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A Continuing Bibliography with Indexes

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Aeronautical Engineering

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

STAR (N-10000 Series)	**N82-22141 - N82-24160**
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NASA SP-7037(151)

AERONAUTICAL ENGINEERING

A CONTINUING BIBLIOGRAPHY WITH INDEXES

(Supplement 151)

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 July 1982 in

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

NASA Scientific and Technical Information Branch 1982
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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 362 reports, journal articles, and other documents originally announced in July 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.

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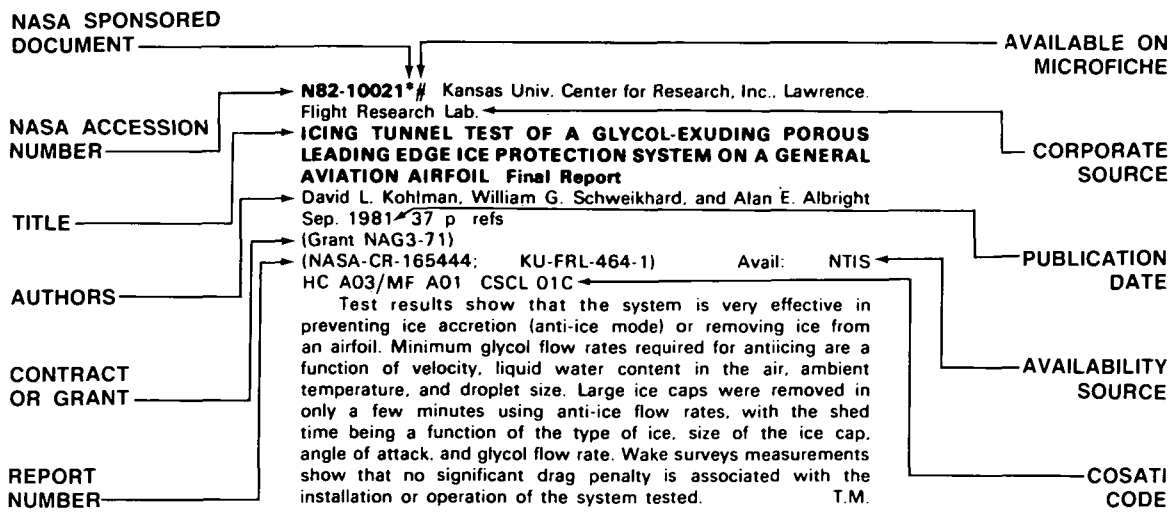

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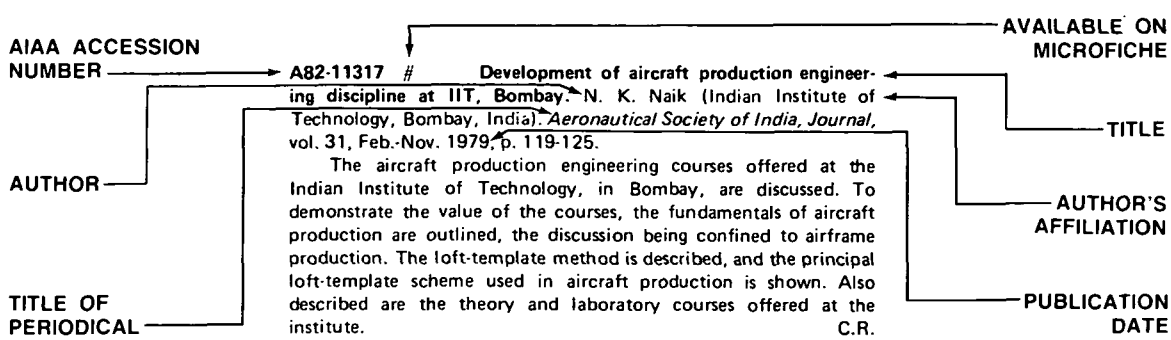

AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 151)

AUGUST 1982

IAA ENTRIES

A82-28543 **Occurrence of fretting fatigue failures in practice.** P. J. E. Forsyth (Royal Aircraft Establishment, Materials Dept., Farnborough, Hants., England). In: Fretting fatigue. London, Applied Science Publishers, Ltd., 1981, p. 99-125.

The basic characteristics of fretting fatigue are identified and practical engineering situations where fretting fatigue problems can arise are discussed. The discussion includes both commonly observed cases, such as flanges and loaded holes, and less common cases such as that of an aircraft lift strut stabilizing point where aerodynamic vibrations are developed in the member. It is pointed out that once a fretting fatigue failure has occurred in service, remedial measures can be found which will eliminate the problem. However, difficulties still arise in applications where the possibilities of fretting have not been identified at the design stage, and in pin-lug combinations where the engineering variables are difficult to control and where anti-fretting compounds are difficult to maintain in situ. V.L.

A82-28565 * **Finite element thermal analysis of convectively-cooled aircraft structures.** A. R. Wieting (NASA, Langley Research Center, Hampton, VA) and E. A. Thornton (Old Dominion University, Norfolk, VA). In: Numerical methods in heat transfer. Chichester, Sussex, England and New York, Wiley-Interscience, 1981, p. 431-443. 8 refs.

The design complexity and size of convectively-cooled engine and airframe structures for hypersonic transports necessitate the use of large general purpose computer programs for both thermal and structural analyses. Generally thermal analyses are based on the lumped-parameter finite difference technique, and structural analyses are based on the finite element technique. Differences in these techniques make it difficult to achieve an efficient interface. It appears, therefore, desirable to conduct an integrated analysis based on a common technique. A summary is provided of efforts by NASA concerned with the development of an integrated thermal structural analysis capability using the finite element method. Particular attention is given to the development of conduction/forced-convection finite element methodology and applications which illustrate the capabilities of the developed concepts. G.R.

A82-28587 **The gas turbine engine.** D. Driver, D. W. Hall, and G. W. Meetham (Rolls-Royce, Ltd., Derby, England). In: The development of gas turbine materials. London, Applied Science Publishers, 1981, p. 1-30. 28 refs.

An historical account is given of the developments in gas turbine engine mechanical design which, by increasing operating temperature requirements in their evolution towards greater thrust and lower fuel consumption, have strongly affected the choice of component materials. The desire to reduce powerplant weight, and especially the weight of rotating components, has also been a significant factor in the development of materials. Compressor materials, which were largely aluminum alloy in the earliest gas turbine engines, were supplanted by steels as temperatures rose above 200 C in the early 1950s; the development of high specific strength titanium alloys led to their application to compressor blades and casings after 1960. Combustion chamber and turbine materials have been a succession of increasingly corrosion-resistant nickel-based superalloys. Attention is also given to drive shafts and bearings. O.C.

A82-28590 **Composite materials.** W. N. Turner, J. W. Johnson, and C. G. Hannah (Rolls-Royce, Ltd., Derby, England). In: The development of gas turbine materials. London, Applied Science Publishers, 1981, p. 121-145. 16 refs.

Since the development of the RB 162 engine, composite materials such as glass fiber/epoxy, glass fiber/polyimide, and carbon or graphite fiber/epoxy have displaced conventional metallic components in aircraft gas turbines through a combination of lower weight and superior performance. Applications of such composites include compressor blades and casings, fan blades, nacelle components and thrust reversers. Emphasis is put on the development of pressure-assisted resin injection and the autoclave molding resin system for the successful application of carbon fiber reinforced plastics. The prospective development of high-temperature, metal-matrix composites able to operate above the polymer limit of 300 C is also considered. Such composites will employ alumina, carbon and silicon carbide fibers in the reinforcement of aluminum and titanium alloy matrices. O.C.

A82-28594 **Sheet materials - Fabrication and joining.** B. Hicks (Lucas Aerospace, Ltd., Fabrication Div., Burnley, Lancs., England). In: The development of gas turbine materials. London, Applied Science Publishers, 1981, p. 229-258. 47 refs.

Aircraft gas turbine engine sheet-fabricated components include fan casings, combustion chambers, and bypass and exhaust ducts of often complex shape which must be produced to high standards. Their production sequence typically entails (1) shaping sheet metal parts by bending, drawing, stretch-forming, stamping and roll-forming, with inter-stage annealing and cleaning; (2) the machining of those forgings and castings which are to become an integral part of the fabricated assembly; (3) degreasing, annealing and descaling of the parts in preparation for welding; (4) tungsten argon-arc or resistance welding; and (5) stress-relieving of the welded assembly and final heat treatment. Materials used range from high-temperature superalloys employed in combustors and exhaust ducting to the alloy steels and titanium alloys of air casings and shrouds. Attention is given to the properties of such sheet alloys as Nimonic 75, Hastelloy X, and Jethete M 152. O.C.

A82-28643 **Processing and uses of carbon fibre reinforced plastics.** (Translation of Verarbeiten und Anwenden kohlenstoffaser-verstärkter Kunststoffe, Düsseldorf, VDI-Verlag GmbH, 1981.) Düsseldorf, VDI-Verlag GmbH, 1981. 286 p. $61.

After an introductory paper on the processing and uses of carbon fiber reinforced plastics (CRP), consideration is given to high-strength carbon fibers based on polyacrylonitrile, high-modulus carbon fibers made from pitch, the surface treatment of carbon fibers, the nondestructive testing of CRP, and the novel high-strength structure materials family of hollow fiber composites. Also discussed are CRP tension-compression struts, the CRP design and construction of the Alpha-Jet elevator unit, the design and finite element method structural analysis of the Airbus CRP rudder assembly, cardan shafts composed of CRP and mixed laminates, an aluminum/CRP bridge, chopped carbon fiber technology, and the use of carbon fiber reinforced epoxy resin for human implants. O.C.

A82-28649 **Elevator unit for the Alpha-Jet, made from carbon-fibre reinforced plastic.** H. Conen and M. Kaitatzidis (Dornier GmbH, Friedrichshafen, West Germany). In: Processing and uses of

carbon fibre reinforced plastics. Düsseldorf, VDI-Verlag GmbH, 1981, p. 151-166. Translation.

A detailed description is given of the design and construction of a carbon fiber-reinforced plastic (CRP) elevator structure for the Alpha-Jet trainer aircraft. The spar box of the elevator unit consists of two continuous CRP shells and 11 metal ribs, and the remainder of the assembly consists of CRP, or glass reinforced plastic, or a combination of the two. Attention is given to comparisons of structural complexity and production costs for the conventional metallic and CRP elevator units, laminate construction details, the stiffening of the spar box shells by means of a supporting sandwich, and preparation of the spar box for autoclaving. A weight saving of 18% has been demonstrated for the CRP structure, which in fatigue tests has exhibited a 20,000 flying hours capability. O.C.

