulse. Under digital control, the filter is capable of switching tuning frequencies in less than six nanoseconds. This rapid tuning feature makes it possible for a single filter to scan all of a selected set of frequencies in the L-band region within the total delay time of the tapped delay line in the transversal filter. Expected benefits of ICNIA are related to gains with respect to size, weight, cost, as well as performance. G.R.

A82-20684 **Relay-augmented data links in an interference environment.** C. E. Cook (Mitre Corp., Bedford, MA). In: NTC '80; National Telecommunications Conference, Houston, TX, November 30-December 4, 1980, Conference Record. Volume 3. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 63.6.1-63.6.5. Contract No. F19628-79-C-0001.

Use of communications relays is examined as a means of improving the operation of line-of-sight links in an interference environment. Expressions are derived that define optimum relay locations and number of relays. The relationships are functions of system and interference parameters, such as effective radiated power (EFP) ratios and processing gain, as well as of distances from the source transmitter and destination receiver to the noise source position. Bounds on flight path orbits of airborne relays are derived. Results obtained can be applied to the analysis of trade-offs among the various design factors when communications links are subject to interference. This can include the assessment of fixed constraints, such as the number of relays, upper limits on ERP and processing gain, or lower limits on data rate. An example is presented that illustrates the effectiveness of a relay in creating a communications corridor in the presence of multiple interference sources. (Author)

A82-20695 **An analysis of antijam communication requirements in fading media.** J. D. Oetting and A. E. Durling (Booz, Allen and Hamilton, Inc., Bethesda, MD). In: NTC '80; National Telecommunications Conference, Houston, TX, November 30-December 4, 1980, Conference Record. Volume 4. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 69.3.1-69.3.5. 6 refs.

The paper discusses the effects of jamming in a multipath propagation environment in which both the desired signal and the jamming signal are subject to Rice or Rayleigh fading. The distribution of the ratio of two independent Rician random variables is calculated, and this result is related to the evaluation of the required processing gain for the case of air-to-air or air-to-ground communication in a hostile electronic environment. An example of a specific jamming scenario is employed to illustrate how these results can be used to estimate the required processing gain of an airborne UHF AJ communication system. (Author)

A82-20728 # **Padé approximation applied to flow past thin airfoils.** S. N. Venkatarangan and G. Narendran (Indian Institute of Technology, Madras, India). *Journal of Mathematical and Physical Sciences,* vol. 14, Oct. 1980, p. 485-489.

Padé approximations derived from nonuniform solutions of flows around elliptic and Joukowski airfoils are examined. Off-diagonal Padé approximants are chosen for the flow past elliptic airfoils and poles are obtained. A perturbation expansion is defined for flow past a Joukowski type airfoil, and nondiagonal Padé approximants are used to accommodate the stagnation point at the leading edge. Comparisons of the values obtained are made with values obtained by the Lighthill method. M.S.K.

A82-20742 * # **Improved plasma sprayed MCrAlY coatings for aircraft gas turbine applications.** F. J. Pennisi and D. K. Gupta (United Technologies Corp., Pratt and Whitney Aircraft Group, East Hartford, CT). *American Vacuum Society, International Conference for Metallurgical Coatings, San Francisco, CA, Apr. 6-10, 1981, Paper.* 17 p. 11 refs. Contract No. NAS3-21730.

Eighteen plasma sprayed coating systems, nine based on the NiCoCrAlY chemistry and nine based on the CoCrAlY composition, were evaluated to identify coating systems which will provide equivalent or superior life to that shown by the electron beam physical vapor deposited NiCoCrAlY and CoCrAlY coatings respectively. NiCoCrAlY-type coatings were examined on a single crystal alloy and the CoCrAlY based coatings were optimized on the B1900 + Hf alloy. Cyclic burner rig oxidation and hot corrosion and tensile ductility tests were used to evaluate the various coating candidates. For the single crystal alloy, a low pressure chamber plasma sprayed NiCoCrAlY + Si coating exhibited a 2X oxidation life improvement at 1121 C (2050 F) over the vapor deposited NiCoCrAlY material while showing equivalent tensile ductility. A silicon modified low pressure chamber plasma sprayed CoCrAlY coating was found to be more durable than the baseline vapor deposited CoCrAlY coating on the B1900 + Hf alloy. (Author)

A82-20743 * # **Power system design optimization using Lagrange multiplier techniques.** Y. Yu (Xerox Corp., El Segundo, CA) and F. C. Lee (Virginia Polytechnic Institute and State University, Blacksburg, VA). *Power Conversion International Conference, Munich, West Germany, Sept. 14, 1981, Paper.* 18 p. 8 refs. Contract No. NAS3-21051.

An optimization technique using the Lagrange Multiplier Method is proposed to facilitate design of switching power converter systems. The essence of the optimization is to identify the optimal battery voltage level and switching frequency along with the detailed converter design so that the total system weight including the battery and the packaged converter is minimized, and concurrently all specified power circuit performances are satisfied. (Author)

A82-20751 **Flight testing in the eighties; Proceedings of the Eleventh Annual Symposium, Atlanta, GA, August 27-29, 1980.** Symposium sponsored by the Society of Flight Test Engineers. Lancaster, CA, Society of Flight Test Engineers, 1980. 451 p.

Flight testing procedures were discussed in terms of F-18 carrier suitability testing, the suitability of using JP-8 fuel for U.S. combat aircraft assigned to NATO forces, and icing test programs for the F-16 and for helicopters. Methods of instrumenting a test airplane were examined, as well as the development of a self-contained flight test data acquisition system. Attention was given to fuel conservation data bases for general aviation aircraft, to flight testing the airborne cruise missile, and testing the Jetwing STOL research aircraft. Tests of the Tornado advanced avionics system were described, as were tests of a jet-powered sailplane, flight tests of effect, and flyover noise level tests. Finally, size reduction of flight test instrumentation and simulator data test instrumentation were considered, and data processing for flight tests and real-time telemetry were reviewed. M.S.K.

A82-20752 **Initial F-18 carrier suitability testing.** J. W. Hakanson (McDonnell Douglas Corp., Patuxent River, MD). In:

Flight testing in the eighties; Proceedings of the Eleventh Annual Symposium, Atlanta, GA, August 27-29, 1980.
Lancaster, CA, Society of Flight Test Engineers, 1980, p. 1-1 to 1-14.

Sea Trials results are reported for carrier basing of the F-18 Hornet, and the instrumentation characteristics are described. Complete ground tests, simulations, and drop tests were performed before the carrier tests, and catapult launches were immediately successful. EMC, deck handling/operation, instrumentation, and data system tests are outlined, noting that real-time data was transmitted to the manufacturer. Thirty-two catapults and 32 arrested landings were completed onboard a carrier, with little pilot compensation for burble and no unintentional bolters. Further trials established startability with the APU, engine crossbleed, and the low and high pressure huffer, use of six different catapults, compatability with shipboard operations, and the need for a fix of the lower nose wheel spin-up speed to alleviate loads on the repeatable release holdback springs. M.S.K.

A82-20753 **F-16 ground and inflight icing testing.** C. M. Core, Jr. (USAF, Aeronautical Systems Div., Wright-Patterson AFB, OH). In: Flight testing in the eighties; Proceedings of the Eleventh Annual Symposium, Atlanta, GA, August 27-29, 1980. Lancaster, CA, Society of Flight Test Engineers, 1980, p. 3-1 to 3-35. 13 refs.

The discovery of icing problems in the F-16 variable inlet vanes, the fixes and the tests necessary to correct the problem, and the design of further tests to assure that military anti-icing specifications are met are discussed. The icing problem was detected during the AF qualifications programs when a second stage glime ice test flown within an ice cloud produced from a tanker aircraft caused damage in nine stages of the fan blades. Subsequent decisions were made to heat the airframe inlet strut, retrofit a three position anti-ice switch into existing F-16s, and improve the icing test procedures and in particular the quality of the ice. Further icing observed in an operational status led to a test program to investigate the effectiveness of electrically heating the inlet strut and moving the anti-ice sensor probe forward. Suggestions are offered for more accurate military specifications for defining ice and ice survival conditions. M.S.K.

A82-20754 **Helicopter icing spray system.** D. Belte (U.S. Army, Aviation Engineering Flight Activity, Edwards AFB, CA). In: Flight testing in the eighties; Proceedings of the Eleventh Annual Symposium, Atlanta, GA, August 27-29, 1980.
Lancaster, CA, Society of Flight Test Engineers, 1980, p. 4-1 to 4-18. 8 refs.

The U.S. Army has used a CH-47C as an airborne spray tanker since 1973 for helicopter qualification testing in icing conditions. The initial icing cloud it produced was found to consist of much larger diameter drops than natural clouds, and problems existed in uniformity and control of its liquid water content. A program was undertaken in 1979 to modify the system to generate a spray plume more closely resembling a natural cloud. This effort included ground and icing wind tunnel evaluation of spray atomizers, a flight survey of turbulence behind the spray aircraft, and in-flight evaluation of atomizer spray characteristics. Modifications were incorporated, and the new system was used for icing tests in 1980. Evaluation of the new spray cloud characteristics shows a vastly improved drop size distribution and a more homogeneous liquid water content, closely resembling that of a natural cloud. (Author)

A82-20755 **JP-8 fuel conversion evaluation.** R. A. Stambovsky (USAF, Flight Test Center, Edwards AFB, CA). In: Flight testing in the eighties; Proceedings of the Eleventh Annual Symposium, Atlanta, GA, August 27-29, 1980. Lancaster, CA, Society of Flight Test Engineers, 1980, p. 6-1 to 6-32. 26 refs.

The test results of determining the operability of the OV-10A, F-5, and A-37B aircraft on both JP-4 and JP-8 fuel to assure compatibility with NATO fuels are reported. Air starts, throttle transients, low temperature tests, thrust stand tests, weight and balance, and smoke evaluations were performed, using on and off trim conditions. Technical specifications were developed for the airstart envelope, preheating procedures, and fuel control gravity settings when using the NATO F-34 (JP-8) fuel. JP-8 is a kerosene type fuel with a higher specific gravity and flash point than JP-4 fuel, leading to safer handling but a greater weight penalty and more limited airstart features. Low temperature starts were within the manual described limits, as were throttle techniqes and center-of-gravity shifts. M.S.K.

A82-20756 * **Development of a simple, self-contained flight test data acquisition system.** R. R. L. Renz, R. Clarke, and J. Roskam (Kansas, University, Lawrence, KS). In: Flight testing in the eighties; Proceedings of the Eleventh Annual Symposium, Atlanta, GA, August 27-29, 1980. Lancaster, CA, Society of Flight Test Engineers, 1980, p. 8-1 to 8-22. 16 refs. NASA-supported research.

The system concepts and the flight test program results for a NASA designed in-flight data acquisition system are described. The system draws power from a rechargeable battery pack and intrudes on the aircraft systems only with a total pressure probe, a static pressure probe, and control position transducers, which are simply taped to the frame. A 4000 byte microcomputer forms the heart of the data recording system for cassette tape storage, and is expansion coupled to an eight-bit interactive microcomputer which interfaces with a transducer package for 16-channel demultiplexing. The transducers, ranges, and accuracies are listed, and a five/sec data acquisition rate minimum requirement is noted, although a 10/sec rate is used. The system components are detailed, along with the control and data processing procedures, and the results of dynamic flight testing are presented. M.S.K.

A82-20757 **General aviation fuel consevation in the 1980's.** G. R. Bromley (Beech Aircraft Corp., Wichita, KS). In: Flight testing in the eighties; Proceedings of the Eleventh Annual Symposium, Atlanta, GA, August 27-29, 1980.
Lancaster, CA, Society of Flight Test Engineers, 1980, p. 9-1 to 9-22.

Techniques for conserving fuel in-flight are given from a flight engineer's point-of-view, noting that aircraft designs will increasingly incorporate cleaner aerodynamics and better engine-to-airframe matching. The effects of wind and temperature at various altitudes and fuel consumption in ascent and descent are considered, and methods for determining maximum range airspeeds are developed, particularly for choosing long-range cruise airspeeds. Specific charts are presented for private pilots in general aviation aircraft, relating wind, no-wind, and tailwind conditions as regards to fuel consumption. M.S.K.

A82-20759 * **Determining performance parameters of general aviation aircraft.** G. Bull and P. D. Bridges (Mississippi State University, Mississippi State, MS). In: Flight testing in the eighties; Proceedings of the Eleventh Annual Symposium, Atlanta, GA, August 27-29, 1980. Lancaster, CA, Society of Flight Test Engineers, 1980, p. 12-1 to 12-16. 6 refs. Grant No. NAG1-3.

A method for determining propeller efficiency and drag from flight tests, using relatively simple instrumentation, is under development at Mississippi State University. Flight test data from several simple maneuvers are combined to produce sufficient information to determine the desired parameters. Information obtained from the transient response of airspeed to a step change in power or drag in level flight is utilized. Theory is developed and results of preliminary computer studies and preliminary flight test are presented. (Author)

A82-20760 **Tornado-avionic development testing.** E. K. Obermeier (Messerschmitt-Bölkow-Blohm GmbH, Manching, West Germany). In: Flight testing in the eighties; Proceedings of the Eleventh Annual Symposium, Atlanta, GA, August 27-29, 1980. Lancaster, CA, Society of Flight Test Engineers, 1980, p. 13-1 to 13-17.

The developmental testing of navigation and terrain following subsystem of the avionics system in the Tornado all-weather combat aircraft are described. Navigation data supplied by inertial navigation, Doppler radar, SAHR, ADC, and sensor data are fed to the main computer through a Kalman filter. The system is hierarchical and reverts to successively lower navigation modes in case of damage to the primary equipment. Quantified flight tests were made during 100 nm flights around the terrain near the air base and the radar tracking data was evaluated for deviation from a preset flight path and for the number of fix points contained in photographs from forward and downward looking cameras. The terrain following subsystem ensures a safe flightpath down to 200 ft altitude, and was evaluated by photographs of the ground and by radar altimeter data. The instrumentation monitoring routing is described, and modifications to correct deficiencies are indicated. M.S.K.

A82-20761 **Design, development and flight testing of a jet powered sailplane.** B. S. Smith (Caproni Vizzola Costruzioni Aeronautiche S.p.A., Vizzola Ticino, Italy). In: Flight testing in the eighties; Proceedings of the Eleventh Annual Symposium, Atlanta, GA, August 27-29, 1980. Lancaster, CA, Society of Flight Test Engineers, 1980, p. 14-1 to 14-17. 15 refs.

The design and development of the tadpole-shaped, turbojet powered A21 powered glider are discussed. The necessity of broadening the fuselage to house the jet led to the use of two wheels on the central core structure, which furnishes greater runway handling stability. An aspect ratio of 25.65 is used for the all-metal wings, and an engine 0.3 m in diameter, 0.61 m long, and weighing 30 kg was installed to provide take-off thrusts of 100 kg. A bifurcated exhaust was fitted to avoid having the exhaust impinge on the tail section, and the engine compartment was lined with steel and titanium as a heat limiter. The plane has been flown at speeds up to 190 knots at altitudes exceeding 33,000 ft without experiencing flutter. M.S.K.

A82-20762 **Performance flight test evaluation of the Ball-Bartoe JW-1 Jetwing STOL research aircraft.** R. D. Kimberlin (Tennessee, University, Tullahoma, TN). In: Flight testing in the eighties; Proceedings of the Eleventh Annual Symposium, Atlanta, GA, August 27-29, 1980. Lancaster, CA, Society of Flight Test Engineers, 1980, p. 16-1 to 16-20.

The initial steps of the flight test program for the Ball-Bartoe JW-1 Jetwing aircraft are reported. The jet wing vents all engine air through the front of the wing and ejects it over the top of the wing through a slot nozzle which extends 70% of the full wing span. A Coanda flap is mounted at the trailing edge of the blown wing section, and a smaller wing is mounted above the slot nozzle to provide thrust augmentation. The initial series of tests, which followed 78 previous flight tests, comprised pilot familiarization flights, airspeed calibration, thrust calibration, and V-gamma maps. Sawtooth climbs were found to facilitate data collection due to longitudinal instability in level acceleration, and thrust losses amounting to 15-20% were experienced from the ducting. Further design iteration to reduce the ducting thrust losses is indicated. M.S.K.

A82-20763 * **Analysis of flight test measurements in ground effect.** E. K. Parks (Arizona, University, Tucson, AZ) and R. C. Wingrove (NASA, Ames Research Center, Aircraft Guidance and Navigation Branch, Moffett Field, CA). In: Flight testing in the eighties; Proceedings of the Eleventh Annual Symposium, Atlanta, GA, August 27-29, 1980. Lancaster, CA, Society of Flight Test Engineers, 1980, p. 17-1 to 17-26. 13 refs.

Three sources of errors, introduced into the air-data measurements of altitude and airspeed as a result of ground proximity, are evaluated. It is shown that the primary error results from ground constraint of the wing lifting pattern. Smaller errors result from constraint of the flow over the fuselage and of the engine exhaust. Equations are derived to provide corrections for the three error contributions. The equations are general and can be applied to airplanes of different geometries operating in different conditions. Applications illustrating different types of flight operations (takeoff and landing) are presented using CV-990 data. Applications illustrating the effect of different static orifice locations (fuselage and nose-boom) are presented with YC-15 data. Finally, an application to trajectory reconstruction is illustrated using DC-10 data. (Author)

A82-20764 **A study of the suitability of the all fiberglass XV-11A aircraft for fuel efficient general aviation flight research.** G. Bennett (Mississippi State University, Mississippi State, MS). In: Flight testing in the eighties; Proceedings of the Eleventh Annual Symposium, Atlanta, GA, August 27-29, 1980. Lancaster, CA, Society of Flight Test Engineers, 1980, p. 18-1 to 18-15. 8 refs.

The impact of rapidly rising fuel prices upon future general aviation aircraft requirements is explored. The current configuration of the fiberglass XV-11A aircraft is presented and it is shown that the aircraft can become a cost effective testbed for fuel efficient general aviation aircraft configurations. Several suitable research tasks for the aircraft are defined. A low cost method to produce master wing molds is proposed. (Author)

A82-20765 **A comprehensive flight test flyover noise program.** J. W. Vogel (Lockheed-California Co., Flight Analysis Dept., Palmdale, CA). In: Flight testing in the eighties; Proceedings of the Eleventh Annual Symposium, Atlanta, GA, August 27-29, 1980. Lancaster, CA, Society of Flight Test Engineers, 1980, p. 19-1 to 19-19.

Preliminary results from a program to develop noise prediction methods from static tests which are applicable to flyover noise levels are presented. The program was developed to provide a data base for future certification, customer requirements, and engine modifications, and involved a Lockheed L-1011 with a Rolls-Royce RB.211 engine. Noise level modifications were observed to be possible by altering the power plant components, the airframe, the effects of the jet-flow on the flaps, and forward velocity. Flyovers were performed over microphones on the ground at heights of 300 and 600 feet at various speeds and with the flaps in varying positions, taking into consideration different configurations of climb or descent. Engine noise was found to dominate in the rear arc while airframe noises were dominant in the forward arc, and either flap or landing gear deployment enhanced the sound levels by up to 8 dB. M.S.K.

A82-20766 **Size reduction flight test airborne data systems.** J. W. Gierer (McDonnell Aircraft Co., St. Louis, MO). In: Flight testing in the eighties; Proceedings of the Eleventh Annual Symposium, Atlanta, GA, August 27-29, 1980. Lancaster, CA, Society of Flight Test Engineers, 1980, p. 20-1 to 20-7.

A redesign of flight test data gathering systems to fit into the removable avionics areas of the F-18 aircraft is outlined. The use of low-power digital data recorders offers a size reduction of 2.2:1, with connections being accomplished by means of aircraft style connectors, lowering the number of connectors, and multiplexing where possible. A system design is presented which features subsystems for local and remote control panels, 8 MHz bandwidth helical scan recording on each channel, and time division multiplexing. Other aspects include a 28 V dc transformer rectifier, electronic packaged video, film, flutter excitation, and signal conditioning equipment, a 40 W transmitter, and low-power ICs. The system is intended for use on eight of the nine test F-18 aircraft. M.S.K.

A82-20767 **Data systems organization - A change for the better.** R. D. Samuelson (McDonnell Aircraft Co., St. Louis, MO). In: Flight testing in the eighties; Proceedings of the Eleventh Annual Symposium, Atlanta, GA, August 27-29, 1980. Lancaster, CA, Society of Flight Test Engineers, 1980, p. 21-1 to 21-7.

The implementation of a data systems organization at McDonnell Aircraft is described in terms of the project and departmental bases for the F-15 program. Key objectives of the flight test reorganization comprised strengthened control over data and instrumentation programs, combination of data and instrumentation operations to broaden individual responsibilities and increase efficiency, manage the data system development and the test support activities separately, combine data and instrumentation design activities, and combine supporting laboratories and supply operations where feasible. The data systems were divided into a design and development branch, an operations branch, and a processing and support branch, with respective subsections. The system carried through to F-18 development and resulted in a reduction of 20% in total expenditures. M.S.K.

A82-20768 **Simulator data test instrumentation - Flight test challenge of the eighties.** W. L. Curtice, III (USAF, Aeronautical Systems Div., Wright-Patterson AFB, OH). In: Flight testing in the eighties; Proceedings of the Eleventh Annual Symposium, Atlanta, GA, August 27-29, 1980. Lancaster, CA, Society of Flight Test Engineers, 1980, p. 22-1 to 22-22.

The development of a Simulator Data Test Instrumentation System (SDTIS) to compare flight test data with results from simulator tests is examined. The SDTIS features 180 channels of digital or analog signal data, TV camera, audio from voice recordings, in-field automatic data reduction and analysis. The problem of matching appropriate cues in response to pilot control actions in the simulator are explored, including the time of aircraft response. The SDTIS allows the matching of the simulator response data regarding time, magnitude, and accuracy against flight data from the aircraft which is simulated. The simulator signals recorded comprise analog signals, digital signals, motion sensors, a g-suit pressure sensor, external-follow-up sensors, control force sensors, and TV cameras. All signals are formatted through a data encoder/decoder, and the necessity for maintaining up-to-date flight test data bases for simulator fidelity measurements is stressed. M.S.K.

A82-20769 **The Boeing Flight Test Data System 1980.** G. J. Zanatta (Boeing Commercial Airplane Co., Seattle, WA). In: Flight testing in the eighties; Proceedings of the Eleventh Annual Symposium, Atlanta, GA, August 27-29, 1980. Lancaster, CA, Society of Flight Test Engineers, 1980, p. 23-1 to 23-15.

The Boeing Flight Test Data System is reviewed, with particular attention to the testing of the 757/767 aircraft. The System provides calibration, conditioning, monitoring, recording, extraction, analysis, manipulation, and reporting of data from aircraft tests. The data gathering system is based on pulse code modulation technology, with data routing and switching allowing up to 800 samples/sec. The airborne data analysis and monitor system is outlined, as is the ground analysis, telemetry analysis, and data processing ground stations. The interactive mainframe data base provides access for software users for data base applications, test data processing, and scientific programs. Provisions are made for floppy disk storage for on-board comparisons. The interactive process of engineer-to-computer eliminates manual data searches or searches for test data requirements. M.S.K.

A82-20770 **Instrumentation remote 'mini' ground station.** J. Nixon (Boeing Commercial Airplane Co., Seattle, WA). In: Flight testing in the eighties; Proceedings of the Eleventh Annual Symposium, Atlanta, GA, August 27-29, 1980. Lancaster, CA, Society of Flight Test Engineers, 1980, p. 24-1 to 24-7.

The methods of decentralizing the data processing for individual, remote aircraft testing at Boeing, and still making the central processing station available to the instrumentation engineer are described. A preflight instrumentation package is developed before testing, checked, and placed on-line with a ready signal to the central processing computer via a remote terminal CRT. The ready response yields a return of a mylar tape to program the ROMs for data acquisition, thus eliminating any ground traffic for flight test information materials. The system can operate from anywhere a modem system can be used, and it is noted that three systems are intended as mobile units, for carriage to areas where remote access is required. M.S.K.

A82-20771 **Color graphics based real-time telemetry processing system.** T. M. Randall (Lockheed-Georgia Co., Engineering Data Systems Dept., Marietta, GA). In: Flight testing in the eighties; Proceedings of the Eleventh Annual Symposium, Atlanta, GA, August 27-29, 1980. Lancaster, CA, Society of Flight Test Engineers, 1980, p. 25-1 to 25-15.

Features of the Lockheed real-time telemetry data processing system for monitoring flight test data acquisition and performing interactive analyses of test results are detailed. All calibration, correction, and conversion to engineering units are performed by the on-board PCM acquisition system, and the main man/machine interface on the ground is a raster scan color graphics display terminal. A scrolled time history format has been developed for use in the testing of the stretch C-141B, and data from tests is subject to analysis two to three minutes after test completion. The system eliminates trial-and-error data acquisition and piecemeal data processing, resulting in increased efficiency and attendant lowered costs, provided that appropriate software is available to utilize the system. M.S.K.

A82-20792 * # **Flow visualization using a computerized data acquisition system.** R. Gallington and G. Sisson (U.S. Air Force Academy, Colorado Springs, CO). In: International Symposium on Flow Visualization, Bochum, West Germany, September 9-12, 1980, Preprints of Contributed Papers. Bochum, West Germany, Ruhr-Universität Bochum, 1981, p. 134-141. 5 refs. NASA-supported research.

A computer-driven traversing mechanism combined with mass data storage, data reduction programs, and general-purpose graphics programs permits a visualization of complex flows. A unique seven-hole probe is used which permits reasonably accurate measurements of all average flow properties if the local flow angle does not exceed 80 degrees. A description is given of the wake of a lifting canard surface as this wake passes over a wing. The flow includes concentrated and dissipating vortices, large regions of reduced total pressure, and local flow angles up to 60 deg. All these features can be clearly seen and accurately located in the graphical output. C.R.

A82-20803 # **Visualization of flow separation and separated flows with the aid of hydrogen bubbles.** H. Bippes (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Experimentelle Strömungsmechanik, Göttingen, West Germany). In: International Symposium on Flow Visualization, Bochum, West Germany, September 9-12, 1980, Preprints of Contributed Papers. Bochum, West Germany, Ruhr-Universität Bochum, 1981, p. 225-230.

Experiments using the hydrogen bubble technique to investigate flow separation and separated flows on inclined wings and bodies are reported. The hydrogen-producing cathode was displaced until a location of interest can be found. The stability and the decay of trailing edge vortices shed from the tips of a rectangular wing at incidence was studied, and the flow was found to separate close to the point of maximum thickness. An axial velocity component was also observed, with a velocity close to the wing that was larger than the velocity of the oncoming flow. In a study of slender bodies the separation of the counter-rotating vortex pair became unstable, and at larger angles of incidence the lifting up of the vortex moved upstream, and another vortex layer separated downstream. On slender wings, the vortex breakdown manifested in a sudden burst. M.S.K.

A82-20811 # **Visualization of laminar separation by oil film method.** T. Ishihara, T. Kobayashi, and M. Iwanaga (Tokyo, University, Tokyo, Japan). In: International Symposium on Flow Visualization, Bochum, West Germany, September 9-12, 1980, Preprints of Contributed Papers. Bochum, West Germany, Ruhr-Universität Bochum, 1981, p. 304-308.

The effectiveness of using the oil film method for flow visualization was experimentally tested, with particular regard being given to the limited lines. A test cylinder was coated with light oil or machine oil adulterated with carbon powder and set in a transparent water channel at flows from 10-25 cm/sec. Photographs were taken, and a dye injection technique was used to repeat the same tests. Two limited lines were observed in the oil flow patterns and in the dye injection, and were found to fluctuate simultaneously. The mean values of the limited lines were also observed to attain a constant value, but only after the passage of a certain period of time. M.S.K.

A82-20813 # **Flow field around an oscillating airfoil.** Y. Oshima (Ochanomizu University, Tokyo, Japan) and A. Natsume (Tokyo, University, Tokyo, Japan). In: International Symposium on Flow Visualization, Bochum, West Germany, September 9-12, 1980, Preprints of Contributed Papers. Bochum, West Germany, Ruhr-Universität Bochum, 1981, p. 315-319. 6 refs.

The wake pattern, the trailing edge flow, and the separated vortex at the leading edge of an oscillating airfoil are discussed, and observed flow patterns are compared with numerical predictions. A NACA 0012 airfoil was affixed to an acrylic plate and heaving and pitching motions were induced. The angle of attack was varied, the half-pitch angle was 10 deg, the oscillation period was 2-5 sec, and the speed of the cart carrying the test object through a tank of water yielded Re between 400-1200. Both the reduced frequency and the reduced heaving amplitude were calculated, and films were taken of each test. The flowfield near the trailing edge was made visible by means of electrolysis and aluminum dust methods. The separation point moved toward the front of the airfoil with increasing angle-of-attack. M.S.K.

A82-20874 * # **Advanced subsonic transport propulsion.** D. L. Nored, C. C. Ciepluch, R. Chamberlin, E. T. Meleason, and G. A. Kraft (NASA, Lewis Research Center, Cleveland, OH). *AIAA, SAE, ASCE, ATRIF, and TRB, International Air Transportation Conference, Atlantic City, NJ, May 26-28, 1981, AIAA Paper 81-0811.* 30 p. 5 refs.

Examination of future subsonic commercial aircraft propulsion trends begins with a brief review of the current NASA Energy Efficient Engine (E3) Project. Included in this review are the factors that influenced the design of these turbofan engines and the advanced technology incorporated in them to reduce fuel consumption and improve environmental characteristics. In addition, factors such as the continuing spiral in fuel cost, that could influence future aircraft propulsion systems beyond those represented by the E3 engines, are also discussed. Advanced technologies that will address these influencing factors and provide viable future propulsion systems are described. And finally, the potential importance of other propulsion system types, such as geared fans and turboshaft engines, is presented. (Author)

A82-20981 **Bolted field repair of graphite/epoxy wing skin laminates.** R. E. Bohlmann, G. D. Renieri (McDonnell Aircraft Co., St. Louis, MO), and M. Libeskind (U.S. Naval Material Command, Naval Air Development Center, Warminster, PA). In: Joining of composite materials; Proceedings of the Symposium, Minneapolis, MN, April 16, 1980. Philadelphia, PA, American Society for Testing and Materials, 1981, p. 97-116. Contract No. N62269-78-C-0272.

Mechanically fastened field repair techniques have been developed for graphite/epoxy skins damaged at or near substructure members and used to repair AV-8B and F-18 wing skin laminates. Damages of up to 101.6 mm in diameter have been repaired by mechanically fastening a titanium patch to the laminate using blind fasteners in single shear, with access only to the outside surface. The design goal of 0.004 mm/mm for a repaired graphite/epoxy wing skin laminate was attained for static strength and for residual strength tests after four lifetimes of spectrum fatigue. V.L.

A82-20982 **Improving composite bolted joint efficiency by laminate tailoring.** J. R. Eisenmann and J. L. Leonhardt (General Dynamics Corp., Fort Worth, TX). In: Joining of composite materials; Proceedings of the Symposium, Minneapolis, MN, April 16, 1980. Philadelphia, PA, American Society for Testing and Materials, 1981, p. 117-130.

An approach to laminate tailoring is presented which makes it possible to uncouple the local bearing capacity from the influence of the laminate axial strain level in a composite bolted joint. This is achieved by partitioning the laminate into two distinct regions: the primary region, which contains a high percentage of 0-deg plies and thus carries a high percentage of the overall axial load, and the bearing region, which contains no 0-deg plies and thus carries only a small portion of the overall axial load. As a result, the bearing region is insensitive to the amount of axial load in the joint and can continue to serve the function of introducing the bolt loads in the laminate even at high axial strains. In validation tests, a 24% increase in weight efficiency and a 60-70% increase in axial strain level were typically obtained when the tailored joint concept was adopted in place of the conventional approach. V.L.

A82-21189 **Airbus Industrie - The year of progress.** K. Regelin. *Interavia,* vol. 37, Jan. 1982, p. 35-39.

At the end of March 1982, the first A310 will take off from Airbus Industrie's Toulouse base. The completion of a one-year flight test program is expected to lead to full certification of the aircraft for airline operations by Mar. 31, 1983. Airbus Industrie claims to have developed the most advanced airliner wing. Compared with the already efficient wing of the A300, the span of the smaller A310 is only 2% shorter. However, the wing area has been reduced by approximately 16%. The resulting higher aspect ratio improves aerodynamic efficiency, while the increased thickness-to-chord ratio reduces weight. Attention is given to the aircraft design, the two-man versus three-man crew issue, the electronic flight instrumentation, the digital Automatic Flight System, the aircraft production plan, design details regarding the three slat sections on each wing, and Airbus Industrie's confidence in further market growth. G.R.

A82-21190 **Boeing's bigger narrowbody.** B. Rek. *Interavia,* vol. 37, Jan. 1982, p. 43-46.

After the termination of 707 production, the biggest production airliner remaining with the classic Boeing six-abreast fuselage is the 180/200-seat 757 twinjet. The first flight of the 757 is scheduled for Feb. 26, 1982. Two engines are currently being considered for use with the 757. Improved technology coupled with a rigorous weight reduction program has made possible significant improvements in fuel efficiency. It is planned to offer a 240,000 lb gross-weight version of the 757 which will be capable of U.S. coast-to-coast range. The single-aisle 757 is regarded as part of a larger program which includes the 767 as well. The 'configuration cab' contains flight deck features which will be common to the 757 and 767. Other common features include the Flight Management System, the Thrust Management Computer, and the Inertial Reference System. Attention is also given to the test program and the 757 market prospects. G.R.

A82-21191 **A new look at the Tupolev Tu-26 'Backfire'.** G. Lafon. *Interavia,* vol. 37, Jan. 1982, p. 78, 79.

The Soviet Air Force has now four types of aircraft with variable-sweep wings in service, including the Sukhoi Su-17/20/22 Fitter and MiG-23/27 Flogger fighters, the Su-24 Fencer strike aircraft, and the Tu-26 Backfire bomber. The characteristics of the Backfire bomber are compared with those of an equivalent design with fixed wings. It is pointed out that the 55 deg swept wing, with a leading edge which goes sonic at Mach 1.75, is not sufficiently swept for supersonic cruising. High sweep must be intended primarily for transonic/supersonic dash. The powerplant is believed to include two reheated Kuznetsov turbofans, as used in the Tu-144 supersonic transport (SST). It is estimated that with an SST powerplant Backfire will be capable to fly at speeds of about Mach 0.85 at sea level, Mach 1.2 at 20,000 ft, and Mach 1.7 at 40,000 ft. Aspects of subsonic performance are also discussed, taking into account a comparison with the U.S. B-1. G.R.

A82-21243 **ALF502 - Plugging the turbofan gap.** R. Whitaker. *Flight International,* vol. 121, Jan. 30, 1982, p. 237-241.

The development history, mechanical design and performance capabilities of the ALF502 turbofan engine are presented. The high-bypass design is based on the T55 turboshaft engine's core, yields low noise and low fuel consumption, and achieves good maintainability by means of a modular construction that comprises separate fan, accessory gearbox, gas producer, and combustor turbine elements. Only three special tools are needed for module changes, and an initial mean time between overhauls of 4000 hours is estimated. Because of the moderate temperatures and pressures for which the engine is designed, it is expected to meet the ICAO's 1983 emission regulations with respect to smoke, CO, hydrocarbons and nitrogen oxides. The engine has been selected for use in the Challenger business aircraft, and is presently employed in the BAe 146. O.C.

A82-21260 **AV-8B Harrier II.** R. Braybrook. *Air International,* vol. 22, Feb. 1982, p. 64-69, 102.