A82-28658 The effect of swirl burner aerodynamics on NOx formation. T. C. Claypole and N. Syred (University College, Cardiff, Wales). In: Symposium /International/ on Combustion, 18th, Waterloo, Ontario, Canada, August 17-22, 1980, Proceedings. Pittsburgh, PA, Combustion Institute, 1981, p. 81-89. 17 refs. Research supported by the Science Research Council.

When swirl is applied to the combustion air of a burner, a complex, highly turbulent flow field is established which produces very stable flames. There is currently little information available regarding the effect of the swirl on pollutant formation. The current investigation is concerned with the influence of the levels of swirl on the aerodynamics and NOx emissions at constant load. The instantaneous velocities in the experiments are measured by dual beam laser anemometry. The flame is sampled with the aid of a quartz probe. It is found that to establish the source of pollutants in a swirl combustor, it is essential to consider the pollutant mass flow profiles. The recirculation zone, despite elevated temperatures, does not appear to play a major role in the formation of NOx. G.R.

A82-28660 NOx formation in flat, laminar, opposed jet methane diffusion flames. W. A. Hahn and J. O. L. Wendt (Arizona, University, Tucson, AZ). In: Symposium /International/ on Combustion, 18th, Waterloo, Ontario, Canada, August 17-22, 1980, Proceedings. Pittsburgh, PA, Combustion Institute, 1981, p. 121-129; Comments, p. 129-131. 18 refs. U.S. Environmental Protection Agency Grant No. R-803715; Contract No. 68-02-2631.

Diffusion flames can play a useful role in the study of the kinetic mechanisms of pollutant formation. A laminar diffusion flame which has a number of useful attributes is the flat laminar opposed jet diffusion flame. Such a flame is established between two coaxial opposed jets, one being fuel only and the other being oxidizer only, impinging on one other. This flame is strained in its own plane, and it can be envisioned as a prototype model for laminar flamelets in turbulent diffusion flames. It is shown that the considered flame, having a given stretching rate, is one dimensional in temperature, concentration, and axial, but not radial, velocity profiles, provided the correct boundary conditions are employed for the velocities of the two incoming jets. G.R.

A82-28692 The combustion of a fuel jet in a stream of lean gaseous fuel-air mixtures. G. A. Karim, I. Wierzba, M. Metwally, and K. Mohan (Calgary, University, Calgary, Alberta, Canada). In: Symposium /International/ on Combustion, 18th, Waterloo, Ontario, Canada, August 17-22, 1980, Proceedings. Pittsburgh, PA, Combustion Institute, 1981, p. 977-990; Comments, p. 990, 991. 8 refs. Research supported by the National Research Council of Canada, Imperial Oil, Ltd., and University of Calgary.

The purpose is to establish the way in which the presence of a fuel vapor homogeneously dispersed in the surrounding air influences the burning characteristics of the jet flame and the corresponding flammability limits for both co-flowing and contra-flowing surrounding streams in the presence of a pilot jet diffusion flame. A wide range of jet diameters and discharge velocities is employed involving methane or hydrogen at ambient temperature and pressure. Both laminar and turbulent co-flowing streams are considered; the streams involve a range of gaseous fuel-air mixtures and include methane, hydrogen, propane and ethylene. It is shown that the presence of very small concentrations of fuel in the surroundings of the jet flame tends to increase the flame thickness and height and to considerably enhance its stabilization. It is also found that the detected flame spread lean limit of the fuels is essentially independent of the type of jet fuel and the initial jet discharge velocity. C.R.

A82-28738 The relaxation oscillation in ramjet combustion. N. Huang (Beijing Institute of Aeronautics and Astronautics, Beijing, People's Republic of China). In: Symposium /International/ on Combustion, 18th, Waterloo, Ontario, Canada, August 17-22, 1980, Proceedings. Pittsburgh, PA, Combustion Institute, 1981, p. 1891-1897. 20 refs.

A mechanism of low frequency relaxation oscillation in ramjet combustion is proposed. Initial pressure disturbances induce combustion instability which results in periodic heat release. Acting as feedback, the periodic heat release boosts the pressure pulsations. The complex shock wave system separating the supersonic and subsonic flows may be replaced by a virtual normal shock which shifts back and forth in the diffuser duct in response to the pulsating pressure. The cold gas column expands or contracts like a buffer plug between the virtual normal shock and the flame front in accordance with the pulsating combustion downstream. This chain of actions and reactions results in a self-excited nonlinear relaxation oscillation with irregular frequency. The proposed mechanism explains quite well the oscillograph obtained from the rig testing of a 220 mm ramjet engine in a free jet of Mach No. 1.94 from a blowdown tunnel. (Author)

A82-28808 Applications of structural adhesives in production. W. J. Charles and S. J. Palmer (3M United Kingdom, Ltd., Adhesives, Coatings and Sealants Div., Swansea, Wales). In: Adhesion 5; Proceedings of the Eighteenth Annual Conference on Adhesion and Adhesives, London, England, March 1980. London, Applied Science Publishers, Ltd., 1981, p. 119-131.

A82-28826 Instruments and installations for meteorological measurements at airports (Pribory i ustanovki dlia meteorologicheskikh izmerenii na aerodromakh). Edited by L. P. Afinogenov and E. V. Romanov. Leningrad, Gidrometeoizdat, 1981. 296 p. In Russian.

A description is given of the systems and devices which are employed to provide the meteorological information which is needed for the conduction of the flight operations of civil aviation according to the established standards of safety, efficiency, and reliability, taking into account the meteorological conditions at the airport and its environment. Problems and organizational aspects concerning the conduction of meteorological measurements at airports are discussed, giving attention also to the accuracy requirements. The various approaches for determining visibility characteristics are examined along with the equipment employed in the measurements. The determination of wind parameters, atmospheric pressure, temperature, and humidity is also considered. A description is provided of an automatic system which was developed in 1971 for the utilization of automatic procedures in connection with the acquisition, the processing, and the distribution of meteorological data. G.R.

A82-28873 Tool use in cutting operations involving integral structural components in aircraft construction (Werkzeugeinsatz bei der Zerspanung von Integralbauteilen im Flugzeugbau). H. Graalmann (Messerschmitt-Bölkow-Blohm GmbH, Augsburg, West Germany). In: Cutting operations for metals (Zerspanung der Metalle). Oberursel, West Germany, Deutsche Gesellschaft für Metallkunde, 1981, p. 97-104. In German.

In connection with the desirability to use lighter and stiffer structural units in aircraft designs, integral constructional approaches have been adopted in the aircraft industry during the last few years. The change involves a replacement of a multitude of small individual sheet metal parts by a few complex integral structural components, which are obtained by suitable machining operations from forgings or plates. The materials used for the production of integral structural components include, in addition to aluminum, also titanium and high-strength steels. However, a number of problems arise in connection with the required metal-cutting operations. Problems related, in particular, to the use of titanium are solved by making use of a new cutting concept involving the use of multiple-spindle machines and special tools. Attention is given to the selection of suitable cutting tools. G.R.

A82-28875 † Cascade converter of dc voltage to ac voltage

of higher frequency with voltage and frequency stabilization devices (Kaskadnyi preobrazovatel' postoiannogo napriazheniia v peremennoe povyshennoi chastoty s ustroistvami dlia stabilizatsii napriazheniia i chastoty). M. M. Krasnoshapka and I. P. Terekhov (Vysshee Inzhenerno-Aviatsionnoe Voennoe Uchilishche VVS, Kiev, Ukrainian SSR). *Tekhnicheskaia Elektrodinamika,* Jan.-Feb. 1982, p. 56-62. In Russian.

A dc-to-ac cascade converter is presented which consists of a dc motor and an asynchronous motor with a three-phase stator winding and a multiphase rotor winding mounted on a common shaft within the same housing. The experimental converter changes 28 V dc to 200/115 V ac, 400 Hz; it has a power of 800 VA at 6000 rpm and an efficiency of 0.56. The voltage stabilization circuit includes a toroidal winding on the back of the stator, an automatic voltage regulator which controls the magnetization current of the toroidal winding, and a capacitor bank controlled by the magnetization current through a contactor. Frequency is stabilized by an automatic current regulator in the control field coil circuit. V.L.

A82-28932 A multidimensional-crack-growth prediction methodology for flaws originating at fastener holes. W. T. Fujimoto and C. R. Saff (McDonnell Aircraft Co., St. Louis, MO). *(Society for Experimental Stress Analysis, International Congress on Experimental Mechanics, 4th, Boston, MA, May 25-30, 1980.) Experimental Mechanics,* vol. 22, Apr. 1982, p. 139-146. 16 refs.

A general two-dimensional crack growth prediction methodology for flawed fastener holes is developed which accounts for the effects of residual stresses due to yielding at the hole edge as well as the changing shape of the flaw. The methodology is based on a slice-synthesis model of the flawed hole which predicts the stress-intensity factor distribution along the periphery of the crack after each increment of advance. Analytic predictions of crack growth rates are found to be in good agreement with test results. It is concluded that the assumption of a constant shape in one-dimensional crack growth prediction schemes can result in highly inaccurate service life estimates. V.L.

A82-28934 Utility of a probability-density-function curve and F-maps in composite-material inspection. J. L. Rose, Y. H. Jeong, and M. J. Avioli (Drexel University, Philadelphia, PA). *Experimental Mechanics,* vol. 22, Apr. 1982, p. 155-160.

The principles of probability-density-function analysis are briefly reviewed and its applications to nondestructive testing are discussed with emphasis on composite materials inspection. It is shown that probability-density-function curves can be used to produce feature maps (F-maps) of a composite material which are useful in both quality control and damage assessment. Sample problems involving graphite-polyimide structures and boron-aluminum materials are examined to illustrate the use of probability-density-function curves and F-maps. The concept of inspectability and its role in selecting a manufacturing technology are also discussed. V.L.

A82-28986 # Prediction of aerodynamically induced vibrations in turbomachinery blading. D. Hoyniak and S. Fleeter (Purdue University, West Lafayette, IN). *In: Fluid/structure interactions in* turbomachinery; Proceedings of the Winter Annual Meeting, Washington, DC, November 15-20, 1981. New York, American Society of Mechanical Engineers, 1981, p. 1-8. 14 refs.