Design improvements, operating characteristics, and performance data of the AV-8B Harrier II V/STOL aircraft are discussed. The Harrier is a joint U.S.-UK development for use by the navies and by the USMC, who have added new combat maneuvers to take advantage of the engine nozzle deflectors for low speed maneuverability. The wing area has been extended to 230 sq ft from the AV-8A 201 sq ft, and the aircraft now has single slotted flaps, a supercritical airfoil, 7500 lb fuel capacity, and carbon fiber main structure, flaps, and ailerons. The nav-attack system includes an ASN-130 inertial navigator, HUD, and AYK-14 mission computer, pod-mounted advanced self-protection system, an all-weather landing system, and an angle-rate bombing system, which uses lasers and TV trackers for locking on a target. Deliveries will begin in Oct. 1983. M.S.K.

A82-21373 * # **We have just begun to create efficient transport aircraft.** D. J. Maglieri and S. M. Dollyhigh (NASA, Langley Research Center, Aeronautical Systems Div., Hampton, VA). *Astronautics and Aeronautics,* vol. 20, Feb. 1982, p. 26-38. 21 refs.

Factors affecting the cost-effectiveness and economics of the air transportation industry are reviewed. The delivery of more fuel-efficient aircraft and eventual total replacement in the 1990's by fleets of advanced aircraft are seen to offset rising fuel costs. Better airport operations are perceived to eliminate fuel-costly delays due to overcrowded runways, lack of available carriers, and maintenance of aircraft in holding patterns. Noise reduction research will lower the lawsuit costs from noise pollution, and the introduction of advanced turbofans for long, short, and medium range flights, advanced commuter planes, and advanced SSTs offering projected 50% increases in current aircraft efficiencies are seen to be limited only by the airlines' ability to provide purchase financing, rather than by a lack of available new technology. M.S.K.

A82-21374 * # **The outlook for advanced transport aircraft.** J. M. Leavens, Jr., R. D. Schaufele (Douglas Aircraft Co., Long Beach, CA), R. T. Jones (NASA, Ames Research Center, Moffett Field, CA), J. E. Steiner (Boeing Co., Seattle, WA), R. Beteille (AirBus Industrie, Blagnac, Haute-Garonne, France), G. A. Titcomb (United Technologies Corp., Pratt and Whitney Aircraft Group, East Hartford, CT), J. F. Coplin (Rolls-Royce, Ltd., London, England), B. H. Rowe (General Electric Co., Aircraft Engine Group, Cincinnati, OH), D. J. Lloyd-Jones (American Airlines, Inc., Fort Worth, TX), and W. J. Overend (Delta Air Lines, Inc., Atlanta, GA). *Astronautics and Aeronautics,* vol. 20, Feb. 1982, p. 39-62, 79.

The technological advances most likely to contribute to advanced aircraft designs and the efficiency, performance, and financial considerations driving the development directions for new aircraft are reviewed. Fuel-efficiency is perceived as the most critical factor for any new aircraft or component design, with most gains expected to come in areas of propulsion, aerodynamics, configurations, structural designs and materials, active controls, digital avionics, laminar flow control, and air-traffic control improvements. Any component area offers an efficiency improvement of 3-12%, with a maximum of 50% possible with a 4000 m range aircraft. Advanced turboprops have potential applications in short and medium haul subsonic aircraft, while a fuel efficient SST may be possible by the year 2000. Further discussion is devoted to the pivoted oblique wing aircraft, lightweight structures, and the necessity for short payback times. M.S.K.

A82-21375 * # **CAD/CAM approach to improving industry productivity gathers momentum.** R. E. Fulton (NASA, Langley Research Center, Hampton, VA). *Astronautics and Aeronautics,* vol. 20, Feb. 1982, p. 64-70. 18 refs.

Recent results and planning for the NASA/industry Integrated Programs for Aerospace-Vehicle Design (IPAD) program for improving productivity with CAD/CAM methods are outlined. The industrial group work is being mainly done by Boeing, and progress has been made in defining the designer work environment, developing requirements and a preliminary design for a future CAD/CAM system, and developing CAD/CAM technology. The work environment was defined by conducting a detailed study of a reference design process, and key software elements for a CAD/CAM system have been defined, specifically for interactive design or experiment control processes. Further work is proceeding on executive, data management, geometry and graphics, and general utility software, and dynamic aspects of the programs being developed are outlined. M.S.K.

A82-21386 **Airborne lidar measurements of smoke plume distribution, vertical transmission, and particle size.** E. E. Uthe, B. M. Morley, and N. B. Nielsen (SRI International Atmospheric Science Center, Menlo Park, CA). *Applied Optics,* vol. 21, Feb. 1, 1982, p. 460-463. 12 refs. Research supported by SRI International.

Observations were made of a dense smoke plume downwind from a forest fire using the ALPHA-1 two-wavelength downward-looking airborne lidar system. Facsimile displays were derived which depict plume dimensions, boundary layer height, and underlying terrain elevations. Results show significantly greater plume attenuation at 0.53-micron wavelengths than at 1.06-micron wavelengths, which indicates about 0.1-micron mean particle diameters, or the presence of gaseous constituents that absorb the visible radiation. D.L.G.

A82-21391 * **Calculation of sensitivity derivatives in thermal problems by finite differences.** R. T. Haftka and D. S. Malkus (Illinois Institute of Technology, Chicago, IL). *International Journal for Numerical Methods in Engineering,* vol. 17, Dec. 1981, p. 1811-1821. 13 refs. Grant No. NsG-1266.

The optimum design of a structure subject to temperature constraints is considered. When mathematical optimization techniques are used, derivatives of the temperature constraints with respect to the design variables are usually required. In the case of large aerospace structures, such as the Space Shuttle, the computation of these derivatives can become prohibitively expensive. Analytical methods and a finite difference approach have been considered in studies conducted to improve the efficiency of the calculation of the derivatives. The present investigation explores two possibilities for enhancing the effectiveness of the finite difference approach. One procedure involves the simultaneous solution of temperatures and derivatives. The second procedure makes use of the optimum selection of the magnitude of the perturbations of the design variables to achieve maximum accuracy. G.R.

A82-21474 **Gateway diversity and competition in international air transportation.** W. B. Tye (Putnam, Hayes and Bartlett, Inc., Cambridge, MA). *Transportation,* vol. 10, Dec. 1981, p. 345-356.

Because of the existence of 'limited designation' gateways, i.e., gateways for international air travel where entry by U.S. flag carriers is limited (in many cases to only one carrier), the U.S. Civil Aeronautics Board (CAB) has announced a policy of 'gateway competition'. This policy seeks to maximize inter-gateway competition as a goal of the carrier selection process. The paper reviews the rationale and history of this policy and the economic principles of gateway competition. After addressing exceptions where gateway competition does not enhance competitive goals, the issue of how to enforce the credibility of the bidding process in route awards is addressed. The paper concludes by identifying circumstances where competitive objectives are not advanced through application of the principal gateway competition. (Author)

A82-21586 **Institute of Navigation, Annual Meeting, 36th, U.S. Naval Postgraduate School, Monterey, CA, June 23-26, 1980, Proceedings.** Washington, DC, Institute of Navigation, 1981. 143 p. Members, $30.; nonmembers, $35.

Papers are presented on the optimal processing of GPS signals, a perspective on the civil use of GPS, the application of strapdown inertial technology to attitude and heading reference system requirements, the emerging need for improved helicopter navigation, and flight control strategies for performance computers. Attention is also given to a systems approach to the design of wind shear avionics, an empirical investigation of an evaluation of Loran-C for nonprecision approach applications, the GPS evaluator, and calibrated and uncalibrated inertial navigation system performance in valid and jammed GPS environments. B.J.

A82-21587 # **Calibrated and uncalibrated inertial navigation system performance in valid and jammed global positioning system environments.** A. J. Brockstein and R. J. Grethel (Litton Industries, Guidance and Control Systems Div., Woodland Hills, CA). In: Institute of Navigation, Annual Meeting, 36th, Monterey, CA, June 23-26, 1980, Proceedings. Washington, DC, Institute of Navigation, 1981, p. 2-10. 10 refs.

INS performance improvement that can be obtained in a jammed environment after calibration of INS instruments with GPS is compared with uncalibrated INS performance. In addition, gimbaled vs. strapdown INS performance is compared for two trajectories (field test conditions) during jammed and valid operations. It is shown that INS performance can be significantly enhanced during extended periods of GPS outage by prejam INS calibration using GPS. In addition, it is shown that strapdown systems are more difficult to calibrate than gimbaled systems since the major position contributors (gyros) are less observable for a maneuvering trajectory. In addition, the lack of gravity compensation in the strapdown system causes the gyro g-sensitive drift effect to be a major error source. B.J.

A82-21588 # **The Global Positioning System Evaluator.** S. Z. Stein (Intermetrics, Inc., Dayton, OH) and G. Pennett (USAF, Wright-Patterson AFB, OH). In: Institute of Navigation, Annual

Meeting, 36th, Monterey, CA, June 23-26, 1980, Proceedings. Washington, DC, Institute of Navigation, 1981, p. 11-16.

The Global Positioning System Evaluator (GPSE) is a test facility for GPSE user equipment which presents the user with the RF signals, inertial measurement, and barometric altimeter data it would sense in a wide range of environments. Testing in the GPSE environment exhibits several advantages over flight testing. In addition to the obvious cost benefits and repeatability of simulator testing, the GPSE can simulate a wide range of dynamics (up to 2100 m/s velocity, 30 g acceleration) and simulates a full 24-satellite configuration (a satellite-selection algorithm is used to choose optimum satellite geometries), allowing real-time segments of up to 10 hours duration. This paper describes GPSE model implementation and presents the system performance characteristics. B.J.

A82-21589 # **A perspective on civil use of GPS.** W. C. Euler (Magnavox Advanced Products and Systems Co., Torrance, CA). In: Institute of Navigation, Annual Meeting, 36th, Monterey, CA, June 23-26, 1980, Proceedings. Washington, DC, Institute of Navigation, 1981, p. 33-39. 19 refs.

It is noted that, while the GPS development program has made remarkable progress, the case for civilian users has advanced only marginally. The absence of a concrete policy regarding access, accuracy, and user charges has resulted in conservatism on the part of the affected government agencies as well as industry. It is suggested that the development of a firm national policy for the civil use of Navstar is essential to optimize the planning and equipment evolution to be carried out by affected government agencies, civil users, and equipment manufacturers. B.J.

A82-21590 # **The application of strapdown inertial technology to Attitude and Heading Reference System requirements.** G. W. Gilster (Litton Industries, Guidance and Control Systems Div., Woodland Hills, CA). In: Institute of Navigation, Annual Meeting, 36th, Monterey, CA, June 23-26, 1980, Proceedings. Washington, DC, Institute of Navigation, 1981, p. 48-56.

The LR-80 AHRS (Attitude and Heading Reference System) for the YAH-64 advanced attack helicopter is described. The LR-80 offers a unique AHRS solution in that it employs a strapdown inertial navigation mechanization and provides 'dynamically exact' measurement of vehicle maneuvers. A competitive system cost is achieved by the use of automatic self-calibration techniques, Doppler damping, and application of the inherent virtues of a strapdown mechanization which minimizes electromechanical complexity. The system configuration and design features are described, and flight test results for representative helicopter mission conditions are presented, showing the combined Doppler/AHRS navigation results obtained. Also considered are other potential applications for the system, including missiles and other aircraft, and the flexibility for integration with other navigation aids. B.J.

A82-21591 # **The emerging need for improved helicopter navigation.** N. T. Fujisaki (FAA, Washington, DC). In: Institute of Navigation, Annual Meeting, 36th, Monterey, CA, June 23-26, 1980, Proceedings. Washington, DC, Institute of Navigation, 1981, p. 57-64. 6 refs.

The paper reviews significant helicopter trends and the new complexion of resultant navigation requirements. Programs aimed at immediate problems are considered along with long-term plans to improve helicopter navigation. The essential elements of the FAA helicopter R&D effort are described, and potential areas for future work are also considered (including integrated cockpit system development). B.J.

A82-21592 # **Helicopters and Navstar/GPS.** G. A. Gilbert (Glen A. Gilbert and Associates, Inc., Washington, DC). In: Institute of Navigation, Annual Meeting, 36th, Monterey, CA, June 23-26, 1980, Proceedings. Washington, DC, Institute of Navigation, 1981, p. 65-70.

The elements of an ideal helicopter navigation system are described and evaluated in relation to GPS. Proposed system architecture is presented and principal elements are discussed; and a concept validation program is outlined. This program could lead into an advanced (fourth generation) air traffic control system which would serve not only helicopters but all civil aviation together with military aircraft in the common NAS. Transition to this system would begin in the mid 1980's, with full operational capability in place by the mid 1990's. B.J.

A82-21593 # **Systems approach to the design of wind shear avionics.** N. J. Cafarelli (Automation Industries, Inc., Wheaton, MD) and J. P. McVicker (FAA, Systems Research and Development Service, Washington, DC). In: Institute of Navigation, Annual Meeting, 36th, Monterey, CA, June 23-26, 1980, Proceedings. Washington, DC, Institute of Navigation, 1981, p. 99-103.

The FAA Wind Shear Program Office has completed an analytical investigation of the wind shear phenomenon, with emphasis on threat definition and the detection and avoidance of atmospheric anomalies. This paper summarizes some of these activities and suggests relevant information categories that should be considered in the design of a wind shear avionics system. These categories are: (1) predictive information, which defines specific characteristics and magnitude of an atmospheric anomaly prior to penetration; (2) anticipatory information, which establishes the existence of an atmospheric anomaly prior to penetration, but does not define its characteristics; and (3) reactive information, which defines the characteristics and magnitude of an atmospheric anomaly during penetration. The advantages and limitations of each information category are considered, along with some representative implementations. B.J.

A82-21597 **The case for helicopter hoisting.** W. J. Maddox, Jr. (Arabian Helicopters, Ltd., Dhahran, Saudi Arabia). *Vertiflite,* vol. 28, Jan.-Feb. 1982, p. 16-19.

Helicopter crew training and operations for hoisting personnel while hovering over offshore oilfields and over tankers, and for personnel transport to and from work in the Persian Gulf area are described. Personnel hoisting by commercial helicopters is noted to be illegal in the U.S., while oil company helicopter crews receive training for such operations in Louisiana. A 15-ft clear zone is needed for off-the-deck hoisting when landing cannot be achieved, and most work done in the Near East zone comprises delivery of harbor pilots to their craft. The pilot nominally approaches from the upwind side of a ship or platform to provide a safety margin in case of a power-out condition, and flights are limited to two passengers. Improvements are suggested for better ship identification lights and better lighted landing and hoist areas. M.S.K.

A82-21629 † **Studies on the stability of thin-walled shells with cutouts /Review/. I (Ob issledovaniiakh ustoichivosti tonkostennykh obolochek s vyrezami /Obzor/. I).** I. N. Preobrazhenskii. *Problemy Prochnosti,* Jan. 1982, p. 21-32. 50 refs. In Russian.

A82-21636 † **Dispersion and temperature-force dependence of the high-temperature strength characteristics of a gas-turbine-engine disk alloy (Dispersiia i temperaturno-silovaia zavisimost' kharakteristik zharoprochnosti splava dlia diskov GTD).** E. P. Golubovskii, I. P. Bulygin, and F. V. Iushakova. *Problemy Prochnosti,* Jan. 1982, p. 68-73. In Russian.

Experimental data are presented on the time-to-failure dispersion (under uniaxial tension and under stress concentration), long-term plasticity, and time of accumulation of a specified amount of creep strain (0.2 and 0.5%) for disk alloy EP109VD. It is shown that the dispersion of high-temperature strength characteristics changes in accordance with the vibration decay law as the time to failure increases. Empirical equations are derived which can be used to calculate the bounds of long-term strength, long-term plasticity, and creep for given fracture probabilities. V.L.

A82-21848 **Very high speed integrated circuits: Into the second generation. II - Entering Phase 1.** J. Martin (National Semiconductor Corp., Santa Clara, CA). *Military Electronics/ Countermeasures,* vol. 8, Jan. 1982, p. 60-63, 65, 66.

The intended applications of the Very High Speed Integrated Circuits (VHSIC) chips and technologies fall into four basic categories. These categories are related to current operational systems which could be improved through VHSIC technologies without change in performance, the addition of new performance features to existing systems, planned upgrades of existing systems through the use of VHSIC technologies, and new systems which could not be developed without the use of VHSIC technology. Attention is given to system design evolution, aspects of technology insertion, advantages related to standardization, applications related to the development of the next generation Advance Tactical Fighter aircraft, the improvement of reliability, and technology transfer issues. G.R.

A82-21897 **Process monitor helps make jet engines reliable.** *Materials Evaluation,* vol. 40, Feb. 1982, p. 159, 160.

A microprocessor-controlled general-purpose process monitor has been developed for automatic testing of jet engine components, in particular wheels or disks of compressors and turbines from 10 to 30 inches in diameter, at speeds up to 60,000 rpm. Load-cycle fatigue-life tests are performed in six spin pits and are automatically controlled within a range defined by low-speed and high-speed setpoints set by the operator. A complete cycle, from low speed to high speed and back to low, may be completed in less than a minute for a small part and in up to 5 min for a large one. V.L.

A82-21900 **Low-frequency eddy current inspection of aircraft structure.** D. J. Hagemaier and A. P. Steinberg (Douglas Aircraft Co., Long Beach, CA). *Materials Evaluation,* vol. 40, Feb. 1982, p. 206-210. 5 refs.

Low-frequency eddy-current inspection is used to detect fatigue cracks emanating from fastener holes in a wing spar cap and shear-lip in thin multiple-layered structures. It is shown that the technique is useful for detecting subsurface cracks in aluminum structures up to 8.9 mm thick at 100 Hz. The low-frequency eddy current method is also shown to be capable of detecting cracks that are not detectable by X-ray radiography, in particular, shear-lip cracks oriented at 45 deg to the X-ray beam. V.L.

A82-21941 # **Analytical control law for desirable aircraft lateral handling qualities.** H. Ohta (Nagoya University, Nagoya, Japan), P. N. Nikiforuk, and M. M. Gupta (Saskatchewan, University, Saskatoon, Canada). *Journal of Guidance, Control and Dynamics,* vol. 5, Jan.-Feb. 1982, p. 79-85. 8 refs. Natural Sciences and Engineering Research Council of Canada Grants No. A-5625; No. A-1080.

A model-matching technique is used to synthesize a control law which augments the lateral dynamics of an aircraft. The feedback and feedforward gains are derived in terms of the lateral stability derivatives and the control law is designed to satisfy specified lateral handling criteria. The augmented plant has specified lateral characteristic poles and a decoupled transfer function matrix between the aileron and rudder angles as inputs and the bank and sideslip angles as outputs. Approximate relationships are derived between the basic and augmented stability derivatives and presented in tabular form. The feedback gains are determined using the augmented derivatives. Simulation examples for three different flight conditions of a STOL aircraft are given to illustrate and substantiate the effectiveness of the control law. (Author)

A82-22027 # **FAA/NWS aviation route forecast /ARF/ development.** T. R. Mitchell (Mitre Corp., McLean, VA). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0013.* 10 p. 15 refs.

It has been recommended that greater emphasis be placed on the mass dissemination of aviation weather data, because a study of such data is important in planning a safe, expeditious flight. An approach which can provide such a mass dissemination of weather data on a cost-effective basis is considered. According to this approach, pilots could partially 'brief themselves' by directly accessing a computer data base of geographically-retrievable weather messages. Access would be by Direct User Access Terminals (DUAT's) or, alternatively, by using Touchtone telephone tones for providing input to the system and a Voice Response System (VRS) for output. To demonstrate the concepts and resolve the uncertainties, a prototype development program was undertaken. A real-time textual aviation weather data base and DUAT retrieval capabilities were developed on a network of minicomputers. Attention is given to the need for aviation route forecasts (ARF) and aspects of ARF development. G.R.

A82-22028 # **A perspective of computational aerodynamics from the viewpoint of airplane design applications.** L. R. Miranda (Lockheed-California Co., Computational Aerodynamics Dept., Burbank, CA). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0018.* 18 p. 56 refs.

A survey of the use of computational aerodynamics as a tool for airplane design is presented. Some general characteristics and requirements of the airplane design process are discussed and particular attention is given to those computer code characteristics that will enhance the effectiveness of computational aerodynamics. The various elements that are needed in a computer code in order to numerically simulate flows for practical applications are identified. The nature of each one of these elements and how it is impacted by considerations of effectiveness are discussed. The most commonly used approaches are reviewed and to what degree they are able to meet the needs of the airplane designer is pointed out. Problem areas are highlighted; present efforts to solve these problems are examined and, in some cases, alternative approaches are indicated. (Author)

A82-22045 * # **Recent advances in applying Free Vortex Sheet theory to the estimation of vortex flow aerodynamics.** J. M. Luckring, W. E. Schoonover, Jr., and N. T. Frink (NASA, Langley Research Center, Transonic Aerodynamics Div., Hampton, VA). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0095.* 18 p. 33 refs.

Free Vortex Sheet theory has been applied to a variety of configurations for the estimation of three-dimensional pressure distributions for wings developing separation-induced leading-edge vortex flows. Correlations with experiment show reasonable estimates for the effects of compressibility, side-slip, side edges, swept-wing blast-induced loads, and leading-edge vortex flaps. Theoretical studies expand upon these correlations to show general aerodynamic trends. Consideration is also given to simple, yet effective techniques which expedite convergence and therefore reduce computational expense. (Author)

A82-22046 # **Wing-canard aerodynamics at transonic speeds - Fundamental considerations on minimum drag spanloads.** W. H. Mason (Grumman Aerospace Corp., Bethpage, NY). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0097.* 10 p. 30 refs. Research supported by the Grumman Aerospace Corp.

Current methods for drag minimization minimize only the induced drag portion of the total drag. For many advanced supersonic aircraft, these methods are not valid when considering the transonic maneuver case. This paper describes an approximate method which extends the drag minimization schemes to include transonic wave drag and viscous drag, and then demonstrates the importance of these contributions when performing aerodynamic design at transonic maneuvering conditions. Typical results show both a reduction in total drag and a shift in the minimum drag center of gravity when these additional drag sources are included in the analysis. Another important consideration in canard-wing design is the canard wake modeling choice. In the second section of the paper, the results of two model problems provide a quantitative measure of the potential errors arising from various wake models. (Author)

A82-22052 * # **Alleviation of the subsonic pitch-up of delta wings.** D. M. Rao (Vigyan Research Associates, Inc., Hampton, VA) and T. D. Johnson, Jr. (Kentron Technical Center, Hampton, VA). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0129.* 10 p. 7 refs. NASA-supported research.

A 'pylon vortex generator' concept has been proposed for alleviating the subsonic pitch-up instability of highly swept supersonic-cruise wings. Fixed at a part-span location, this leading-edge device utilizes the lateral velocity component in the flow approaching the swept leading edge to generate a streamwise vortex, opposite in sense to the tip vortex. The vortex-induced downwash outboard of the device serves to control the leading-edge stall development in the wing-tip regions. Wind-tunnel results on 60-deg and 74-deg flat-plate delta wings are presented to illustrate the operation of the pylon vortex generator in modifying the spanwise leading-edge separation characteristics resulting in effective alleviation of the pitch-up. (Author)

A82-22054 # **Isolated nacelle performance - Measurement and simulation.** J. L. Crook, D. P. Nelson, R. H. Wiley, and W. M. Presz, Jr. (United Technologies Corp., Pratt and Whitney Aircraft Group, East Hartford, CT). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0134.* 10 p. 16 refs.

Results are presented from isolated flow through nacelle model tests which were conducted to acquire reliable data for computational nacelle performance prediction verification. The data includes static external and internal pressures, boundary layer rakes, hot film transition measurements, and momentum drag measurements. External surface pressure coefficients are compared against inviscid analytical predictions from state of the art transonic potential flow codes including non-conservative potential, conservative potential, and Euler solvers. Comparisons are made for free stream Mach numbers in the range of 0.71 to 0.84 and mass flow ratios between 0.54 and 0.80. Viscous predictions from an integral boundary layer technique are compared to measured transition location. Nacelle drag components are compared to an inviscid viscous analysis including pressure drag, additive drag, skin friction drag and total momentum loss. These analyses are shown to accurately predict nacelle drag, and drag trends with flow conditions and contour variations. (Author)

A82-22060 # **Basic studies of the flow fields of airfoil-flap-spoiler systems.** S. Bodapati, K. Karamcheti (Stanford University, Stanford, CA), and M. D. Mack (Boeing Commercial Airplane Co., Seattle, WA). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0173.* 10 p. 6 refs.

Spoilers are used as lateral controls, speed brakes and lift dumpers during various stages of flight. The wakes created by the spoilers interact with horizontal tail and may cause buffet. A theoretical and experimental investigation has been undertaken at Stanford University to study steady and fluctuating flow fields of airfoil-flap-spoiler systems. A series of experiments have been conducted to investigate steady and fluctuating boundary layers, wakes and pressures. The results are being analyzed in conjunction with the unsteady Schlieren photographs and will be reported in different papers. Here a complete investigation relating various aspects including the design philosophy, instrumentation and data acquisition and analysis techniques will be reported and typical results will be discussed. (Author)

A82-22074 * # **High angle-of-attack characteristics of three-surface fighter aircraft.** M. A. Croom, S. B. Grafton, and L. T. Nguyen (NASA, Langley Research Center, Hampton, VA). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0245.* 11 p. 6 refs.

As part of a research program aimed at providing information on the high angle-of-attack characteristics of three-surface fighter concepts incorporating a close-coupled canard, an investigation is being conducted on two specific configurations based on the F-18 and F-15 designs. The study configurations are being subjected to a wide range of tests including wind-tunnel tests, dynamic model tests, and piloted simulation. This paper summarizes the results obtained to date in this study. High-alpha results in the areas of static stability, damping, and control characteristics are reviewed and some of the more significant aerodynamic phenomena are identified. (Author)

A82-22077 * # **Transonic perturbation analysis of wing-fuselage-nacelle-pylon configurations with powered jet exhausts.** J. C. Wai, H. Yoshihara (Boeing Co., Seattle, WA), and W. K. Abeyounis (NASA, Langley Research Center, Hampton, VA). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0255.* 16 p. 8 refs. Research supported by the Boeing Co; Contract No. NAS1-15887.

A transonic small perturbation method has been developed for the analysis of general wing-fuselage-nacelle-pylon configurations with powered jet exhausts. Finite difference successive line relaxation algorithm is used to solve the small disturbance potential equation in conservative form. The nacelle tangency condition and the jet exhaust plume contact conditions are fulfilled in a quasi-cylindrical fashion on a surface fitting the Cartesian grid. The pylon tangency condition is treated in a quasi-planar manner as for the wing. Viscous displacement effects on the wing are modeled by suitable shape changes including the placement of a viscous ramp at the base of the shock. Computed results of a transport configuration show satisfactory correlation with test data. (Author)

A82-22079 # **A simulator assessment of a wide field of view head-up display for presenting a FLIR sensor image during low level navigation and ground attack missions.** R. A. Cooke and J. C. Mabberley (Royal Aircraft Establishment, Flight Systems Dept., Farnborough, Hants., England). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0261.* 5 p.

The paper describes an initial simulator trial which will assess a very wide-angle head-up display and a thermal imaging system optimized for ground attack missions. An air-to-ground simulator developed for the trial is discussed in detail and results of early experiments are presented. It is found that the displayed image, general flight cues, and cockpit environment are realistic in terms of pilot operation and behavior, and thus, the facility described provides a valuable tool for assessing various trade-offs between system configurations and performance. V.L.

A82-22081 * # **Aerodynamic characteristics of airfoils with ice accretions.** M. B. Bragg and G. M. Gregorek (Ohio State University, Columbus, OH). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0282.* 15 p. 19 refs. Grant No. NAG3-28.

Results of a wind tunnel test to evaluate the performance of an airfoil with simulated rime ice are presented with theoretical comparisons. A NACA 65A413 airfoil was tested in the OSU 6 x 22 inch Transonic Airfoil Wind Tunnel at a Reynolds number near three million and Mach numbers from 0.20 to 0.80. The model was tested in four configurations to determine the aero-dynamic effects of the roughness and shape of a rime ice accretion. The simulated rime ice shape was obtained analytically using a time-stepping dry ice accretion computer code. Lift, drag, moment coefficients, and pressure distributions for the clean and simulated rime ice cases are reported. The measured degradation in airfoil performance is compared to an analytical method which uses existing airfoil analysis computer codes with empirical corrections for the surface roughness. A discussion of the empirical surface roughness correction and uses of other airfoil computer methods is included. (Author)

A82-22082 # **A split coefficient/locally monotonic scheme for multishocked supersonic flow.** J. E. Daywitt, D. J. Szostowski (General Electric Co., Re-Entry Systems Div., Philadelphia, PA), and D. A. Anderson (Iowa State University of Science and Technology, Ames, IA). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0287.* 14 p. 27 refs. Research sponsored by the General Electric Co.; Contract No. F04701-78-C-0104.

A new finite difference technique is developed for solving three-dimensional, steady, inviscid, supersonic, equilibrium real-gas flows with embedded shock waves. The technique employs the split coefficient matrix (SCM) method to solve the gasdynamic equations in the form of decoupled compatibility relations. In the SCM technique the coefficient matrices are split according to the sign of their eigenvalues. The derivatives associated with each split coefficient matrix are approximated by one-sided difference operators consistent with signal propagation paths. Results demonstrate that problems of conventional finite difference methods with non-orthogonal grids are alleviated in the SCM approach. In addition, solutions obtained using the SCM technique show that strong cross-flow gradients, including cross-flow shocks, can be accurately computed. To treat flows containing embedded stream-wise shock waves the SCM technique is replaced, at grid points detected to be in the vicinity of a shock, by the monotonic self-adjusting hybrid/artificial compression method (ACM). The governing equations are cast in conservation-law form in the shock-capturing ACM approach with damping terms added to eliminate post-shock oscillations. Stream-wise shocks of sufficient strength to cause conventional shock-capturing methods to fail are resolved using the combined SCM/ACM technique. (Author)

A82-22083 # **Measurements of a three-dimensional boundary layer on a sharp cone at Mach 3.** W. J. Yanta, D. W. Ausherman, and E. R. Hedlund (U.S. Navy, Naval Surface Weapons Center, Silver Spring, MD). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0289.* 11 p. 9 refs. Navy-sponsored research.

Three-dimensional boundary layer measurements were carried out on a 7 deg semi-vertex angle sharp cone for angles of attack of 0, 2 and 4 deg in the NSWC Supersonic Tunnel number 2 at a freestream Reynolds number of 2.3 x 10 to the 6th/ft. (7.0 x 10 to the 5th/m). Included were measurements of the mean U, V, and W velocity components for seven circumferential locations around the body and one axial station. These were obtained using a three-dimensional laser Doppler velocimeter. The flow was investigated in both the viscous and inviscid portions of the flow field, yielding information about the velocity profile behavior in both regions. In addition, skin friction measurements were made with a surface mounted Preston probe at five axial stations along the cone. The effects of angle of attack and body roll position on the three-dimensional boundary layer profiles and skin friction are discussed. (Author)

A82-22091 # **Propulsion system controls design and simulation.** E. Tjonneland and C. M. Carlin (Boeing Military Airplane Co., Seattle, WA). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0322.* 27 p. 11 refs.

A propulsion system real-time simulation facility was developed for the design, analysis, simulation and evaluation of propulsion control systems. The functional requirements for the facility, the implementation of these requirements, and the utilization of the facility in advanced control technology programs is described. A hybrid approach to plant simulation permits realization of the desired levels of portability, flexibility, computational accuracy, and reliability. Control development tools have been integrated into a facility to support the development of digital propulsion control systems as well as their integration with airframe control systems. The success of controls and simulation development depends largely on the attention to the detailed work tasks, and much of the computational technology has already been transferred to automated interactive minicomputer work methods. J.F.

A82-22094 * # **Steady and unsteady nonlinear hybrid vortex method for lifting surfaces at large angles of attack.** O. A. Kandil, L.-C. Chu, and T. Tureaud (Old Dominion University, Norfolk, VA). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0351.* 14 p. 20 refs. Grant No. NsG-1560; Contract No. N62269-80-C-0704.

Steady and unsteady Nonlinear Hybrid Vortex (NHV) method, for low aspect ratio wings at large angles of attack, is developed. The method uses vortex panels with first-order vorticity distribution (equivalent to second-order doublet distribution) to calculate the induced velocity in the near field using closed form expressions. In the far field, the distributed vorticity is reduced to concentrated vortex lines and the simpler Biot-Savart's law is employed. The method is applied to rectangular wings in steady and unsteady flows without any restriction on the order of magnitude of the disturbances in the flow field. The numerical results show that the method accurately predicts the distributed aerodynamic loads and that it is of acceptable computational efficiency. (Author)

A82-22096 * # **Store separation from cavities at supersonic flight speeds.** R. L. Stallings, Jr. (NASA, Langley Research Center, High-Speed Aerodynamics Div., Hampton, VA). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0372.* 6 p. 5 refs.

An experimental investigation has been conducted to determine the aerodynamic characteristics of a typical wing-control missile configuration during separation from a box-type cavity having depth to length ratios (D/L) ranging from 0.088 to 0.225. The cavity was located in a splitter plate that spanned the low Mach number test section of the Langley Unitary Plan Wind Tunnel. Aerodynamic characteristics are presented for Mach 2.36 and a free-stream unit Reynolds number of 2,000,000/ft. For the shallow cavity (D/L = 0.088), large interactions existed between the cavity and the flat plate flow field, which resulted in unfavorable separation characteristics for the missile model. For the deep cavity (D/L = 0.225), the flat plate flow field essentially bridged the cavity, resulting in minor interactions and favorable separation characteristics for the missile model. (Author)

A82-22110 # **Aerodynamic characteristics of maneuvering flaps.** B. Fang, B. Hu, H. Wang, and Y. Zhang (Shengyang Aircraft Corp., People's Republic of China). *Acta Aeronautica et Astronautica Sinica,* vol. 2, Sept. 1981, p. 1-13. In Chinese, with abstract in English.

Results of wind tunnel tests on the effects of aircraft maneuvering flaps are reported, specifically for reducing drag, and for the effects of the flap span, the flap chord, the strake, and the wing planform on the aerodynamics of the maneuvering flap. The matching of leading edge and trailing edge flaps, and the improvement in large angle of attack flying due to the presence of maneuvering flaps are discussed. Maneuvering flaps allow control of the flow separation and decrease drag at large angles of attack, and expand the buffet boundary and decrease the buffet intensity. Methods of incorporating the effects of the maneuvering flaps into the design of the aircraft structure and the control system are indicated. M.S.K.

A82-22111 # **Numerical calculation of lift, moment coefficient and dynamic stability derivatives on sideslipping wings in unsteady supersonic flows.** G. Zhang (Nanjing Aeronautical Institute, Nanjing, People's Republic of China). *Acta Aeronautica et Astronautica Sinica,* vol. 2, Sept. 1981, p. 14-22. In Chinese, with abstract in English.

This paper presents a numerical solution of unsteady supersonic flows for sideslipping wings by means of the characteristic lines network method of unsteady supersonic sources distributed on the wing plane. This paper provides the oscillating mode of undulatory, pitching-and-rolling harmonic oscillations of the wings with sideslip angles, and the methods to calculate its lift, moment coefficient, and dynamic stability derivatives. The dynamic stability derivatives of a typical wing with sideslip angle equal to zero were worked out both by analytical formula in conformity with the conventional quasi-stationary theory and by the present method, and were compared and examined. The results show that the present method is satisfactory. (Author)

A82-22112 # **Numerical computation of unsteady subsonic aerodynamic forces on wing-body-tail exposed to travelling gust.** G. Wen (Beijing University, Beijing, People's Republic of China) and Z. Sun (Air Force Laboratory, People's Republic of China). *Acta Aeronautica et Astronautica Sinica,* vol. 2, Sept. 1981, p. 23-30. In Chinese, with abstract in English.

The effects of unsteady subsonic aerodynamic forces on the wing-body-tail configuration and the interference effects between the components are examined numerically. A small angle of attack and a weak shock is assumed, and a linear method for the moving vortex finite element solution is employed to solve an initial boundary value problem of the wave equation. A set of algebraic equations is solved at each time interval, and numerical calculations are performed for various blast orientations, elevation angles, and different complex planforms. The derived lift coefficients for wing-body configurations are found to match experimental data, while convergence was not obtained for the complex planform for the variations of lift and moment coefficients. M.S.K.

A82-22120 # **The simulation study on a redundant flight control system.** D. Xue (Institute of Automatic Flight Control, People's Republic of China). *Acta Aeronautica et Astronautica*

Sinica, vol. 2, Sept. 1981, p. 84-93. In Chinese, with abstract in English.

The results of a simulation study of a triple redundant flight control system are reported. The system featured the capability of fail-operation and employed three on-line signal selectors, six off-line comparators, and an active standby servomechanism. The signal selector consisted of operational amplifiers, and the triplex system involved the selection of an intermediate voltage transmitted among three input signals. All failure signals were isolated and neglected, while a servo loop was employed to compare a servo model with the active-standby servomechanism. The signal selectors, comparators, and servomechanism provided adequate performance, within the bounds that the active-standby servomechanism be limited to control functions which accept small failure transients. M.S.K.

A82-22198 † **The use of Doppler spectroscopy to study the characteristics of the polydisperse characteristics of emulsion water and solid microimpurities in aviation fuels (Primenenie metoda Doplerovskoi spektroskopii dlia issledovaniia kharakteristik polidispersnosti emul'sionnoi vody i tverdykh mikroprimesei v aviatoplivakh).** A. N. Korolevich, T. V. Oleinik, and A. Ia. Khairullina. *Zhurnal Prikladnoi Spektroskopii,* vol. 35, Dec. 1981, p. 1016-1023. 11 refs. In Russian.

The feasibility of using Doppler spectroscopy to determine drop sizes of emulsion water and particle sizes of solid microimpurities in kerosene flow through a pipe is confirmed. Measured Doppler spectra are used to reconstruct particle size distribution functions for fractions of microparticles beginning with 2 microns. The method makes possible the rapid continuous monitoring of the disperse phase in aviation fuel and may be suitable in the automated analysis of multicomponent disperse media. B.J.

A82-22209 # **Rotating stall in blade rows operating in shear flow.** T. Sekido (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan), I. Sasaki, and H. Takata (Tokyo, University, Tokyo, Japan). *JSME, Bulletin,* vol. 24, Dec. 1981, p. 2074-2081.

The nature of the unsteady small perturbations in a sheared mean flow with a linear velocity profile is investigated. The results are used to analyze the actuator-disk of a rotating stall in three-dimensional blade rows which are placed in cartesian coordinates and are exposed to a spanwise shear flow. It is assumed that the blades have no twist and that the aerofoil section does not vary with radius. The axial velocity is continuous everywhere on the actuator plane, and the exit flow angle is constant as well as independent of both the inlet flow angle and the spanwise position. The total pressure loss is assumed to arise through the blade row, and is related to the flow by the total pressure loss coefficient. It is shown that the three-dimensional effect in shear flow greatly changes the nature of the rotating stall. Spanwise distribution of the disturbances of the rotating stall in shear flow is also examined. J.F.

A82-22222 **Can low-speed jet noise be predicted (Peut-on prédire le bruit d'un jet quelconque de faible fitesse).** J. M. Fitremann (Ecole Nationale Supérieure de Mécanique, Nantes, France). *(Association Aéronautique et Astronautique de France, Colloque d'Acoustique Aéronautique, 7th, Ecole Centrale de Lyon, Ecully, Rhône, France, Nov. 4, 5, 1980.) Revue d'Acoustique,* vol. 14, no. 58, 1981, p. 145-152. 18 refs. In French.

Attempts to analytically define the noise emitted by a turbulent jet and the refraction of noise off the surface of an aircraft are discussed. Modeling turbulent flow for a given geometry is nominally accomplished by applications of theories of radiation and turbulent shear flow, and of three-dimensional refraction phenomena. Turbulent flow is calculated from average flow, energy, dissipation, and time and length scales, with reference to known flows, and by making quadruple correlations; stress, mixed, algebraic, and linear diffusion models are possible. Turbulent spectral quantities are calculated at discrete points volumetrically, and the spatial and temporal characteristics are quantified as the acoustic spectra diverge from the main flow. Inhomogeneous radiation is described by Lighthill's theory. Nonlinear propagation phenomena are quantified in terms of fields of average velocities or densities, of simple or nonlinear, multiple diffusion, for random fluctuations in amplitude and phase, and from spectral broadening of pure frequencies during refraction. M.S.K.

A82-22240 * **Deposit formation in liquid fuels. II - The effect of selected compounds on the storage stability of Jet A turbine fuel.** J. H. Worstell and S. R. Daniel (Colorado School of Mines, Golden, CO). *Fuel,* vol. 60, June 1981, p. 481-484. 30 refs. Grant No. NsG-3122.

The influence of substituted pyridines, pyrroles, indoles, and quinolines on the storage stability of conventional Jet A turbine fuel is evaluated. Significant increases in the amount of deposit formed in accelerated storage tests are found upon addition of these compounds at levels as low as one ppm nitrogen. While the effect is correlated with basicity of the nitrogen compound within a given compound class, the correlation does not hold between classes (pyridines, quinolines, etc.). Steric hindrance at the nitrogen atom greatly inhibits deposit promotion. The characteristics, but not the elemental composition, of deposits vary with the identity of the added nitrogen compound and with deposition temperature. (Author)

A82-22241 * **Deposit formation in liquid fuels. I - Effect of coal-derived Lewis bases on storage stability of Jet A turbine fuel.** K. E. Dahlin, S. R. Daniel, and J. H. Worstell (Colorado School of Mines, Golden, CO). *Fuel,* vol. 60, June 1981, p. 477-480. 24 refs. Grant No. NsG-3122.

The development of reasonably precise techniques for the measurement of storage stability of jet aviation fuel is described. Lewis bases, extracted by ligand-exchange from a coal-derived liquid, are shown to adversely affect storage stability (as determined by an accelerated storage test) when added to Jet A turbine fuel. JFTOT results suggesting slight decreases in thermal stability of fuel 'spiked' (i.e., contaminated with a measured quantity of reagent) with extract are reported. Addition to Jet A turbine fuel of individual heterocyclic nitrogen compounds is shown to produce comparable decreases in storage stability. (Author)

A82-22245 # **Aerodynamic evaluation of winglets for transport aircraft.** J. A. Dahlin (Douglas Aircraft Co., Long Beach, CA). *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 14th, Palo Alto, CA, June 23-25, 1981, Paper 81-1215.* 7 p. 8 refs.

The applications of winglets to new and existing transport aircraft are discussed. The calculation of induced drag of highly nonplanar lifting configurations (i.e. wing/winglet combinations) using the Trefftz-Plane (far-field) method is substantiated. Further, it is established that the method of surface pressure integration to calculate induced drag characteristics is unreliable. A trade study evaluating the effects of winglet dihedral and span on induced drag and wing root-bending-moment characteristics is presented. The effect of wing loading on winglet performance and the resulting implications to existing transport aircraft is discussed. Comparisons of predicted and measured (wind tunnel and flight) induced drag improvements due to winglet and wing-tip extensions are presented for the KC-135 and DC-10 aircraft. (Author)

STAR ENTRIES

N82-16042*# Boeing Vertol Co., Philadelphia, Pa.
PREDESIGN STUDY FOR A MODERN 4-BLADED ROTOR FOR THE NASA ROTOR SYSTEMS RESEARCH AIRCRAFT
H. E. Bishop, J. E. Burkam, R. C. Hemingway, C. N. Keys, K. E. Smith, J. H. Smith, and J. A. Staley Jan. 1981 312 p refs
(Contract NAS2-10689)
(NASA-CR-166153) Avail: NTIS HC A14/MF A01 CSCL 01B

Trade-off study results and the rationale for the final selection of an existing modern four-bladed rotor system that can be adapted for installation on the Rotor Systems Research Aircraft (RSRA) are reported. The results of the detailed integration studies, parameter change studies, and instrumentation studies and the recommended plan for development and qualification of the rotor system is also given. Its parameter variants, integration on the RSRA, and support of ground and flight test programs are also discussed. Author

N82-16043*# Hughes Helicopters, Culver City, Calif.
PRE-DESIGN STUDY FOR A MODERN FOUR-BLADED ROTOR FOR THE ROTOR SYSTEM RESEARCH AIRCRAFT (RSRA) Final Report
Charles W. Hughes and Andrew H. Logan Mar. 1981 140 p refs
(Contract NAS2-10690)
(NASA-CR-166154) Avail: NTIS HC A07/MF A01 CSCL 10A

Various candidate rotor systems were compared in an effort to select a modern four-bladed rotor for the RSRA. The YAH-64 rotor system was chosen as the candidate rotor system for further development for the RSRA. The process used to select the rotor system, studies conducted to mate the rotor with the RSRA and provide parametric variability, and the development plan which would be used to implement these studies are presented. Drawings are included. A.R.H.

N82-16046*# Texas A&M Univ., College Station. Dept. of Aerospace Engineering.
SUMMARY OF THEORETICAL CONSIDERATIONS AND WIND TUNNEL TESTS OF AN AERODYNAMIC SPOILER FOR STALL PROOFING A GENERAL AVIATION AIRPLANE
Howard L. Chevalier Jan. 1982 55 p refs
(Grant NsG-1407)
(NASA-CR-165100) Avail: NTIS HC A04/MF A01 CSCL 01A

An airplane stall proofing system utilizing a spoiler was investigated for application on a low wing airplane representative of typical general aviation aircraft. Tests of the full scale airplane were conducted in the NASA Langley 30 x 60 foot full scale wind tunnel. The test velocity was 86 feet per second, corresponding to a Reynolds number of 2.20 million. The stall proofing capability of the spoiler is shown and a theoretical approach to the design of the spoiler and analysis of the spoiler's contribution to the airplane's trim and longitudinal stability is verified. Controlled spoiler deployment in a narrow angle of attack range, 4 degrees, immediately preceding the stall angle will stall proof the airplane. The results also show some of the limitations of flight tests to determine spoiler deployment rate for good handling qualities. M.G.

N82-16049*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
APPLICATION OF IMAGE PROCESSING TECHNIQUES TO FLUID FLOW DATA ANALYSIS
Charles C. Giamati 1981 16 p Presented at the 11th Ann. Computer Output Microfilm (COMtec) Conf., Lincolnshire, Ill., 24-26 Feb. 1981
(NASA-TM-82760; E-1081) Avail: NTIS HC A02/MF A01 CSCL 01A

The application of color coding techniques used in processing remote sensing imagery to analyze and display fluid flow data is discussed. A minicomputer based color film recording and color CRT display system is described. High quality, high resolution images of two-dimensional data are produced on the film recorder. Three dimensional data, in large volume, are used to generate color motion pictures in which time is used to represent the third dimension. Several applications and examples are presented. System hardware and software is described. M.G.

N82-16050# National Aerospace Lab., Tokyo (Japan).
SOME EXPERIMENTAL INVESTIGATIONS ON TRANSONIC FLUTTER CHARACTERISTICS OF THIN PLATE WING MODELS WITH SWEPTBACK AND TAPERED TIPS
Eiichi Nakai Sep. 1981 49 p refs In JAPANESE; ENGLISH summary
(NAL-TR-682; ISSN-0389-4010) Avail: NTIS HC A03/MF A01

Some experimental investigations on the transonic flutter characteristics were conducted using thin plate cantilevered wing models with sweptback tapered tips, which were elastically supported at the root, in the NAL 0.6m x 0.6m transonic blowdown wind tunnel for flutter testing in the range of Mach numbers from 0.804 to 1.171. The wing models have the tip planform of sweptback angles of 35 degrees at the leading edge and 30 degrees at 1/4 chord line, and an aspect ratio of 1.017 and a taper ratio of 0.6. It is concluded that the flutter boundaries of the wing models have been obtained and the boundaries expressed by the 'experimental flutter speed coefficient' are characterized as having minimum values at around Mach number 1.0. It is also concluded that the considerable increase in the flutter instability area is caused by the decrease in the stiffness of the elastic support at the root of the model. Author

N82-16054# Federal Aviation Administration, Oklahoma City, Okla. Civil Aeromedical Inst.
THE PREVALENCE OF VISUAL DEFICIENCIES AMONG 1979 GENERAL AVIATION ACCIDENT AIRMEN
J. R. Dille and C. F. Booze, Jr. Jul. 1981 10 p refs
(AD-A106489; FAA-AM-81-14) Avail: NTIS HC A02/MF A01 CSCL 01/2

Analyses of the accident experience of pilots who were monocular, did not meet (even the liberal) vision standards, had color vision defects and no operational restrictions, or wore contact lenses, have shown higher-than-expected accident experience in previous studies. However, no causal role had been assigned by accident investigators and reexamination of the records failed to show any obvious pattern or relationship between the defects and the accidents. In the present study of 1979 accidents, the relatively small number of pilots with aphakia and artificial lens implants, as well as the total eye pathology population, had significantly higher accident rates, but the monocular pilots did not. Again, no causal role had been ascribed. Some associations are debatable, but there is no clear recurring problem. There are still unresolved questions about the consistent operational performance of monocular pilots, those who are not fully corrected to 20/20 distant visual acuity bilaterally, airmen with near vision deficiencies only who are not required to wear corrective glasses, those without fusion, and several with appreciable pathology who have 20/20 corrected central visual acuity but about whom we know very little concerning their dynamic, peripheral, depth or accommodative function.
Author (GRA)

N82-16055# Naval Air Development Center, Warminster, Pa. Aircraft and Crew Systems Technology Directorate.
A GENERALIZED ESCAPE SYSTEM SIMULATION COMPUTER PROGRAM: A USER'S MANUAL Final Report
Louis A. DAulerio, Kathleen M. Breakey (Computer Sciences Corp., Huntington Valley, Pa.), Shirley W. Trimble (Computer Sciences Corp., Huntington Valley, Pa.), and Bruce Waldron (Computer Sciences Corp., Huntington Valley, Pa.) Aug. 1981 105 p
(Contract N62269-78-C-0191)
(AD-A106152; NADC-81224-60) Avail: NTIS HC A06/MF A01 CSCL 01/3

The Generalized Escape System Simulation Computer Program was developed to simulate the operation of various ejection seats.

The program generates a three dimensional trajectory of the ejection seat and its occupant, and is intended to be used in the evaluation of ejection seat design and performance. The program is written in FORTRAN IV and is highly structured for ease of modification and updating. This report outlines the steps necessary to succesfully execute the program. Author (GRA)

N82-16056# Army Research and Technology Labs., Fort Eustis, Va. Applied Technology Lab.
TEST AND EVALUATION OF IMPROVED AIRCREW RESTRAINT SYSTEMS
G. T. Singley, III Sep. 1981 352 p refs
(DA Proj. 1L1-62209-AH-76)
(AD-A107576; USAAVRADCOM-TR-81-D-27) Avail: NTIS HC A16/MF A01 CSCL 01/3

US Army aviation accident data shows that a majority of all injuries in attack helicopters could have been avoided if these aircraft had been equipped with crashworthy seat and restraint systems. The compactness of the cockpit and the close proximity of mission equipment to the aircrew in attack and scout helicopters pose serious crash impact hazards. Although not desirable from a crashworthiness standpoint, operational considerations may dictate that mission equipment and structure be located within the occupant's crash impact motion envelope, particularly for his head. The cockpit can be delethalized further when the improved restraint is complemented by padding potential strike surfaces in the cockpit; making contact surfaces frangible; and providing weapon system sights with frangibility, telescoping, and/or swing-away features. This report presents the results of an effort to test and compare the potential of several aircrew restraint systems to reduce the crash impact motion envelope of helicopter aircrewmen. Author (GRA)

N82-16057# Department of Energy, Washington, D. C.
SYMPOSIUM ON COMMERCIAL-AVIATION ENERGY-CONSERVATION STRATEGIES
1981 373 p refs Proceedings of Symp. on Commercial Aviation Energy Conserv. Strategies, Washington, D.C., 2-3 Apr. 1981 Sponsored in part by FAA, Washington, D.C.
(DE81-028406; CONF-8104103) Avail: NTIS HC A16/MF A01

Energy conservation strategies applicable to commercial aviation are presented. General topics discussed include Federal and industry conservation programs such as flight operations, air traffic control, engineering and maintenance, and corporate management strategies. Included is a discussion of possible future actions. DOE

N82-16058# National Transportation Safety Board, Washington, D. C. Bureau of Technology.
SPECIAL INVESTIGATION REPORT. SEARCH AND RESCUE PROCEDURES AND ARMING OF EMERGENCY LOCATOR TRANSMITTER: AIRCRAFT ACCIDENT NEAR MICHIGAN CITY, INDIANA, 7 DECEMBER, 1980
11 Aug. 1981 19 p
(PB81-249427; NTSB-SIR-81-2) Avail: NTIS HC A02/MF A01 CSCL 01B

A special investigation of the circumstances surrounding the crash of a Beechcraft E-90, near Michigan City, Indiana, on December 7, 1980 and of the search and rescue activities following the accident, and the associated operation of the aircraft's emergency locator transmitter (ELT) is presented. As a result of not following proper notification procedures, coordination oversights, and communicaton gaps, the search for the missing aircraft was significantly hampered. The actual crash site was not reached by search personnel until nearly 4 hours after the crash. Some or all of the aircraft's four occupants, who died of hypothermia, probably survived the original crash. Examination of the ELT switch revealed that it was in the OFF position. A rescue could have been effected if the proper authorities had been notified and given the aircraft's last known position. GRA

N82-16059* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SPECTRALLY BALANCED CHROMATIC LANDING APPROACH LIGHTING SYSTEM Patent
Wendell D. Chase, inventor (to NASA) Issued 22 Sep. 1981 10 p Filed 10 Dec. 1976 Supersedes N77-12031 (15 - 03, p 0286)
(NASA-Case-ARC-10990-1; US-Patent-4,291,294; US-Patent-Appl-SN-749420; US-Patent-Class-340-26; US-Patent-Class-244-114R) Avail: US Patent and Trademark Office CSCL 17G

Red warning lights delineate the runway approach with additional blue lights juxtaposed with the red lights such that the red lights are chromatically balanced. The red/blue point light sources result in the phenomenon that the red lights appear in front of the blue lights with about one and one-half times the diameter of the blue. To a pilot observing these lights along a glide path, those red lights directly below appear to be nearer than the blue lights. For those lights farther away seen in perspective at oblique angles, the red lights appear to be in a position closer to the pilot and hence appear to be above the corresponding blue lights. This produces a very pronounced three dimensional effect referred to as chromostereopsis which provides valuable visual cues to enable the pilot to perceive his actual position above the ground and the actual distance to the runway. Official Gazette of the U.S. Patent and Trademark Office

N82-16060*# Analytical Mechanics Associates, Inc., Hampton, Va.
TERMINAL AREA AUTOMATIC NAVIGATION, GUIDANCE, AND CONTROL RESEARCH USING THE MICROWAVE LANDING SYSTEM (MLS). PART 3: A COMPARISON OF WAYPOINT GUIDANCE ALGORITHMS FOR RNAV/MLS TRANSITION Final Report
Samuel Pines Washington NASA Jan. 1982 87 p refs
(Contract NAS1-15116)
(NASA-CR-3512; AMA-81-7) Avail: NTIS HC A05/MF A01 CSCL 17G

The results of an investigation carried out for the Langley Research Center Terminal Configured Vehicle Program are presented. The investigation generated and compared three path update algorithms designed to provide smooth transition for an aircraft guidance system from DME, VORTAC, and barometric navaids to the more precise MLS by modifying the desired 3-D flight path. The first, called the Zero Cross Track, eliminates the discontinuity in cross track and altitude error by designating the first valid MLS aircraft position as the desired first waypoint, while retaining all subsequent waypoints. The discontinuity in track angle is left unaltered. The second, called the Tangent Path also eliminates the discontinuity in cross track and altitude and choose a new desired heading to be tangent to the next oncoming circular arc turn. The third, called the Continued Track eliminates the discontinuity in cross track, altitude and track angle by accepting the current MLS position and track angle as the desired ones and recomputes the location of the next waypoint. A method is presented for providing a waypoint guidance path reconstruction which treats turns of less than, and greater than, 180 degrees in a uniform manner to construct the desired path. Author

N82-16063# Lincoln Lab., Mass. Inst. of Tech., Lexington.
ATCRBS UPLINK ENVIRONMENT MEASUREMENT NEAR JACKSONVILLE, FLORIDA
F. Nagy, Jr. 25 Sep. 1981 124 p
(Contracts F19638-80-C-0002; DOT-FA72WAI-261; FAA Proj. 052-241-04)
(AD-A108053; ATC-94; FAA-RD-80-70) Avail: NTIS HC A06/MF A01 CSCL 17/7

Airborne measurements of the Air Traffic Control Radar Beacon System (ATCRBS) 1030 MHz uplink environment are described. Measurements were made using the AMF, a special purpose airborne sensor-recorder, during a 23 May 1979 flight in the greater Jacksonville, Florida area. The 2-way flight covered the 450 nm coastline between Fayetteville (NC) and Vero Beach (FL) first at 10,000 then at 25,000 feet. Data recorded at 61 locations have been analyzed to plot combined pulse, interrogation and suppression rates for all locations and individual rates, received powers and angles for 37 locations. Fifty-nine ground interrogators were detected and a list included serves as an all-interrogator/all location (59 x 37) visibility matrix. PRI/PRF distributions of interrogations received are shown at three selected measurement locations. A pulse-by-pulse plot of over 50 Mode 4 interrogations shows their effect on a typical transponder. A worst location is examined for peak instantaneous interrogation rates capable of causing transponder reply-rate limiting (RRL), desensitization and track loss. Durations and periods of recurrence of synchronous jamming for 23 near-equal scan periods are computed. Probabilities or multiple mainbeam coincidences (multi-PRF jamming) are also calculated. Airborne (AMF) and ground based (FAA En-route) coverages are compared, and reported operational problems (target splits, lost tracks, poor coverage) are addressed. Author

N82-16067# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
AIRCRAFT POSITION MEASUREMENT USING LASER BEACON OPTICS M.S. Thesis - Princeton Univ.
Steven G. Webb 1981 107 p refs
(AD-A107973; AFIT-CI-81-58T) Avail: NTIS HC A06/MF A01 CSCL 17/7

The development of a system to precisely measure the relative position between two aircraft in-flight utilizing a laser beacon, an optical detector array, and on-board microprocessing is examined. The laser beacon board, mounted on the helicopter, consists of two orthogonal fan-shaped narrow width beams, which rotate at a constant four revolutions per second and have fields of view approaching 166 degrees. The photodiode transmits the detected beams, as pulses, to an electronics system where they pass through a band-pass filter and are converted into digital pulses for signal processing. The laser pulses are detected in the presence of background solar interference through optical spectral filtering of the incident light and electronic filtering of the photodiode signal. Initial tests of the laser beacon and the detector optics have demonstrated the potential for their use as elements of a relative position measurement system. GRA

N82-16068*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SPIN TESTS OF A SINGLE-ENGINE, HIGH-WING LIGHT AIRPLANE
Eric C. Stewart, William T. Suit, Thomas M. Moul, and Philip W. Brown Jan. 1982 93 p refs
(NASA-TP-1927; L-14305) Avail: NTIS HC A05/MF A01 CSCL 01C

The airplane has a relatively steep spin mode (low angle of attack) with a high load factor and high velocity. The airplane recovers almost immediately after any deviation from the prospin control positions, except for one maneuver with reduced flexibility in the elevator control system. T.M.

N82-16069*# Nielsen Engineering and Research, Inc., Mountain View, Calif.
INTEGRATION OF A CODE FOR AEROELASTIC DESIGN OF CONVENTIONAL AND COMPOSITE WINGS INTO ACSYNT, AN AIRCRAFT SYNTHESIS PROGRAM Final Report, 1972 - 1974
Joseph Mullen, Jr. Ames Research Center, Calif. NASA May 1976 143 p refs
(Contract NAS2-8558)
(NASA-CR-137805) Avail: NTIS HC A07/MF A01 CSCL 01C

A comparison of program estimates of wing weight, material distribution, structural loads and elastic deformations with actual Northrop F-5A/B data is presented. Correlation coefficients obtained using data from a number of existing aircraft were computed for use in vehicle synthesis to estimate wing weights. The modifications necessary to adapt the WADES code for use in the ACSYNT program are described. Basic program flow and overlay structure is outlined. An example of the convergence of the procedure in estimating wing weights during the synthesis of a vehicle to satisfy F-5 mission requirements is given. A description of inputs required for use of the WADES program is included. T.M.

N82-16070*# Lockheed-Georgia Co., Marietta.
TURBOPROP CARGO AIRCRAFT SYSTEMS STUDY
J. C. Muehlbauer, J. G. Hewell, Jr., S. P. Lindenbaum, C. C. Randall, N. Searle, and R. G. Stone, Jr. Nov. 1981 232 p refs
(Contract NAS1-15708)
(NASA-CR-165813; LG81ER0222) Avail: NTIS HC A11/MF A01 CSCL 01C

The effects of using advanced turboprop propulsion systems to reduce the fuel consumption and direct operating costs of cargo aircraft were studied, and the impact of these systems on aircraft noise and noise prints around a terminal area was determined. Parametric variations of aircraft and propeller characteristics were investigated to determine their effects on noiseprint areas, fuel consumption, and direct operating costs. From these results, three aircraft designs were selected and subjected to design refinements and sensitivity analyses. Three competitive turbofan aircraft were also defined from parametric studies to provide a basis for comparing the two types of propulsion. S.L.

N82-16071# Aeronautical Research Labs., Melbourne (Australia).
RESONANCE TESTS ON A PIPER PA-32R TAILPLANE BEFORE AND AFTER DAMAGE Technical Memo, Feb. - Jul. 1980
A. Goldman and B. Quinn Apr. 1981 16 p ref
(AD-A106273; ARL/STRUC-TM-328) Avail: NTIS HC A02/MF A01 CSCL 01/3

Investigations have been carried out, on the tailplane of a Piper PA-32R aircraft, to determine the effect of damage, in the form of a split in the underside skin, on the modes of vibration of the tailplane. Details and results of the investigations are described. Author (GRA)

N82-16072# Rockwell International Corp., El Segundo, Calif. Aircraft Div.
CONFIGURATION DEVELOPMENT SYSTEM/NAVAIR REPORT Final Report
Daniel Paul Raymer 26 May 1981 8 p
(Contract N00019-80-C-0489)
(AD-A106727; NA-81-290) Avail: NTIS HC A02/MF A01 CSCL 01/3

A fixed price level of effort was performed to install Rockwell's Configuration Development System (CDS) at the Naval Air Systems Command (NAVAIR) facility in Washington, D.C. (Crystal City). Installation of CDS permits NAVAIR the capability to conceptually design aircraft concepts on an interactive graphics terminal and also perform conceptual analysis and concept iteration. Under the contract, the CDS system was converted to run on a VAX 11-780 computer. Program modifications were implemented to allow a greater degree of device-independence, especially for terminal input/output. Also, the CDS program was tested and debugged, the command interpreter was improved, and some additional capabilities were developed. The manual was rewritten including the addition of training materials for classroom and hands-on instruction. Finally, the system was installed and users were trained. Author (GRA)

N82-16073# Aeronautical Research Labs., Melbourne (Australia).
GROUND CALIBRATION OF A STRAIN-GAUGED CT-4A AIRCRAFT (1979)
R. P. Carey and S. P. Costolloe Apr. 1981 53 p refs
(AD-A107847; ARL/SRUC-TM-330) Avail: NTIS HC A04/MF A01 CSCL 01/3

A strain gauged CT-4A aircraft was calibrated for external loadings as a supplement to flight testing. The loading has been described and the outputs from regression analyses on the strain/load data have been tabulated. Author (GRA)

N82-16074# Army Aviation Engineering Flight Activity, Edwards AFB, Calif.
ICE PHOBICS BLADE TRACKING AND COMPARISON OF VIBRATION ANALYSIS TECHNIQUES Final Report, Jun. 1979 - Mar. 1980
William Y. Abbott, Floyd I. Dominick, and Stuart Arthur May 1981 64 p refs
(AD-A108121; USAAEFA-79-86) Avail: NTIS HC A04/MF A01 CSCL 01/3

The United States Army Aviation Engineering Flight Activity conducted an evaluation of two vibration measuring devices, the Chadwick-Helmuth VIBREX and the Scientific-Atlanta Vibration Signature Recorder, as flight test instrumentation. During the course of those evaluations, it was determined that the Dow Corning E2460-40-1 (redesignated E2978-46) ice phobic coating applied to the rotor blades of a UH-1H helicopter, did not induce undesirable vibrations. It was also concluded that the VIBREX may be used as test instrumentation if the frequencies of interest are already known, and the Scientific-Atlanta device provides good 'quick look' spectral vibration data. Author (GRA)

N82-16075* National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.
SYSTEM FOR PROVIDING AN INTEGRATED DISPLAY OF INSTANTANEOUS INFORMATION RELATIVE TO AIRCRAFT ATTITUDE, HEADING, ALTITUDE, AND HORIZONTAL SITUATION Patent
Robert James, inventor (to NASA) (James and Associates, Lancaster, Calif.) Issued 11 Aug. 1981 19 p Filed 30 May 1979 Supersedes N79-24988 (17 - 16, p 2074) Sponsored by NASA
(NASA-Case-FRC-11005-1; US-Patent-4,283,705; US-Patent-Appl-SN-043942; US-Patent-Class-340-27NA;

US-Patent-Class-73-178R) Avail: US Patent and Trademark Office CSCL 01D

A display device is disclosed which is particularly suited for providing the pilot of an aircraft with combined inflight altitude, heading, altitude, and horizontal situation information previously available only by using two or three devices providing separate displays. The preferred embodiment combines a commonly used and commercially available flight director-type device for providing a display in combination with a miniature aircraft supported for angular displacement from a vertical orientation to indicate heading error, or heading offset, and an extended course deviation indicator bar which projects into juxtaposition with the miniature aircraft for providing a true picture of the aircraft's horizontal situation relative to a selective VOR, ILS, or MLS course.

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

N82-16076*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

THREAT PERCEPTION WHILE VIEWING SINGLE INTRUDER CONFLICTS ON A COCKPIT DISPLAY OF TRAFFIC INFORMATION

Stephen R. Ellis and Everett Palmer Jan. 1982 17 p refs

(NASA-TM-81341; A-8798) Avail: NTIS HC A02/MF A01 CSCL 01D

Subjective estimates of the threat posed by a single intruder aircraft were determined by showing pilots photographs of a cockpit display of traffic information. The time the intruder was away from the point of minimum separation was found to be the major determinant of the perception of threat. When asked to choose a maneuver to reduce the conflict, pilots selected maneuvers with a bias toward those that would have kept the intruders in sight had they been visible out the cockpit window.

Author

N82-16077# Boeing Commercial Airplane Co., Seattle, Wash.

AIRCRAFT ALERTING SYSTEMS STANDARDIZATION STUDY. VOLUME 2: AIRCRAFT ALERTING SYSTEM DESIGN GUIDELINES Final Report

B. L. Berson, D. A. Po-Chedley, G. P. Boucek, D. C. Hanson, M. F. Leffler, and R. L. Wasson Jan. 1981 186 p refs

(Contract DOT-FA79WA-4268)

(AD-A106732; D6-49976TN; FAA-RD-81-38-vol-2) Avail: NTIS HC A09/MF A01 CSCL 01/4

This report is one of a series of documented studies directed to the improvement and standardization of aircraft alerting systems. The purpose of the study was to develop and validate, through simulation, functional design criteria that can be used in designing effective aircraft alerting systems. The major objectives of this phase of the study were to: resolve system component questions; validate the two candidate system/concepts by comparison to a representative baseline system, for both the pilot and flight engineer stations; evaluate presentation media and display formats for time-critical warnings; and develop guidelines for the design of alerting systems. This document presents a set of design guidelines directed to the improvement and standardization of aircraft alerting systems. The objective of the guidelines is not to define a simple hardware design that each manufacturer must use, but rather to provide functional design criteria that can be used to develop effective alerting systems, and to promote standardization within the industry.

GRA

N82-16079# TRW Defense and Space Systems Group, Redondo Beach, Calif.

DIGITAL AVIONICS INFORMATION SYSTEM (DAIS): DEVELOPMENT AND DEMONSTRATION Final Report, 1 Oct. 1978 - 31 Jul. 1981

M. J. Cook, R. C. Mason, J. L. Stautberg, L. E. Self, R. L. Ellison, and M. J. Strathman Wright-Patterson AFB, Ohio AFWAL Sep. 1981 201 p

(Contract F33615-78-C-1502; AF Proj. 2052)

(AD-A107906; AFWAL-TR-81-1165) Avail: NTIS HC A10/MF A01 CSCL 09/2

The Digital Avionics Information System (DAIS) represents a significant advance in the technology of avionics system architecture. DAIS is a total systems concept, exploiting standardization, modularity, and application independent executive software to provide a system architecture adaptable to many aircraft, missions, and avionics configurations and fully capable of accommodating new advances in technology. These fundamental system characteristics are described in this report; the specific system features which provide these characteristics and attributes are presented.

GRA

N82-16080*# United Technologies Research Center, East Hartford, Conn.

RESEARCH AND DEVELOPMENT PROGRAM FOR NON-LINEAR STRUCTURAL MODELING WITH ADVANCED TIME-TEMPERATURE DEPENDENT CONSTITUTIVE RELATIONSHIPS Final Report

Kevin P. Walker 25 Nov. 1981 187 p refs

(Contract NAS3-22055)

(NASA-CR-165533; PWA-5700-50) Avail: NTIS HC A09/MF A01 CSCL 21E

Results of a 20-month research and development program for nonlinear structural modeling with advanced time-temperature constitutive relationships are reported. The program included: (1) the evaluation of a number of viscoplastic constitutive models in the published literature; (2) incorporation of three of the most appropriate constitutive models into the MARC nonlinear finite element program; (3) calibration of the three constitutive models against experimental data using Hastelloy-X material; and (4) application of the most appropriate constitutive model to a three dimensional finite element analysis of a cylindrical combustor liner louver test specimen to establish the capability of the viscoplastic model to predict component structural response.

M.D.K.

N82-16081*# Pratt and Whitney Aircraft Group, East Hartford, Conn.

STUDY OF CONTROLLED DIFFUSION STATOR BLADING. 1. AERODYNAMIC AND MECHANICAL DESIGN REPORT

E. Canal, B. C. Chisholm, D. Lee, and D. A. Spear Jan. 1981 97 p refs

(Contract NAS3-22008)

(NASA-CR-165500; PWA-5698-28) Avail: NTIS HC A05/MF A01 CSCL 21E

Pratt & Whitney Aircraft is conducting a test program for NASA in order to demonstrate that a controlled-diffusion stator provides low losses at high loadings and Mach numbers. The technology has shown great promise in wind tunnel tests. Details of the design of the controlled diffusion stator vanes and the multiple-circular-arc rotor blades are presented. The stage, including stator and rotor, was designed to be suitable for the first-stage of an advanced multistage, high-pressure compressor.

Author

N82-16083*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

COMPARISON OF ACOUSTIC DATA FROM A 102 MM CONIC NOZZLE AS MEASURED IN THE RAE 24-FOOT WIND TUNNEL AND THE NASA AMES 40- BY 80-FOOT WIND TUNNEL

A. Atencio, Jr. and J. McKie (Royal Aircraft Establishment, England) Jan. 1982 23 p refs

(NASA-TM-81343; A-8801) Avail: NTIS HC A02/MF A01 CSCL 21E

A cooperative program between the Royal Aircraft Establishment (RAE), England, and the NASA Ames Research Center was initiated to compare acoustic measurements made in the RAE 24-foot wind tunnel and in the Ames 40- by 80-foot wind tunnel. The acoustic measurements were made in both facilities using the same 102 mm conical nozzle supplied by the RAE. The nozzle was tested by each organization using its respective jet test rig. The mounting hardware and nozzle exit conditions were matched as closely as possible. The data from each wind tunnel were independently analyzed by the respective organization. The results from these tests show good agreement. In both facilities, interference with acoustic measurement is evident at angles in the forward quadrant.