To predict the aerodynamically forced response of an airfoil, an energy balance between the unsteady aerodynamic work and the energy dissipated through the airfoil structural and aerodynamic damping is performed. Theoretical zero incidence unsteady aerodynamic coefficients are then utilized in conjunction with this energy balance technique to predict the effects of reduced frequency, inlet Mach number, cascade geometry, and interblade phase angle on the torsion mode aerodynamically forced response of the cascade. In addition, experimental unsteady aerodynamic gust data for flat plate and cambered cascaded airfoils are used together with these theoretical cascade unsteady aerodynamic damping coefficients to indicate the effects of incidence angle and airfoil camber on the forced response of the airfoil cascade. (Author)

A82-28987 * # Measurement of aerodynamic work during fan flutter. A. P. Kurkov (NASA, Lewis Research Center, Cleveland, OH). In: Fluid/structure interactions in turbomachinery; Proceedings of the Winter Annual Meeting, Washington, DC, November 15-20, 1981. New York, American Society of Mechanical Engineers, 1981, p. 9-18. 12 refs.
(Previously announced in STAR as N81-25080)

A82-28993 # The excitation of compressor/duct systems. R. E. Peacock (U.S. Naval Postgraduate School, Monterey, CA) and D. K. Das (Cranfield Institute of Technology, Cranfield, Beds., England). In: Fluid/structure interactions in turbomachinery; Proceedings of the Winter Annual Meeting, Washington, DC, November 15-20, 1981. New York, American Society of Mechanical Engineers, 1981, p. 71-78. 5 refs. Research sponsored by the Ministry of Defence of England.

A series of experiments is reported in which the flow through a compressor/duct combination was perturbed in a cyclic way. The unsteady flows generated were mapped through the system in the regime of stable compressor operations and the variation of their magnitude evaluated. It was found that in approaching the stability limit the stagnation pressure pulses tended to be magnified and that the position of the stability limit line depended both upon the mean operating point of the compressor and the pulsation characteristics. Further, it was possible to destabilize the system in a surge type manner at any superimposed frequency. (Author)

A82-28994 Advanced aluminum and titanium structures; Proceedings of the Winter Annual Meeting, Washington, DC, November 15-20, 1981. Meeting sponsored by the American Society of Mechanical Engineers. Edited by J. W. Goodman (USAF, Aeronautical Systems Div., Wright-Patterson AFB, OH). New York, American Society of Mechanical Engineers (Aerospace Symposia Series. Volume AD-02), 1981. 47 p. Members, $7.00; nonmembers, $14.

Among the topics discussed are the use of the sheet metal weldbonding process in A-10 aircraft production, the structural integrity of an adhesively bonded aircraft fuselage, and the superplastic forming of 7475 aluminum alloy high-strength aircraft structures. Also considered are the development of low-cost titanium alloy structures using blended elemental powder metallurgy, and the techniques of built-up, low-cost advanced titanium alloy aircraft structure manufacture. O.C.

A82-28995 # Production weldbonding on the A-10 aircraft. R. L. Rupp, A. Shames (Fairchild Republic Co., Farmingdale, NY), and S. G. Lee (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH). In: Advanced aluminum and titanium structures; Proceedings of the Winter Annual Meeting, Washington, DC, November 15-20, 1981. New York, American Society of Mechanical Engineers, 1981, p. 1-10. 6 refs. Contract No. F33615-78-C-5121.

The weldbonding process - an energy conservative manufacturing process where the detail parts are fixtured by spotwelding through a structural adhesive with subsequent curing to obtain the strength and fatigue life characteristic of adhesive bonded structure has been production implemented on the A-10. A four-phase program has been conducted to provide near-term service experience and production experience on the A-10 and to define weldbond applicability to fatigue and fracture critical primary aircraft structure and secondary structure by mechanical property and environmental durability testing. The production costs for the first 100 weldbond shipsets are discussed with an analysis of the key cost drivers. Planned production is in excess of 2000 weldbond assemblies. (Author)

A82-28996 # Structural integrity of an adhesively bonded aircraft fuselage. D. L. Potter (Douglas Aircraft Co., Long Beach, CA). In: Advanced aluminum and titanium structures; Proceedings of the Winter Annual Meeting, Washington, DC, November 15-20, 1981. New York, American Society of Mechanical Engineers, 1981, p. 11-17. 11 refs. USAF-sponsored research.

Procedures and test results used in the selection of a surface treatment and adhesive system, and methods for its nondestructive inspection, are described for the case of the Primary Adhesively Bonded Structure Technology (PABST) program. PABST is concerned with evaluating the potential cost savings, weight reductions, and structural integrity improvements that may result from the

application of recently developed environment-resistant, 250 F-cure modified epoxy adhesives and their primers. NDI-detected adhesive flaws in the full-scale demonstration component structure, destructively exposed after completion of the test program, showed precise correlation with the Fokker Bondtester Model 70. It is also found that metal crack propagation is contained within the stiffened boundaries of pressurized panels. The damage tolerance and durability of bonded primary structures are shown to be superior to those of mechanically-fastened structures despite the fabrication quality latitude permitted by the PABST program. O.C.

A82-28997 # **SPF of high strength aluminum structures.** F. T. McQuilkin (Rockwell International Corp., North American Aircraft Div., Los Angeles, CA), C. H. Hamilton (Rockwell International Science Center, Thousand Oaks, CA), and J. Waldman (U.S. Army, Research and Development Command, Dover, NJ). In: Advanced aluminum and titanium structures; Proceedings of the Winter Annual Meeting, Washington, DC, November 15-20, 1981. New York, American Society of Mechanical Engineers, 1981, p. 19-25.

The aluminum alloy 7475 has been shown to exhibit excellent superplastic properties upon thermomechanical processing, allowing the one-step production of complex structures otherwise realizable only through the use of many parts and fasteners. After reviewing the results of tests characterizing elongation as a function of temperature and strain rate, and corresponding measurements of flow stress as a function of strain rate, over the temperature range of 371-516 C, the strain rate sensitivity exponent was determined as a function of temperature strain rate for the selection of optimum forming parameters. The 7475 alloy was then applied to the production of a redesigned T-39 Saberliner forward fuselage bulkhead consisting of a single, complex-formed sheet with four small clips, by contrast to 18 parts and over 100 rivets in conventional form, demonstrating a 36% cost reduction and 22% weight saving. O.C.

A82-28998 # **Development of low-cost titanium structures using blended elemental powder metallurgy.** P. C. Eloff (Imperial Clevite Technology Center, Cleveland, OH). In: Advanced aluminum and titanium structures; Proceedings of the Winter Annual Meeting, Washington, DC, November 15-20, 1981. New York, American Society of Mechanical Engineers, 1981, p. 27-31. Research supported by Gould, Inc., United Technologies Corp., and Magnavox Government and Industrial Electronics Co.

By using blends of titanium sponge fine powder and elemental or masteralloy powders, powder metallurgy techniques have demonstrated a halving of materials costs by comparison with conventional wrought titanium alloy hardware production. An additional advantage of powder metallurgy in the working of the titanium alloy family in question, which is difficult to machine, is the ability to produce near-net shapes requiring little subsequent machining. The two structural components by which these capabilities are demonstrated are a compressor-stator connecting link for the F-100 turbofan engine, and a warhead body for the Army Stinger ground-to-air missile. The alloy compositions used are Ti-6Al-4V and Ti-6Al-6V-2Sn, respectively. It is suggested that it may be possible to formulate alloys through powder blending which would not be obtainable by means of conventional ingot metallurgy. O.C.

A82-29000 # **Advanced technology DFCS control panel for the L-1011-500.** T. E. Foster (Rockwell International Corp., Collins Air Transport Div., Cedar Rapids, IA). *American Institute of Aeronautics and Astronautics and Institute of Electrical and Electronics Engineers, Digital Avionics Systems Conference, 4th, St. Louis, MO, Nov. 17-19, 1981, AIAA Paper 81-2240.* 8 p.

The design features and development are described of a digital glareshield panel for the digital FCS-240 system that achieves the following design objectives: (1) an efficient interface with the digital FCC's; (2) improved mean time between failures; (3) required aircraft wiring; (4) improved monitoring and fault isolation features; (5) accommodation of new operational features; (6) increased flexibility for configuration changes. Besides providing traditional functions, the panel contains these advanced technology features: gas discharge displays, multifunctional displays, ARINC 429 interfaces, microprocessor control, dual redundant design, monitoring and fault isolation, human factor design, and growth and flexibility accommodation. C.D.

A82-29005 # **A Schwarz-Christoffel method for generating internal flow grids.** K. P. Sridhar (United Technologies Corp., Pratt and Whitney Aircraft Group, East Hartford, CT) and R. T. Davis (Cincinnati, University, Cincinnati, OH). In: Computers in flow predictions and fluid dynamics experiments; Proceedings of the Winter Annual Meeting, Washington, DC, November 15-20, 1981. New York, American Society of Mechanical Engineers, 1981, p. 35-44. 17 refs.

A new coordinate generation technique, developed by Davis for external flows, is extended to allow for accurate grid generation for a variety of complex internal flow configurations. The approach is based on numerical integration of the Schwarz-Christoffel transformation for polygonal surfaces. It is shown to be second-order accurate with mesh size due to analytic treatment of boundary singularities. The method is flexible enough to allow for treatment of severe internal geometries, for a high degree of control of mesh spacing, and for generation of either orthogonal or nonorthogonal grids. In addition, this technique directly provides the two-dimensional incompressible potential flow solution for internal flows, as well as a simple expression for calculating the grid metric coefficients. Sample cases include symmetric and asymmetric channel, diffuser, and cascade flows. (Author)

A82-29008 * # **Application of computer generated color graphic techniques to the processing and display of three dimensional fluid dynamic data.** B. H. Anderson, C. W. Putt, and C. C. Giamati (NASA, Lewis Research Center, Cleveland, OH). In: Computers in flow predictions and fluid dynamics experiments; Proceedings of the Winter Annual Meeting, Washington, DC, November 15-20, 1981. New York, American Society of Mechanical Engineers, 1981, p. 65-72. 12 refs.
(Previously announced in STAR as N81-29782)

A82-29018 # **A computer-controlled oscillation mechanism for unsteady aerodynamics experiments.** J. P. Retelle (U.S. Air Force Academy, Colorado Springs, CO), M. S. Francis (USAF, Office of Scientific Research, Bolling AFB, Washington, DC), and J. E. Keese (USAF, Ballistic Missile Office, Norton AFB, CA). In: Computers in flow predictions and fluid dynamics experiments; Proceedings of the Winter Annual Meeting, Washington, DC, November 15-20, 1981. New York, American Society of Mechanical Engineers, 1981, p. 213-218. 5 refs.