Author

N82-16084*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

NASA RESEARCH ACTIVITIES IN AEROPROPULSION

John F. McCarthy, Jr. and Richard J. Weber 1982 30 p refs

Presented at the 24th Ann. Conf. on Aviation and Astronautics, Tel Aviv, Israel, 17-18 Feb. 1982

(NASA-TM-82788; E-1113) Avail: NTIS HC A03/MF A01 CSCL 21E

NASA is responsible for advancing technologies related to air transportation. A sampling of the work at NASA's Lewis Research Center aimed at improved aircraft propulsion systems is described. Particularly stressed are efforts related to reduced noise and fuel consumption of subsonic transports. Generic work in specific disciplines are reviewed including computational analysis, materials, structures, controls, diagnostics, alternative fuels, and high-speed propellers. Prospects for variable cycle engines are also discussed. Author

N82-16085# Ford Motor Co., Dearborn, Mich.

BRITTLE MATERIALS DESIGN, HIGH TEMPERATURE GAS TURBINE Final Report, 1 Jul. 1971 - 31 Aug. 1979

Arthur F. McLean and Eugene A. Fisher Mar. 1981 232 p refs

(Contract DAAG46-71-C-0162; DARPA Order 1849)

(AD-A106670; AMMRC-TR-81-14) Avail: NTIS HC A11/MF A01 CSCL 21/5

A goal of 200 hours of engine rig demonstrations for representative duty cycle temperatures in a regenerated vehicular gas turbine was chosen, with uncooled ceramic components to operate at least 25 hours at 2500 F, beyond the temperatures possible with uncooled metal components. The total systems approach included major efforts in ceramic design, materials development, fabrication process development, and test and evaluation methodology. Progress was made in each of these areas during the course of the program. For example, the strength of reaction bonded silicon nitride (RBSN) used in the stator and rotor blades was more than tripled. By the end of the program, 200 hours of duty cycle durability on turbine test rigs (between 1930 F - 2500 F) was attained on RBSN stationary components including stators, nose cones and turbine rotor tip shrouds. Similarly, 200 hours of duty cycling on test rigs was attained with reaction sintered SiC combustors and stators. GRA

N82-16086# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio. Turbine Engine Div.

A COMPUTER PROGRAM FOR VARIABLE-GEOMETRY SINGLE-STAGE AXIAL COMPRESSOR TEST DATA ANALYSIS (UD0400) Interim Report, 1 Jun. 1980 - 31 May 1981

C. Herbert Law Sep. 1981 147 p refs

(AF Proj. 2307)

(AD-A106676; AFWAL-TR-81-2078) Avail: NTIS HC A07/MF A01 CSCL 21/5

This report describes a computer program that is designed for the analysis of single-stage axial compressor data. The axisymmetric flow of a thermally perfect compressible fluid is assumed, and the streamline curvature method of solution is employed. Details of the blade geometry may be computed or input, and a detailed account of the flow through the blading may be obtained. The analysis is limited to a single-stage compressor, but inlet guide vanes may be included. Variable geometry is permitted in both the inlet guide vanes and the stator vanes. An option in the analysis is to match computed and experimental static pressures at any radius by varying annulus blockage or relative flow deviation angles. Author (GRA)

N82-16087*# Analytical Mechanics Associates, Inc., Mountain View, Calif.

AN INVESTIGATION OF AUTOMATIC GUIDANCE CONCEPTS TO STEER A VTOL AIRCRAFT TO A SMALL AVIATION FACILITY SHIP

J. A. Sorensen, T. Goka, A. V. Phatak, and S. F. Schmidt Jul. 1980 253 p refs

(Contract NAS2-10288)

(NASA-CR-152407) Avail: NTIS HC A12/MF A01 CSCL 01C

A detailed system model of a VTOL aircraft approaching a small aviation facility ship was developed and used to investigate several approach guidance concepts. A preliminary analysis of the aircraft-vessel landing guidance requirements was conducted. The various subelements and constraints of the flight system are described including the landing scenario, lift fan aircraft, state rate feedback flight control, MLS-based navigation, sea state induced ship motion, and wake turbulence due to wind-over-deck effects. These elements are integrated into a systems model with various guidance concepts. Guidance is described in terms of lateral, vertical, and longitudinal axes steering modes and approach and landing phases divided by a nominal hover (or stationkeeping) point defined with respect to the landing pad. The approach guidance methods are evaluated, and the two better steering concepts are studied by both single pass and Monte Carlo statistical simulation runs. Four different guidance concepts are defined for further analysis for the landing phase of flight. J.M.S.

N82-16088*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

AUTOMATION OF ON-BOARD FLIGHTPATH MANAGEMENT

Heinz Erzberger Dec. 1981 22 p refs

(NASA-TM-84212; A-8809) Avail: NTIS HC A02/MF A01 CSCL 07C

The status of concepts and techniques for the design of onboard flight path management systems is reviewed. Such systems are designed to increase flight efficiency and safety by automating the optimization of flight procedures onboard aircraft. After a brief review of the origins and functions of such systems, two complementary methods are described for attacking the key design problem, namely, the synthesis of efficient trajectories. One method optimizes en route, the other optimizes terminal area flight; both methods are rooted in optimal control theory. Simulation and flight test results are reviewed to illustrate the potential of these systems for fuel and cost savings. J.M.S.

N82-16089*# Kansas Univ. Center for Research, Inc., Lawrence. Flight Research Lab.

A PROGRAM TO EVALUATE A CONTROL SYSTEM BASED ON FEEDBACK OF AERODYNAMIC PRESSURE DIFFERENTIALS Final Report

David W. Levy, Paul Finn, and Jan Roskam Dec. 1981 205 p refs

(Grant NAG4-5)

(NASA-CR-163466; KU-FRL-490-2) Avail: NTIS HC A10/MF A01 CSCL 01C

The use of aerodynamic pressure differentials to position a control surface is evaluated. The system is a differential pressure command loop, analogous to a position command loop, where the surface is commanded to move until a desired differential pressure across the surface is achieved. This type of control is more direct and accurate because it is the differential pressure which causes the control forces and moments. A frequency response test was performed in a low speed wind tunnel to measure the performance of the system. Both pressure and position feedback were tested. The pressure feedback performed as well as position feedback implying that the actuator, with a break frequency on the order of 10 Rad/sec, was the limiting component. Theoretical considerations indicate that aerodynamic lags will not appear below frequencies of 50 Rad/sec, or higher. S.L.

N82-16090*# Goodyear Aerospace Corp., Akron, Ohio.

STUDY OF GROUND HANDLING CHARACTERISTICS OF A MARITIME PATROL AIRSHIP Contractor Final Report, Oct. 1980 - Mar. 1981

Mar. 1981 280 p refs

(Contract NAS2-10448)

(NASA-CR-166253; GER-16948) Avail: NTIS HC A13/MF A01 CSCL 01E

Mooring concepts appropriate for maritime patrol airship (MPA) vehicles are investigated. The evolution of ground handling systems and procedures for all airship types is reviewed to ensure that appropriate consideration is given to past experiences. A tri-rotor maritime patrol airship is identified and described. Wind loads on a moored airship and the effects of these loads on vehicle design are analyzed. Several mooring concepts are assessed with respect to the airship design, wind loads, and mooring site considerations. Basing requirements and applicability of expeditionary mooring also are addressed. Author

N82-16091*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

CALIBRATION OF THE AMES ANECHOIC FACILITY. PHASE 1: SHORT RANGE PLAN Final Report, Dec. 1980

David Hickey, Paul T. Soderman, K. Karamcheti, S. P. Koutsoyannis, R. Hopkins, and B. McLachlan Dec. 1980 129 p refs

Prepared in cooperation with Stanford Univ., Calif.

(NASA-TM-84081) Avail: NTIS HC A07/MF A01 CSCL 14B

A calibration was made of the acoustic and aerodynamic characteristics of a small, open-jet wind tunnel in an anechoic room. The jet nozzle was 102 mm diameter and was operated subsonically. The anechoic-room dimensions were 7.6 m by 5.5 m by 3.4 m high (wedge tip to wedge tip). Noise contours in the chamber were determined by various jet speeds and exhaust collector positions. The optimum nozzle/collector separation from an acoustic standpoint was 2.1 m. Jet velocity profiles and turbulence levels were measured using pressure probes and hot wires. The jet was found to be symmetric, with no unusual characteristics. The turbulence measurements were hampered by oil mist contamination of the airflow. Author

N82-16092*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
RESEARCH THROUGH SIMULATION
James L. Copeland, comp. [1982] 30 p refs
(NASA-Facts-125) Avail: NTIS HC A03/MF A01 CSCL 14B
The design of the computer operating system at Langley Research Center allows for concurrent support of time-critical simulations and background analytical computing on the same machine. Signal path interconnections between computing hardware and flight simulation hardware is provided to allow up to six simulation programs to be in operation at one time. Capabilities and research applications are discussed for the: (1) differential maneuvering simulator; (2) visual motion simulator; (3) terminal configured vehicle simulator; (4) general aviation aircraft simulator; (5) general purpose fixed based simulator; (6) transport simulator; (7) digital fly by wire simulator; (8) general purpose fighter simulator; and (9) the roll-up cockpit. The visual landing display system and graphics display system are described and their simulator support applications are listed. A.R.H.

N82-16093# Southwest Research Inst., San Antonio, Tex. Mobile Energy Div.
DEVELOPMENT OF THE AUTOMATED AFAPL ENGINE SIMULATOR TEST FOR LUBRICANT EVALUATION Final Technical Report, 1 May 1978 - 1 Jan. 1981
B. B. Baber, M. L. Valtierra, and J. E. Eichelberger Wright-Patterson AFB, Ohio AFWAL May 1981 104 p refs
(Contract F33615-78-C-2012; AF Proj. 3048)
(AD-A106128; SWRI-MED-119; AFWAL-TR-81-2022) Avail: NTIS HC A06/MF A01 CSCL 14/2
A description of an automated gas turbine engine simulator, designated the AFAPL engine simulator, and a discussion of the test results obtained using the simulator are presented. The No. 4-5 bearing compartment areas of a J57 turbine engine are used as the basic hardware for the simulator. The simulator is driven by a variable-speed drive system, through the accessory drive gearbox, providing simulator mainshaft speeds up to 10,000 rpm. Electrical resistance heaters are used to heat the air surrounding the oil-wetted areas within the No. 4-5 bearing compartment areas. The temperatures, pressures, and rpm are automatically controlled at predetermined levels and monitored throughout the 9120-6000 rpm speed cycling sequences and the soakback periods by a Hewlett-Packard mini-computer system, which is also programmed to automatically draw 5-hr interval test-oil samples, control test-oil sump level, provide safety shut-off protection, as well as print out and plot test information generated during each individual test. Simulator results obtained on eight turbine engine lubricants, for which full-scale engine data are available, show a very good correlation of the deposit ratings obtained using the AFAPL engine simulator and the deposit ratings from full-scale engine tests. Author (GRA)

N82-16094# Florida Inst. of Tech., Melbourne. Dept. of Electrical and Computer Engineering.
IMPLEMENTATION OF THE RECOMMENDATIONS MADE ON THE TECHNICAL REPORT TITLED ANALYSIS OF ADVANCED SIMULATOR FOR PILOT TRAINING Final Report
Jonn Hadjilogiou Jun. 1981 111 p
(Grant AF-AFOSR-0120-81; AF Proj. 2313)
(AD-A106779; AFOSR-81-0704TR) Avail: NTIS HC A06/MF A01 CSCL 14/2
This study which was conducted to implement some of the recommendations made on the technical report titled 'Analysis of Advanced Simulator for Pilot Training'. The final report specify guidelines for writing custom micro-programs routine for the 32/75 computer. It includes the hardware feature of the digital system with special emphasis on micro-program control section. The micro-instruction format is analyzed in detail to allow the reader to follow the example of the SEL report reproduced on the Appendices. GRA

N82-16095# Aeronautical Research Labs., Melbourne (Australia).
PROGRAMS FOR THE TRANSONIC WIND TUNNEL DATA PROCESSING INSTALLATION. PART 9: PRESSURE MEASUREMENTS UPDATED
J. B. Willis May 1981 16 p refs
(AD-A106271; ARL/AERO-TM-329) Avail: NTIS HC A02/MF A01 CSCL 09/2
It is now ten years since the original pressure measurement program for the transonic wind tunnel PDP 8/I data processing installation was written. During this period considerable changes have been made, and this memorandum describes the current program. Author (GRA)

N82-16096# Aeronautical Research Labs., Melbourne (Australia).
CURRENT PRESSURE MEASURING SYSTEM IN THE TRANSONIC WIND TUNNEL
J. B. Willis May 1981 16 p ref
(AD-A106272; ARL/AERO-TM-328) Avail: NTIS HC A02/MF A01 CSCL 14/2
A simple system for wind tunnel pressure measurements is described. It is intended for use with Scanivalves, a minicomputer and stagger scans at a preset, variable rate. The scan may be started and stopped under program control, and all Scanivalves are automatically homed at the end of the computer initiated scan. Scanivalve number, port number, and four digits representing the measured pressure are displayed and provided for the minicomputer. Author (GRA)

N82-16097# Aeronautical Research Labs., Melbourne (Australia).
A VERSATILE DATA ACQUISITION SYSTEM FOR A LOW SPEED WIND TUNNEL
W. F. L. Sear, C. W. Sutton, and J. F. Harvey Nov. 1980 54 p
(AD-A106269; ARL/AERO-155; AR-002-248) Copyright. Avail: Issuing Activity CSCL 14/2
A data acquisition system for the Aeronautical Research Laboratories Low Speed Wind Tunnel is described. The system is versatile and simple to operate. Illuminated press button switches connect selected data sources with the addresses automatically generated within the system. Provision also exists for external addressing by a dedicated minicomputer. Author (GRA)

N82-16099# Tactical Air Warfare Center, Eglin AFB, Fla.
QOT AND E OF THE F-16 20MM AMMUNITION LOADING SYSTEM'S ABILITY TO UPLOAD/DOWNLOAD A-7D AIRCRAFT Final Report
27 Oct. 1981 8 p
(AD-A108007) Avail: NTIS HC A02/MF A01 CSCL 19/1
The purpose of this qualification operational test and evaluation (QOT and E) was to evaluate the ability of the F-16 20mm ALS to upload/download A-7D aircraft. Testing included uploading/downloading of 20mm ammunition on A-7D aircraft during normal day-to-day operations and during simulated combat conditions. A portion of the test was conducted with load crews wearing chemical warfare defense ensembles (CWDE). Specific Objectives are: Operational Effectiveness - to assess the capability of the F-16 ALS to upload/download ammunition into/from the A-7D aircraft; to assess the interoperability of the ALS with both the A-7D gun system and the modified replenisher, and to assess the capability of the modified replenisher to replenish the loader. Operational Suitability - Specific suitability objectives were not evaluated during this test. On site observations of some suitability areas (equipment failures, technical data, human factors, and chemical defense) were performed. GRA

N82-16100# Transportation Research Board, Washington, D.C. Commission on Sociotechnical Systems.
AIR SERVICE, AIRPORT ACCESS AND FUTURE TECHNOLOGY
Samuel Ewer Eastman, Frank LaMagna, Edward M. Whitlock, Mark Gorstein, and Richard Tilles 1981 60 p refs
(PB82-105958; TRB/TRR-803; ISBN-0-309-03717-2; ISSN-0361-1981; LC-81-14158) Avail: NTIS HC A04/MF A01; paper copy also available from Transportation Research Board, 2101 Constitution Ave., NW, Washington, D.C. 20418 CSCL 01B
Contents: (1) economic regulation of air service to small communities: origins of Airline Deregulation Act of 1978; (2) response to terminal access problems at American and United Airlines--John F. Kennedy International Airport; (3) automating the delivery of ground transportation information; (4) airport access--case study of a remote terminal operation; (5) airport geometric compatibility of future aircraft; (6) flight simulators; (7) gravitational-cueing system--an enhancement of aircraft flight simulation; and (8) laser system for visual simulation. GRA

N82-16176*# TRW, Inc., Cleveland, Ohio.
FABRICATION OF BORON/ALUMINUM FAN BLADES FOR SCR ENGINES Final Report, Jun. 1976 - Jun. 1980
G. S. Doble Mar. 1981 49 p refs
(Contract NAS3-20360)

(NASA-CR-165294; ER-7891-F) Avail: NTIS HC A03/MF A01 CSCL 11D

The fabrication of boron/aluminum fan blades for the F-404 Supersonic Cruise Research prototype engine by rapid air bonding of fully dense monotapes is described, and the fan blades evaluated. The F-404 configuration is representative of a low aspect ratio advanced design blade with supersonic capability. Dovetail pull tests of this geometry, which substituted boron/aluminum for titanium, suggested that excessive shear stresses were present in the root. A re-designed blade, incorporating a titanium tang and root, was fabricated by hot isostatic pressing. Blades appeared well bonded but the airfoil contained sizable areas of deformation and identification from the alumina grain used as a pressure transmitting medium. The use of hot isostatic pressing with a formed steel encapsulator should eliminate this problem. J.D.H.

N82-16178*# Boeing Commercial Airplane Co., Seattle, Wash.
ENVIRONMENTAL EXPOSURE EFFECTS ON COMPOSITE MATERIALS FOR COMMERCIAL AIRCRAFT ***Interim*** **Technical Report, Nov. 1977 - Jul. 1981**
Martin N. Gibbins and Daniel J. Hoffman Washington NASA Jan. 1982 129 p refs
(Contract NAS1-15148)
(NASA-CR-3502; D6-51227) Avail: NTIS HC A07/MF A01 CSCL 11D

The effects of environmental exposure on composite materials are studied. The environments considered are representative of those experienced by commercial jet aircraft. Initial results have been compiled for the following material systems: T300/5208, T300/5209 and T300/934. Specimens were exposed on the exterior and interior of Boeing 737 airplanes of three airlines, and to continuous ground level exposure at four locations. In addition specimens were exposed in the laboratory to conditions such as: simulated ground-air-ground, weatherometer, and moisture. Residual strength results are presented for specimens exposed for up to two years at three ground level exposure locations and on airplanes from two airlines. Test results are also given for specimens exposed to the laboratory simulated environments. Test results indicate that short beam shear strength is sensitive to environmental exposure and dependent on the level of absorbed moisture. S.L.

N82-16182*# Rensselaer Polytechnic Inst., Troy, N. Y. School of Engineering.
COMPOSITE STRUCTURAL MATERIALS Semiannual Progress Report, 30 Apr. - 30 Sep. 1981
George S. Ansell, Robert G. Loewy, and Stephen E. Wiberly Dec. 1981 164 p refs Sponsored in part by Air Force
(Grant NGL-33-018-003)
(NASA-CR-165121; SAR-41) Avail: NTIS HC A08/MF A01 CSCL 11D

Physical properties of fiber reinforced composites; structural concepts and analysis; manufacturing; reliability; and life prediction are subjects of research conducted to determine the long term integrity of composite aircraft structures under conditions pertinent to service use. Progress is reported in (1) characterizing homogeneity in composite materials; (2) developing methods for analyzing composite materials; (3) studying fatigue in composite materials; (4) determining the temperature and moisture effects on the mechanical properties of laminates; (5) numerically analyzing moisture effects; (6) numerically analyzing the micromechanics of composite fracture; (7) constructing the 727 elevator attachment rib; (8) developing the L-1011 engine drag strut (CAPCOMP 2 program); (9) analyzing mechanical joints in composites; (10) developing computer software; and (11) processing science and technology, with emphasis on the sailplane project. A.R.H.

N82-16385# Dynamic Science, Phoenix, Ariz.
ADVANCED RECORDER DESIGN AND DEVELOPMENT Final Report, Jun. 1977 - Feb. 1981
Carroll D. Thatcher Feb. 1981 192 p refs
(Contract DOT-HS-7-01640)
(PB81-244105; DOT-HS-805914) Avail: NTIS HC A09/MF A01 CSCL 13L

A prototype crash recorder measuring and storing time histories of vehicle lateral and longitudinal accelerations, during a collision was designed, fabricated, and subjected to environmental tests. The recorder features low cost accelerometers, signal conditioning circuitry, A/D converter, microprocessor and digital storage. Accelerometer outputs are continuously sampled and stored in digital memory. The microprocessor monitors Delta V and compares it to a selectable criterion. When Delta V exceeds the criterion recent acceleration time histories are permanently stored in memory. The stored signals include acceleration data prior to and subsequent to the crash event. Methods of implementing the recorder including discussion of distribution in vehicle fleets, data retrieval, including hardware and software, and data processing software are provided. DOE

N82-16655*# MCS, Inc., Boulder, Colo.
NUMERICAL AND FLIGHT SIMULATOR TEST OF THE FLIGHT DETERIORATION CONCEPT Interim Report
John McCarthy and Vern Norviel Washington NASA Jan. 1982 37 p refs
(Contract NAS8-33458)
(NASA-CR-3500; M-370) Avail: NTIS HC A03/MF A01 CSCL 04B

Manned flight simulator response to theoretical wind shear profiles was studied in an effort to calibrate fixed-stick and pilot-in-the-loop numerical models of jet transport aircraft on approach to landing. Results of the study indicate that both fixed-stick and pilot-in-the-loop models overpredict the deleterious effects of aircraft approaches when compared to pilot performance in the manned simulator. Although the pilot-in-the-loop model does a better job than does the fixed-stick model, the study suggests that the pilot-in-the-loop model is suitable for use in meteorological predictions of adverse low-level wind shear along approach and departure courses to identify situations in which pilots may find difficulty. The model should not be used to predict the success or failure of a specific aircraft. It is suggested that the pilot model be used as part of a ground-based Doppler radar low-level wind shear detection and warning system. T.M.

N82-16759# Radio Technical Commission for Aeronautics, Washington, D. C.
SOFTWARE CONSIDERATIONS IN AIRBORNE SYSTEMS AND EQUIPMENT CERTIFICATION
18 Nov. 1981 67 p refs
(RTCA/DO-178) Avail: NTIS HC A04/MF A01 CSCL 09B

A disciplined approach to avionics software design, development, testing, configuration management, and documentation is presented. Guidance is provided for different levels of criticality of the functions for which the software is designed. The need for software modification by manufacturers and users is considered, together with its impact on pre- and post-certification configuration management and documents. Methods alternative to the techniques recommended here may be used if equivalence is shown. A glossary of terms is provided. J.D.H.

N82-16800* National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.
MULTIPLE PURE TONE ELIMINATION STRUT ASSEMBLY Patent
Frank W. Burcham, inventor (to NASA) Issued 17 Nov. 1981 4 p Filed 11 Sep. 1980 Supersedes N80-32393 (18 - 23, p 3094)
(NASA-Case-FRC-11062-1; US-Patent-4,300,656; US-Patent-Appl-SN-185869; US-Patent-Class-181-214) Avail: US Patent and Trademark Office CSCL 20A

An acoustic noise elimination assembly is disclosed which has a capability for disrupting the continuity of fields of sound pressures forwardly projected from fans or rotors of a type commonly found in the fan or compressor first stage for air-breathing engines, when operating at tip speeds in the supersonic range. The assembly includes a tubular cowl defining a duct for delivering an air stream axially into the intake for a jet engine. A sound barrier, defined by a number of intersecting flat plates or struts has a line of intersection coincident with a longitudinal axis of the tubular cowl, which serves to disrupt the continuity of rotating fields of multiple pure tonal components of noise.
Official Gazette of the U.S. Patent and Trademark Office

N82-16801*# Texas A&M Univ., College Station. Dept. of Mechanical Engineering.
ANALYTICAL STUDY OF TWIN-JET SHIELDING Annual Progress Report
Carl H. Gerhold Jan. 1982 39 p refs
(Grant NAG1-11)
(NASA-CR-165102; APR-2) Avail: NTIS HC A03/MF A01 CSCL 20A

Progress in the refinement and evaluation of an analytical jet shielding model are summarized. The model consists of a point noise source impinging on a cylinder of heated flow in which the temperature and velocity are uniform across the cross section of the jet. The shielding jet is infinite in extent along the jet axis and the radius of the jet is constant. The analytical model was compared to experimental data for a point noise source impinging on an ambient temperature, subsonic jet and on a subsonic simulated hot jet using helium as the flow medium. Results of these comparisons are discussed. M.D.K.

N82-16802*# Texas A&M Univ., College Station. Dept. of Mechanical Engineering.
ANALYTICAL STUDY OF TWIN-JET SHIELDING Semiannual Progress Report
Carl H. Gerhold 30 Jun. 1981 26 p refs
(Grant NAG1-11)
(NASA-CR-165103) Avail: NTIS HC A03/MF A01 CSCL 20A

Development of jet noise source model, and comparison to experiments with a point noise source are summarized. The refinement of the noise source is expected to resolve discrepancies noted between previous analytical results with a point noise source model and experimental results for twin-jet shielding. Comparison of the analytical model with experimental program which include shielding of a point noise source by a jet and twin jet shielding are also made. The comparisons should serve to define more completely the mechanisms of shielding M.D.K.

N82-16803*# Texas A&M Univ., College Station. Dept. of Mechanical Engineering.
ANALYTICAL STUDY OF TWIN-JET SHIELDING Annual Progress Report
Carl H. Gerhold 31 Dec. 1980 38 p refs
(Grant NAG1-11)
(NASA-CR-165104) Avail: NTIS HC A03/MF A01 CSCL 20A

An analytical model a three-dimensional model, of twin-jet shielding, consisting of a point noise source impinging on a cylinder of heated flow in which the temperature and flow velocity are uniform across the cross-section is discussed. Wave equations are given for the regions outside the flow and within the flow cylinder and solutions are matched at the jet boundary under the conditions of continuity of pressure and continuity of the vortex sheet. The model was analyzed to identify mechanisms of transmission and diffraction which control sheilding in the shadow of the shielding jet. It was found that in the zone of the shadow region dominates, shielding is relatively insensitive to variations of such parameters as Mach Number and spacing ratio, but in the zone in which diffraction dominates; shielding is more sensitive to variations in Mach Number, jet temperature and spacing ratio. M.D.K.

N82-16804*# Texas A&M Univ., College Station. Dept. of Mechanical Engineering.
ANALYTICAL STUDY OF TWIN-JET SHIELDING Semiannual Progress Report
Carl H. Gerhold 6 Jun. 1980 18 p refs
(Grant NAG1-11)
(NASA-CR-165105) Avail: NTIS HC A02/MF A01 CSCL 20A

The development of an analytical model, an aircraft noise prediction computer program, to estimate the shielding of one jet by an adjacent jet in a twin jet configuration, is discussed. Noise estimations included consideration not only of noise sources on the aircraft, but also of the propagation path between source and receiver. A three-dimensional case is considered in which noise source is a discrete frequency point source at rest with respect to the jet axis. The shielding jet is assumed to be a cylinder of heated flow in which the temperature and flow velocity profiles are constant across the jet. The effect on shielding of the orientation of the emitting jet with respect to the shielding jet was investigated. Forward and backward scattering phenomena as well as the influence of jet flow speed were also investigated. M.D.K.

N82-16805*# Texas A&M Univ., College Station. Dept. of Mechanical Engineering.
ANALYTICAL STUDY OF TWIN-JET SHIELDING DEVELOPMENT OF A 3-DIMENSIONAL MODEL Progress Report
Carl H. Gerhold 4 Nov. 1980 24 p refs Sponsored by NASA
(NASA-CR-165106) Avail: NTIS HC A02/MF A01 CSCL 20A

The solution for a point source impinging on a cylinder of heated flow is presented. The indefinite integral is solved approximately using a saddle of point method. Comparison of the three-dimensional model to a previously obtained two-dimensional model of twin jet noise indicate the the approximate solution of the integral is valid. The model was analyzed to differentiate among the mechanims of shielding. Zone in which diffraction and transmission dominate are identified. The model was found to compare to experimental shielding results. M.D.K.

N82-16806*# Texas A&M Univ., College Station. Dept. of Mechanical Engineering.
ANALYTICAL STUDY OF TWIN-JET SHIELDING TWO-DIMENSIONAL MODEL
Carl H. Gerhold 15 Aug. 1980 17 p refs
(Grant NAG1-11)
(NASA-CR-165107) Avail: NTIS HC A02/MF A01 CSCL 20A

The development of an analytical model to estimate the shielding of one jet by an adjacent jet in a twin jet configuration is discussed in relation to aircraft generated noise. The azimuthal redistribution of sound defining the shadow zone is investigated. Wave equations were solved in the plane normal to the jet axis to estimate the diffraction and reflection of sound by a heated, cylindrical jet. Thus, the noise source considered is essentially a line source assumed to emit at discrete frequency and at rest with respect to the shielding jet which is assumed to be a cylinder of heated flow in which the temperature is constant across the jet. Results show that the sound pressure decreases rapidly with frequency beyond the onset of the shielding to a minimum value. Results also show that increasing the spacing between the source and the jet shifts the curves toward higher frequencies. M.D.K.

N82-16807*# Bolt, Beranek, and Newman, Inc., Canoga Park, Calif.
COMMUNITY SENSITIVITY TO CHANGES IN AIRCRAFT NOISE EXPOSURE Final Report
S. Fidell, R. Horonjeff, S. Teffeteller, and K. Pearsons NASA Dec. 1981 122 p refs
(Contract NAS1-14611)
(NASA-CR-3490; BBN-4212) Avail: NTIS HC A06/MF A01 CSCL 20A

Interviews were conducted in the vicinity of Burbank Airport during a four month period during which a counterbalanced series of changes in aircraft noise exposure occurred due to runway repairs. Another interview was undertaken approximately one year after completion of the initial runway repairs. Noise measurements were made in conjunction with administration of a brief questionnaire to a near exhaustive sample of residents in four airport neighborhoods. The magnitude and direction of change of annoyance with aircraft noise exposure corresponded closely to the actual changes in physical exposure. Estimates were made of time constants for the rate of change of attitudes toward aircraft noise. S.L.

N82-16808*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NOISE OF THE SR-3 PROPELLER MODEL AT 2 DEG AND 4 DEG ANGLE OF ATTACK
James H. Dittmar and Robert J. Jeracki Dec. 1981 30 p refs
(NASA-TM-82738; E-1051) Avail: NTIS HC A03/MF A01 CSCL 20A

The noise effect of operating supersonic tip speed propellers at angle of attack with respect to the incoming flow was determined. Increases in the maximum blade passage noise were observed for the propeller operating at angle of attack. The noise increase was not symmetrical with one wall of the wind tunnel having significantly more noise increase than the other wall. This was apparently the result of the rotational direction of the propeller. The lack of symmetry of the noise at angle of attack to the use of oppositely rotating propellers on opposite sides of an airplane fuselage as a way of minimizing the noise due to operation at angle of attack. J.D.H.

N82-16809*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A SHOCK WAVE APPROACH TO THE NOISE OF SUPERSONIC PROPELLERS
James H. Dittmar and Edward J. Rice Dec. 1981 19 p refs
(NASA-TM-82752; E-1068) Avail: NTIS HC A02/MF A01

CSCL 20A

To model propeller noise expected for a turboprop aircraft, the pressure ratio across the shock at the propeller tip was calculated and compared with noise data from three propellers. At helical tip Mach numbers over 1.0, using only the tip shock wave, the model gave a fairly good prediction of the noise for a bladed propeller and for a propeller swept for aerodynamic purposes. However for another propeller, which was highly swept and designed to have noise cancellations from the inboard propeller sections, the shock strength from the tip over predicted the noise. In general the good agreement indicates that shock theory is a viable method for predicting the noise from these supersonic propellers but that the shock strengths from all of the blade sections need to be properly included. M.G.

N82-16810*# Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.

PREDICTION OF SOUND RADIATION FROM DIFFERENT PRACTICAL JET ENGINE INLETS Semiannual Status Report, 1 Jun. 1981 - 1 Dec. 1981

Ben T. Zinn and William L. Meyer 1982 127 p refs
(Grant NAG3-67)
(NASA-CR-165120) Avail: NTIS HC A07/MF A01 CSCL 20A

The computer codes necessary for this study were developed and checked against exact solutions generated by the point source method using the NASA Lewis QCSEE inlet geometry. These computer codes were used to predict the acoustic properties of the following five inlet configurations: the NASA Langley Bellmouth, the NASA Lewis JT15D-1 Ground Test Nacelle, and three finite hyperbolic inlets of 50, 70 and 90 degrees. Thirty-five computer runs were done for the NASA Langley Bellmouth. For each of these computer runs, the reflection coefficient at the duct exit plane was calculated as was the far field radiation pattern. These results are presented in both graphical and tabular form with many of the results cross plotted so that trends in the results verses cut-off ratio (wave number) and tangential mode number may be easily identified. Author

N82-16834# Pacific Northwest Lab., Richland, Wash.

DEVELOPMENT OF IN-CAN MELTING PROCESS AND EQUIPMENT, 1979 AND 1980

L. L. Petkus, D. E. Larson, W. J. Bjorklund, and L. K. Holton Sep. 1981 46 p refs
(Contract DE-AC06-76RL-01830)
(DE82-001050; PNL-3957) Avail: NTIS HC A03/MF A01

Nonradioactive process testing continued with the in-can melter as part of an investigation into the applicability of this vitrification process to various calcined high level and incinerator ash radioactive wastes. How waste composition and canister fins affect in-can melter capacity and how waste composition affects glass quality were examined. Process performance proved to be generally satisfactory. Pilot scale in-can melter runs were performed with synthetic, nonradioactive, high level wastes to produce eight canisters of glass. The synthetic waste processed included high level wastes as well as transuranic ash waste. Full scale in-can melter runs using nonradioactive materials were also conducted, producing ten canisters of glass. In the full scale in-can melter furnace the baffles separating the six heating zones were removed because of baffle warping. A remotely operated section connecting the spray calciner to the canister was tested. Some problems were encountered with calcine plugging. DOE

N82-16850# HTL Industries, Inc., Duarte, Calif. Advanced Technology Div.

TEST AND EVALUATION OF UV FIBER OPTICS FOR APPLICATION FOR AIRCRAFT FIRE DETECTOR SYSTEMS Final Report, 23 May 1980 - 23 Mar. 1981

Dayton, Ohio AFWAL Jun. 1981 58 p refs
(Contract F33615-80-C-2042; AF Proj. 3048)
(AD-A106129; AFWAL-TR-81-2049) Avail: NTIS HC A04/MF A01 CSCL 17/5

It was found that in the U.V. solar blind region, there are severe limitations on the field of view obtainable in Fiber Optic coupled systems. These restrictions are such as to make further consideration of the wide angle system concept unprofitable. This effectively limits the use of such systems in fire detection to applications where the precise location of a flame can be predicted. It is concluded that the performance of optical fibers in the U.V. solar blind wavelengths is such that the trade-off gains proposed in AFAPL-TR-78-84 cannot be realized in practice. Author (GRA)

N82-16927*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala. Management Services Office.

FISCAL YEAR 1981 SCIENTIFIC AND TECHNICAL REPORTS, ARTICLES, PAPERS, AND PRESENTATIONS

Sarah S. Thacker, comp. Oct. 1981 70 p
(NASA-TM-82445) Avail: NTIS HC A04/MF A01 CSCL 05B

This bibliography lists approximately 503 formal NASA technical reports, papers published in technical journals, and presentations by MSFC personnel in FY-1981. It also includes papers of MSFC contractors. Citations announced in the NASA scientific and technical information system are noted. N.W.

N82-17081*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

RESEARCH AND TECHNOLOGY ANNUAL REPORT, 1981 Annual Report, 1981

1981 44 p
(NASA-TM-81333; A-8744) Avail: NTIS HC A03/MF A01 CSCL 05A

Various research and technology activities at Ames Research Center are described. Highlights of these accomplishments indicate the Center's varied and highly productive research efforts for 1981. Author

N82-17082# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.

FLIGHT DYNAMICS TECHNOLOGY DEVELOPMENT: STRUCTURES AND DYNAMICS, VEHICLE EQUIPMENT/ SUBSYSTEMS, FLIGHT CONTROL AND AEROMECHANICS

Dec. 1980 87 p Supersedes AFFDL-TR-79-3133
(AD-A096636; AFWAL-TR-80-3144; AFFDL-TR-79-3133) Avail: NTIS HC A05/MF A01 CSCL 05/1

The document presents an overview of the four Technical Planning Objectives (TPO) and supporting data for each. These are extracted from the technical plan of the Flight Dynamics Laboratory (FDL). Information is largely based on FDL fiscal 1982 technology plan omitting specific funding and timing information of an 'Official Use Only' nature. Technical objectives are described for the technical areas of Structures and Dynamics, Vehicle Equipment/Subsystems, Flight Control and Aeromechanics. Points of contact for more information in each of the areas are identified. GRA

N82-17085# Institute for Defense Analyses, Arlington, Va. Program Analysis Div.

BUILT-IN-TEST EQUIPMENT REQUIREMENTS WORKSHOP. WORKSHOP PRESENTATION Final Report, 1 Oct. 1980 - 28 Feb. 1981

Aug. 1981 235 p refs Workshop held at Arlington, Va., 11-13 Feb. 1981
(Contract MDA903-79-C-0320)
(AD-A107842; AD-E500460; IDA-P-1600) Avail: NTIS HC A11/MF A01 CSCL 09/3

A workshop was held for the purpose of assessing progress and problems in specifying and testing Built-In-Test (BIT) used in complex electronic equipment. The workshop's principal recommendation is that the current specification and test approach be broadened to include all capabilities associated with the detection and isolation of faults. Current practices generally address only a narrow subset of these capabilities, namely, BIT. The workshop participants defined this broad capability as '100 Percent Diagnostics.' The diagnostic capability is considered to have two components--'automatic' and 'manual.' The automatic component consists of BIT or semi-automatic BIT with technical manuals, while the manual component consists of personnel using logic, external test equipment and/or manual test procedures. Observations on current experience with BIT, recommendations to improve specification and testing of '100 Percent Diagnostics' that can be put into practice in the near term, and proposed research areas are presented. GRA

N82-17086# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).

TACTICAL AIRBORNE DISTRIBUTED COMPUTING AND NETWORKS

Oct. 1981 415 p refs Partly in ENGLISH and FRENCH Meeting held in Roros, Norway, 22-25 Jun. 1981
(AGARD-CP-303; ISBN-92-835-0302-3) Avail: NTIS HC A18/MF A01

Distributed processing and its application to avionic systems are discussed.

N82-17087# Georgia Inst. of Tech., Atlanta. School of Information and Computer Science.
DISTRIBUTED DATA PROCESSING: WHAT IS IT?
Philip H. Enslow, Jr. *In* AGARD Tactical Airborne Distributed Computing and Networks Oct. 1981 10 p refs

(Contract N00014-79-C-0873)
Avail: NTIS HC A18/MF A01

Distributed processing is presented as the means to obtain improvements in a number of areas of system performance. Utilizing a list of these desired improvements as the motivational factors, the key design characteristics of systems that delivers a major proportion of these improvements are presented. J.D.H.

N82-17088# Ferranti Ltd., Bracknell (England). Computer Systems Div.
THE EFFECT OF INCREASINGLY MORE COMPLEX AIRCRAFT AND AVIONICS ON THE METHOD OF SYSTEM DESIGN
J. T. Martin *In* AGARD Tactical Airborne Distributed Computing and Networks Oct. 1981 5 p

Avail: NTIS HC A18/MF A01

The evolution of aircraft and their associated avionics is described. The evolutionary progress is considered as starting from a simple low speed aircraft with rudimentary flight instruments and sighting systems, through the interconnection of some of these systems and progressing to recent avionic systems with centralized digital computing. It is shown how the changes in aircraft systems, from the simple analog connection of a few systems, through the analog sensor/interface box/centralized digital system, to the sensor producing digital outputs/interface box/centralized digital system, have produced comparatively small changes in the methodology used for the design of these systems. The move to systems containing distributed processing interconnected by digital highways is shown to be revolutionary rather than evolutionary and to require a new approach to the system design problem so as to reap the maximum advantage from the available computing capability. Author

N82-17089# Naval Air Systems Command, Washington, D. C. Control and Guidance Research and Technology Group.
A TUTORIAL ON DISTRIBUTED PROCESSING IN AIRCRAFT/AVIONICS APPLICATIONS
Bernard A. Zempolich *In* AGARD Tactical Airborne Distributed Computing and Networks Oct. 1981 11 p

Avail: NTIS HC A18/MF A01

An overview of the state of the art in real time distributed processing as applied to aircraft/avionics is presented. Definitions and concepts are presented starting with the total aircraft as a real time distributed computer-controlled system. The relationship of aircraft mission and avionic system architectures is discussed. Overall system architectural considerations are identified and their impact upon a real time distributed computer-controlled system is detailed. A top-down hierarchical, architectural structure is presented. This top-down structuring is described in terms of the logical functional decomposition of the system as follows: total aircraft/avionic system partitioning of aircraft/avionic subsystems, interconnect bus structure (network), system-wide processing architecture, subsystems definition, and computer systems. Author

N82-17092# Elektronik-System G.m.b.H., Munich (West Germany).
FUNCTIONAL VERSUS COMMUNICATION STRUCTURES IN MODERN AVIONIC SYSTEMS
K. Brammer and A. Weimann *In* AGARD Tactical Airborne Distributed Computing and Networks Oct. 1981 11 p refs

Avail: NTIS HC A18/MF 01

The implications of the increase in functional and communication interfaces on avionic system structures are analyzed. Especially the passage from functional design to implemented communication structure of the airborne electronic system is scrutinized. The distributed organization of an avionic system, the realization of which is greatly simplified by bus type intrasystem signal transmission, is compared to the conventional hierarchical system organization. Advantages and drawbacks of both organizations are reviewed especially with respect to interface efficiency, cabling requirements, and the typical topology of avionic systems. J.D.H.

N82-17097# Naval Air Systems Command, Washington, D. C. Control and Guidance Research and Technology Group.
ECONOMIC CONSIDERATIONS FOR REAL-TIME NAVAL AIRCRAFT/AVIONICS DISTRIBUTED COMPUTER CONTROL SYSTEMS
Bernard A. Zempolich *In* AGARD Tactical Airborne Distributed Computing and Networks Oct. 1981 10 p

Avail: NTIS HC A18/MF A01

Economic considerations for Distributed Computer Control Systems (DCCS) are discussed. Centralized, distributed and federated processing architectures are used as the primary set of systems alternatives from which economic factors are developed. The economic impact of subsequent logistic support for standardized computer hardware and software versus non-standard products is identified. System considerations such as reliability, maintainability, availability, built-in-test, fault tolerance, and redundancy are examined from the standpoint of resources available to design and develop the DCCS, and also from the viewpoint of economic impact of failure of the DCCS to perform as expected. The economic impact of external factors such as the rate of technology advancement, technology independence, limited production runs, and the general lack of economic leverage upon the market are examined and related to the life-cycle support requirements of the DCCS. Author

N82-17104# Boeing Military Airplane Development, Seattle, Wash. Digital Flight Controls Research Dept.
STAGE-STATE RELIABILITY ANALYSIS TECHNIQUE
Alan D. Stern *In* AGARD Tactical Airborne Distributed Computing and Networks Oct. 1981 7 p refs

Avail: NTIS HC A18/MF A01

An advanced flight control system reliability analysis technique must properly account for the defined success criteria, redundancy level, redundancy management, technique, system dependencies, and failure detection coverage. The stage state reliability analysis technique properly accounts for these factors. It is also computationally simple such that triplex redundant systems have been analyzed using an early 1970's desktop computer. This method is well suited for analysis by the system architect. The process begins with a system block diagram showing all element connections. A success logic diagram is then written reflecting all possible success states. The probability of success equation is written directly from the logic diagram and evaluated by substituting the probability expression for each system element. Multiple success criteria can be applied to one problem formulation simply by deleting those states which do not satisfy the success criterion. Author

N82-17105*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
METHODOLOGY FOR MEASUREMENT OF FAULT LATENCY IN A DIGITAL AVIONIC MINIPROCESSOR
John C. McGough, Fred Swern, and Salvatore J. Bavuso *In* AGARD Tactical Airborne Distributed Computing and Networks Oct. 1981 18 p refs Prepared in cooperation with Bendix Corp., Teterboro, N.J.

(Contract NAS1-15946)
Avail: NTIS HC A18/MF A01 CSCL 01D

Using a gate level emulation of a typical avionics miniprocessor, fault injection experiments were performed to (1) determine the time to detect a fault by comparison monitoring, (2) forecast a program's ability to detect faults and (3) validate the fault detection coverage of a typical self test program. To estimate time to detect, six programs ranging in complexity from 6 to 147 instructions, were emulated. Each program was executed repetitively in the presence of a single stuck at fault at a gate node or device pin. Detection was assumed to occur whenever the computed outputs differed from the corresponding outputs of the same program executed in a nonfaulted processor. Histograms of faults detected versus number of repetitions to detection were tabulated. Using a simple model of fault detection, which was based in an analog with the selection of balls in an urn, distributions of time to detect were computed and compared

with those obtained empirically. A self test program of 2,000 executable instructions was designed expressly for the study. The only requirement imposed on the design was that it should achieve 95% coverage. The program was executed in the presence of a single stuck-at fault at a gate node on device pin. The proportion of detected faults are tabulated. In all experiments faults were selected at random over gate nodes or device pins.
Author

N82-17106*# SRI International Corp., Menlo Park, Calif. Computer Science Lab.
HIERARCHICAL SPECIFICATION OF THE SIFT FAULT TOLERANT FLIGHT CONTROL SYSTEM
P. M. Melliar-Smith and Richard L. Schwartz *In* AGARD Tactical Airborne Distributed Computing and Networks Oct. 1981 15 p refs
(Contract NAS1-15428)
Avail: NTIS HC A18/MF A01 CSCL 01B
The specification and mechanical verification of the Software Implemented Fault Tolerance (SIFT) flight control system is described. The methodology employed in the verification effort is discussed, and a description of the hierarchical models of the SIFT system is given. To meet the objective of NASA for the reliability of safety critical flight control systems, the SIFT computer must achieve a reliability well beyond the levels at which reliability can be actually measured. The methodology employed to demonstrate rigorously that the SIFT computer meets as reliability requirements is described. The hierarchy of design specifications from very abstract descriptions of system function down to the actual implementation is explained. The most abstract design specifications can be used to verify that the system functions correctly and with the desired reliability since almost all details of the realization were abstracted out. A succession of lower level models refine these specifications to the level of the actual implementation, and can be used to demonstrate that the implementation has the properties claimed of the abstract design specifications.
Author

N82-17107# Litton Technische Werke, Freiburg (West Germany).
RECONFIGURATION: A METHOD TO IMPROVE SYSTEMS REALIABILITY
J. Szlachta *In* AGARD Tactical Airborne Distributed Computing and Networks Oct. 1981 8 p

Avail: NTIS HC A18/MF A01
A system with hardware and software reconfiguration capabilities was developed to improve the reliability of a flight-augmentation computer. The system consists of a network of n redundant computers, linked via m serial buses. A two computer processing units and two or more input/output drivers. A fault in one of the components of the redundant computers causes a hardware reconfiguration which replaces the faulty component by its still functioning twin. If a redundant computer fails altogether, all tasks allocated to it are transferred to one of the still working computers of the network. This is made possible by loading dormant copies of the tasks into at least one other computer of the initial system. These dormant copies are periodically supplied with the program status of the active copy.
Author

N82-17108# Societe d'Applications Generales d'Electricite et de Mecanique, Paris (France).
A RECONFIGURABLE CHANGE NETWORK FOR DISTRIBUTED PROCESS CONTROL [RESEAU D'ECHANGE RECONFIGURABLE POUR CONTROLE DE PROCESSUS REPARTI]
Ch. Meraud and B. Maurel (Societe. Anonyme de Telecommunications) *In* AGARD Tactical Airborne Distributed Computing and Networks Oct. 1981 10 p refs In FRENCH

Avail: NTIS HC A18/MF A01
A highly reliable, high output system of change is described which permits decentralized exchange between the diverse equipment onboard an aircraft or other type of vehicle in order to integrate and reconfigure the functions, no matter how critical. Very large scale integration and fiber optics which are insensitive to electromagnetic perturbations made possible a performing decentralized solution by incorporating intelligence in a universal type linking module called the subsystem interface. For the traditionally programmed mechanism for generating change, a dynamic mechanism immediately adapted to modification, is substituted which permits a great degree of synchronization.
Transl. by A.R.H.

N82-17114# Hughes Aircraft Co., Fullerton, Calif.
NEXT GENERATION MILITARY AIRCRAFT WILL REQUIRE HIERARCHICAL/MULTILEVEL INFORMATION TRANSFER SYSTEMS
James W. McCuen *In* AGARD Tactical Airborne Distributed Computing and Networks Oct. 1981 8 p refs

Avail: NTIS HC A18/MF A01
Changes in avionic subsystems and mission roles of next generation aircraft require new concepts in data transfer. New aircraft need total airframe/weapon system integration which means new approaches must be developed for the interconnection of avionic subsystems. Effort has begun to develop a Military Standard (MIL-STD) which will define the requirements for a high speed data bus network. The standard shall characterize a higher order information transfer system (ITS) that will interconnect avionic systems, that contain their own multiplex ITS, into a fully integrated data complex. The higher order ITS shall employ an operational protocol that will provide subsystems and common sensors, independence and fault isolation by distributed control of the common data bus.
Author

N82-17115# Bendix Corp., Teterboro, N. J. Flight Systems Div.
SIFT: AN ULTRA-RELIABLE AVIONIC COMPUTING SYSTEM
Kurt Moses *In* AGARD Tactical Airborne Distributed Computing and Networks Oct. 1981 10 p

Avail: NTIS HC A18/MF A01
Software implemented fault tolerance (SIFT) is an ultra-reliable computing system which is based on a multiprocessor architecture that achieves fault tolerance by replicating computing tasks among processing units. Error detection and system configuration are performed by software to maintain the operational integrity of the computing system. The high speed inter-computer communication system required for operation realized by dedicated serial links arrayed in a star connection. Software algorithms are used for failure detection by means of voting, failure isolation to the faulty processor, and reconfiguration after fault detection. Frame synchronization between processors is employed to reduce data skew and minimize false alarms. The architecture of SIFT, its hardware implementation, and the test stand used for evaluation. Potential applications of this technique to current and anticipated ultra-reliable electrical flight control systems are given.
A.R.H.

N82-17117# Royal Aircraft Establishment, Farnborough (England).
INTEGRATED CONTROL OF MECHANICAL SYSTEM FOR FUTURE COMBAT AIRCRAFT
G. W. Wilcock, P. A. Lancaster, and C. Moxey *In* AGARD Tactical Airborne Distributed Computing and Networks Oct. 1981 16 p refs Prepared in cooperation with British Aerospace, Warton Sponsored in part by Procurement Executive MOD

Avail: NTIS HC A18/MF A01
Various techniques for the application of digital control to aircraft utility systems were investigated. It is shown that the prefered approach utilizes a number of distributed processors and terminals that interface with the utility components. Analysis performed to data shows a weight saving of approximately 100 Kg (i.e., 50%), and a pilot workload reduction of the order of 4:1, may be achieved in a twin engine combat aircraft.
A.R.H.

N82-17119# McDonnell Aircraft Co., St. Louis, Mo.
F/A-18A TACTICAL AIRBORNE COMPUTATIONAL SUBSYSTEM
T. V. McTigue *In* AGARD Tactical Airborne Distributed Computing and Networks Oct. 1981 14 p refs

Avail: NTIS HC A18/MF A01
The F/A-18A Hornet tactical computer subsystem consists of two central mission computers and a number of distributed processors embedded in various sensor and display subsystems. This distributed processing system is interconnected by and communicates over a MIL-STD-1553A serial 1 MHz command/response multiplex network. The distributed processing system architecture is discussed and the rationale is presented for the partitioning of the computational tasks between the central mission computers and the distributed processors embedded in the sensor subsystems. The salient features of the central mission computer and the distributed processors are discussed along with a

description of the functional operation of the interconnecting MIL-STD-1553A multiplex communications system. The development process for the Operational Flight Program (OFP) for the Central mission computers is described and the support facilities which were used for the software integration and validation are discussed. A.R.H.

N82-17120# Naval Weapons Center, China Lake, Calif. F-18 Facility Branch.
F/A-18 WEAPONS SYSTEM SUPPORT FACILITIES
Thomas F. O'Neill *In* AGARD Tactical Airborne Distributed Computing and Networks Oct. 1981 7 p

Avail: NTIS HC A18/MF A01
The U.S. Navy is currently acceptance-testing the McDonnell Douglas F/A-18 aircraft. Since the F/A-18 is so much more complex than any aircraft current deployed, more sophisticated support tools will be required. The main support tool is to be a weapons system support facility including all of the hardware and software necessary to test, modify, and validate all of the avionics hardware, software, and firmware. A distributed processing approach is used in the facility, which contains several minicomputers and super minicomputers. Author

N82-17121*# Hughes Helicopters, Culver City, Calif.
BLADE PLANFORM FOR A QUIET HELICOPTER Final Report
D. S. Janaki Ram Sep. 1980 31 p refs
(NASA Order A-65550B)
(NASA-CR-166256; T-35584) Avail: NTIS HC A03/MF A01 CSCL 01C
The effects of blade planform and tip speed on noise and performance for a Hughes 500 C rotor system were studied. A cursory examination of the effects of such planform shapes as regular, inverse, and no taper on the noise and performance of the rotor was conducted. It was found that a constant width wide chord planform at tower tip speed provided the best performance and lowest noise. The tapered planforms had lower performance figures due to the reduced solidity. However, some noise reductions were achieved. R.J.F.

N82-17122*# McDonnell-Douglas Corp., St. Louis, Mo.
TESTS OF A D VENTED THRUST DEFLECTING NOZZLE BEHIND A SIMULATED TURBOFAN ENGINE Final Report
T. L. Watson Washington NASA Jan. 1982 139 p refs
(Contract NAS3-21733)
(NASA-CR-3508; MDC-A6930) Avail: NTIS HC A07/MF A01 CSCL 01A
A D vented thrust deflecting nozzle applicable to subsonic V/STOL aircraft was tested behind a simulated turbofan engine in the verticle thrust stand. Nozzle thrust, fan operating characteristics, nozzle entrance conditions, and static pressures were measured. Nozzle performance was measured for variations in exit area and thrust deflection angle. Six core nozzle configurations, the effect of core exit axial location, mismatched core and fan stream nozzle pressure ratios, and yaw vane presence were evaluated. Core nozzle configuration affected performance at normal and engine out operating conditions. Highest vectored nozzle performance resulted for a given exit area when core and fan stream pressure were equal. Its is concluded that high nozzle performance can be maintained at both normal and engine out conditions through control of the nozzle entrance Mach number with a variable exit area. E.A.K.

N82-17123# National Aerospace Lab., Tokyo (Japan).
A NEW METHOD OF ESTIMATING THE LATERAL WALL EFFECT ON THE AIRFOIL INCIDENCE DUE TO THE SUCTION AT SIDE WALLS
Hideo Sawada, Seizo Sakakibara, Mamoru Sato, Hiroshi Kanda, and Toshio Karasawa Aug. 1981 20 p refs In JAPANESE; ENGLISH summary
(NAL-TR-680; ISSN-0389-4010) Avail: NTIS HC A02/MF A01
The velocity component is approximated from the pressure difference across the plates by the aid of an experimental equation which states that the normal velocity component to a porous plate induced by the pressure difference across the plate is proportional to the square root of the pressure difference. In this method, the proportional constant number need not be known. An experiment was carried out in which the pressure in a suction box, one side of which consisted of a porous plate, was set at various values in this experiment. The lift coefficient of an airfoil model changed with the variation of the pressure in the suction box even at the same uniform flow speed and the same incidence. The unique value of the lift coefficient was determined from several such lift coefficients at the same incidence. The corrected lift coefficient curve obtained is very close to one obtained in a test section with fully solid side walls. T.M.

N82-17124# National Aerospace Lab., Tokyo (Japan). STOL Aircraft Project Group.
SURVEYS OF FLOW-FIELD AROUND EMPENNAGE OF THE NAL STOL-RESEARCH-AIRCRAFT MODEL
Jul. 1981 80 p refs In JAPANESE; ENGLISH summary
(NAL-TR-677; ISSN-0389-4010) Avail: NTIS HC A05/MF A01
The flow field around the empennage for the STOL landing were measured. The down wash angle, the side wash angle, and the dynamic pressure at the aerodynamic center of the empennage were obtained by linear interpolation at the two sections perpendicular to the free steam. Effects of the engine thrust coefficient and the two types of vortex generator on the flow field, and the directional stability in the case of an inner engine becoming inoperative, were studied. E.A.K.

N82-17125# Old Dominion Univ., Norfolk, Va. Dept. of Mechanical Engineering.
EXPERIMENTAL STUDY OF DELTA WING LEADING-EDGE DEVICES FOR DRAG REDUCTION AT HIGH LIFT M.S. Thesis
Thomas Dwight Johnson, Jr. Dec. 1980 139 p refs
Avail: NTIS HC A07/MF A01
Future fighter aircraft requirements specify efficient supersonic cruise and high-g maneuverability at high lift. The slender delta wing meets the first requirement but has large lift induced drag increments at high lift. One method to alleviate the drag is to control the flow at the wind leading edge (LE) by means of small LE devices, so as to maintain locally attached flow to higher angles of attack and thus increase the level of aerodynamic thrust. The devices selected for evaluation were the fence, slot, pylon-type vortex generator (VG), and sharp leading-edge extension (SLEE). These devices were tested on a 60 deg flatplate delta (with blunt LE) in the Langley Research Center (NASA) 7- by 10-foot high-speed tunnel at low-speed and to angles of attack of 28 degrees. Balance and static pressure measurements were taken. The results indicate that all the devices have significant drag reduction capability and improved longitudinal stability while a slight loss of lift and increased cruise drag occurred. T.M.

N82-17126*# George Washington Univ., Washington, D.C. School of Engineering and Applied Science.
EXPERIMENTAL TRIM DRAG VALUES FOR CONVENTIONAL AND SUPERCRITICAL WINGS M.S. Thesis
Peter Fredric Jacobs Dec. 1981 165 p refs Sponsored by NASA
(NASA-CR-168500) Avail: NTIS HC A08/MF A01 CSCL 01A
Supercritical wings were studied to determine whether they incur higher trim drag values at cruise conditions than wide body technology wings. Relative trim drag increments were measured in an experimental wind tunnel investigation. The tests utilized high aspect ratio supercritical wing and a wide body wing in conjunction with five different horizontal tail configurations, mounted on a representative wide body fuselage. The three low tail configurations and two T tail configurations were chosen to measure the effects on horizontal tail size, location, and camber on the trim drag increments for the two wings. The increase in performance (lift to drag ratio) for supercritical wing over the wide body wing was 11 percent for both the optimum low tail and T tail configurations. S.L.

N82-17127# Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.
ROLL UP MODEL FOR ROTOR WAKE VORTICES, PART 5
Maarten Landahl Stockholm Aeronautical Research Inst. of Sweden 13 Nov. 1981 28 p refs
(Contract NE-5061-014)
(ASRL-TR-194-4; FFA-HU-2262-Pt-5) Avail: NTIS HC A03/MF a01
Conservation of momentum and energy is used to estimate the core size of a rolled-up vortex from a propeller or rotor blade tip. A simplified planar model due to Prandtl is employed to determine the strength, position, and vore size of the rolled-up vortices. This model is valid when the number of blades is large

such that the distance between the wake vortex sheets is much less than the diameter of the rolled-up vortex spirals. The vortex is assumed to have a core of constant vorticity (Rankine vortex). Three dimensionality is then accounted for by modeling the actual spiral wake vortex as a row of regularly spaced vortex rings. The core diameter is found to be about 40 percent of this distance, with a slight decrease with increase in spacing-to-diameter ratio. The core velocity is found to increase with increased spacing from 0.5 of the wake velocity at zero spacing to about 0.7 of the wake velocity at a spacing of three times the wake radius. Author

N82-17128# National Aerospace Lab., Amsterdam (Netherlands). Fluid Dynamics Div.
THEORY AND EXPERIMENT IN UNSTEADY AERODYNAMICS
H. Bergh, H. Tijdemann, and R. J. Zwaan 11 Dec. 1980 26 p refs Presented at Aeroelastic Colloq., Goettingen, West Germany, 24 Sep. 1980
(NLR-MP-80046-U) Avail: NTIS HC A03/MF A01

A historical review is given of the role of theory and experiment in investigations of unsteady aerodynamics. Author

N82-17129# National Aerospace Lab., Amsterdam (Netherlands). Dept. of Aeroelasticity.
A WIND TUNNEL STUDY OF THE FLUTTER CHARACTERISTICS OF A SUPERCRITICAL WING
R. Houwink, A. N. Kraan, and R. J. Zwaan 28 Jan. 1981 10 p refs Presented at 22nd SDM/Dyn. Specialists Conf., Atlanta, 6-10 Apr. 1981 Sponsored by Netherlands Agency for Aerospace Programs Prepared in cooperation with Royal Netherlands Aircraft Factories Fokker, Amsterdam
(NLR-MP-81002-U) Avail: NTIS HC A02/MF a01

A wind-tunnel flutter test on a supercritical wing model is described. Objectives of the test were to investigate the transonic dip and to enable comparison with calculated flutter characteristics in which a quasi-three dimensional transonic theory was used. The beginning of a transonic dip was measured and a satisfactory agreement with theory could be found. An additional flutter instability in the bottom of the transonic dip could be correlated with the loose of transition strip effectivity at low Reynolds numbers. Author

N82-17131# Ohio State Univ., Columbus. Dept. of Mechanical Engineering.
DEVELOPMENT OF A COMPUTER BASED PRESENTATION OF NON-STEADY HELICOPTER ROTOR FLOWS Interim Report, 1 Jul. 1979 - 30 Apr. 1981
Henry R. Velkoff and Richard R. Navarro Sep. 1981 121 p refs
(Contract DAAG29-79-C-0074)
(AD-A108107; ARO-14142.6-EX; OSURF-761646/711999) Avail: NTIS HC A06/MF A01 CSCL 01/3

A system to measure the non-steady velocities in the model rotor wake was modified to provide velocity data in a form more useful to the user of the data. Hot wire angle parameters were modified so as to provide better correlations by using cosine law in place of the usual K-squared technique common in hot-wire anemometry. The results of the non-steady measurements were presented in the form of motion pictures of the non-steady computer generated vector plots. Author (GRA)

N82-17132# Ohio State Univ., Columbus. Dept. of Mechanical Engineering.
ROTOR FLOW RESEARCH IN LOW SPEED HELICOPTER FLIGHT Final Report, 1 Jul. 1979 - 30 Apr. 1981
Henry R. Velkoff Sep. 1981 24 p refs
(Contract DAAG29-79-C-0074)
(AD-A107873; ARO-14142.7-EX) Avail: NTIS HC A02/MF A01 CSCL 20/4

Measurements of helicopter rotor wake flow were made at low advance ratio. Both steady and non-steady data were taken in the wake using 3-D hot-film anemometry. Emphasis was placed on the presentation of the data. Motion pictures were obtained from the computer plots of the experimental velocity data. Author (GRA)

N82-17133# Ohio State Univ., Columbus. Dept. of Mechanical Engineering.
NON-STEADY VELOCITY MEASUREMENT OF THE WAKE OF A HELICOPTER ROTOR AT LOW ADVANCE RATIOS Interim Report, 1 Jul. 1979 - 30 Apr. 1981
H. R. Velkoff and H. Terkel Sep. 1981 127 p refs
(Contract DAAG29-79-C-0074)
(AD-A107722; ARO-14142.5-EX; OSURF-761646/711999) Avail: NTIS HC A07/MF A01 CSCL 20/4

A system was developed which could measure the instantaneous velocities in the wake of a model helicopter rotor operating at low advance ratios. A three-wire hot film probe was mounted on a traverse and placed at many positions in the wake. The output of the probe was fed into an on-line computer operating in an interactive mode. Computer generated vector plots were made of both time averaged velocities and instantaneous velocities for the case of mu = 0.06. Author (GRA)

N82-17134# Calspan Field Services, Inc., Arnold Air Force Station, Tenn.
EXPERIMENTAL VERIFICATION OF AN AERODYNAMIC PARAMETER OPTIMIZATION PROGRAM FOR WIND TUNNEL TESTING Final Report, Oct. 1980 - Sep. 1981
Richard L. Palko and Margaret Anne Crawford AEDC Nov. 1981 32 p refs
(AD-A107727; AEDC-TR-81-23) Avail: NTIS HC A03/MF A01 CSCL 20/4

The optimization algorithm developed for the SOFT wing program has been revised to make it more applicable for use in routine wind tunnel testing. The algorithm modification removed some unused routines and simplified the control input requirements. The modified optimization algorithm was demonstrated in the 1-ft transonic Aerodynamic Wind Tunnel (1T) using a 3-degree-of-freedom model. The test Mach number was 0.8. The algorithm was successfully demonstrated for all three optimization runs attempted. These included minimization of drag coefficient for a specified coefficient of lift, maximization of lift coefficient for a specified coefficient of drag, and maximization of lift-to-drag ratio for a specified coefficient of drag. Author (GRA)

N82-17135# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium). Aeronautics and Aerospace Dept.
FINITE DIFFERENCE COMPUTATION OF THE CONICAL FLOW FIELD OVER A DELTA WING
L. Vigevano Aug. 1981 55 p refs
(VKI-TN-140) Avail: NTIS HC A04/MF A01

A numerical approach using finite differences applied to a nonlinear governing equation was adopted in order to introduce compressibility effects in a model of the vertical flow past a sharp leading edge on a delta wing. A conical line vortices model was adapted to a through field computation. From numerical experiments, criteria for the representation of a mathematical vortex in a finite difference scheme are derived Comparison of the numercial results with the Brown and Michael analytical solution shows that the first order scheme employed preserves satisfactory accuracy in the prediction of the wing loads. Author (ESA)

N82-17137*# Textron Bell Helicopter, Fort Worth, Tex.
ASSESSMENT OF HISTORICAL AND PROJECTED SEGMENTS OF US AND WORLD CIVIL AND MILITARY ROTORCRAFT MARKETS 1960 - 1990 Contractor Report, 2 Aug. 1981
William J. Yates 2 Aug. 1981 203 p
(Contract NAS2-10404)
(NASA-CR-166151) Avail: NTIS HC A10/MF A01 CSCL 05C

The future military and civil worldwide market potential for current and future rotorcraft configurations was assessed. Comparisons by region, mission, civil or military, etc., are made for both historial and forecast data. A comprehensive historical data base was utilized to determine historical and future trends. Consideration was given to socio-political, economic, and technological factors in determining future trends. Author

N82-17138# National Transportation Safety Board, Washington, D. C. Bureau of Accident Investigation.
AIRCRAFT ACCIDENT REPORT - UNIVERSAL AIRWAYS, INC., BEECH 65-A80/EXCALIBUR CONVERSION, N100UV, NEAR MADISONVILLE, TEXAS, JULY 2, 1981
17 Dec. 1981 25 p
(NTSB-AAR-81-17) Avail: NTIS HC A02/MF A01

About 1230 Central Daylight Time, on July 2, 1981, a Universal Airways, Inc. Beech 65-A80, N100UV, crashed into an open, level field about 7 nautical miles east southeast of Madisonville, Texas. Witnesses heard a small explosion and saw the aircraft descend from a dark cloud; the wings and the empennage were not attached during the observed portion of the aircraft's descent. The pilot and the two passengers were killed. The aircraft was destroyed. The National Transportation Safety Board determines that the probable cause of the accident was a pilot induced airframe overload following loss of aircraft control which resulted in the structural breakup of the aircraft. The reason(s) for the loss of aircraft control could not be determined. Contributing to the loss of control was the pilot's lack of instrument proficiency in multiengine aircraft. R.J.F

N82-17139# National Transportation Safety Board, Washington, D. C. Bureau of Technology.
AIRCRAFT ICING AVOIDANCE AND PROTECTION
9 Sep. 1981 16 p
(PB82-108135; NTSB-SR-81-1) Avail: NTIS HC A02/MF A01 CSCL 01C

The problems of aircraft icing from the standpoint of icing statistics, the meteorological factors which cause icing, the certification of aircraft by the FAA for the flight into known icing conditions, and the forecasting of icing conditions are investigated. It is noted that icing accidents are a problem primarily for general aviation aircraft and that in addition to the accidental losses due to icing, there are significant operational losses due to inadequacies in the weather forecasting system. The problems revealed can be alleviated, but in order to do so new technology will have to be developed based upon a better understanding of ice formation and improvements in the quality of icing forecasts. GRA

N82-17142*# Analytical Mechanics Associates, Inc., Hampton, Va.
TERMINAL AREA AUTOMATIC NAVIGATION, GUIDANCE, AND CONTROL RESEARCH USING THE MICROWAVE LANDING SYSTEM (MLS). PART 2: RNAV/MLS TRANSITION PROBLEMS FOR AIRCRAFT Final Report
Samuel Pines Washington, D.C. NASA Jan. 1982 139 p refs
(Contract NAS1-15116)
(NASA-CR-3511; AMA-80-12-Pt-2) Avail: NTIS HC A07/MF A01 CSCL 17G

The problems in navigation and guidance encountered by aircraft in the initial transition period in changing from distance measuring equipment, VORTAC, and barometric instruments to the more precise microwave landing system data type navaids in the terminal area are investigated. The effects of the resulting discontinuities on the estimates of position and velocity for both optimal (Kalman type navigation schemes) and fixed gain (complimentary type) navigation filters, and the effects of the errors in cross track, track angle, and altitude on the guidance equation and control commands during the critical landing phase are discussed. A method is presented to remove the discontinuities from the navigation loop and to reconstruct an RNAV path designed to land the aircraft with minimal turns and altitude changes. B.W.