Numerous wind tunnel studies of airfoil dynamic stall have been limited to harmonic model oscillations, but new microcomputers and hybrid servo systems have now been exploited to produce a mechanism which provides a high degree of flexibility in achieving arbitrary model motions in multiple degrees of freedom over a wide range of motion alternatives. An apparatus capable of providing simultaneous motions of an airfoil or wing model in both pitch and translation has been designed and fabricated. Drive motors provide independent motion in two axes under control of servo-translator units which respond to pulse trains generated by a microcomputer using analog position and feedback loops to smooth the pulses. Programs are developed in a higher-level language using a larger disk-based computer system with subsequent downline loading of the program task image through a network communications link to the smaller computer. In addition to a description of the experimental apparatus, the various elements of motion control, including servo-translator dynamic characteristics, software techniques for pulse train generation, and required computer interface circuitry, are discussed. System performance characteristics are also discussed. (Author)

A82-29032 # **Fatigue behavior of adhesively bonded joints.** W. B. Jones, Jr. (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) and J. Romanko (General Dynamics Corp., Fort Worth, TX). In: 1981 advances in aerospace structures and materials; Proceedings of the Winter Annual Meeting, Washington, DC, November 15-20, 1981. New York, American Society of Mechanical Engineers, 1981, p. 61-65. 5 refs. Contract No. F33615-76-C-5220.

Adhesively bonded metal aircraft structural joints are multi-

component systems, and as such, may display complex fatigue behaviors over the range of loads and environments typically experienced in service. In order to explore the fatigue behavior of the adhesive layer itself, thick-adherend lap-shear joints were fabricated, stress analyzed, and tested. Stress distributions in the adhesive layer were calculated using a finite element program. Instrumented fatigue tests were conducted at several loads, frequencies, humidities and temperatures. Some of these tests were interrupted, and the metal had been chem milled away. Only specimens which had experienced unduly high load amplitudes displayed damage. The damage initiated in the (calculated) high stress regions as interface cracks with scrim plane crazing. The cracks grew, with concurrent reduction in joint stiffness, until cohesive failure occured in the scrim plane. The adhesive material tested is surprisingly tough and resistant to fatigue crack growth. (Author)

A82-29036 # **Effects of moisture on the mechanical properties of glass/epoxy composites.** C. D. Douglas and E. R. Pattie (U.S. Army, Army Materials and Mechanics Research Center, Watertown, MA). In: 1981 advances in aerospace structures and materials; Proceedings of the Winter Annual Meeting, Washington, DC, November 15-20, 1981. New York, American Society of Mechanical Engineers, 1981, p. 91-97. 11 refs.

Data are presented showing the effects of moisture on the mechanical properties of a specific glass/epoxy composite system that is a candidate material for fabrication of Army composite helicopter rotor blades. The test specimens were immersed in distilled water at temperatures of 25, 40, 60, and 80 C. Immersion times were one week, one, two, three, six, and nine months, and one year. Tension testing was then done on an Instron floor-model machine at a contant crosshead speed of 0.127 cm/min, and the tangent modulus was determined. Specimen strength was found to decrease by 60 percent at 80 C immersion, less at lower temperatures. The modulus dropped about 50 percent at 80 C immersion for 90 deg off-axis specimens, less for those that were less off-axis. A coupling agent with high-fiber, low-resin content was found to be superior to other couplers. C.D.

A82-29042 # **Turbulence-excited flapping motion of a rotor blade in hovering flight.** Y. K. Lin (Illinois, University, Urbana, IL) and C. Y. R. Hong. In: 1981 advances in aerospace structures and materials; Proceedings of the Winter Annual Meeting, Washington, DC, November 15-20, 1981. New York, American Society of Mechanical Engineers, 1981, p. 149-153. 10 refs. Grant No. DAAG29-78-G-0039.

Statistical properties of a randomly vibrating rotor blade under the excitation of turbulence is investigated using a simple model which consists of a rigid blade, centrally hinged, with elastic restraint for the flapping motion. It is shown that turbulence affects the blade motion in two ways, distinguished by two types of terms in the equation of motion. The first type appears in the coefficients, thus causing the dynamic system to change randomly with time. The second type appears among the inhomogeneous terms. A theoretical procedure is proposed in which both effects of the turbulence can be accounted for. Application of the methodology is illustrated by numerical examples. (Author)

A82-29098 * **Addition polyimide adhesives containing various end groups.** A. K. Saint Clair and T. L. Saint Clair (NASA, Langley Research Center, Hampton, VA). *Polymer Engineering and Science,* vol. 22, no. 1, Jan. 1982, p. 9-14. 11 refs.

Addition polyimode oligomers have been synthesized from 3,3 prime, 4,4 prime-benzophenone tetracarboxylic acid dianhydride and 3,3 prime-methylenedianiline using a variety of latent crosslinking groups as end-caps. The nominal 1300 molecular weight imide prepolymers were isolated and characterized for solubility in amide, chlorinated and ether solvents, melt-flow and cure properties, glass transition temperature, and thermal stability on heating in an air atmosphere. Adhesive strengths of the polyimides were obtained both at ambient and elevated temperatures before and after aging at 232 C. Properties of the novel addition polyimides were compared to a known nadic end-capped adhesive, LARC-13. (Author)

A82-29165 * **Comparing the relationships between noise level and annoyance in different surveys - A railway noise vs. aircraft and road traffic comparison.** J. M. Fields (NASA, Langley Research Center, Hampton, VA; Southampton, University, Southampton, England) and J. G. Walker (Southampton University, Southampton, England). *Journal of Sound and Vibration,* vol. 81, Mar. 8, 1982, p. 51-80. 24 refs. Research supported by the British Railways; Science Research Council of England Grant No. B/RG/3777/3.

Annoyance expressed in a railway noise survey is compared with that from two road traffic and three aircraft surveys in order to determine whether responses to various types of environmental noise are source-specific. Railway noise is found to be less annoying than other noises at any given high noise level. Railway noise annoyance rises less rapidly with increasing noise level. At high levels, this gap in reactions averages about 10 dB; it ranges from 4 dB to more than 20 dB. The methods used for comparing the surveys are examined. It is found that methodological uncertainties lead to imprecise comparisons and that different annoyance scales yield different estimates of intersurvey differences. C.R.

A82-29258 **Low cost aircrew training devices.** M. A. G. Knight (RAF Support Command, Brampton, Cumb., England). *Aeronautical Journal,* vol. 86, Mar. 1982, p. 98-101. 5 refs.

A description is presented of the simple aids that may be used in the elementary stages of aircrew training, and illustrations are given of their integration with flight simulators and aircraft to constitute a systematic approach to flight training. The techniques described include books and manuals, two-dimensional trainers, cardboard cockpits, suitcase trainers, table top trainers, cockpit procedures and instruments trainers, computer-based trainers, videogames and videodisks. Attention is given to computer-assisted instruction, in which a microcomputer assumes many of the functions of an instructor and a low-cost graphics terminal takes the role of a more complex and detained simulator display. O.C.

A82-29259 **The micro revolution comes to civil air transport.** M. Ryland (British Airways, Heathrow Airport, Middx., England). *Aeronautical Journal,* vol. 86, Mar. 1982, p. 102-108.

A presentation is made of the range of microprocessor applications currently available on civil aircraft, the hardware technology on which these applications are based is reviewed, and the software disciplines and certification procedures pertinent to airborne digital computers are outlined. Attention is given to the application of microcomputer-based systems in the B 757 new-generation airliner, which include flight control computers, flight management computer systems, CRT flight instrumentation, thrust management, air data computation, supervisory engine control, radio navigation and communication equipment control, and electrical generation regulation. It is shown that most problems encountered in applying microcomputers to civil aircraft are software-related. O.C.

A82-29268 **A review of U.S. Air Force research related to airframe and engine materials.** A. H. Rosenstein (USAF, Office of Scientific Research, Bolling AFB, Washington, DC). *Journal of Metals,* vol. 34, Mar. 1982, p. 14-23. 16 refs. USAF-sponsored research.

It is noted that the research addresses the fundamental physical nature of solids most directly relating to mechanical and thermal behavior. This involves an understanding of strengthening mechanisms, fatigue, plasticity, creep, fracture, shock loading, the effect of stress state, the kinetics of phase transformations, lattice imperfections, and the thermal dependence of properties. An important result of this research is information that will lead to improved structural alloys of aluminum, titanium, and nickel and to a thorough understanding of the scientific principles governing their properties and behavior. C.R.

A82-29275 **The investigation of aircraft accidents and incidents - Some recent national and international developments.** A. van Wijk (KLM Royal Dutch Airlines, Schiphol Airport, Netherlands). *Zeitschrift für Luft- und Weltraumrecht,* vol. 31, Mar. 1982, p. 20-55. 75 refs.

In June 1981, an International Civil Aviation Organization (ICAO) Panel of Experts on the General Work Programme of the ICAO Legal Committee recommended that the subject 'Legal Implications of Aircraft Accident and Incident Investigation' deserved consideration as a possible new item to be added to the General Programme of the Legal Committee and that a basic research

study should be undertaken by the ICAO Secretariat. A report is provided on developments both at national and international levels connected with the considered subject. Major trends in recent ICAO thinking on the technical side of aircraft and incident investigation procedures are examined, and developments in the U.S. are considered. Resolutions adopted by the European Parliament in relation to air traffic safety issues are also discussed, and attention is given to developments in the Netherlands, Switzerland, Sweden, New Zealand, and Canada. G.R.

A82-29414 Soaring Society of America, National Convention, Phoenix, AZ, January 14-18, 1981, Proceedings. Edited by J. Lincoln. Phoenix, AZ, Arizona Soaring Association, 1981. 120 p.

Features of modern sailplaning, contests, and hang gliding are reviewed. Equipment maintenance and use in sailplanes are discussed, including the calibration of variometers, charging batteries, and types of batteries. Sport hang gliding is described, as is competition tactics and photography. Homebuilt sailplanes are examined from the point of view of a home sailplane builder and a manufacturer of kits, and NASA research relevant to sailplane airfoils is explored. Finally, new concepts in Dolphin Tactics for continuously changing airspeed to maximize performance during a variety of sailplane maneuvers are detailed. M.S.K.

A82-29415 Checking and calibrating variometers in place in the sailplane instrument panel. R. H. Ball. In: Soaring Society of America, National Convention, Phoenix, AZ, January 14-18, 1981, Proceedings. Phoenix, AZ, Arizona Soaring Association, 1981, p. 29-38.

Techniques for calibrating the variometer, pitot total energy compensation, and netto and cruise controls while they are in a glider instrument panel are described. The panel is assumed to feature an altimeter and clock, and further tools recommended are a bottle, a needle valve, a hypodermic syringe, tubing, and fittings. Exact calibration of the variometer in conjunction with the altimeter by setting the pressure equal to 3000 ft using a bottle is described, along with descent rate measurements to assure proper altitude change tracking. Further discussion is given of calibrating a total energy variometer, checking airspeed with an altimeter, the netto compensation principle and calibration, and calibrating the cruise control. Finally, attention is given to altitude errors with a variometer and to best flying speed at various altitudes. M.S.K.

A82-29416 Development of a homebuilt powered sailplane. A. Strojnik. In: Soaring Society of America, National Convention, Phoenix, AZ, January 14-18, 1981, Proceedings. Phoenix, AZ, Arizona Soaring Association, 1981, p. 77-89.

Design and problem solving in the fabrication of the S-2, a 15 m powered sailplane test flown in 1980, are discussed. Weight penalties, the use of a retractable engine to maintain aerodynamic cleanliness, increases in drag due to the presence of an enlarged fuselage area and a propeller, and the normal solution of placing the engine at the rear of a pod-and-boom fuselage are detailed. The S-2 features outrigger wheels on the wingtips, one under the pod, and the steering wheel under the tail. The wings are constant chord with trapezoidal outer 4 ft sections to furnish an elliptical lift distribution at high lift coefficients. A middle wing section is reinforced by a carbon fiber spar, covered in 3-layer fiberglass skins, and shaped into a Wortman airfoil. Young's moduli for the materials are provided. The quality of the wing skin and the precision machining of the propeller are regarded as the two most crucial aspects of the S-2. M.S.K.

A82-29417 * NASA research related to sailplane airfoils. D. M. Somers (NASA, Langley Research Center, Hampton, VA). In: Soaring Society of America, National Convention, Phoenix, AZ, January 14-18, 1981, Proceedings. Phoenix, AZ, Arizona Soaring Association, 1981, p. 99-109. 8 refs.

The theoretical methods and experimental facilities at the NASA Langley Research Center have been employed to conduct investigations of sailplane airfoils. The unique and powerful capabilities of the Eppler Program have been used to design and analyze many airfoils and to smooth several Wortmann airfoils. Wind-tunnel investigations of two sailplane airfoils have been conducted in the Langley low-turbulence pressure tunnel. A procedure for sailplane performance improvement has been outlined. (Author)

A82-29576 Fighting fire and other disasters from the air; International Scientific-Technical Symposium, Hanover, West Germany, June 11, 12, 1980, Reports (Brand- und Katastrophenbekämpfung aus der Luft; Internationales Wissenschaft-Technisches Symposium, Hanover, West Germany, June 11, 12, 1980, Vorträge). Symposium sponsored by the Bundesministerium für Forschung und Technologie. Melsungen, West Germany, A. Bernecker Verlag, 1981. 242 p. In German. $16.25.

Attention is given to fighting forest fires with the aid of aircraft in the U.S., the fighting of forest fires as a task for the Swiss air force, the current state of technology concerning the fighting of forest fires from the air in Austria, the utilization of agricultural aircraft in economical operations for fighting fires in Israel, and the utilization of aircraft in fighting forest fires in France. The use of 'water bombers' and chemical agents against forest fires is considered along with the employment of two-engine and four-engine aircraft for dropping the latest chemical fire extinguishing agents in connection with the fighting of forest fires, the adaptation and equipment of aircraft for the fighting of forest fires, and the employment of helicopters in Austria in connection with large-scale fires in buildings. Other topics discussed are related to the performance characteristics and employment profiles of the new helicopter BK117, and a comparative evaluation of fire extinguishing agents involving the use of foam. G.R.

A82-29577 # Fighting forest fires with the aid of aircraft in the United States of America (Waldbrandbekämpfung mit Luftfahrzeugen in den Vereinigten Staaten von Amerika). E. W. Keegan (U.S. Forest Service, Washington, DC). In: Fighting fire and other disasters from the air; International Scientific-Technical Symposium, Hanover, West Germany, June 11, 12, 1980, Reports. Melsungen, West Germany, A. Bernecker Verlag, 1981, p. 17-27. In German.

A82-29578 # Fighting forest fires - A task for the Swiss air force (Waldbrandbekämpfung - Eine Aufgabe der Schweizerischen Flugwaffe). R. Salzborn (Schweiger Luftwaffe, Locarno, Switzerland). In: Fighting fire and other disasters from the air; International Scientific-Technical Symposium, Hanover, West Germany, June 11, 12, 1980, Reports. Melsungen, West Germany, A. Bernecker Verlag, 1981, p. 28-33. In German.

Forest fires in the Swiss Alps are considered. It is found that the great majority of all fires is produced by people. The development of a fire as a consequence of lightning is a very rare event. Long-term consequences of forest fires are related to a reduction in the natural capacity of forests to provide protection against avalanches and falling stones. Efforts to fight fires with the aid of aircraft go back to 1962. Fixed-wing aircraft were first utilized in firefighting operations. However, in recent years the use of such aircraft has decreased significantly in connection with the advantages provided by the helicopter for the considered applications. Attention is given to the methods used in firefighting operations conducted with fixed-wing aircraft and with helicopters, taking into account direct approaches and indirect support action. G.R.

A82-29579 # The current state of technology concerning the fighting of forest fires from the air in Austria (Stand der Technik zur Waldbrandbekämpfung aus der Luft in Österreich). T. Angermair (Berufsfeuerwehr, Innsbruck, Austria). In: Fighting fire and other disasters from the air; International Scientific-Technical Symposium, Hanover, West Germany, June 11, 12, 1980, Reports. Melsungen, West Germany, A. Bernecker Verlag, 1981, p. 34-39. In German.

In 1973, difficulties related to the fighting of forest fires by conventional means led in Austria to an investigation of more effective firefighting methods. It was first attempted to provide aircraft to ensure rapid transportation for the men and the equipment needed for the firefighting operations. The helicopter was found to provide significant advantages as a rapid means of transportation, taking into account its capability to convey men and material to and from locations not readily accessible by any other means. The successful solution of all problems related to the

envisaged use of the aircraft in firefighting operations was practiced in approximately 300 exercises. Attention is given to the number of aircraft used in Austria for firefighting operations, the employed fire extinguishing agents, the attachment of the containers to the aircraft, financial questions, and details concerning the firefighting operations. G.R.

A82-29580 # **The utilization of agricultural aircraft in economical operations for fighting forest fires in Israel (Die Nutzung landwirtschaftlicher Flugzeuge zur ökonomischen Waldbrandbekämpfung in Israel).** I. Hirsch (Chimavir Services, Tel Aviv, Israel). In: Fighting fire and other disasters from the air; International Scientific-Technical Symposium, Hanover, West Germany, June 11, 12, 1980, Reports. Melsungen, West Germany, A. Bernecker Verlag, 1981, p. 40-43. In German.

The approaches used to protect the coniferous forests of Israel against destruction by forest fires are discussed. The need for such a protection is illustrated by the fact that, in 1979, 2,500,000 trees were destroyed in connection with a total of 500 fires. It had been found that forest fires cannot be effectively controlled on the basis of an exclusive use of ground operations. However, financial considerations made it impossible to obtain for the protection of the forests special aircraft expressly designed for firefighting applications. It was, therefore, decided to utilize aircraft normally used for agricultural applications also for operations related to the fighting of forest fires. Particular attention is given to special approaches which make it possible to apply water for extinguishing fires most effectively from the available aircraft. G.R.

A82-29581 # **The utilization of aircraft in fighting forest fires - French experience (Nutzung der Luftfahrtmittel bei der Waldbrandbekämpfung - Französische Erfahrungen).** H. Bolzinger (Ministère de l'Intérieur, Securité Civile, Marignane, Bouches-du-Rhône, France). In: Fighting fire and other disasters from the air; International Scientific-Technical Symposium, Hanover, West Germany, June 11, 12, 1980, Reports. Melsungen, West Germany, A. Bernecker Verlag, 1981, p. 44-52. In German.

Environmental and weather-related conditions in the case of a substantial part of the French forests, taking into account, in particular, coniferous woods, make it necessary to employ aircraft in connection with the protection of these forests against destruction by fire. In 1963, aircraft were used, for the first time in France, in operations related to the fighting of fires in forests. A review is provided of the aircraft available in 1980 for the protection of French forests against destruction by fire, giving attention to light aircraft used in surveillance operations, helicopters, and air tankers. The helicopter can provide a flying command post for the direction of firefighting operations. Other functions of the helicopter are related to its use as a convenient means of transportation in areas with accessibility problems. The air tanker carries water and other agents for an employment in direct firefighting operations from the air. G.R.

A82-29582 # **The use of 'water bombers' and chemical agents against forest fires, taking into account the employment of a first-attack system (Einsatz von Wasserbombern und chemischen Mitteln gegen Waldbrände unter Verwendung eines Erstangriffssystems).** K. B. Marsden (Conair Aviation, Ltd., Abbotsford, British Columbia, Canada). In: Fighting fire and other disasters from the air; International Scientific-Technical Symposium, Hanover, West Germany, June 11, 12, 1980, Reports. Melsungen, West Germany, A. Bernecker Verlag, 1981, p. 66-79. In German.

Fires in the forests, arid lands, and agricultural areas of Western Canada are efficiently controlled by making use of aircraft which drop chemical firefighting agents that remain effective for a long time. The considered approach of fighting fires must be integrated into a coordinated program, involving an early detection of the fire, the availability of aircraft for immediate employment, and the ultimate complete extinction of the fire in connection with ground-based operations. Attention is given to the geographical features of the area of Western Canada, its meteorological characteristics and its vegetation, the design of the employed aircraft, and details regarding the implementation of the considered program. The operations performed by the aircraft are illustrated with the aid of pictures. G.R.

A82-29583 # **The employment of two-engine and four-engine aircraft for dropping the latest chemical fire extinguishing agents in connection with the fighting of forest fires (Einsatz von zwei- und viermotorigen Flugzeugen für den Abwurf der neuesten chemischen Löschmittel bei der Waldbrandbekämpfung).** R. A. Davis (Sis-Q Flying Service, Inc., Santa Rosa, CA). In: Fighting fire and other disasters from the air; International Scientific-Technical Symposium, Hanover, West Germany, June 11, 12, 1980, Reports. Melsungen, West Germany, A. Bernecker Verlag, 1981, p. 88-96. In German.