N82-17144# Mitre Corp., McLean, Va. Metrek Div.
REQUIREMENTS FOR INSTRUMENT APPROACHES TO CONVERGING RUNWAYS
L. C. Newman, W. J. Swedish, and T. N. Shimi Sep. 1981 116 p refs
(Contract DTFA01-81-C-10001)
(AD-A108075; MTR-81W230; FAA-EM-82-4) Avail: NTIS HC A06/MF A01 CSCL 01/2

This document discusses the technical issues relevant to converging approaches and examines the feasibility of conducting instrument approaches as a means of increasing airport capacity. The main considerations in the analysis were: runaway geometry; missed approach paths; and pilot acceptance. A safety analysis was conducted to determine requirements and control procedures to provide protection against: random lateral variation from the missed approach path; Heading blunder; and rare and unexpected events. Requirements for final and missed approach are presented as are strategies for applying these requirements to airports with a wide variety of converging runway geometries. Preliminary recommended procedures are presented for conducting independent instrument approaches to Category I minima. GRA

N82-17146# Systems Control, Inc., Palo Alto, Calif.
DIFFERENTIAL OMEGA SYSTEM DEVELOPMENT AND EVALUATION Final Report, 27 Aug. 1977 - 15 Aug. 1981
T. M. Watt, L. E. Abrams, and F. G. Karkalik Washington FAA Aug. 1981 105 p refs
(Contract DOT-FA75WA-3662)
(AD-A107857; FAARD-81-69) Avail: NTIS HC A06/MF A01 CSCL 17/7

This report describes a development and evaluation program for Differential Omega in general aviation. The program was a cooperative venture between the FAA and Transport Canada. SCT performed system design, program management, and flight test on behalf of the FAA. Tracor, Inc. provided modified Omega airborne receivers under subcontract to SCT. Flight tests took place in Alaska aboard a Convair 580 provided by the FAA. Monitor stations were located in Anchorage and at Deadhorse. The most definitive results were obtained from flight tests conducted in October 1980 and February 1981. Important results included: (a) data-link range varied from 44 nm to 198 nm, (b) random component of navigation error was 0.25 nm, 2-D RMS, (c) range decorrelation error was about 2 nm over a distance of 550 nm, (d) transient response of the system-following aircraft procedure turns was characterized by a positional overshoot of about 1.5 nm, followed by a monotonically decreasing error with a two-minute time constant. Recommendations are made for improving system performance. Author (GRA)

N82-17148# Federal Aviation Administration, Atlantic City, N.J. Technical Center.
ACTIVE BEACON COLLISION AVOIDANCE LOGIC EVALUATION. VOLUME 2: COLLISION AVOIDANCE (BCAS) THREAT PHASE Final Report, Apr. 1979 - Jun. 1980
A. Adkins, J. Thomas, B. Billmann, and J. Windle Sep. 1981 59 p refs
(FAA Proj. 052-241-320)
(AD-A107805; FAA-CT-80-51-2-Vol-2; FAA-RD-80-125-2) Avail: NTIS HC A04/MF A01 CSCL 01/2

The purpose of this project was to evaluate and refine the April 1979 version of the Beacon Collision Avoidance System (BCAS) logic prior to Active BCAS prototype flight testing. The April 1979 version of the BCAS logic added changes to support multiple aircraft conflict resolution, Conflict Indicator Register (CIR) interfacing and new surveillance logic interfacing. The results of the first phase of the Active BCAS logic, evaluating the Air Traffic Control Radar Beacon System (ATCRBS) threat phase, identified several improvements that should be made to the BCAS logic. These improvements were incorporated into the logic prior to beginning the second phase, the BCAS equipped threat phase. The second phase was conducted from September to November 1979 and was designed to evaluate the BCAS performance against BCAS equipped threats. The results are presented in this report. Several logic improvements have been identified. These changes have been implemented in both the threat logic and the BCAS command coordination logic (CIR logic). In general, BCAS performance for equipped threats was not as sensitive to vertical rate tracker noise as in the ATCRBS threat case. Resolution performance has been improved through a reduction in undesirable BCAS alarms and by reducing excessive separation with the inclusion of a projected vertical miss distance (VMD) filter for equipped threats. A better method of selecting threat volume parameters has been incorporated. GRA

N82-17149# Federal Aviation Administration, Atlantic City, N.J. Technical Center.
INVESTIGATION OF WILCOX MODEL 585B VERY HIGH FREQUENCY OMNIDIRECTIONAL RADIO RANGE (VOR) SYSTEM, PART 3 Final Report, Mar. 1980 - Feb. 1981
Wayne E. Bell Oct. 1981 53 p refs
(FAA Proj. 041-305-830)
(AD-A107855; FAA-CT-81-46; FAA-RD-81-52; ACT-100) Avail: NTIS HC A04/MF A01 CSCL 17/7

A three-part investigation of the Wilcox 585B Very High Frequency Omnidirectional Radio Range (VOR) System was conducted. In Part 1, the magnitude of the ground error was reduced by modification and suitable adjustment of antenna element lengths of the field detector. In Part 2, investigation developed an acceptable calibration procedure for system 30 hertz (Hz) modulation. Obtaining compatible 30 Hz modulation reading between aircraft (far-field) and edge of counterpoise (near-field) measurements was an additional requirement. In Part 3, tests resolved any discrepancies in the tuning adjustments prescribed by the manufacturer's equipment manuals. This report, which is the last in a series of three, contains an outline of the tests and procedures for setting the lengths of the adjustable field detector elements, a recommended procedure for obtaining compatible near-field and airborne 30 Hz modulation readings, and recommended changes to the manufacturer antenna tuning procedures in order that the system meet required operational tolerances. Author (GRA)

N82-17150# Air Navigation Services, Inc., Westerngrund (West Germany).
AERONAUTICAL INFORMATION DATA SUBSYSTEM (AIDS): A GROUND-BASED COMPONENT OF AIR NAVIGATION SERVICES SYSTEMS
Frank W. Fischer 1981 5 p Presented at 11th AIDS Symp., Cologne, 22-24 Sep. 1981 Sponsored by DFVLR
Avail: NTIS HC A02/MF A01

The construction of an air navigation services information data base for internal and external use (airspace users before and during flight) of internally and externally produced information data is advocated. A data bank, which holds all current operational information data, controls the data switching and processing machine which constitutes the data communication subsystem. Benefits of AIDS include costs in data compiling and the provision of precise data for air traffic control, flight planning or rescue operations. Apart from the airlines, AIDS is of most use to general aviation operators. Author (ESA)

N82-17151*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
USE OF OPTIMIZATION TO PREDICT THE EFFECT OF SELECTED PARAMETERS ON COMMUTER AIRCRAFT PERFORMANCE Progress Report
Valana L. Wells and Richard S. Shevell Feb. 1982 45 p refs
(Grant NAG1-202)
(NASA-CR-168439) Avail: NTIS HC A03/MF A01 CSCL 01C

The relationships between field length and cruise speed and aircraft direct operating cost were determined. A gradient optimizing computer program was developed to minimize direct operating cost (DOC) as a function of airplane geometry. In this way, the best airplane operating under one set of constraints can be compared with the best operating under another. A constant 30-passenger fuselage and rubberized engines based on the General Electric CT-7 were used as a baseline. All aircraft had to have a 600 nautical mile maximum range and were designed to FAR part 25 structural integrity and climb gradient regulations. Direct operating cost was minimized for a typical design mission of 150 nautical miles. For purposes of C sub L sub max calculation, all aircraft had double-slotted flaps but with no Fowler action. T.M.

N82-17152*# Goodyear Aerospace Corp., Akron, Ohio.
PRELIMINARY DESIGN STUDY OF A HYBRID AIRSHIP FOR FLIGHT RESEARCH
Ronald G. E. Browning Jul. 1981 286 p refs
(Contract NAS2-10777)
(NASA-CR-166246; GER-17016) Avail: NTIS HC A13/MF A01 CSCL 01C

The feasibility of using components from four small helicopters and an airship envelope as the basis for a quad-rotor research aircraft was studied. Preliminary investigations included a review of candidate hardware and various combinations of rotor craft/airship configurations. A selected vehicle was analyzed to assess its structural and performance characteristics. Author

N82-17153*# Lockheed-California Co., Burbank.
SYSTEMS STUDY OF TRANSPORT AIRCRAFT INCORPORATING ADVANCED ALUMINUM ALLOYS Final Report
I. Frank Sakata Jan. 1982 187 p refs
(Contract NAS1-16434)
(NASA-CR-165820; LR-29984) Avail: NTIS HC A09/MF A01 CSCL 01C

A study was performed to quantify the potential benefits of utilizing advanced aluminum alloys in commercial transport aircraft and to define the effort necessary to develop fully the alloys to a viable commercial production capability. The comprehensive investigation (1) established realistic advanced aluminum alloy property goals to maximize aircraft systems effectiveness (2) identified performance and economic benefits of incorporating the advanced alloy in future advanced technology commercial aircraft designs (3) provided a recommended plan for development and integration of the alloys into commercial aircraft production (4) provided an indication of the timing and investigation required by the metal producing industry to support the projected market and (5) evaluate application of advanced aluminum alloys to other aerospace and transit systems as a secondary objective. The results of the investigation provided a roadmap and identified key issues requiring attention in an advanced aluminum alloy and applications technology development program. Author

N82-17154* Textron Bell Helicopter, Fort Worth, Tex.
CORRELATING MEASURED AND PREDICTED INPLANE STABILITY CHARACTERISTICS FOR AN ADVANCED BEARINGLESS ROTOR Final Report
William H. Weller Jan. 1982 72 p refs
(Contract NAS2-10772)
(NASA-CR-166280; Rept-699-099-046) Avail: NTIS HC A04/MF A01 CSCL 01C

The experimental data were obtained from hover tests for a scaled model of an advanced bearingless main rotor. Both isolated rotor and ground resonance conditions were tested. Test parameters included blade built-in cone and sweep angles, rotor inplane structural damping, pitch link location and fuselage structural damping. Analytical results for the conditions tested were obtained using current Bell Helicopter analyses. In addition, variations in the analytical models were made to assess their impact on the correlation between computed and measured results. Results are presented in tabular and graphical form. T.M.

N82-17155# Arinc Research Corp., Santa Ana, Calif.
TECHNOLOGY OVERVIEW FOR ADVANCED AIRCRAFT ARMAMENT SYSTEM PROGRAM
H. Rosenberg, R. Brooks, J. Alderman, K. Braman, G. OBryan, and G. Wright May 1981 284 p refs
(Contract N60530-80-C-0270)
(AD-A107680; Rept-1789-01-1-2406) Avail: NTIS HC A13/MF A01 CSCL 01/3

Presented herein are overviews of state-of-the-art technologies applicable to the Stores Management System and Suspension and Release Equipment of the Advanced Aircraft Armament System. Technology briefs are presented for selected areas, and references are made to detailed sources of desired information. Author (GRA)

N82-17156# Arinc Research Corp., Santa Ana, Calif.
STANDARDIZATION STUDY FOR ADVANCED AIRCRAFT ARMAMENT SYSTEM PROGRAM
Larry J. Graham and William G. Schulz May 1981 103 p refs
(Contract N60530-80-C-0339)
(AD-A107681; Rept-1783-01-1-2405) Avail: NTIS HC A06/MF A01 CSCL 01/3

Results of a 6-month study of standardization criteria and characteristics are presented that may be effectively applied to the Advanced Aircraft Armament System (AAAS) Program. System elements feasibly for standardization are identified. Standardization characteristics for those feasible elements are developed for various levels of standardization (subsystem, module, piece part) and standardization approaches (horizontal, vertical, area, functional, logistical, and cooperative). Alternative standardization characteristics are also postulated and recommendations are formulated for application to the AAAS Program. Author (GRA)

N82-17157# Hochschule der Bundeswehr, Munich. (West Germany). Fachbereich Luft- und Raumfahrttechnik.
OPTIMAL DOLPHIN HANG GLIDER FLIGHT [OPTIMALER DELPHIN-SEGELFLUG]
E. D. Dickmanns Mar. 1981 71 p refs In GERMAN
Avail: NTIS HC A04/MF A01

Time minimal gliding flight in vertical air currents is discussed. If the vertical current wavelength is large as opposed to the trajectory oscillation taken by an airplane, an optimal flight with approximately n sub z = 1 can be obtained. In short vertical currents the dynamic warming up maneuver in the downwind gives great advantages. During the transition local conditions may interfere. Two fundamentally different control maneuvers of equal value to the sail functions are described. Transl. by E.A.K.

N82-17158# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Betriebsbereich.
THE ARMED HELICOPTER IN AIR TO AIR MISSIONS
Emil Weiland 1981 18 p Presented at Royal Aeronautical Soc. Rotorcraft Section Symp., London, 4 Feb. 1981
(MBB-UD-317-81-O) Avail: NTIS HC A02/MF A01

The antihelicopter-helicopter must be superior in performance and agility. The basic vehicle must be supplemented by a specialized armament demonstrating a combination of guns and fire and forget air to air missiles. In order to ensure a system superior to the possible enemy gunship, the helicopter needs to be designed to take full advantage of the inherent performance and agility potential of the basic helicopter elements. The agility aspect of the rotorcraft inherent characteristics of the major rotorcraft components are discussed and a possibility for a practical solution is indicated. Author

N82-17160# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Structures and Materials Panel.
DESIGN MANUAL FOR IMPACT DAMAGE TOLERANT AIRCRAFT STRUCTURE
John G. Avery (Boeing Military Airplane Co., Seattle) Oct. 1981 230 p refs Sponsored in part by Dept. of Defense
(AGARD-AG-238; ISBN-92-835-1403-3) Avail: NTIS HC A11/MF A01
The structural design information is grouped into three major sections: description of projectile threats; analysis methods for predicting structural response to projectile impact; and design guidelines for impact tolerance. The hydrodynamic ram effect and aircraft engine disintegration are highlighted.

N82-17161# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
DESCRIPTION OF PROJECTILE THREATS
In its Design Manual for Impact Damage Tolerant Aircraft Struct. Oct. 1981 p 1-24 refs

Avail: NTIS HC A11/MF A01
Evaluating the degradation of aircraft structure resulting from projectile impact requires a knowledge of the threat and encounter conditions. This is necessary in understanding the failure mechanisms and structure response modes induced by the various types of threats. Projectile types, important encounter parameters, and typical terminal effects are discussed. Information that is helpful in understanding the analysis of structural response to impact and the design guidelines for impact damage tolerance is presented. T.M.

N82-17162# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
ANALYSIS METHODS FOR PREDICTING STRUCTURAL RESPONSE TO PROJECTILE IMPACT
In its Design Manual for Impact Damage Tolerant Aircraft Struct. Oct. 1981 p 27-44

Avail: NTIS HC A11/MF A01
Analysis methods and data available for predicting the response of metal and fiber composite structure to projectile impact are presented. The analysis methods discussed are applicable to impacts from small arms projectiles, missile warhead fragments, and the fragmentation and blast effects of high-explosive projectiles. The responses addressed include penetration capability, damage size and type, strength degradation of damaged structure, and internal load redistribution. T.M.

N82-17163# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
ANALYSIS METHODS FOR BALLISTIC DAMAGE SIZE AND TYPE
In its Design Manual for Impact Damage Tolerant Aircraft Struct. Oct. 1981 p 45-78

Avail: NTIS HC A11/MF A01
The parameters which influence the size and character of projectile impact damage are described. Predicting damage size is the first step is assessing the structural capability of impacted structure, since damage size determines net section strength loss, stiffness loss, and the flaw size for failure analysis. The discussion is organized according to projectile type as follows: non-exploding projectiles; high explosive projectiles; and engine debris projectiles. Within each projectile category the responses of both metallic and fiber composite structure are discussed. The effects of fluid pressure in causing damage, a phenomenon known as hydrodynamic ram, are discussed. T.M.

N82-17164# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
DAMAGE FROM HIGH EXPLOSIVE (HE) PROJECTILES
In its Design Manual for Impact Damage Tolerant Aircraft Struct. Oct. 1981 p 79-135 refs

Avail: NTIS HC A11/MF A01
The structural damage done by HE projectiles (20- to 30-mm, for example) is the result of multiple fragment penetrations and internal blast pressures, acting separately and in combination. The fragments are created as the metal casing surrounding the explosive bursts due to the intense pressures generated by the detonation. Fragment damage degrades structural strength and stiffness, and blast pressures added to the existing flight loads can cause excessive deformations and element failures. The nature and extent of structural damage from HE projectile fragments and blast pressure depend upon these variables: material type and thickness; projectile size and delay characteristics; striking velocity and obliquity; distance from detonation to impacted structure (standoff); and internal volume of structural cell and extent of venting. The significance of each of these variables is discussed. Qualitative descriptions of HE projectile damage in metallic and fiber composite structure are presented followed by a discussion of damage prediction analysis techniques for blast and fragments. T.M.

N82-17165# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
DAMAGE FROM ENGINE DEBRIS PROJECTILES
In its Design Manual for Impact Damage Tolerant Aircraft Struct. Oct. 1981 p 136-139

Avail: NTIS HC A11/MF A01
The effects of uncontained projectile emanating from an engine and subsequently striking an adjacent portion of the airframe are assessed. The effects are treated the same as for effects resulting from nonexploding military projectiles. There is an important distinction, however, in that the engine debris projectile is typically an irregular fragment (as opposed to a bullet), behaving more like a warhead fragment or the fragments generated from a high-explosive projectile. T.M.

N82-17166# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
HYDRODYNAMIC RAM DAMAGE
In its Design Manual for Impact Damage Tolerant Aircraft Struct. Oct. 1981 p 140-152

Avail: NTIS HC A11/MF A01
Hydrodynamic ram is a phenomenon that may cause extensive structural failure of aircraft fuel cells when they are subjected to ballistic impact. During impact and penetration of the fuel cell, intense pressure waves are generated within the liquid by the projectile. The response of the fuel cell to this pressure loading varies according to its construction. For example, the walls of an integral fuel cell are formed by the aicraft skin, which is usually constructed of high-strength metal designed to withstand normal flight loads. This type of structure can fail catastrophically in response to hydrodynamic ram pressure loading due to fracturing of the walls of the cell. Self-sealing fuel cells can also be defeated due to hydrodynamic ram by gross tearing of the material or by misalignment of the wound edges, thereby defeating the self-sealing process. Both of these effects become increasingly severe as fuel cells become smaller, or projectile kinetic energies increase. An analysis method to predict hydrodynamic ram pressures generated by small arms ammunition was developed. The analysis method is based on the conversion of projectile kinetic energy to pressure field energy and includes the effects of reflections from the tank walls. T.M.

N82-17167# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
EFFECTS OF CYCLIC LOADING ON PROJECTILE IMPACT DAMAGE
In its Design Manual for Impact Damage Tolerant Aircraft Struct. Oct. 1981 p 153-157

Avail: NTIS HC A11/MF A01
The cyclic loading induced during flight can influence the severity of existing impact damage by initiating fatigue cracks at the damage site, subsequent crack sharpening or blunting and crack growth. There can be significant time dependent changes in the residual strength of the structure due to these alterations in the size and character of the impact damage. Projectile produce a wide variety of damage types, including cracks, holes, tears, large determination, even totally severed structural elements. The response of the damaged structure when exposed to cyclic loads reflects this wide variety of structural damage. For example,

the cyclic loading can result in immediate growth when the projectile damage is a crack. There may be, however, a time (number of cycles) devoted to crack nucleation. Several important aspects of the fatigue response of impact damaged structure are described in terms of crack initiation and extension. An approach which basically consists of assuming immediate fatigue crack initiation at the damage site, and then applying conventional crack growth analysis is suggested. T.M.

N82-17168# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
STIFFNESS DEGRADATION OF IMPACT DAMAGED STRUCTURE
In its Design Manual for Impact Damage Tolerant Aircraft Struct. Oct. 1981 p 159-160

Avail: NTIS HC A11/MF A01

Stiffness reduction in impact damaged structural elements can be important from two standpoints. The first is the alteration of load distribution within the structure, potentially causing overloading and failure of undamaged elements. The second area of potential concern is the residual stiffness of major structural components, since stiffness degradation may lead to instability and control inadequacy. These two topics are discussed, however, there are few verified analysis methods for predicting stiffness degradation associated with ballistic damage. Both of these stiffness degradation effects, but particularly the latter, become increasingly significant as the extent of the inflicted damage becomes larger. Stiffness degradation may well be a problem for HE projectile impacts, but it is generally insignificant with small arms. T.M.

N82-17169# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
STRENGTH DEGRADATION OF IMPACT DAMAGED STRUCTURE
In its Design Manual for Impact Damage Tolerant Aircraft Struct. Oct. 1981 p 161-194

Avail: NTIS HC A11/MF A01

Projectile damage destroys a portion of the load carrying capability of the structure, alters the distribution of internal loads, and introduces a flaw which may cause failure by locally disturbing the stress field. The latter effect is most significant with regard to the relatively small damage induced by small arms projectile and dispersed warhead or engine debris fragments. High explosive projectiles can often create damage of sufficient size to substantially degrade structural performance by all three effects. Estimating the residual strength of structure damaged by projectile impact is a major step in predicting structural capability. The analysis methods presented for evaluating strength capability are organized according to structural complexity: analysis of monolithic panels; analysis of multiple load path panels; and analysis of multielement structure. The application of conventional and modified fracture mechanics analysis to ballistic damaged panels is discussed. The extension of these approaches to the requirements of panels having discrete stiffening members are discussed. T.M.

N82-17170# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
ANALYSIS OF MULTIPLE LOAD PATH PANELS CONTAINING IMPACT DAMAGE
In its Design Manual for Impact Damage Tolerant Aircraft Struct. Oct. 1981 p 195-209

Avail: NTIS HC A11/MF A01

Many structural configurations cannot be represented as monolithic panels in assessing strength degradation from impact damage. The wings of transport aircraft, for example, often consist of skin with riveted stiffeners. The stiffeners can provide damage containment or crack assessment capability that is not considered in element residual strength analysis. Since the crack arrestment capability can significantly improve the residual strength of damaged structure, the stiffening must be included in the analysis. The response of stiffened panels to projectile damage, and available analytical techniques for residual strength prediction, are discussed. T.M.

N82-17171# McDonnell Aircraft Co., St. Louis, Mo.
CORROSION CONTROL TEST METHOD FOR AVIONIC COMPONENTS Final Report, 27 Sep. 1979 - 27 May 1981
A. W. Morris 25 Sep. 1981 60 p refs
(AD-A108061; NADC-81174-60) Avail: NTIS HC A04/MF A01 CSCL 01/3

The program objective was to develop an accelerated laboratory corrosion test capable of simulating the severe corrosive effects of an aircraft carrier deployment environment. The current standard 5% salt fog test is not severe enough to simulate the carrier environment, thus limiting its usefulness in forecasting corrosion failures. To provide test standards, representative electrical and electronic units were exposed on an oil burning carrier during a 9 month tropical cruise and on a nuclear carrier during a 10 month tropical cruise. A series of laboratory tests were run to identify corrosion environments which provide good correlation with actual carrier results. The tests were also judged on their ability to promote moisture related electrical failures. During the final phase of the program, 25 electronic and electrical components were exposed to the two most promising test methods. The selected test method is a modification of the NADC sulfur dioxide salt fog test. It utilizes a much higher exposure temperature and a dilute substitute ocean water solution for fog generation. In one week this test method produces both corrosion damage and electrial failures that correlate with the condition of the test articles exposed for nine to ten months on an aircraft carrier. Author (GRA)

N82-17172# Systran Corp., Dayton, Ohio.
DIGITAL AVIONICS INFORMATION SYSTEM (DAIS) DOCUMENTATION Final Report, Aug. 1979 - Jun. 1981
F. Forster and R. Gregory Wright-Patterson AFB, Ohio AFWAL Sep. 1981 97 p
(Contract F33615-79-C-1818; AF Proj. 2052)
(AD-A108000; AFWAL-TR-81-1162) Avail: NTIS HC A05/MF A01 CSCL 09/2

This report covers the work performed by SYSTRAN Corporation in providing Configuration control, technical editing and generation of documentation for the DAIS Program Branch. This effort encompassed the following functions: (1) maintaining the DAIS library, (2) generating certain specifications, plans, drawings and/or test reports, (3) performing configuration audits per MIL-STD-1521, (4) assuring that DAIS documents conformed to MIL-STD-490 and 483, (5) technical editing and configuration control over all DAIS documentation. The DAIS documentation effort was highly successful and could set an example for other R&D programs on how to properly document their efforts in MIL-STD format. Author (GRA)

N82-17173# Naval Research Lab., Washington, D. C.
FUNCTION SPECIFICATIONS FOR THE A-7E FUNCTION DRIVER MODULE Interim Report
P. C. Clements 27 Nov. 1981 177 p refs
(XF21242101)
(AD-A107922) Avail: NTIS HC A09/MF A01 CSCL 09/2

As part of the experimental redesign of the flight software for the Navy's A-7E aircraft, software modules were designed to encapsulate the characteristics of the behavioral requirements of the system. The purpose of these Function Driver modules is to allow the remainder of the software to remain unchanged when the required system behavior is modified without associated hardware changes. This document specifies the behavior of the system without regard to specific hardware devices. This report contains an explanation of the standard organization of each functional description, a description of the review procedures, specifications for all of the functional aspects of the A-7E software, and a set of indices and cross-references to help integrate this module with the rest of the system. As well as serving as development and maintenance documentation for the A-7E redesign, this document is intended to serve as a model for other people interested in applying our documentation and structuring techniques to other software projects. Author (GRA)

N82-17174*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
CF6 JET ENGINE PERFORMANCE IMPROVEMENT: HIGH PRESSURE TURBINE ROUNDNESS
W. D. Howard and W. A Fasching Jan. 1982 136 p refs
(Contract NAS3-20629)
(NASA-CR-165555; R82AEB115) Avail: NTIS HC A07/MF A01 CSCL 21E

An improved high pressure turbine stator reducing fuel consumption in current CF6-50 turbofan engines was developed. The feasibility of the roundness and clearance response improvements was demonstrated. Application of these improvements will result in a cruise SFC reduction of 0.22 percent for new engines. For high time engines, the improved roundness and response characteristics results in an 0.5 percent reduction in cruise SFC. A basic life capability of the improved HP turbine stator in over 800 simulated flight cycles without any sign of significant distress is shown. E.A.K.

N82-17176# Pratt and Whitney Aircraft Group, West Palm Beach, Fla.
DAMAGE TOLERANT DESIGN FOR COLD-SECTION TURBINE ENGINE DISKS Final Report, Aug. 1977 - Feb. 1981
C. H. Cook, H. E. Johnson, and C. E. Spaeth Wright-Patterson AFB, Ohio AFWAL Jun. 1981 243 p
(Contract F33615-77-C-2064; AF Proj. 3066)
(AD-A107863; PWA-FR-14442; AFWAL-TR-81-2045) Avail: NTIS HC A11/MF A01 CSCL 21/5

This report describes the development, test evaluation, and refinement of a Damage Tolerant Design System for cold-section turbine engine disks. To substantiate the Design System the 42-month effort included the design and test of a functional replacement 2nd-stage fan disk for the F100 engine. This disk would be able to support a 0.030-inch crack for three maintenance intervals without a rapid fracture failure. The program was totally successful and resulted in a disk design that was three pounds heavier than the Bill of Material (B/M) disk but had over ten times the B/M life even with a 0.030-inch crack in the bolthole and a 0.020 inch elox crack starter in the rim slot. Included in this report are the design criteria and rationale used in creation of the damage tolerant configuration, the testing and analysis methodology, and results as well as recommendations for application and improvements. GRA

N82-17177# Strategic Air Command, Offutt AFB, Nebr. Aircraft Engineering Div.
MAINTENANCE POSTURE FOR QUICK START Final Report
John M. Connolly 12 Aug. 1981 46 p
(AD-A107553; SAC/LGME-ER-P-328) Avail: NTIS HC A03/MF A01 CSCL 12/5

Quick start is an aircraft modification which installed cartridge starters on all engines of the B-52G/H and non-fan KC-135 aircraft. Routine peacetime use of the modification was suspended due to an excessive amount of smoke and toxic gases created by the cartridge exhaust. The SAC Aircraft Engineering Division then investigated respiratory and eye protection for ground crew personnel. As an interim solution, they found that an aircraft firefighter's smoke mask connected to a Mine Safety Appliance Corp Type N model SW as filter canister adequately protects the user. To minimize the crew chief's exposure to the smoke cloud, the Division designed and tested a roll-over chock, evaluated a wireless interphone communication system, and implemented alert B-52 battery engine starts. With these new concepts, response timing is only limited to aircrew checklist items and engine start time. GRA

N82-17178# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
THROUGH FLOW CALCULATIONS IN AXIAL TURBOMACHINES
C. Hirsch, ed. (Vrije Universiteit, Brussels) and J. D. Denton, ed. (Cambridge Univ.) Oct. 1981 330 p refs
(AGARD-AR-175) Avail: NTIS HC A15/MF A01

The objectives were to review the existing information on blade performance and wall effect prediction, and to extend this information by systematic application of numerical methods to representative geometries. Only axial turbomachines were examined and they were split into a turbine sub-group and a compressor sub-group. Axial turbine performance predicted included an examination of the influence of correlations and computational procedures on the prediction of overall efficiency. A comprehensive survey of the various loss and deviation mechanisms was conducted for the compressor sub-group.

N82-17180# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
INFLUENCE OF CORRELATIONS AND COMPUTATIONAL METHODS ON THE PREDICTION OF OVERALL EFFICIENCY
In its Through Flow Calculations in Axial Turbomachines Oct. 1981 p 29-31 refs

Avail: NTIS HC A15/MF A01

The process of designing a gas turbine or a steam turbine begins with an evaluation of the influence of component design parameters on the overall cost. For both the steam turbine and the gas turbine, energy costs are rapidly increasing and component efficiency is therefore a primary design objective. For the aircraft gas turbine, the weight of the component influences the fuel consumption and is therefore also an important energy cost consideration. Turbine efficiency predictions, together with information which influence the weight and cost, were obtained from flow field calculations which define the thermodynamic properties and velocity triangles throughout the turbine. These computational methods may be full span through flow calculations which predict the fluid properties from the hub to the tip between each blade row or they may be mean line calculations. In either case they are dependent upon loss and deviation models for their effectiveness in the efficiency optimization stage of the design process. The loss and deviation correlations which are in common use by steam turbine and gas turbine manufacturers are frequently developed internally and are maintained as proprietary information. The overall efficiency predictions which are discussed are therefore limited to results obtained using the correlations built into the methods which are described. T.M.

N82-17183# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
THE TWO STAGE AERO ENGINE TURBINE
In its Through Flow Calculations in Axial Turbomachines Oct. 1981 p 69-83 ref

Avail: NTIS HC A15/MF A01

The turbine was a model of the H.P. and I.P. stages of an aircraft gas turbine with the two rotors running at different speeds. It was 'cold flow' tested using air at 420 K and 2.95 bar. Both hot wire and pressure probe instrumentation was used with radial and circumferential traverses after each blade row. The through-flow program used to provide sample results is based on a method of solution for axisymmetric and steady flow in axial turbomachines; it solves the complete radial equilibrium equation - acounting for enthalpy and entropy gradients and streamline curvature effects - in a specified number of stations ahead of and after the blade rows. An orthogonal curvilinear system of coordinates, having the meridional coordinates coincident with the generatrices of the flow stream surfaces, is used in the solution. Overall predicted efficiency is 89.1% of the measured results. T.M.

N82-17186# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
SURVEY ON DIFFUSION FACTORS AND PROFILE LOSSES
In its Through Flow Calculations in Axial Turbomachines Oct. 1981 p 115-126 refs

Avail: NTIS HC A15/MF A01

Emphasis is placed upon the development of stage and blade design procedure that will replace the simple loss prediction techniques in use today. These techniques are difficult to apply to real machine design because extensive iterative hub-to-tip, blade-to-blade, and boundary-layer flow calculation is needed. Parametric studies with blade-to-blade flow and boundary layer calculation codes were examined which attempt to refine the diffusion factor concept and loss correlation at design as well as off-design compressor operation. The codes begin to demonstrate how the flow parameters (including Mach- and Re-number) and the details of blade geometry interact to produce performance characteristics. T.M.

N82-17188# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
END-WALL BOUNDARY LAYER CALCULATION METHODS
In its Through Flow Calculations in Axial Turbomachines Oct. 1981 p 137-150 refs

Avail: NTIS HC A15/MF A01

The end-wall boundary layer (EWBL) approach to secondary losses is based on the integration of the pitch-averaged three-dimensional boundary layers along the hub and tip walls, with extra assumptions for the blade force defect terms. From there an efficiency drop is calculated including secondary flow effects, as well as blockage. The method allows in principle for the influence of inlet blockage, clearance, axial gap, aspect ratio and other parameters to be included through their effect on the end-wall boundary layers. From the knowledge of the velocity profiles inside the boundary layers, the full radial variations of incidence and turning can be predicted by coupling a radial equilibrium calculation to the EWBL calculation. T.M.

N82-17189# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
CORRELATION FOR SECONDARY FLOWS AND CLEARANCE EFFECTS
In its Through Flow Calculations in Axial Turbomachines Oct. 1981 p 151-165 refs

Avail: NTIS HC A15/MF A01
It is concluded that correlations obtained from straight cascade data will at least provide correct trends for the effect of clearance in compressors. With cascade data, the effect of variation of blade circulation with span is not known. This will cause problems if spanwise distributed correction for losses and angle are to be considered. For turbine, it is well known that for secondary flow effect the loss level as obtained from cascade data may differ of an order of magnitude from the machine losses. This is linked most probably to the effect of relative motion when passing from nozzle to rotor or vice-versa. In compressors this effect tends to bring back the end-wall boundary layer to a more collateral state, and the difference might be somewhat less. T.M.

N82-17190# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
EFFECTS OF REYNOLDS NUMBER AND TURBULENCE LEVEL ON AXIAL CASCADE PERFORMANCE
In its Through Flow Calculations in Axial Turbomachines Oct. 1981 p 164-170 refs

Avail: NTIS HC A15/MF A01
A semiempirical theory was developed which will predict the behavior of the shear layer across a laminar separation bubble. The method is proposed for two dimensional incompressible flow and is applicable down to short bubble bursting. The method can be used to predict the length of the laminar bubble, the bursting Reynolds number, and the development of the shear layer through the separated region. As such, it is a practical method for calculating the profile losses of axial compressor and turbine cascade in the presence of laminar separation bubbles. It can also be used to predict the abrupt leading edge stall associated with thin airfoil sections. The predictions made by the method are compared with the available experimental data. T.M.

N82-17191# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
SURVEY ON THE EFFECT OF BLADE SURFACE ROUGHNESS ON COMPRESSOR PERFORMANCE
In its Through Flow Calculation in Axial Turbomachines Oct. 1981 p 171-180 refs

Avail: NTIS HC A15/MF A01
Analysis of limited experimental data reveals that critical roughness Reynolds number of compressor blades manufactured with typical present day methods as forging/etching and electrochemical machining are around 90 and therefore very close to sand type roughness if roughness height is based on the largest peaks. Modern high pressure ratio engines suffer from blade surface roughness in the back stages of the compression system. Surface quality needed to keep the flow hydrodynamically smooth exceeds considerably the best present day quality achievable, thus limiting the potential efficiency gain at high Reynolds number flight conditions, i.e., essentially low level flight conditions. L.F.M.

N82-17192# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
PART SPAN DAMPER LOSS PREDICTION FOR TRANSONIC AXIAL FAN ROTORS
In its Through Flow Calculations in Axial Turbomachines Oct. 1981 p 181-183 refs

Avail: NTIS HC A15/MF A01
For off design conditions, the maximum loss due to the damper and region of influence at design point are calculated and these values are used as reference quantities for all off design calculations. The point of intersection of a constant throttle or area operating line through the design point with a speed line defines the reference point where the PSD loss is minimum. From this point the suction surface incidence at the damper location is determined from experimental data or off design analysis code. Then the damper maximum loss region of influence is calculated for any point on the speed line by taking the difference in suction surface incidence at that point and the reference incidence. To minimize damper loss, several things should be taken into consideration. Both approaches agree on the following: the damper should be as thin as possible so as to minimize the area influenced; the damper should be located as near to the hub as possible; work input should be minimized at the PSD location. Correlation of experimental results shows further that damper trailing and leading edge thickness should be as sharp as possible. L.F.M.

N82-17193# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
DEVIATION/TURNING ANGLE CORRELATIONS
In its Through Flow Calculations in Axial Turbomachines Oct. 1981 p 184-211 refs

Avail: NTIS HC A15/MF A01
In the past, compressor through flow solutions used substantial input from experimental measurements made in actual fan and compressor flow messages or in flows simulating real compressor conditions. For example, almost total reliance was placed on experimentally supported methods for estimation of fluid turning angles in individual blade rows. Compressor design is, as a result, heavily dependent on the quality of the experiment and data correlations associated with these methods. The three principal currently used prediction methods for flow turning angle were developed during the period 1945 to 1960. One of these methods directly predicts fluid turning angles in terms of cascade geometry and aerodynamic parameters. The others predict the exit flow deviation angle, defined as the angle between the average exit flow direction and the direction of a line tangent to the blade section camber line at the trailing edge. There has been no substantial modernization of these deviation/turning angle procedures since 1960, while during this time the methods have been widely applied to airfoil section profiles and in aerodynamic regimes far outside the limits suggested by the original derivations and data correlations. A discussion of these problems is presented. L.F.M.