A82-29584 # **Adaptation and equipment of aircraft for the fighting of forest fires (Anpassung und Ausrüstung von Flugzeugen zur Waldbrandbekämpfung).** R. E. Foy (Aero Union Corp., Chico, CA). In: Fighting fire and other disasters from the air; International Scientific-Technical Symposium, Hanover, West Germany, June 11, 12, 1980, Reports. Melsungen, West Germany, A. Bernecker Verlag, 1981, p. 97-103. In German.

In connection with the selection of an aircraft for aerial firefighting operations, two alternatives have to be considered. An aircraft expressly designed for firefighting applications can be purchased, or an available aircraft designed for civil or military service applications can be acquired with the aim to adapt the aircraft to the requirements which have to be met in connection with the intended future use. Taking into account the high cost of a new aircraft design, it might be preferable, on the basis of economic considerations, to decide in favor of the second alternative. All private firms concerned with the operation of aircraft for the aerial application of fire retardants and fire extinguishing agents in North America use currently surplus civil aircraft or former military aircraft. Attention is given to economic considerations regarding the operations of such aircraft, questions of aircraft suitability for the envisaged applications, and operational details. G.R.

A82-29585 # **The employment of helicopters in Austria in connection with large-scale fires in buildings (Hubschraubereinsätze bei Gebäudegrossbränden in Österreich).** T. Angermair (Berufsfeuerwehr, Innsbruck, Austria). In: Fighting fire and other disasters from the air; International Scientific-Technical Symposium, Hanover, West Germany, June 11, 12, 1980, Reports. Melsungen, West Germany, A. Bernecker Verlag, 1981, p. 139-145. In German.

Special problems concerning rescue operations in the case of large fires in buildings and the fighting of these fires exist in Austria in a very significant number of cases. About one tenth of all Austrians live in high buildings at levels above the 'critical height' of 22 m from the ground. In connection with fires, situations arise in which people are isolated because all possible avenues of retreat have been cut off. The chances for the rescue of people in burning buildings can be significantly improved by supplementing the conventional approaches of the fire department with techniques involving the use of helicopters. It has been found that in the case of pilots experienced in rescue operations in mountainous areas very little additional training is required for the conduction of operations involving the rescue of people in buildings. The conduction of such operations is discussed in detail. G.R.

A82-29586 # **Performance characteristics and employment profiles of the new helicopter BK117 (Leistungsmerkmale und Einsatzprofile des neuen Hubschraubers BK117).** Mr. Schmidt-Bischoffshausen (Messerschmitt-Bölkow-Blohm GmbH, Ottobrunn, West Germany). In: Fighting fire and other disasters from the air; International Scientific-Technical Symposium, Hanover, West Germany, June 11, 12, 1980, Reports. Melsungen, West Germany, A. Bernecker Verlag, 1981, p. 146-158. In German.

Attention is given to a new helicopter developed jointly by a German aerospace company and a Japanese company. The helicopter can take off and land vertically, has the ability to hover, and can also move slowly in any lateral direction. These flight characteristics have provided for the helicopter a special area of application related to the prevention of fires, the fighting of fires, and protective operations in the case of the occurrence of disasters. Requirements for successful operations involving the fighting of fires are considered, taking into account the importance of an early detection of a fire, the need for an immediate initiation of operations, the achievement of an

optimum of operational safety, and design and constructional details. The various types of operations for which the BK117 has been employed are discussed, giving attention to specific data regarding the weight relations in each case. G.R.

A82-29592 F-15 fighter abilities evaluated. R. R. Ropelewski. *Aviation Week and Space Technology,* vol. 116, Apr. 26, 1982, p. 39-43, 45, 46.

Modifications, features, and operations of the F-15 in an all weather air-to-ground capability configuration are described. The rear cockpit has been outfitted with four multifunction CRT displays, the mission computer memory has been expanded by 50%, updates in the inertial navigation are now high velocity, and integration of the FLIR and laser ranging system has been accomplished. The total program took a year and a half, and successful demonstration ground strikes are detailed. Specific attention is given to lock-on and forget radar systems and digital menus for calling up enlargements of displayed scenes on the CRT. Images lost during maneuvers could be restored by recycling the computer. The controlled maneuverability of the aircraft is stressed, as are necessities for calibrating the radar systems, proving the sensors, and testing a variety of munitions. M.S.K.

A82-29596 * Test methodology for evaluation of fireworthy aircraft seat cushions. D. A. Kourtides and J. A. Parker (NASA, Ames Research Center, Chemical Research Projects Office, Moffett Field, CA). *Journal of Fire and Flammability,* vol. 13, Jan. 1982, p. 56-76. 8 refs. FAA-sponsored research.

Aircraft seat materials were evaluated in terms of their thermal performance. The materials were evaluated using (a) thermogravimetric analysis, (b) differential scanning calorimetry, (c) a modified NBS smoke chamber to determine the rate of mass loss and (d) the NASA T-3 apparatus to determine the thermal efficiency. In this paper, the modified NBS smoke chamber will be described in detail since it provided the most conclusive results. The NBS smoke chamber was modified to measure the weight loss of materials when exposed to a radiant heat source over the range of 2.5 to 7.5 W/cm sq. This chamber has been utilized to evaluate the thermal performance of various heat blocking layers utilized to protect the polyurethane cushioning foam used in aircraft seats. Various kinds of heat blocking layers were evaluated by monitoring the weight loss of miniature seat cushions when exposed to the radiant heat. The effectiveness of aluminized heat blocking systems was demonstrated when compared to conventional heat blocking layers such as neoprene. All heat blocking systems showed good fire protection capabilities when compared to the state-of-the-art, i.e., wool-nylon over polyurethane foam. (Author)

A82-29597 An evaluation study of aluminide and chromoaluminide coatings on IN-100. R. Sivakumar (Defence Metallurgical Research Laboratory, Hyderabad, India). *Oxidation of Metals,* vol. 17, Feb. 1982, p. 27-41. 21 refs.

Aluminide and chromoaluminide diffusion coatings on IN-100, a cast Ni-base superalloy, have been investigated under laboratory conditions with reference to their structure and protective properties. The observed differences in the cyclic oxidation and hot corrosion behavior of the coatings are rationalized in terms of the coating chemistry, and in particular, Cr and Al contents in the outer layers. The results obtained provide a way to predict the performance of NiAl-base coatings on Ni-base alloys. V.L.

A82-29659 # Crossflow shock on the suction side of a flat delta wing with supersonic leading edges. S. Kubo and T. Fujimoto (Kyoto University, Kyoto, Japan). *(Asian Congress of Fluid Mechanics, Ist, Bangalore, India, Dec. 8-13, 1980). Japan Society for Aeronautical and Space Sciences, Transactions,* vol. 24, Feb. 1982, p. 211-221. 11 refs.

A theoretical investigation is made on the crossflow shock on the suction side of a flat delta wing with supersonic leading edges in a uniform supersonic flow. An extension of the analytic characteristic method is carried out for a three dimensional inviscid flow past a wing. Special care is taken in the treatment of the boundary conditions at the leading edge, at which there is a centered simple expansion wave. A crossflow shock is analyzed on the wing surface. It is found that a weak crossflow shock appears under every condition of the angle of attack and sweepback angle of the leading edge. The location and the strength of the shock are compared with those of available experimental and numerical results. They are compatible with each other within the accuracy of the present analysis. (Author)

A82-29714 Sea-based remotely piloted vehicles. I - Issues and concepts. C. Henderson (Institute for Defense Analyses, Alexandria, VA). *Military Electronics/Countermeasures,* vol. 8, Apr. 1982, p. 61-64.

Remotely piloted vehicles (RPVs) in the 10,000-15,000 lb class, equipped with radar and designed to operate from a variety of naval vessels, are proposed as long-range early warning platforms for carrier battle groups. Consideration is given to the inherent potential of RPVs for such missions as command, control and communications (C3), surface surveillance, anti-air warfare, antisubmarine warfare and electronic warfare. It is noted that the RPV payload weight plays an important role in determining the propulsion system thrust required, takeoff and landing modes, and the fuel volume needed for a mission of given duration. While C3 RPVs would be equipped with communication gear and early warning RPVs with powerful search radars, all RPVs would carry data link hardware for command and control and sensor data transmissions. Attention is given to the use of conformal radar arrays, which are shaped to the contour of the aircraft skin. O.C.

A82-29773 Computational aerodynamics - Its coming of age and its future. L. R. Miranda (Lockheed-California Co., Burbank, CA). *Lockheed Horizons,* Spring 1982, p. 14-24.

Current capabilities of computational aerodynamics are examined and an attempt is made to assess its future role in aircraft design. Computational aerodynamics is the numerical solution of equations of motion of fluids using digital computers and subsequent simulation of the corresponding aerodynamic flowfields. Simulations are noted to be significant for performance, design, and safety of aircraft. Fields of numerical analysis, aerodynamic theory, and computer technology are combined to produce the numerical simulation, with the projected flowfields being generated by solutions to the Navier-Stokes equations in the form of increasingly closer approximations. Panel methods, a simplified form of the full solution, are explored, and their ability to remain computationally efficient with complex geometries is stressed. Advances in computer technology are foreseen to enhance the option of using full Navier-Stokes equations for high-speed aerodynamic simulations. M.S.K.

A82-29774 Fuel efficient and Mach 0.8, too. W. E. Arndt (Lockheed-Georgia Co., Marietta, GA). *Lockheed Horizons,* Spring 1982, p. 26-34.

Principles of propfan technology and problems which must be solved for the introduction of propfans to production aircraft are discussed. The Hamilton-Standard concept, introduced in 1975, includes thin profile, swept-back multiple blades (8-10) suitable for cruise speeds of Mach 0.8 with 15-20% less fuel consumption than currently available with turbofans. Studies in loading fatigue are necessary to determine if the cyclic loading caused by high-speed swept back wings will adversely affect the integrity of composite-material propfans. Additional areas of concern are effects on the aerodynamic efficiency of aircraft induced by the presence of multibladed propfans, and the necessity of adding noise-reducing materials to maintain satisfactory cabin noise levels is a potential weight penalty factor. NASA trials on a converted Jetstar are described, along with possible techniques to reduce near- and farfield noise levels. M.S.K.

A82-29789 Aerodynamics at the 1981 Le Bourget show (L'aérodynamique au Salon du Bourget 1981). L. Rosenthal (Centre de Documentation de l'Armement, Paris, France). *L'Aéronautique et l'Astronautique,* no. 92, 1982, p. 37-56. 20 refs. In French.

Applications of the current state of the art in aircraft aerodynamics and general tendencies in the development of the field as manifested at the 23rd International Air and Space Show at Le Bourget in 1981 are considered. Among the new aircraft presented at the show, the most original include the Transavia T 300 Sky Farmer, the Edgley EA7 Optica three-seat observation plane and the NASA Bell XV-15 experimental STOL craft. Configurations receiving

significant attention at the show were those with winglets, canards and strakes, especially on military aircraft, leading edge flaps, the remotely piloted HiMAT aircraft and aircraft with forward-swept wings. Developments in propulsion aerodynamics involved air intakes, streamlined and multi-bladed propellers and the prop-fan. The importance of developments in composite materials, propulsion and systems to the realization of these aerodynamic configurations is emphasized. A.L.W.

A82-29792 Laser gyros - The guiding light. J. Hecht. *High Technology,* vol. 2, May-June 1982, p. 24, 26-28.

The key advantages of laser gyros over mechanical gyroscopes are the absence of moving parts and lower cost. The laser gyro is a rotation sensor consisting of a rotating ring in which intense monochromatic light going in both directions is generated by the excitation of an active medium in an optical resonator defined by three or more mirrors. Rotating the ring laser changes the effective resonator length so that the frequency of one beam is upshifted and the other downshifted. Turning a typical ring laser by 10 degrees per hour will cause a detectable frequency shift of a few hertz. A number of approaches have been taken to solve the systems's main problem, the tendency of the beams to lock together at the same frequency when the rotation rate is very small. Optical fiber gyros may find use in systems where cost and compactness rather than accuracy are the chief consideration. C.D.

A82-29793 Future auto engines - Competition heats up. C. Rain. *High Technology,* vol. 2, May-June 1982, p. 39-47.

The conventional internal combustion engine will remain an important factor in future automobile engines because it is perfectly suited to the widely varying conditions of city and highway driving, and engineers continue to eke out design advances. Diesels will continue to make strong gains in the near term because of their fuel economy advantage, but their emissions and fuel requirement problems are serious. Stratified charge engines could challenge the diesel because they satisfy governmental goals and would require the lowest retooling costs. Their multifuel capability gives them long-term viability. The gas turbine and the Stirling offer the best fuel economies and are clean-burning, and both run on a wide range of fuels. The Stirling requires engineering to improve its power density and to cut costs, while the gas turbine needs a breakthrough in durable high-temperature ceramics. C.D.

A82-29800 Handling air freight in the 1980s - Meeting the challenge. P. L. Peoples and V. Sweetland (Boeing Commercial Airplane Co., Renton, WA). *Aircraft Engineering,* vol. 54, Mar. 1982, p. 7-10.

Flight hardware and ground system development areas which are necessary to meet the expected growth in air cargo in the 1980 decade are reviewed. Boeing has undertaken studies involving full-scale mock-ups of the 767 and 757 and various cargo loads to attempt optimization of cargo pallets, container shapes, and handling procedures in moving freight. The large cargo-handling capacity of the 747 is outlined, noting the commonality designed into the cargo configurations for the 767 and 747. Freight and baggage handling procedures have been observed to have divergent requirements, although the LD-4 pallet offers an opportunity for the most efficient loading of either. Cargo and baggage packaging within standardized modules for loading on pallets is asserted to offer 95-97% space utilization. M.S.K.

A82-29820 † The stressed state of a parachute canopy during opening (Napriazhennoe sostoianie kupola parashiuta pri raskrytii). G. N. Gaiubov (Tashkentskii Politekhnicheskii Institut, Tashkent, Uzbek SSR). *Akademiia Nauk Uzbekskoi SSR, Doklady,* no. 1, 1982, p. 12-14. 5 refs. In Russian.

A82-29826 † Optimization of measurements in the state estimation of systems using the least squares method (Optimizatsiia sostava ispol'zuemykh izmerenii v zadachakh otsenivaniia sostoianiia sistem metodom naimen'shikh kvadratov). L. G. Ambartsumov. *Aviatsionnaia Tekhnika,* no. 4, 1981, p. 3-6. 5 refs. In Russian.

Problems of the state estimation of aircraft systems are characterized by a large quantity of information to be processed. This results in an increase in the cost of computations, a decrease in the reliability of the results, and an increase in data processing time. For this reason it is necessary to limit the number of measurements. This paper gives a mathematical formulation and examines the characteristics of the optimization of the number and character of measurements made in the problem of state estimation using the least squares method in the case of an arbitrary matrix of measurements. B.J.

A82-29827 † The stability of maneuverable flight vehicles (K ustoichivosti manevrennykh letatel'nykh apparatov). A. B. Aminov. *Aviatsionnaia Tekhnika,* no. 4, 1981, p. 7-11. 5 refs. In Russian.

A method is developed for obtaining the region of asymptotic stability in the coefficient space of the nonlinear differential equations of the perturbed motion of a maneuverable flight vehicle. As an example, an analysis is presented of the stability of the longitudinal motion of a flight vehicle with large attack-angle deviations. B.J.

A82-29828 † Comparison of light aircraft with strutted and cantilever wings (Sravnenie legkikh samoletov s podkosnym i svobodnonesushchim krylom). A. A. Badiagin. *Aviatsionnaia Tekhnika,* no. 4, 1981, p. 11-17. 5 refs. In Russian.

A general formula for the analysis of the mass of strutted and cantilever wings of light aircraft is proposed. Optimal aspect ratio is analyzed, and a formula for determining the maximum flight velocity of a strutted-wing aircraft is presented. The strutted wing is found to be somewhat more cost effective than the cantilever wing. B.J.

A82-29829 † Design principles of a computer-aided design system (Printsipy postroeniia sistemy mashinnogo konstruirovannia). Iu. V. Davydov, A. A. Zazhigin, and V. A. Osipov. *Aviatsionnaia Tekhnika,* no. 4, 1981, p. 17-22. 11 refs. In Russian.

The structure and basic features of a computer system for the design of flight vehicles are described. Particular attention is given to mathematical models for the description of wing contours, the determination of external loads, strength analyses, the determination of the geometric characteristics of the components, the graphics system, and the formation of control programs. The input and output parameters of each module of the system are discussed. B.J.

A82-29831 † Investigation of the aerodynamic-contour method with control functions in the form of smooth constant-sign contours (Issledovanie metoda aerodinamicheskogo kontura s upravliaiushchimi funktsiiami v vide gladkikh obvodov postoiannogo znaka). R. Kh. Akhatov and V. A. Osipov. *Aviatsionnaia Tekhnika,* no. 4, 1981, p. 27-31. In Russian.

A modified aerodynamic-contour method is developed which is based on the use of a control function in the form of smooth contours of constant sign. This makes it possible to obtain a mathematical model for a profile curve with normalized constancy of sign and a wide range of variation of the input information. The method is convenient for controlling profile shape and produces a considerable savings in machine time. B.J.

A82-29832 † Estimation of the performance of non-stationary discontinuous control systems for flight vehicles (Otsenka effektivnosti nestatsionarnykh razryvnykh sistem upravleniia letatel'nykh apparatov). E. A. Kuklev. *Aviatsionnaia Tekhnika,* no. 4, 1981, p. 37-41. In Russian.

The paper examines a linear dynamic system with discontinuous controls conditioned by changes in the operational modes of the system at random moments of time. An analytical method is proposed for determining the averaged values of the performance functionals of the system, with allowance for a finite number of discontinuities. B.J.

A82-29834 † Analysis of a multihinged empennage with allowance for shear strain (Raschet mnogosharnirnogo opereniia s uchetom deformatsii sdviga). V. A. Pavlov and V. A. Portnoi. *Aviatsionnaia Tekhnika,* no. 4, 1981, p. 46-51. In Russian.

A method for analyzing a multihinged empennage is presented, wherein the shear displacements included in the resolvent compatibility equations are determined by the Timoshenko method. Analysis results are presented on the empennage of an actual aircraft, and the necessity of taking into account shear strain of the control surface and stabilizer in their own plane is found to be confirmed. B.J.

A82-29836 † **The stability of monocoque panels under bending (Ustoichivost' panelei kessona pri izgibe).** V. I. Shalashilin, O. B. Lozhkin, and V. A. Nagaev. *Aviatsionnaia Tekhnika,* no. 4, 1981, p. 60-65. In Russian.

An analysis is presented of the elastic stability of cylindrical monocoque panels under bending. The critical loading conditions are investigated, and the selection of parameter values for the discrete transverse reinforcement is considered. B.J.

A82-29837 † **Application of a dimensionless criterion of transport efficiency in evaluating aircraft modifications (O primenenii bezrazmernogo kriteriia transportnoi effektivnosti v otsenkakh modifikatsii samoletov).** V. N. Sheptunov. *Aviatsionnaia Tekhnika,* no. 4, 1981, p. 65-70. 6 refs. In Russian.

A dimensionless criterion of transport efficiency (defined as the ratio of aircraft performance to energy consumed in cruising flight) is proposed, and its possible applications are considered. The relationship between transport efficiency and cost efficiency is established, and a method is developed for estimating the cost efficiency of aircraft design solutions and modifications on the basis of the relationship between the dimensionless criterion and transport costs. A numerical example is discussed. B.J.

A82-29838 † **Zone loading of flight-vehicle structures (Zonnoe nagruzhenie konstruktsii letatel'nykh apparatov).** V. S. Azarin and B. L. Patsenker. *Aviatsionnaia Tekhnika,* no. 4, 1981, p. 71-73. 5 refs. In Russian.

A82-29841 † **Analysis of shells of straight-wing type (K raschetu obolochek tipa priamogo kryla).** S. N. Bulatov and P. N. Kurochka. *Aviatsionnaia Tekhnika,* no. 4, 1981, p. 80-83. In Russian.

Obraztsov's (1966, 1973) approach is used to develop a method for the analysis of variable-thickness shells of arbitrary cross section. The resolvent system is obtained by means of the Lagrange variational principle. The solutions are obtained in the form of expansions whose first terms correspond to the hypothesis of plane sections, while the other terms take into account displacements caused by warping. B.J.