N82-17194# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
AXIAL COMPRESSOR STALL AND SURGE
In its Through Flow Calculations in Axial Turbomachines Oct. 1981 p 212-213 refs

Avail: NTIS HC A15/MF A01
The so called surge line evaluation is an extremely complex area, which deserves in itself full attention. The intention here was only to define the problem. The existing methods of prediction do not take the real physics of the flow into account, and cannot explain or consider or identify all the parameters of importance. They are however quick and useful for the range in which they have been calibrated, but are mostly not available in public literature. A more generalized use of the pseudoend wall boundary layer approach seems interesting. Satisfactory solutions will come however only from the logical approach of instability detection, second flow regime and system response characterization, for which solid elements are now in hand but require further development. L.F.M.

N82-17195# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
SUMMARY OF ANSWERS TO THE QUESTIONNAIRE
In its Through Flow Calculations in Axial Turbomachines Oct. 1981 p 214-218 refs

Avail: NTIS HC A15/MF A01
To ascertain better the state of the art, a questionnaire bearing on particular points raised by the general survey paper of Hirsch was prepared and distributed to industry and research groups. Questions concerning compressor loss correlations, flow turning correlations, and secondary and clearance effects were asked. Answers were received from six countries and a summary is presented. L.F.M.

N82-17196# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
SINGLE STAGE TRANSONIC COMPRESSOR AND EQUIVALENT PLANE CASCADE
In its Through Flow Calculations in Axial Turbomachines Oct. 1981 p 221-228 refs

Avail: NTIS HC A15/MF A01
The working group 12 activities cover primarily turbomachinery off design performance prediction, however include also blade to blade calculation on relevant test cases to get more information on those basic flow phenomena that affect flow losses and turning in blade rows. One of the test cases selected is the DFVLR single stage transonic compressor that was tested in great detail with the results well documented, particularly intrablade velocity data of the rotor are available from extensive flow studies with laser velocimetry. The data allow to compare blade to blade calculations to actual transonic compressor flow. Additionally to the rotor tests the rotor blade section at 45% span was investigated in the DFVLR transonic cascade windtunnel. L.F.

N82-17197# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
BBC/SULZER. 4 STAGE TRANSONIC COMPRESSOR
In its Through Flow Calculations in Axial Turbomachines Oct. 1981 p 229-244
Avail: NTIS HC A15/MF A01
Tests were performed on the BBC/SULZER 4 stage Transonic Compressor. The overall performance map and some traverse of stagnation pressure and temperature at compressor outlet are presented. L.F.M.

N82-17198# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
RESULTS OF CALCULATIONS
In its Through Flow Calculations in Axial Turbomachines Oct. 1981 p 245-246 ref

Avail: NTIS HC A15/MF A01
The types of calculations were performed by various participants, each using his own method for through flow calculations and blade to blade calculations. The Working Group's task was to demonstrate that the use of systematic blade to blade calculations could provide a support for the confirmation of an existing correlation or the development of a new one. It is believed that the present development and state of the numerical tools available in order to compute complex flow structures, should be used more and more extensively in order to develop a deeper understanding of the flow mechanism of loss production and of turning. L.F.M.

N82-17199# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
THE THROUGH FLOW CALCULATIONS
In its Through Flow Calculations in Axial Turbomachines Oct. 1981 p 247-268 refs

Avail: NTIS HC A15/MF A01
Through flow calculations of three test cases were performed by various authors belonging to industrial or research organizations. The four-stage transonic compressor, the two-stage compressor, and the single stage compressor are discussed. L.F.M.

N82-17200# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
EVALUATION OF PROFILE LOSS PREDICTIONS BASED ON DIFFUSION FACTORS
In its Through Flow Calculations in Axial Turbomachines Oct. 1981 p 269-280 refs

Avail: NTIS HC A15/MF A01
A comparison between theoretically predicted and measured profile losses was made, in order to evaluate the precision of the different prediction methods. These prediction methods are based on the relation between suction side diffusion and profile losses. The evaluation concerns as well the prediction of diffusion factor as predicted values of profile losses. It is further shown that these correlations are not universally valid for all blade shapes and that some correlations perform as well at design as at off design if the suction side diffusion is correctly predicted. Author

N82-17201# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
AXIAL-FLOW TURBOMACHINE THROUGH FLOW CALCULATION METHODS
In its Through Flow Calculations in Axial Turbomachines Oct. 1981 p 285-305 refs

Avail: NTIS HC A15/MF A01
Through flow calculation methods are considered to be computational techniques for prediction of fluid velocities and thermodynamic properties at designated locations in the internal flow path of a turbomachine. The objectives are to trace the development of several classes of through flow calculation, to suggest the importance of understanding the assumptions underlying representative examples of each class, and to outline the principal problems in application of through flow methods to current axial-flow compressors and turbines. L.F.M.

N82-17202# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
BLADE-TO-BLADE COMPUTATIONS AND BOUNDARY LAYER CORRECTIONS IN AXIAL COMPRESSORS AND TURBINES
In its Through Flow Calculations in Axial Turbomachines Oct. 1981 p 307-326 refs

Avail: NTIS HC A15/MF A01
The number of inviscid calculation methods available today is quite impressive, and they allow an accurate prediction of inviscid incompressible, subsonic compressible and transonic flow. Recent progress has also resulted in a remarkable decrease of required computational effort, which makes them even more attractive to industrial applications. However, as these methods do not account for viscosity, the field of application is quite restricted, and good predictions can be obtained only for flow configurations where viscous effects can be neglected (e.g., turbines and low loaded compressor cascades). A similar conclusion can be drawn about boundary layer methods, with a limitation on shock boundary layer interaction, where complete solutions still require a large amount of computational effort. The combination of these two types of calculations started quite recently, and a lot of progress can be expected in the near future. Improvements which can be expected from a better combination of these two types of calculations will be more important than an improvement in the inviscid calculations. Based on the present state of the art concerning shock boundary layer interaction calculations, it appears that integral or inverse methods are the best suited to industrial calculations. However, in view of the considerable efforts currently made towards the development of the Navier-Stokes equation solution, it is more likely that, in the near future, this method will lead to more reasonable computation times and permit practical applications. L.F.M.

N82-17203# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
HELICOPTER PROPULSION SYSTEMS
Sep. 1981 277 p refs Partly in ENGLISH, partly in FRENCH Meeting held in Toulouse, 11-14 May 1981
(AGARD-CP-302; ISBN-92-835-0299-X) Avail: NTIS HC A13/MF A01
Component technology for turboshaft engines and transmissions, inlet protection systems, engine-airframe dynamic compatibility, and future requirements are described.

N82-17204# Textron Bell Helicopter, Fort Worth, Tex.
HELICOPTER PROPULSION SYSTEMS: PAST, PRESENT AND FUTURE
Robert R. Lynn and Gordon E. Holbrook *In* AGARD Helicopter Propulsion Systems Sep. 1981 12 p refs

Avail: NTIS HC A13/MF A01
Helicopter propulsion systems are reviewed, and it is noted that helicopter development is paced to a major extent by the power plant. Power available, reliability, fuel consumption, power-to-weight ratio, and life cycle costs are key parameters. The application of emerging technologies such as microelectronics, ceramics and other new materials and approaches, and the continuing refinement of the aerodynamics and dynamics of gas turbine power plants are discussed and noted to result in a significant benefit to the helicopter and its operator. Important airframe-propulsion system interface requirements are given, and

the need is discussed for new innovative certification procedures that provide for emergency operation with acceptable economics. Finally, future propulsion system capabilities are projected and their dramatic benefit for the helicopter noted. Author

N82-17205# Societe Turbomeca, Bordes (France).
DEVELOPMENT TEST PROGRAMS ADAPTED TO HELICOPTER ENGINES [PROGRAMMES D'ESSAIS DE DEVELOPMENT ADAPTES AUX MOTEURS D'HELICOPTERES]
J. Fresco *In* AGARD Helicopter Propulsion Systems Sep. 1981 9 p In FRENCH

Avail: NTIS HC A13/MF A01
The path to follow in a general program of engine development is shown with constraints of various kinds. There are regulatory requirements established by laws of navigability for civil aviation engines, and particular technical specifications for military aviation engines. Requirements of an operational order happen to be juxtaposed to precedents which are set by the different types of usages envisioned: flight profiles of various missions, and the environmental conditions likely to be encountered. This second factor is particularly important for a helicopter turbine because of the different utilizations and environmental conditions compared to a jet or turboprop engine. To address all these requirements, a test program must be built which, among others, takes into consideration this group of sometimes contradictory constraints in order to obtain certification and as well as to bring about development and operation without major risk. Specific tests for a helicopter turbine are examined with emphasis on the MAKILA program turbine which is on the AS-332 super PUMA. Transl. by A.R.H.

N82-17206# Army Aviation Research and Development Command, St. Louis, Mo.
AIRCRAFT TURBINE ENGINE DEVELOPMENT: CURRENT PRACTICES AND NEW PRIORITIES
Charles C. Crawford, Jr. and William J. Crawford, III (GE, Lynn, Mass.) *In* AGARD Helicopter Propulsion Systems Sep. 1981 8 p
Avail: NTIS HC A13/MF A01
The T700 engine program was conducted during the 1970's and is representative of recent practices employed in the development of turboshaft engines for U.S. military application. The engine, which is in the 1,600 horsepower class, recently entered service in the twin engine U.S. Army UH-60A Black Hawk helicopter. The T700's field introduction follows an extensive program of technology demonstration, development, qualification and maturity. Requirements applied in the T700 program and associated benefits, challenges and penalties are surveyed. Suggested improvements for future programs are offered, and technology needs revealed during T700 development are identified. Post-qualification maturity testing, which was conducted to provide early exposure of high time failure modes, is described. Program features which are important for development costs payback are summarized. J.D.H.

N82-17207# Ministry of Defence, London (England). Directorate of Engine Technology.
FUTURE TECHNOLOGY AND REQUIREMENTS FOR HELICOPTER ENGINES
M. D. Paramour and M. J. Sapsard *In* AGARD Helicopter Propulsion Systems Sep. 1981 12 p refs

Avail: NTIS HC A13/MF A01
The design considerations and technology needed to meet possible future operational requirements are discussed and the relevant technological work being carried out or supported by the UK Ministry of Defence (Procurement Executive) is described. Also considered are the tradeoffs which become necessary in seeking a suitable solution to conflicting needs. Finally the sizes of engines required to meet likely aircraft applications are examined. J.D.H.

N82-17208# Rolls-Royce Ltd., Leavesden (England).
MECHANICAL ADVANCES IN THE DESIGN OF SMALL TURBOSHAFT ENGINES
J. Dominy and K. J. Hart *In* AGARD Helicopter Propulsion Systems Sep. 1981 12 p

Avail: NTIS HC A13/MF A01
Mechanical components have a significant influence on the efficiency of a small gas turbine engine. Some of the performance losses associated with the design of the power transmission and internal air system are defined and discussed. Improvements in engine efficiency must be considered in conjunction with cost, reliability and size or weight. Many of the problems considered are applicable to gas turbines in general but become acute in small engines due to the adverse effects of scale on many components design parameters. To meet the increasing demand for more efficient powerplants the mechanical research engineer must improve the analysis of mechanical component behavior to produce optimized engine designs. Author

N82-17209# Motoren- und Turbinen-Union Muenchen G.m.b.H. (West Germany).
ADVANCED COMPONENT DEVELOPMENT DESIGN BASIS FOR NEXT GENERATION MEDIUM POWER HELICOPTER ENGINES
Jean Hourouziadis and Horst B. Kreiner *In* AGARD Helicopter Propulsion Systems Sep. 1981 13 p refs

Avail: NTIS HC A13/MF A01
Assuming an optimized thermodynamic cycle, engine components requiring intensive research and development efforts to produce a mature and reliable production engine are identified. Aerodynamic and structural data from rig and demonstrator test programs are presented. J.D.H.

N82-17210# Societe Turbomeca, Bordes (France).
THE INFLUENCE OF NEW TURBINE TECHNOLOGIES ON THEIR COMPONENTS [INFLUENCE DES NOUVELLES TECHNOLOGIES DES TURBINES SUR LEURS COMPOSANTS]
M. Giraud and H. Loustalet *In* AGARD Helicopter Propulsion Systems Sep. 1981 11 p In FRENCH

Avail: NTIS HC A13/MF A01
The interdependence of the turbine engine with that of its components is considered as well as the objectives for developing future helicopter engines with average power. The classic design of an engine is used to show that a new architecture is required in order to reduce costs and increase reliability. The engine architecture has a strong impact on the technology and performance of its components and this places imposes on the designer new technologies for construction. High pressure turbines, reverse flow combustion chambers, and axial and centrifugal compressors are discussed. Transl. by A.R.H.

N82-17211# Avco Lycoming Div., Stratford, Conn. Preliminary Design and Advanced Programs.
AERODYNAMIC COMPONENTS FOR SMALL TURBOSHAFT ENGINES
J. W. Schrader and W. F. Schneider *In* AGARD Helicopter Propulsion Systems Sep. 1981 15 p

Avail: NTIS HC A13/MF A01
Future developments of advanced helicopter engines are projected from an aerothermodynamic viewpoint. Cycles for engines aiming at lower specific fuel consumption, improved power lapse rates, and implementation of contingency ratings are discussed. These cycles include nonregenerative and regenerative cycles. Design trends are presented for the major engine aerodynamic components. Author

N82-17212# Motoren- und Turbinen-Union Muenchen G.m.b.H. (West Germany).
REGENERATIVE HELICOPTER ENGINES: ADVANCES IN PERFORMANCE AND EXPECTED DEVELOPMENT PROBLEMS
H. Grieb and W. Klussmann *In* AGARD Helicopter Propulsion Systems Sep. 1981 12 p ref Sponsored by Ministry of Defence of the Federal Republic of Germany

Avail: NTIS HC A13/MF A01
On the basis of modem engine component technology, including and emphasizing recent progress in high temperature heat exchanger technology, a conventional and a regenerative helicopter engine in the 900 kW power class are compared in design, performance and life cycle costs. The comparison shows that the installation properties of the two engines are roughly the same. The variable power turbine, being an indispensable part of a regenerative engine, leads to an extremely favorable transient behaviour with a moderate influence of severe-cyclic loading on hot-part lifetime. No significant difference exists in

infrared (IR) emission at part load, due to the design of the IR suppressor for the same exhaust temperature at maximum power. The life-cycle costs of a future fleet of attack helicopters equipped with regeneratived engines can be lower than with conventional engines. J.D.H.

N82-17213# Westland Helicopters Ltd., Hayes (England).
LUBRICATION BREAKDOWN BETWEEN GEAR TEETH
B. A. Shotter *In* AGARD Helicopter Propulsion Systems Sep. 1981 11 p
Avail: NTIS HC A13/MF A01

Damage to gear teeth attributable to lubrication failure is an important failure mode. Detailed observations of the early stages of breakdown suggest that one may not be dealing with a single process: hence great care is necessary when drawing conclusions from observing a damaged pair of gears. A study of a number of these critical areas and discussion about others highlights the complexity of the problem. J.D.H.

N82-17214# Sikorsky Aircraft, Stratford, Conn.
ADVANCED TRANSMISSION COMPONENT DEVELOPMENT
Kenneth M. Rosen and Harold K. Frint *In* AGARD Helicopter Propulsion Systems Sep. 1981 17 p refs

Avail: NTIS HC A13/MF A01

Design innovations in helicopter gearbox development which permit high temperature operation at increased speeds without degrading strength or weight goals are discussed. One avenue of investigation, which shows promising strength or weight advantages, is high contact ratio gearing. The means taken to obtain a high contact ratio tends to produce an inherently weaker tooth and reliance must be placed on the multiple load-sharing feature of this design to achieve an advantage over low contact ratio gears. The appropriate consideration which must be addressed in the design stage to achieve optimum results is described. To provide high temperature capability, two UH-60A helicopter main transmission housings were fabricated from a stainless steel alloy to replace the conventional magnesium alloy casing. Design details and fabrication procedures are discussed. J.D.H.

N82-17215# Costruzioni Aeronautiche Giovanni Agusta S.p.A., Gallarate (Italy).
DESIGN CRITERIA OF THE A 129 HELICOPTER DRIVE SYSTEM
A. Garavaglia and G. Gattinoni *In* AGARD Helicopter Propulsion Systems Sep. 1981 11 p

Avail: NTIS HC A13/MF A01

The design philosophy of the Agusta-A 129 drive system which is developed to meet the modern requirements for a light helicopter in the antitank role with night and day fighting capability are discussed. The stringent requirements of system layout and achieving low weight, high life, maximum reliability, survivability and ballistic tolerance, through integrated system design, modular concepts, use of redundant system and dry run capability are outlined. E.A.K.

N82-17216# Service Techniques des Programmes Aeronautiques, Paris (France).
HELICOPTER DEVELOPMENT IN FRANCE [LE DEVELOPPEMENT DES HELICOPTERES EN FRANCE]
Daniel Berthault *In* AGARD Helicopter Propulsion Systems Sep. 1981 9 p In FRENCH

Avail: NTIS HC A13/MF A01

For the French helicopter industry, the last two decades correspond to a period of rapid growth. The national armed forces were supplied with significant quantities of good quality military equipment well adapted to their operational objectives. Considerable successes were met in the sale for exploration of military helicopters as well as other machines for civilian use, which were developed by taking account of market requirements. These were often classed in a very favorable manner in relation to the products of competitors. The essential characteristics of helicopter development in France during this period are traced. The lines of direction and the modality of action taken by various public services in this regard are analyzed. By defining future needs and the centers of action, perspectives for the future are outlined. Transl. by A.R.H.

N82-17217# Societe Nationale Industrielle Aerospatiale, Marignane (France.)
HELICOPTER AIR INLETS [ENTREES D'AIR D'HELICOPTERES]
A. Vuillet *In* AGARD Helicopter Propulsion Systems Sep. 1981 9 p refs In FRENCH

Avail: NTIS HC A13/MF A01

Because of engine architecture, air inlets on low and medium tonnage helicopters are located behind the rotor head, which makes feeding very difficult. This is particularly the case of the Ecureuil AS 350 and the Dauphin SA 365 which are equipped with new generation engines. These turbines have axial or annular intakes behind which the reductor is located beside either the blast pipe or the compressor. An indepth study of the air intakes from the project stage can permit their design with a minimum of unlucky repercussions on the power supplied by the engine, on the layer of the device, and on risks to pumping. For this reason, such a study is needed to reduce the delays and costs of operating such an intake in flight. Methods used at Aerospatial and results obtained on different devices are described. Transl. by A.R.H.

N82-17218# Westland Helicopters Ltd., Yeovil (England).
INTAKE DESIGN WITH PARTICULAR REFERENCE TO ICE PROTECTION AND PARTICLE SEPARATORS
P. A. H. Brammer and D. J. Rabone *In* AGARD Helicopter Propulsion Systems Sep. 1981 13 p ref

Avail: NTIS HC A13/MF A01

Total environmental protection for helicopter engines is discussed. The problems associated with different environments and intake systems which are used to give protection against particular environments are outlined. Three intake systems for evaluation in natural environments are proposed. E.A.K.

N82-17219# Societe Nationale Industrielle Aerospatiale, Marignane (France.)
THE DISTRESS REGIME ON THE BIMOTORED HELICOPTER [REGIME DE DETRESSE SUR HELICOPTERE BIMOTEUR]
J. P. Dedieu, M. Russier, and H. Dabbadie (Societe Turbomeca, Bordes, France) *In* AGARD Helicopter Propulsion Systems Sep. 1981 8 p refs In FRENCH

Avail: NTIS HC A13/MF A01

The trend toward bimotorization of civil and military helicopters raises the question of choice of power level for each engine in order to obtain acceptable performance in case of engine trouble, particularly at very low speed. The use of a distress regime to obtain a very high power level, for a short time, once in the life of an engine seems to be an interesting and promising approach. The relation between the levels of distress power and parameters related to the use of the helicopter, takeoff, mass, ceiling, and operating cost are considered for the case of a bimotored helicopter of average weight. The perspectives of homologization and the civil certification of such a regime on real technology engines are examined. Transl. by A.R.H.

N82-17220# Boeing Vertol Co., Philadelphia, Pa.
ENGINE/DRIVE/AIRFRAME COMPATIBILITY: A WAY OF LIFE
Carl Albrecht *In* AGARD Helicopter Propulsion Systems Sep. 1981 7 p refs
Avail: NTIS HC A13/MF A01

Engine/drive/airframe compatibility in development stages or during production of a new design were studied. Various compatibility encounters on Boeing Vertol helicopters, analyses, solutions as effected by current technology and engine/airframe manufacturer relationships and dynamic interface items are discussed. E.A.K.

N82-17221# Pisa Univ. (Italy). Ist. di Macchine.
PROBLEMS OF ENGINE RESPONSE DURING TRANSIENT MANEUVERS
Dino Dini *In* AGARD Helicopter Propulsion Systems Sep. 1981 14 p refs
Avail: NTIS HC A13/MF A01

Helicopter transition flight regime and extreme flight maneuvers which determine abrupt variation of the rotor drag torque during each revolution, and the corresponding effects on the engine are discussed. Repeated surging and the attendant transient torsional loads from the engine cause damage to the airframe components. The angular rotor acceleration, cyclically variable, influences the turbine gas producer rotor speed, introducing flow distortions and aeromechanical effects in all the engine. It is found that periodic and inertial blade loading has serious consequences to discs and shaft to which the blades are attached. The higher harmonics of the excitation over the discs provokes relevant flexural modes of forced vibration. Operation in transient rating with pitch increase or decrease has the greatest effect on the helicopter flight performance, owing to the power application capability and the fuel control system adaptability. It is shown that to obtain sufficient engine/airframe dynamic compatibility, aircraft developments have to incorporate technical advances, which include harmonic integrated controls for propulsion and flight systems. E.A.K.

N82-17222# Societe Nationale Industrielle Aerospatiale, Marignane (France.) Helicopter Div.
HELICOPTER PROPULSIONS SYSTEMS. 1: VIBRATION PREVENTION SYSTEMS ON HELICOPTERS 2: PROBLEM OF NOISE IN THE CABIN
Gerard Genoux and Henri-James Marze *In* AGARD Helicopter Propulsion Systems Sep. 1981 19 p refs

Avail: NTIS HC A13/MF A01
Two different facets of the propulsion system/structure interaction are presented. The first interaction deals with low frequency vibration associated with the operation of the main rotor. These problems are either mechanical material fatigue and stressing or related to comfort. Implementation for reduction excitations and filtration of their transfer from the source to the cabin are described. The second interaction type is cabin noise associated with the operation of the reduction gear box. The vibratory energy generated at the gears propagates all the way to the passengers via the air and the structure. Cutting the intensity of transmission noise sources, the energy transfer between such sources and the structure and the energy radiation from the structure to the passengers is discussed. E.A.K.

N82-17223# Rolls-Royce Ltd., Leavesden (England).
AN ALTERNATIVE APPROACH TO ENGINEERING STRUCTURES USING MONITORING SYSTEMS
D. Lewis *In* AGARD Helicopter Propulsion Systems Sep. 1981 11 p
Avail: NTIS HC A13/MF A01
The micro processor based engine monitoring system (EMS) which reevaluates the rating structure and presents limitations to the pilots is discussed. The EMS system allows the achievement of a better relationship between the demonstrated capability of the engine and the authorized release for in service use. This is a first step to be followed later by a change of the qualification test to a more representative form in which the EMS gives a more tangible link between bench test and customer operation. This allows better use of the engine to be made for the short time/high power requirements giving a more efficient engine performance at cruise conditions. E.A.K.

N82-17224*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
COMPONENT RESEARCH FOR FUTURE PROPULSION SYSTEMS
C. L. Walker (Army Propulsion Lab., Cleveland, Ohio), G. J. Weden (Army Propulsion Lab., Cleveland, Ohio), and J. Zuk *In* AGARD Helicopter Propulsion Systems Sep. 1981 12 p refs

Avail: NTIS HC A13/MF A01 CSCL 21E
The factors affecting the helicopter market for the past, present, and future are reviewed. Acquisition cost, mission reliability, life cycle cost and civil and military aspects are reviewed. The potential for advanced vehicle configurations with substantial improvements in energy efficiency, operating economics, and characteristics to satisfy the demands of the future market are identified. Advanced propulsion systems required to support these vehicle configurations and the component technology for the engine systems are discussed. The selection of components in areas of economics and efficiency is considered.
E.A.K.

N82-17225# Ministry of Defence, Bonn (West Germany).
FUTURE REQUIREMENTS FOR HELICOPTER PROPULSION SYSTEMS
H.-G. Bree and G. Backmann *In* AGARD Helicopter Propulsion Systems Sep. 1981 13 p refs

Avail: NTIS HC A13/MF A01
The measurements for single or twin engine systems are discussed. The trend to more sophisticated engines is reviewed in the light of diminishing resources of materials and fuel. Expected future economic conditions make it mandatory to counteract the increase of life cycle cost experienced in most of today's military systems. Means to reduce LCC are discussed. E.A.K.

N82-17226# National Aeronautical Establishment, Ottawa (Ontario). Flight Research Lab.
AN INVESTIGATION OF MULTI-AXIS ISOMETRIC SIDE-ARM CONTROLLERS IN A VARIABLE STABILITY HELICOPTER
M. Sinclair and M. Morgan Aug. 1981 25 p ref
(AD-A106759; NAE-LR-606; NRC-19629) HC A02/MF A01 CSCL 01/4
The test aircraft was the NAE Airborne Simulator, an extensively modified Bell Model 205A-1, and the evaluation flights encompassed a wide range of demanding tasks from hover maneuvering and transitions to cruising flight, to nap-of-the-earth flight and precision IFR tracking. The isometric control systems included several two-handed and one-handed configurations with force-pedals for directional control, and one fully-integrated system which provided full control of the helicopter with either hand.
T.M.

N82-17227# Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Electrical Computer and Systems Engineering.
PARALLEL COMPUTATION FOR DEVELOPING NONLINEAR CONTROL PROCEDURES Final Report, 1 Sep. 1977 - 30 Sep. 1979
Howard Kaufman and Richard Travassos Jul. 1981 238 p refs
(Grant AF-AFOSR-3418-77; AF Proj. 2307)
(AD-A107914; AFWAL-TR-81-3016) Avail: NTIS HC A11/MF A01 CSCL 09/2
Efforts since 1 October 1978 have been concerned with the application of the developed parallel optimization procedures to the design of non-linear flight control systems. Consideration has been given to the advantages to be gained from the direct use of the non-linear equations of motion and to the potential for rapid on-line optimization in response to tracked parameter changes and/or changes in the mission objectives. To date, based upon the non-linear longitudinal equations for the F-8, it has been shown that parallel optimization procedures alone can reduce the time required for optimization by at least 30% and that the direct use of the nonlinear (rather than the linearized) equations of motion does indeed improve attitude control. A study of further incorporation of parallelism into the basic utility routines such as integration and matrix manipulation has shown that the convergence time for a representative optimal control computation can be reduced by a factor of 20. Thus, it was concluded that incorporation of parallel computers might indeed permit online control computation and/or adaptation. To this effect possible architectural structures for such computers have also been studied. GRA

N82-17228*# Old Dominion Univ., Norfolk, Va. Dept. of Mechanical Engineering and Mechanics.
SCALE-MODEL STUDIES FOR THE IMPROVEMENT OF FLOW PATTERNS OF A LOW-SPEED TUNNEL Final Report, 1 Mar. - 31 May 1981
P. Stephen Barna Jan. 1982 46 p refs
(Grant NsG-1563)
(NASA-CR-169413) Avail: NTIS HC A03/MF A01 CSCL 14B
Parameters affecting the performance of a scale model V/STOL wind tunnel were measured. These included: (1) static pressure variation around the closed tunnel circuit as affected by the application of various screens; (2) pressure rise and radial distribution of flow through the fan; (3) variation of screen parameters and screen location affecting the flow; and (4) effects of multiple screens on the velocity distribution in the fourth diffuser. In these tests the fan was driven through a long shaft by an externally situated 11,190-W (15-HP) motor equipped to turn at 4 speeds. B.W.

N82-17229# Mitre Corp., McLean, Va.
SURVEY OF 101 US AIRPORTS FOR NEW MULTIPLE

INSTRUMENT APPROACH CONCEPTS
L. C. Newman, T. N. Shimi, and W. J. Swedish Sep. 1981 85 p refs
(Contract DOT-FA01-81-C-10001)
(AD-A107812; MTR-81W234; FAA-EM-82-3) Avail: NTIS HC A05/MF A01 CSCL 01/5

Several new concepts for multiple instrument approaches have been proposed to improve capacity and reduce delays at U.S. airports. The concepts include: dependent parallel approaches at reduced runway spacing; independent parallel approaches at reduced runway spacing; converging approaches; and triple approaches. One of the runways involved may be a separate short runway for general aviation and commuter traffic. A survey of 101 top U.S. airports was performed to determine the potential for applying the concepts to the existing runways. Specific applications of each relevant concept are provided. Calculations were performed for the top 30 U.S. air carrier airports to determine the actual delay improvement which could be expected to result from application of the multiple-approach concepts. Additionally, some general results are obtained for the remaining 71 airports.
Author (GRA)

N82-17232# European Space Agency, Paris (France).
A SIMPLE HYBRID VISUAL SIMULATION FOR RESEARCH FLIGHT SIMULATORS
Friedrich Erdmann and Eckhard Biertuempel Nov. 1981 46 p refs Transl. into ENGLISH of "Eine einfache hybride Sichtsimulation fuer Forschungsflugsimulatoren" Rept. DFVLR-Mitt-80-13 Brunswick, Jul. 1980
(ESA-TT-690; DFVLR-Mitt-80-13) Avail: NTIS HC A03/MF A01; DFVLR, Cologne DM 14,40

The basic theory of the system is described together with its realization with general purpose computers (digital-analog). The images generated consist of contour lines of the object. A contour line brightness control (depth screwing) is employed to produce a stereoscopic effect. The applicability of the method is demonstrated using runway, target and horizon symbols and combinations of these symbols. Different scenarios can be simulated in this way.
Author (ESA)

N82-17338# Rockwell International Corp., Thousand Oaks, Calif. Science Center.
SUPERPLASTIC ALUMINUM EVALUATION Final Report, 16 Apr. 1979 - 31 Dec. 1980
M. W. Mahoney and C. W. Hamilton Wright-Patterson AFB, Ohio AFWAL Jun. 1981 203 p refs Sponsored in part by Delaware Univ.
(Contract F33615-79-C-3218; AF Proj. 2401)
(AD-A107760; SC5214.34FR; AFWAL-TR-81-3051) Avail: NTIS HC A10/MF A01 CSCL 11/6

With the development of a process to produce fine grain aluminum alloys, it is now possible to superplastically form (SPF) structural aircraft components. This document presents results from several important areas which are considered to be critical to providing a realistic assessment of the technical and economic potential for superplastic forming structures using a high strength 7475 aluminum alloy. Areas of study included (1) the evaluation of structural applications; (2) the determination of superplastic forming limits; (3) a microstructural study of cavities formed during superplastic deformation; (4) the application of hydrostatic gas pressures to suppress cavitation, and (5) the effect of superplastic deformation on subsequent service properties.
Author (GRA)

N82-17342# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
CORROSION FATIGUE
Oct. 1981 92 p refs Presented at the 52nd Meeting of the AGARD Struct. and Mater. Panel, Cesme, Turkey, 5-10 Apr. 1981
(AGARD-CP-316; ISBN-92-835-1402-5) Avail: NTIS HC A05/MF A01

The objectives, scope, and technical requirements of a cooperative program for corrosion fatigue testing and prevention/aircraft environment simulation fatigue testing are presented. An overview of current and supplemental programs designed to assess current protection systems for aircraft structures is also given.

N82-17343# Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Materials Engineering.
MECHANISMS OF CORROSION FATIGUE
D. J. Duquette *In* AGARD Corrosion Fatigue Oct. 1981 12 p refs Sponsored in part by Office of Naval Research

Avail: NTIS HC A05/MF A01

An overview of experimental variables which are considered critical to understanding the mechanisms of corrosion fatigue of high strength aluminum alloys is presented. Based on this overview, an examination of previously proposed mechanisms is attempted. These models include anodic dissolution, surface energy reduction, and hydrogen embrittlement. It is concluded that hydrogen embrittlement of process zones at alloy surfaces (for crack initiation) and at crack tips (for crack propagation) best explains observed results. A general model of corrosion fatigue of these alloys is proposed. This model suggests that the nature of the naturally formed oxide film on aluminum alloys may be a critical factor. Chemical or mechanical damage of the film allows hydrogen ingress. The presence of second phase particles which may act as sinks for dislocation transported hydrogen, may also be a necessary prerequisite to significant amounts of reduction in fatigue resistance associated with corrosion.
Author

N82-17344# Toronto Univ. (Ontario). Dept. of Mechanical Engineering.
FRACTURE MECHANICS BASED MODELLING OF THE CORROSION FATIGUE PROCESS
David W. Hoeppner, Douglas Mann, and J. Weeks *In* AGARD Corrosion Fatigue Oct. 1982 17 p refs Sponsored in part by NSERC and Dept. of Energy, Mines and Resources of Canada

Avail: NTIS HC A05/MF A01

Corrosion fatigue of structural elements involves a synergism between cyclic load and a chemical environment involving both time and temperature as rate-controlling parameters. The development of rational life prediction methods is hampered by both the lack of mechanistic understanding, the large number of corrosion-fatigue synergisms, and the inadequacies of fracture mechanics based models in both pre mode I fatigue cracking and initial mode I cracking. Aspects of mechanisms related to the formulation of corrosion fatigue life prediction models are discussed in relation to micromechanical modelling based on fracture mechanics. Emphasis was placed on the formation of mode I fatigue cracks from pits, and fretting surface damage. A discussion of the needs in this area is presented. It is believed that with further analytical and experimental information the models presented can be verified and provide useful guidance to engineers and scientists attempting to deal with corrosion and fretting fatigue.
Author

N82-17345# Societe Nationale Industrielle Aerospatiale, Suresnes (France). Central Lab.
CORROSION FATIGUE BEHAVIOUR OF SOME ALUMINIUM ALLOYS
D. Aliaga and E. Budillon *In* AGARD Corrosion Fatigue Oct. 1981 12 p
Avail: NTIS HC A05/MF A01

An evaluation of corrosion fatigue strength of aluminum alloys currently used in the aeronautical industry was made. Crack propagation was evaluated in various different environments (dry argon, wet air, salt water). The effect of frequency, of test specimen thickness, and of ratio R (R = Kmin/Kmax) were investigated. And the effect of these various environments on the endurance limit of 10 to the 7th power cycles was likewise studied and some surface protections evaluated. The intent of the survey was to compare the response in fatigue of various aluminum alloys used in the aeronautical construction. The environments studied were the following: dry argon, wet air and salt-water. They were retained so as to simulate and amplify the more or less aggressive nature of these environments in which aircraft can find themselves both on the ground or in the air. The two major aspects of corrosion fatigue namely crack initiation and crack propagation were studied with an emphasis on in-service behaviour. As far as crack initiation is concerned some surface treatments and protections currently used in aeronautics were examined in various environmental conditions.
M.D.K.

N82-17348# Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (West Germany).
FLIGHT-BY-FLIGHT CORROSION FATIGUE TESTS
Walter Schuetz *In* AGARD Corrosion Fatigue Oct. 1981 10 p refs
Avail: NTIS HC A05/MF A01

Corrosion fatigue tests should be conducted under realistic load sequences especially for tests with riveted specimens because the rare high loads of the spectrum may loosen the fasteners, damaging the corrosion protection system and therefore rendering it ineffective. Possibly this does not happen in constant amplitude tests because the loads may not be high enough to crack the protection system. This was the reasoning behind the test program carried out with flight-by-flight tests. Tests were carried out with two aluminum alloys typical for use in modern and in faying aircraft respectively, namely 7475-T 761 and 7075-T6. The sheet materials were exchanged between two laboratories so that both would use materials of the same heats. The specimens used differed, however, in the corrosion protection systems and in the manufacturing of the specimens by different firms. A project status report is made. M.D.K.

N82-17349# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
AIRCRAFT CORROSION
Aug. 1981 194 p refs Partly in ENGLISH, partly in FRENCH Meeting held in Cesme, Turkey, 5-10 Apr. 1981
(AGARD-CP-315; ISBN-92-835-0298-1) Avail: NTIS HC A09/MF A01

Corrosion resistant materials and protection systems for aircraft are addressed. The incidence of corrosion of aircraft structures under varying environmental conditions is discussed. Maintenance, cost factors, education and retraining, and the communication link among the designers, manufacturers and the research community are among the topics covered.

N82-17350# Atlantic Fleet, Norfolk, Va.
US NAVAL FLEET AIRCRAFT CORROSION
G. T. Browne *In* AGARD Aircraft Corrosion Aug. 1981 15 p

Avail: NTIS HC A09/MF A01

Water entry and its associated corrosion problems were minimized. A method for sealing environmental connectors without degrading wire quick disconnect capability was incorporated by sealing the back connector shell rubber grommet with clear room temperature vulcanizing silicone type sealant. The screw holes and equipment lids were also sealed in a similar manner. Drain holes were located and drilled in nonstructural areas at low points to remove trapped water and eliminate the corrosive agents. Hidden corrosion was detected by nondestructive inspection methods during rework. These include ultrasonic, X-ray and eddy current inspection and neutron radiography on double skin areas and on areas behind stringers, etc., where corrosion is caused by moisture entrapment. Stress corrosion cracking in high strength components was discovered occasionally. Standard fleet corrosion maintenance is accomplished in accordance with procedures provided in technical manuals. Paint and corrosion removal procedures and tools are discussed. N.W.

N82-17351# Royal Air Force, Dereham (England). Central Servicing and Development Establishment.
DETECTION AND PREVENTION OF CORROSION IN ROYAL AIR FORCE AIRCRAFT
C. R. Pye *In* AGARD Aircraft Corrosion Aug. 1981 10 p

Avail: NTIS HC A09/MF A01

The problems that sometimes are created by corrosion in Royal Air Force aircraft are outlined. The problem of the harsh environment facing some military aircraft is described, and some of the materials used in aircraft construction are considered. Corrosion prevention and rectification is also discussed briefly. Some typical examples of corrosion damage found during service are illustrated, and the nondestructive testing methods used for detecting corrosion are described. These methods include visual inspection, eddy current techniques, ultrasonic techniques and X-radiography. The use of neutron radiography and other future developments is also considered. Service methods of removing corrosion and re-protecting the aircraft are mentioned. Finally the need for the manufacturer to consider corrosion at the aircraft design stage is considered. N.W.

N82-17352# British Airways, Middlesex (England). Aircraft Engineering (Structures).
AN AIRLINE VIEW OF THE CORROSION PROBLEM
R. G. Mitchell *In* AGARD Aircraft Corrosion Aug. 1981 11 p

Avail: NTIS HC A09/MF A01

Although the corrosion phenomenon is well understood by aircraft manufacturers and operators alike, most current aircraft types continue to exhibit many of the fundamental corrosion defects shown by earlier designs. It is estimated that the total annual cost to IATA member airlines is around $100 million based on 1976 operations. Environmental and maintenance effects are important and should be fully understood in their importance in minimizing corrosive attack. In addition to the more common forms, filiform corrosion and microbiological contamination present hazards to aircraft operating in certain areas of the world. Temporary water displacing fluids are becoming common in their use, and subject to certain limitations are providing valuable short term protection. The FAA design rules require the effects of corrosion to be considered at the design stage which should result in an improved product for the operator. In addition the IATA document Guidance Material on Design and Maintenance Against Corrosion of Aircraft Structures specifies practices which should also improve the overall product. Author

N82-17353# Middle East Technical Univ., Ankara (Turkey).
SOME OBSERVATIONS ON THE CORROSION OF AIRCRAFT AT THE AIR FORCE BASE IN BANDIRMA, TURKEY
M. Doruk *In* AGARD Aircraft Corrosion Aug. 1981 8 p

Avail: NTIS HC A09/MF A01

The types and the causes of corrosion which have been observed primarily on aircraft of Type F-5A in Turkey are studied. Visual inspection showed many locations of concentration of corrosion. The vertical stabilizer attach angle (alloy 7075-T6) fails through exfoliation corrosion and galvanic attack in the bolt holes. Galvanic corrosion has also been observed around the jaw bolts under the main wings. Another case of exfoliation attack has been found on the uplock support rib (Alloy 7075-T6 or 7079-T6) in the main landing gear well. Damage in the honeycomb assembly which appears as a debonding between the honeycomb structure and the top plate has been regarded as a serious problem. Corrosion damage is attributed to the high corrosiveness of the atmosphere of Air Force Base laden with sea salt and polluted from industries in the neighborhood. Author

N82-17354# Technical Univ. of Istanbul (Turkey).
ON THE CORROSION PROBLEMS OF THE TAF F-5 AIRCRAFT
A. Inalhan *In* AGARD Aircraft Corrosion Aug. 1981 1 p

Avail: NTIS HC A09/MF A01

Corrosion problems of the F-5 aircraft in Turkey are examined. The importance of atmospheric effects are disputed. The investigation and conclusions are recounted. N.W.

N82-17355# Service Techniques des Programmes Aeronautiques, Paris (France).
THE EXPERIENCE OF CORROSION ON FRENCH MILITARY AERODYNES [L'EXPERIENCE DE LA CORROSION SUR AERODYNES MILITAIRES FRANCAIS]
Melle M. Huret *In* AGARD Aircraft Corrosion Aug. 1981 9 p In FRENCH
Avail: NTIS HC A09/MF A01

Several examples of corrosion occurring in French military aircraft in detail, e.g., honeycomb sections and metal-to-metal adhesively bonded structures were described. Information about the various measures which were taken to diminish the problem was given. The manufacturing specifications do not take care of all protection requirements. Furthermore, the paint systems which are applied are not the best available, or they have been applied in the wrong way. Bad sealing also occurs frequently. Other preventive measures, e.g., water displacing fluids, can given additional, short term, protection. N.W.

N82-17356# KLM Royal Dutch Airlines, Amsterdam (Netherlands).
DESIGN AND MAINTENANCE AGAINST CORROSION OF AIRCRAFT STRUCTURES
H. J. Versteegen and M. J. M. Versteeg *In* AGARD Aircraft Corrosion Aug. 1981 7 p

Avail: NTIS HC A09/MF A01

The publication 'Guidance Material on Design and Maintenance against Corrosion of Aircraft Structures' is reviewed. A greater understanding among manufacturers and airline managements of the magnitude of the corrosion problems and the need for measures to be taken at the design stage is considered. The best available anti-corrosion design knowledge in critical areas as a basic standard is addressed. The guidelines cover basic requirements, including material choice, design principles and manufacturing procedures. Furthermore, they cover the critical areas including origin of problems, design objectives and protective requirements. They are supplemented by an appendix giving a detailed acceptable means of compliance. N.W.

N82-17357# Michigan State Univ., East Lansing. Dept. of Metallurgy, Mechanics, and Materials Science.
FORECASTING CORROSION DAMAGE AND MAINTENANCE COSTS FOR LARGE AIRCRAFT
R. Summitt and F. Fink *In* AGARD Aircraft Corrosion Aug. 1981 11 p refs Sponsored by AF

Avail: NTIS HC A09/MF A01
Studies relating environmental and operational factors of large aircraft to corrosion damage were conducted. They provide a basis for predicting maintenance costs and for logistics decisions. The studies included: (1) an Environmental corrosion severity index, based on pollutant and weather factors; (2) an atmospheric testing program to determine environmental corrosiveness; and (3) analysis of corrosion maintenance experience in aircraft systems. Results are discussed. M.D.K.

N82-17358# Royal Aircraft Establishment, Farnborough (England). Materials Dept.
CORROSION CONTROL MEASURES FOR MILITARY AIRCRAFT: PRESENT UK REQUIREMENTS AND FUTURE DEVELOPMENTS
V. C. R. McLoughlin *In* AGARD Aircraft Corrosion Aug. 1981 15 p refs
Avail: NTIS HC A09/MF A01
The philosophy behind selection of aircraft metallic materials based on resistance to corrosion and behind mandatory requirements for processes and materials used in the protection of aircraft structures is discussed. The impact of legislation, current and future, aimed at protecting the environment is reported. The necessity for finding replacements for cadmium, chromates, and various metal finishing operations used in aircraft construction is discussed in terms of both protecting the environment and corrosion control methods used in the aircraft industry. M.D.K.

N82-17359# Aeritalia S.p.A., Torino (Italy). G.V.C. Labs.
CORROSION PREVENTION METHODS DEVELOPED FROM DIRECT EXPERIENCE WITH AEROSPACE STRUCTURES
M. Scolaris *In* AGARD Aircraft Corrosion Aug. 1981 18 p

Avail: NTIS HC A09/MF A01
Some examples of various types of corrosion experienced during hardware service are reviewed and the significant remedial action adopted first to repair and then to eliminate the problem are presented. The changes in design incorporated during design development as a function of the experience and technical knowledge acquired are also presented. Examples of effective protection validated through service life and present trends for effective corrosion prevention are also illustrated. Author

N82-17360# Avions Marcel Dassault-Breguet Aviation, Saint-Cloud (France).
CORROSION PREVENTION MEASURES USED IN THE CONSTRUCTION OF AN AIRCRAFT AIRFRAME: THE CASE OF 2014 AND 2214 ALLOYS [SOLUTIONS PREVENTIVES UTILISEES CONTRE LA CORROSION LORS DE LA CONSTRUCTION D'UNE CELLULE D'AVION. CAS DES ALLIAGES 2014 ET 2214]
J. Bevalot *In* AGARD Aircraft Corrosion Aug. 1981 14 p In FRENCH
Avail: NTIS HC A09/MF A01
Discussions of practical aircraft corrosion problems are presented. Aluminum alloy 2214 is evaluated in terms of its resistance to stress corrosion and its excellent fatigue properties. Heat treatment, aging at 178 C instead of 153 C, and the use of wet sandblasting techniques are discussed in terms of maintaining fatigue resistance while increasing resistance to stress corrosion. M.D.K.

N82-17361# Naval Air Development Center, Warminster, Pa.
RECENT DEVELOPMENTS IN MATERIALS AND PROCESSES FOR AIRCRAFT CORROSION CONTROL
Sara J. Ketcham and John J. DeLuccia *In* AGARD Aircraft Corrosion Aug. 1981 9 p refs

Avail: NTIS HC A09/MF A01
Advances in materials and processes for aircraft corrosion control currently in use and those under development in the laboratory for future use are described. Areas covered are corrosion preventive compounds, organic and inorganic coatings, alloy selection and heat treatments. Available materials highlighted are water displacing compounds, sealant primers, aluminum alloys 7050 and 7010 including a state-of-the-art report on the use of exfoliation and stress corrosion resistant tempers. Materials under development that offer promise of contributing to future advances include water displacing paints, flexible primer, crack arrestment compounds, powder metallurgy, aluminum alloys and substitutes for cadmium plating. Author

N82-17362# Systems Research Labs., Inc., Dayton, Ohio.
NEW CONCEPTS IN MULTIFUNCTIONAL CORROSION FOR AIRCRAFT AND OTHER SYSTEMS
M. Khobaib and F. W. Vahldiek *In* AGARD Aircraft Corrosion Aug. 1981 13 p refs

Avail: NTIS HC A09/MF A01
Multifunctional nonchromate inhibitors were developed for a Rinse Facility to reduce corrosion maintenance costs by removing corrosive contaminants from aircraft which operate in aggressive environments such as marine environments. These inhibitor systems are low cost, water soluble, nontoxic formulations which are effective against general corrosion, localized corrosion, and environmentally assisted crack growth under conditions of stress corrosion and corrosion fatigue. Extensive polarization, immersion, and galvanic-coupling experiments were conducted to determine effectiveness. A borax-nitrite-based inhibitor containing small additions of nitrate, silicate, phosphate, and mercaptobenzothiazole was found to provide excellent corrosion protection for high strength aluminum and steel alloys used in aerospace applications and for copper-bearing alloys used in electronic components and in parts of the Rinse Facility. Envionmental effects upon crack-growth rates of aluminum and high strength steel alloys were eliminated, reducing the rates in corrosion fatigue as compared to those obtained in air. A test program using these inhibitors is described. Tracking of maintenance costs and corrosion damage in being conducted to determine the effectiveness of the inhibited rinse in reducing corrosion costs. M.D.K.

N82-17363# Naval Air Development Center, Warminster, Pa.
CORROSION IN NAVAL AIRCRAFT ELECTRONIC SYSTEMS
Irving S. Shaffer *In* AGARD Aircraft Corrosion Aug. 1981 12 p refs
Avail: NTIS HC A09/MF A01
Naval aircraft electronic equipment suffer frequently from the effects of moisture and corrosion. The critical design features which have led to excessive susceptibility to these failure modes are described. Several examples are cited of inadequately protected equipment located in aircraft installations where they were subjected to repeated moisture intrusion during rainstorms, low level flights over water and high pressure fresh water washdowns. The specific deterioration effects that occurred on the various components that make up the avionic systems are presented. Maintenance data summaries are included to denote further the corrosion problem severity. Corrective measures in design, testing and maintenance are also discussed. Author

N82-17364# Vereinigte Flugtechnische Werke G.m.b.H., Bremen (West Germany).
CORROSION PROTECTION SCHEMES FOR AIRCRAFT STRUCTURES: SOME EXAMPLES FOR THE CORROSION BEHAVIOUR OF Al ALLOYS
Henri Lajain *In* AGARD Aircraft Corrosion Aug. 1981 16 p

Avail: NTIS HC A09/MF A01
A summary of the main groups of aircraft surface protection procedures frequently applied is presented. In addition, some examples are given on the corrosive behavior of aluminum alloys. Information is also given on novel nondestructive test methods serving to recognize corrosion within the scope of aircraft maintenance. The following requirements which must be imposed with regard to the performance and quality of the surface

protection are considered and discussed: (1) the potential differences of the materials used are to be kept as low as possible, i.e., constructive measures must be taken; (2) prevention of any local element activity by providing insulating protective coatings, i.e., by preventing a current; (3) inhibition by providing cover layers (e.g., chromate passivation); and (4) introducing layers which act as so-called sacrificial anodes. M.D.K.

N82-17377# Swedlow, Inc., Garden Grove, Calif.
TRANSPARENT POLYOLEFIN FILM ARMOR Final Report, 30 Mar. 1976 - 28 Feb. 1981
Ralph Shelton Watertown, Mass. AMMRC Aug. 1981 264 p refs
(Contract DAAG46-76-C-0034)
(AD-A107562; SI-ER-1001; AMMRC-TR-81-41) Avail: NTIS HC A12/MF A01 CSCL 19/4

The general objective of this project was to determine the optimum processing conditions for the large scale conversion, by molding and laminating of oriented polyolefin film into fragment resistant transparent armor suitable for Army aircraft glazing applications. The manufacturing process must produce a laminate with sufficient adhesion to resist debonding during thermal cycling and yet react as a laminar structure during ballistic impact. Author (GRA)

N82-17401# Chevron Research Co., Richmond, Calif.
REFINING AND UPGRADING OF SYNFUELS FROM COAL AND OIL SHALES BY ADVANCED CATALYTIC PROCESSES Interim Report
R. F. Sullivan, D. J. ORear, and H. A. Frumkin Sep. 1981 319 p refs
(Contracts DE-AC22-76ET-10532; EF-76-C-01-2315)
(DE82-001127; DOE/ET-10532/T3; FE-2315-61; IR-5) Avail: NTIS HC A14/MF A01

Two coal syncrudes derived from Illinois No. 6 and Wyodak coals were refined in a extensive program which included pilot plant and laboratory studies. These studies demonstrated that advanced, commercial petroleum technology can be used to refine these syncrudes to gasoline, jet, diesel and heating fuels. The coal syncrudes have a low hydrogen content, compared to petroleum, and high concentrations of oxygen and nitrogen impurities. These syncrudes are a blend of two coal distillates boiling between C sub 5 and 680 F. Consequently, they contain no residual and have about 95% boiling in the gasoline or diesel fuel ranges. With these properties, an appropriate way to refine the syncrudes is by hydroprocessing. Hydroprocessing yields a volume of finished products which is almost equivalent to the original volume of syncrude. In addition, the heteroatoms are ultimately removed as sulfur and salable ammonia. The engineering studies provided estimates of the refining costs. DOE

N82-17459# Open Univ., Milton (England). Energy Research Group.
EVALUATION OF THE DESIGN, CONSTRUCTION AND OPERATION OF A GAS FUELED ENGINE DRIVEN HEAT PUMP
C. A. Phillips Jan. 1981 76 p refs
(ERG-034) Avail: NTIS HC A05/MF A01

The design, construction, testing, and evaluation of a gas fueled engine driven heat pump are considered. The heat pump, using air as its source of heat is driven by a 360 cc single cylinder marine engine converted to run on natural gas. The unit was built, installed in a laboratory, and underwent intensive performance testing. The heat pump works well and justifies the design assumptions made, having allowed for a poor performance from the particular engine used. At 6 C (ambient) an output of 14 kW with an overall efficiency or C.O.P. (total heat output/gas input) of 1.1 was achieved. Results compare favorably with a seasonal efficiency of a gas boiler of around 0.65 to 0.70. J.M.S.

N82-17469# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany).
[SCIENTIFIC REPORT OF THE FLUID MECHANICS RESEARCH DEPARTMENT] Annual Report, 1980
1980 105 p refs
Avail: NTIS HC A06/MF A01

Research in theoretical and experimental fluid mechanics, propulsion technology, acoustics, and aerodynamic design is reported. Boundary layer flow, high speed train aerodynamics, cryogenic wind tunnels, compressors, helicopter interior noise, and aircraft design are among the topics described. Test facilities computational methods and experimental procedures are outlined. Author (ESA)

N82-17477# National Aerospace Lab., Tokyo (Japan).
A VELOCITY VECTOR MEASURING SYSTEM WITH 13 ASYMMETRIC WEDGE TYPE YAWMETERS
Teruomi Nakaya, Hideo Hoshio, and Masayoshi Noguchi Jun. 1981 20 p refs In JAPANESE; ENGLISH summary
(NAL-TR-674; ISSN-0389-4010) Avail: NTIS HC A02/MF A01

In order to survey the flow field around the empennage of the NAL STOL research aircraft model in the 6m low speed wind tunnel, a velocity vector measuring system with 13 asymmetric wedge type yawmeters was developed. The rotational angle of the 13 probes and the setting angle of this system are automatically controlled following the sequence previously programmed into a minicomputer system. The hardware, control modes, data reduction, and data processing are described. The accuracy of the flow angle measurement turned out to be satisfactory, but measurements of dynamic pressure and static pressure were less accurate. An example of measurements taken of the flow field around the empennage of the STOL research aircraft model is included. A.R.H.

N82-17478*# Kansas Univ. Center for Research, Inc., Lawrence. Flight Research Lab.
DEVELOPMENT OF A SIMPLE, SELF-CONTAINED FLIGHT TEST DATA ACQUISITION SYSTEM Progress Report
Ronald R. L. Renz Feb. 1981 208 p refs
(Grant NsG-4019)
(NASA-CR-168438; KU-FRL-407-6) Avail: NTIS HC A10/MF A01 CSCL 14B

A low cost flight test data acquisition system, applicable to general aviation airplanes, was developed which meets criteria for doing longitudinal and lateral stability analysis. Th package consists of (1) a microprocessor controller and data acquisition module; (2) a transducer module; and (3) a power supply module. The system is easy to install and occupies space in the cabin or baggage compartment of the airplane. All transducers are contained in these modules except the total pressure tube, static pressure air temperature transducer, and control position transducers. The NASA-developed MMLE program was placed on a microcomputer on which all data reduction is done. The flight testing program undertaken proved both the flight testing hardware and the data reduction method to be applicable to the current field of general aviation airplanes. A.R.H.

N82-17482# Spectron Development Labs., Inc., Costa Mesa, Calif.
DEVELOPMENT AND LABORATORY TESTING OF A THERMAL EMISSION VELOCIMETER FOR APPLICATION TO AN EROSION NOSE TIP TEST FACILITY Final Report, Jul. 1979 - Nov. 1980
James D. Trolinger and M. J. Houser Wright-Patterson AFB, Ohio AFWAL Aug. 1981 23 p refs
(Contracts F33615-76-C-3145; F33615-79-C-3030; AF Proj. 2404)
(AD-A107713; SDL-80-6526; AFWAL-TR-81-3080) Avail: NTIS HC A02/MF A01 CSCL 14/2

A thermal emission velocimeter concept was explored and a system was developed for use in measuring particle velocities up to 5,000 meters per second in a reentry erosion facility. The particles, ranging from 10 to 100 micrometers in diameter, are generated to study reentry nose tip erosion and ablation. The approach passively utilizes optical components of a laser transit anemometer coupled to a microprocessor data management system. The system was laboratory tested and has inherent characteristics which should produce quality data in the severe and noisy environment of a reentry test facility. The system sensitivity has been calculated to measure velocity of micrometer sized particles whose temperature are minimally 1700 K. Author (GRA)

N82-17483# Calspan Field Services, Inc., Arnold Air Force Station, Tenn.
A DURABLE, INTERMEDIATE TEMPERATURE, DIRECT READING HEAT FLUX TRANSDUCER FOR MEASUREMENTS IN CONTINUOUS WIND TUNNELS Final Report, 1 Oct. 1980 - 30 Jun. 1981
C. T. Kidd AEDC Nov. 1981 66 p refs
(AD-A107729; AEDC-TR-81-19) Avail: NTIS

HC A04/MF A01 CSCL 14/2

The design and development of a high durability, intermediate service temperature (< or = 600 F), direct reading transducer for the measurement of aerodynamic heating in the continuous wind tunnels of the von Karman Gas Dynamics Facility is described. This transducer operates on the axial temperature gradient or Schmidt-Boelter measurement concept. Considerable emphasis is placed upon the practical use of finite-element, two-dimensional heat conduction code for analysis of gage behavior rather than the indiscriminate use of invalid exact mathematical solutions. Laboratory evaluation and calibration of prototype transducers at ambient temperature levels varying from 70 to 500 F are discussed. Results of wind tunnel aerodynamic heating measurements using limited numbers of prototype Schmidt-Boelter gages are presented. Recommendations for future work efforts with regard to further development and testing of this measurement concept are discussed. Author (GRA)

N82-17513 British Aerospace Aircraft Group, Warton (England). Materials and Development Dept.

THE ULTRASONIC INSPECTION OF C.F.C.

R. Wilson 7 Jul. 1981 12 p

(MDR-0465) Avail: Issuing Activity

Four carbon fiber composite sine wave spars, produced using various manufacturing techniques, were inspected ultrasonically. Procedures used for examining the web and the flanges are described. A quality representative test piece must be produced containing artificial defects of a known size in order to further NDI development work on these spars. A.R.H.

N82-17597# Southwest Research Inst., San Antonio, Tex. Dept. of Mining Technology.

STUDY OF AIR COMPRESSOR HAZARDS IN UNDERGROUND AND SURFACE MINES Open File Report, Nov. 1979 - Jan. 1981

Martin B. Treuhaft and B. Chope Dial Jan. 1981 93 p refs

(Contract DI-BM-JO-10006)

(PB82-105164; BM-OFR-122-81) Avail: NTIS HC A05/MF A01 CSCL 08I

Air compressor hazards in mines are analyzed and guidelines for eliminating fires, explosions, and their operational hazards that can result when compressors are used in coal and metal nonmetal mining applications are presented. Government data bases and reports for mine accident are reviewed and examined. Foreign and domestic standards, regulations, and codes governing air compressor usage are discussed and compared industry trends toward air compressor usage are considered and their impact on compressor safety is analyzed. Recommendations are directed toward MSHA, mine management, and the Bureau of Mines regarding their involvement in accident reporting and prevention. GRA

N82-17638# Stuttgart Univ. (West Germany). Inst. fuer Statik und Dynamik.

ROTOR MODEL FOR THE VERIFICATION OF COMPUTATIONAL METHODS Final Report

J. H. Argyris, W. Aicher, F. Karl, W. Kuemmerle, and M. Mueller 1980 66 p refs Sponsored in cooperation with International Energy Agency

(Contract BMFT-ET-4086-A)

(ISD-275; ISSN-0170-6071) Avail: NTIS HC A04/MF A01

A windmill rotor model with 7.3 m rotor diameter was constructed in order to test a data acquisition/transmission system and computational models. Data, e.g., strains, angles, linear movements, accelerations, are measured at the rotor, digitized, and transmitted optoelectronically. Measurements of rotor blade dynamic response to cyclic gravity loading are compared with theoretical values. Deviation between measurements and calculations is 11%. Author (ESA)

N82-17639# Stuttgart Univ. (West Germany). Inst. fuer Statik und Dynamik.

STATIC INVESTIGATIONS OF ROTOR BLADES UNDER DEADWEIGHT AND DURING STATIONARY OPERATION Final Report

J. H. Argyris, K. A. Braun, and B. Kirchgaessner 1980 62 p refs Transl. into ENGLISH of "Statische untersuch. von rotorblaettern unter eigengewicht und im stationaeren betrieb" Rept. ISD-243 Stuttgart Univ., Stuttgart, 1979 57 p Original report in GERMAN previously announced as N82-17639 Sponsored in cooperation with International Energy Agency

(Contract BMFT-ET-4086-A)

(ISD-269; ISD-243; ISSN-0170-6071) Avail: NTIS HC A04/MF A01

Several rotorblades of a horizontal axis windmill are studied both nonoperating under deadweight, and under quasi-stationary loading with constant forces at rated operation, the blades of which have flap and lead-lag freedom as well as flap-pitch coupling. With a suitable mass distribution it is possible to reduce the blade bending moments in the flap direction drastically. The use of aircraft construction materials is considered. Carbon fiber reinforced plastic is the most suitable. Most of the blade models are investigated without lag hinge. The coning angle of rated operation assumed for the layout is reduced considerably for the blade models with lead-lag freedom in order to obtain sufficient centrifugal stiffness in the lag direction. Author (ESA)

N82-17640# Stuttgart Univ. (West Germany). Inst. fuer Statik und Dynamik.

STABILITY AND RESPONSE TO GRAVITY OF THE FLAP LAG MOTION FOR A RIGID ROTOR BLADE WITH FLAP-PITCH COUPLING Final Report

J. H. Argyris and B. Kirchgaessner 1980 59 p refs Transl. into ENGLISH of "Stabilitaet und schwerkraftresponse der schlag-schwenkbewegung eines starren rotorblattes mit blattwinkelruecksteuerung" Rept. ISD-244 Stuttgart Univ., Stuttgart, 1979 80 p Original report in GERMAN announced as N80-30949 Sponsored in cooperation with International Energy Agency

(Contract BMFT-ET-4086-A)

(ISD-270; ISD-244; ISSN-0170-6071) Avail: NTIS HC A04/MF A01

The coupled flap lag motion of a single, rigid rotor blade of a wind energy converter with flap and lag hinges and a coupling of the angle of attack with the flap motion is investigated. The equations of motion are developed under the assumption of linearized quasi-stationary aerodynamic forces. Static and dynamic stability of the coupled flap and lag motion are investigated. The equations are integrated for different cases under cyclic gravitational forces in order to estimate the importance of nonlinear terms and of the error resulting from the linearization of the conservative system. The nonlinear terms can be neglected, as can the effects of cyclic stiffness resulting from gravitational force. Results for nonlinearities arising from aerodynamic forces are inconclusive. Author (ESA)

N82-17641# Stuttgart Univ. (West Germany). Inst. fuer Statik und Dynamik.

DYNAMIC ANALYSIS OF A ROTOR BLADE WITH FLAP AND LAG FREEDOM AND FLAP-PITCH COUPLING Final Report

J. H. Argyris, K. A. Braun, and B. Kirchgaessner 1980 103 p refs Transl. into ENGLISH of "Dyn. anal. eines rotorblattes mit schlagfreiheit, schwenkreiheit u. blattwinkerluecksteuerung" Rept. ISD-258 Stuttgart Univ., Stuttgart, 1979 95 p Original report in GERMAN previously announced as N80-30950 Sponsored in cooperation with International Energy Agency

(Contract BMFT-ET-4086-A)

(ISD-271; ISD-258; ISSN-0170-6071) Avail: NTIS HC A06/MF A01

For a windmill rotor blade, a linearized system of differential equations of motion is developed, using a finite element idealization of linearized quasi-stationary aerodynamic forces. Constant rotational speed and a rigidly supported hub are assumed. For two rotor blade models, which differ only in their stiffness in lag direction, the complex eigenfrequencies are calculated. The dynamic response of the rotor blades is computed for cyclic gravity loads at rated operation, for a gust, and, in one case, for the tower wake. From the deformation of the structure the stresses at selected points along the blade are calculated. Torque and rotor thrust are determined for one model. Additional stiffness improves stability and lead-lag ancles. The coning angle is excellently stabilized by the flap-pitch coupling. Author (ESA)

N82-17642# Stuttgart Univ. (West Germany). Inst. fuer Statik und Dynamik.

STATIC AND DYNAMIC INVESTIGATIONS FOR THE MODEL OF A WIND ROTOR Final Report

J. H. Argyris, K. A. Braun, B. Kirchgaessner, and R. Walther 1980 71 p refs Transl. into ENGLISH of "Statische und dyn. untersuch. and einem windrotormodell" Rept. ISD-259 Stuttgart Univ., Stuttgart, Jun. 1979 69 p Original report in GERMAN

previously announced as N81-12626 Sponsored in cooperation with International Energy Agency
(Contract BMFT-ET-4086-A)
(ISD-272; ISD-259; ISSN-0170-6071) Avail: NTIS HC A04/MF A01

A wind rotor was constructed in order to test a data acquisition/transfer system which collects experimental data from the operating model and displays it on a screen. The comparison between the experimental data and the model results is used to check the applied computation methods. The static and dynamic analyses of the rotor model are considered. An 11% difference between experimental and model results is shown. A response problem with variable stiffness in time which arose during the dynamic analysis is solved by setting the structural stiffness constant over small time intervals, diagonalizing the time interval considered and integrating. After integration the solutions of the generalized degrees of freedom are transformed back into the physical system, using the time interval eigenvectors.
Author (ESA)

N82-17643# Stuttgart Univ. (West Germany). Inst. fuer Statik und Dynamik.
LOADING CYCLES AND MATERIAL DATA FOR THE LAYOUT OF A WIND TURBINE OF SPECIAL HUB CONCEPT Final Report
J. H. Argyris and K. A. Braun 1980 38 p refs Transl. into ENGLISH of "Lastwechselzahlen und materialwerte fuer die *auslegung einer windturbine spezieller nabenkonstruktion*" Rept. ISD-260 Stuttgart Univ., Stuttgart, Jun. 1979 38 p Original report in GERMAN previously announced as N81-12627 Sponsored in cooperation with International Energy Agency
(Contract BMFT-ET-4086-A)
(ISD-273; ISD-260; ISSN-0170-6071) Avail: NTIS HC A03/MF A01

The number of loading cycles of a rotor blade was estimated in order to assess allowable blade stress. Fatigue strengths and allowable stresses are calculated for aeronautic construction materials. Using wind data, the number of starts and stops was estimated. With a guess for the number of revolutions necessary to reach stationary operation from standstill, the number of loading cycles was determined, using the blade aerodynamics. The number of operational hours gives the number of loading cycles for rated operation. Rotation speeds of 1.67 and 2 rad/sec are considered. For 1.67, the number of loading cycles during stationary operation = 2.06 x 10 to the 8th power; during starts and cut offs = 357,000. For 2 rad/sec, results are 2.47 x 10 to the 8th power and 463,000. Stress values, expressed in installed power/sqmm, are: aluminum alloy = 98; stainless steel = 294; glass fiber reinforced plastic = 98; and carbon fiber reinforced plastic = 147.
Author (ESA)

N82-17654*# Old Dominion Univ., Norfolk, Va. Dept. of Economics.
ENERGY ENVIRONMENT STUDY Final Report, 16 May 1980 - 15 Mar. 1981
Raymond Strangways Dec. 1981 123 p refs
(Contract NAG1-66)
(NASA-CR-168458) Avail: NTIS HC A06/MF A01 CSCL 13B

The international demand for and supply of oil between the years 1980 and 2000 is assessed and future world oil prices and their implications for the price of jet fuel are estimated. Three critical questions are investigated: (1) how long will the world supply of oil continue to keep pace with its demand under likely trends in its use and discovery; (2) at what price will demand and supply clear the world oil market; (3) what does the analysis imply about the price of jet fuel. Projection of oil price is based upon supply and demand, which is consistent with microeconomic analysis.
E.A.K.

N82-17655# *Committee on Commerce, Science, and Transportation (U. S. Senate).*
NOISE IMPACT ON COMMUNITIES FROM AIRCRAFT
Washington GPO 1981 40 p Hearing before the Comm. on Com., Sci., and Transportation, 97th Congr., 1st Sess., 10 Feb. 1981
(GPO-80-617) Avail: Committee on Commerce, Science, and Transportation

The environmental and noise pollution problems of Cannon International Airport in Reno, Nevada are discussed. Restrictions imposed by the Federal government and the airport management on flight into and out of the airport were reviewed. Near-by urban development projects are described and the impact of airport traffic on them was evaluated. Discussion focused on the balance of economic development brought about by the airport and the rights of residents to enjoy a comfortable environment.
T.M.

N82-17879*# Case Western Reserve Univ., Cleveland, Ohio.
INVESTIGATION AND EVALUATION OF A COMPUTER PROGRAM TO MINIMIZE THREE-DIMENSIONAL FLIGHT TIME TRACKS Final Report, 15 Sep. 1980 - 12 Aug. 1981
Frederic I. Parke 12 Aug. 1981 150 p
(Grant NAG3-101)
(NASA-CR-168419) Avail: NTIS HC A07/MF A01 CSCL 09B

The program for the DC 8-D3 flight planning was slightly modified for the three dimensional flight planning for DC 10 aircrafts. Several test runs of the modified program over the North Atlantic and North America were made for verifying the program. While geopotential height and temperature were used in a previous program as meteorological data, the modified program uses wind direction and speed and temperature received from the National Weather Service. A scanning program was written to collect required weather information from the raw data received in a packed decimal format. Two sets of weather data, the 12-hour forecast and 24-hour forecast based on 0000 GMT, are used for dynamic processes in testruns. In order to save computing time only the weather data of the North Atlantic and North America is previously stored in a PCF file and then scanned one by one.
R.J.F.

N82-17887# Ohio State Univ., Columbus. Computer Graphics Research Group.
TERRAIN MODEL ANIMATION Final Report, 1 Dec. 1979 - 15 Oct. 1980
John L. Booker, Charles Csuri, Robert Marshall, and Roger Wilson Sep. 1981 48 p
(Contract N61339-80-C-0008)
(AD-A107911; NAVTRAEQUIPC-80-C-0008-1) Avail: NTIS HC A03/MF A01 CSCL 09/2

Procedure models are used to combine fundamental data elements in the creation of unified objects comprising the terrain model. A procedure model to generate trees of various species was implemented. Interactive techniques were developed to generate mountains. An analysis was made of the performance of a Z-buffer display algorithm. Test results are included in the report.
Author (GRA)

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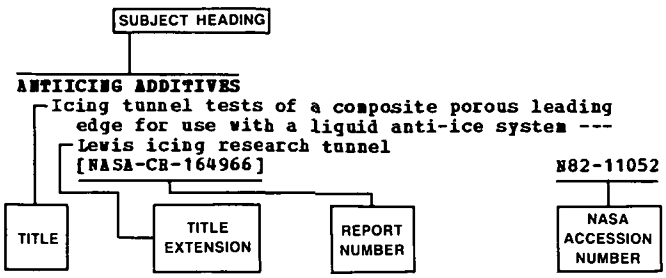

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