A82-29844 † **Thermal stability analysis for conical shells with variable parameters (Raschet termoprochnosti konicheskikh obolochek s peremennymi parametrami).** V. R. Kotel'nikov. *Aviatsionnaia Tekhnika,* no. 4, 1981, p. 90-93. In Russian.

A method based on an approximate solution of an integral elasticity equation is proposed for analyzing, at an early design stage, thermoelastic stress-strain state of thin-walled conical shells with variable parameters. The proposed method is demonstrated in a case involving analysis of the effect of the wall thickness profile on the stress-strain state of a shell for specified temperature distributions. It is shown that thinning of the shell in the direction of the larger base results in increased stresses and shifting of the maximum stresses to the region of higher temperatures. It is therefore recommended that the wall increase in thickness toward the larger base. V.L.

A82-29845 † **Determination of an optimal control program for an aircraft power plant during climb (Opredelenie optimal'noi programmy upravleniia silovoi ustanovkoi samoleta na uchastke razgona-nabora vysoty).** O. K. Iugov. *Aviatsionnaia Tekhnika,* no. 4, 1981, p. 96-98. In Russian.

The paper examines the development of an optimal control program for an aircraft power plant during climb on the basis of a criterion of minimum fuel consumption. Theoretical results obtained using this approach are presented, and attention is given to the validity of the assumption of the constant flight weight of aircraft at subsonic and supersonic speeds in calculating longitudinal acceleration loading during climb. B.J.

A82-29871 # **Sudden changes in wind velocity - Their effect on aircraft and means of reducing hazard. I (Uskok wiatru - Działanie na samolot, srodki zmniejszajace zagrozenie. I).** J. M. Morawski and T. Smolicz (Instytut Lotnictwa, Warsaw, Poland). *Technika Lotnicza i Astronautyczna,* vol. 37, Apr. 1982, p. 5, 6. In Polish.

The effect of abrupt changes in wind velocity and direction on the trajectory and aerodynamic stability of aircraft are examined and possible counter measures, including flying techniques and the use of special devices, are suggested. Expressions are presented for calculating the downward drift angle and the effect of horizontal wind currents. V.L.

A82-29872 # **Analysis of changes in the gas-dynamic parameters of a gas-turbine helicopter engine during acceleration (Analiza przebiegu parametrow gazodynamicznych i mocy turbinowego silnika smiglowcowego podczas przyspieszania).** E. Jaworski. *Technika Lotnicza i Astronautyczna,* vol. 37, Apr. 1982, p. 13-17. In Polish.

Changes in the gas-dynamic parameters of a gas-turbine engine during acceleration are analyzed using the results of a mathematical model for the engine transients. The parameters examined include compressor and rotor rpm, compression ratio and air flow rate, margin of stability, turbine inlet temperature, excess air ratio, turbine pressure drop, and engine power. The effects of the working medium inertia and mass and heat accumulation on the transient processes in the engine are also discussed. V.L.

A82-29880 † **Numerical study of vibrational relaxation in the turbulent mixing of jets in a supersonic nozzle (Chislennoe issledovanie kolebatel'noi relaksatsii pri turbulentnom smeshenii strui v sverkhzvukovom sople).** A. V. Lavrov and V. A. Pospelov (Leningradskii Politekhnicheskii Institut, Leningrad, USSR). *Inzhenerno-Fizicheskii Zhurnal,* vol. 42, Apr. 1982, p. 586-592. 23 refs. In Russian.

The turbulent boundary layer equations are used to examine gasdynamic and physical processes in the nozzle and resonator of a CO2 gasdynamic laser with selective thermal excitation. In order to verify the adequacy of the proposed mathematical model of the laser, a comparison is made with experimental data for various values of stagnation temperature and pressure; good agreement between theoretical and experimental results is found. The effects of the composition of the secondary jet, and stagnation temperature and pressure on specific energy output are investigated. It is shown that, at high pressures and temperatures, sufficiently high specific outputs can be obtained only in the case of optimal CO2 concentration in the secondary jet. B.J.

A82-29923 **Air Traffic Flow Management and Air Traffic Flow Control (Air Traffic Flow Management und Air Traffic Flow Control).** R. Küttner (Gesellschaft für Internationalen Flugverkehr mbH, Berlin, East Germany). *Technisch-ökonomische Information der zivilen Luftfahrt,* vol. 17, no. 4, 1981, p. 172-177. 7 refs. In German.

The growth in the volume of air traffic and the concentration of air traffic in certain areas and during certain time periods have caused operational difficulties for a number of area control centers (ACC) and approach control offices (APP) in the German Democratic Republic. These difficulties are related to an insufficient capacity of ACC and APP to cope with peak traffic demands, because, in connection with economic considerations, it is often not possible to design installations for peak demands. Two approaches are used to reduce the considered difficulties as much as possible. The approach of Air Traffic Flow Management (ATFM) involves the assignment of a certain flight to a specific time slot. There are generally no delays, if the resulting requirements are met. The approach of Air Traffic Flow Control is only employed if the ATFM process is unsuitable. Air Traffic Flow Control specifies the number of aircraft which can enter per unit of time. G.R.

A82-29924 **Flight simulators (Flugsimulatoren).** G. Westphal (Gesellschaft für Internationalen Flugverkehr mbH, Berlin, East Germany). *Technisch-ökonomische Information der zivilen Luftfahrt,* vol. 17, no. 4, 1981, p. 180-189. 5 refs. In German.

Simulation involves the employment of models. A 'model' is a material or a conceptual system which corresponds to the object to be simulated on the basis of certain analogies. Flight simulators are concerned with the simulation of conditions and events occurring during the flight of an aircraft. With respect to their employment, the simulators can be divided into devices for research and for training. Research simulators make it possible to achieve an optimum design for the man-machine system in the cockpit of modern aircraft. The reasons for the employment of flight simulators in the training programs for the pilots of airlines are discussed, taking into account also the various subsystems used in the simulator. Particular

attention is given to the cockpit, the computer, and the system providing a simulation of the visual scene. G.R.

A82-29925 New processes and methods of technical diagnostics and prognostics in the case of the engine NK-8-4. II (Neue Verfahren und Methoden der technischen Diagnostik und Prognostik beim Triebwerk NK-8-4. II). S. Jung (Gesellschaft für Internationalen Flugverkehr mbH, Berlin, East Germany). *Technisch-ökonomische Information der zivilen Luftfahrt,* vol. 17, no. 4, 1981, p. 193-195. In German.

A82-30004 Composite bonds improve thermal integrity. A. Kleider (U.S. Army, Avionics Laboratory, Fort Monmouth, NJ), J. T. Johnson (Westinghouse Defense and Electronic Systems Center, Baltimore, MD), and R. L. Kolek (Westinghouse Electric Corp., Marine Div., Sunnyvale, CA). *ManTech Journal,* vol. 6, no. 3, 1981, p. 37-41. Army-supported research.

Production process considerations which, once solved, permitted fabrication of 1000 parts/yr of stabilized line-of-sight gimbals for aircraft electrooptical systems and sensors are discussed. A thermal sample was fabricated of composites to evaluate the expansion characteristics for mating bearings to the bore with resultant constant friction and stiffness values over the operating temperature range. Titanium rings were chosen to interface with the outer bearing race, and a series of thermal cycles were performed in order to test the bonds. Procedures of a design change and implementation are outlined, noting the final design called for 121 parts, some formed with expandable internal mandrels. Curing conditions for the fiber composite structures are detailed, including formation of the base plate stiffener ring. The gimbal produced features a 33% weight savings over previous gimbals. M.S.K.

A82-30076 Structures, Structural Dynamics and Materials Conference, 23rd, New Orleans, LA, May 10-12, 1982, Collection of Technical Papers. Part 1 - Structures and materials. Part 2 - Structural dynamics and design engineering. Conference sponsored by AIAA, ASME, ASCE, and AHS. New York, American Institute of Aeronautics and Astronautics, 1982. Pt. 1, 532 p.; pt. 2, 645 p. Price of two parts, members, $100.; nonmembers, $125.

An integration scheme to determine the dynamic response of a launch vehicle with several payloads is considered along with aeroelastic characteristics of the Space Shuttle external tank cable trays, the structural design of integral tankage for advanced space transportation systems, and optimum damping locations for structural vibration control. Attention is given to a damage induced aeroelastic failure mode involving combination and parametric resonant instabilities of lifting surfaces, passive damping mechanisms in large space structures, an automated technique for improving modal test/analysis correlation, pressure measurements on twin vertical tails in buffeting flow, and a wind-tunnel study of the aerodynamic characteristics of a slotted versus smooth-skin supercritical wing. Other topics explored are related to the active control of aeroelastic divergence, stress constraints in optimality criteria design, and damage tolerant design using collapse techniques. G.R.

A82-30087 * # Effects of 50,000 hours of thermal aging on graphite/epoxy and graphite/polyimide composites. J. R. Kerr and J. F. Haskins (General Dynamics Corp., Convair Div., San Diego, CA). In: Structures, Structural Dynamics and Materials Conference, 23rd, New Orleans, LA, May 10-12, 1982, Collection of Technical Papers. Part 1. New York, American Institute of Aeronautics and Astronautics, 1982, p. 101-108. Contract No. NAS1-12308. (AIAA 82-0657)

Thermal effects on tensile strengths of advanced composite systems have been determined for exposure times of 100 to 50,000 hours (5.7 years). Exposures were conducted at both ambient and reduced pressures at two temperatures for each composite. At the completion of the various aging periods, specimens were removed from the specially constructed aging furnaces, visually examined, and tensile tested at elevated temperature. After tensile testing, many of the thermal aging specimens were examined using a scanning electron microscope. Results of these studies are presented, and the changes in properties and the degradation mechanisms during high-temperature aging are discussed and illustrated using metallographic techniques. (Author)

A82-30091 # A comparison of properties of single overlap tension joints prepared by ultrasonic welding and other means. T. Renshaw, K. Wongwiwat, and A. Sarrantonio (Fairchild Republic Co., Farmingdale, NY). In: Structures, Structural Dynamics and Materials Conference, 23rd, New Orleans, LA, May 10-12, 1982, Collection of Technical Papers. Part 1. New York, American Institute of Aeronautics and Astronautics, 1982, p. 137-144. (AIAA 82-0661)

An employment of the ultrasonic welding process in aircraft assembly operations might possibly lead to an achievement of very significant cost and weight reductions. A development program has been in progress with the objective to realize the potentials of the ultrasonic welding process for aircraft production. The present investigation represents an extension of studies reported by Renshaw and Sarrantonio (1980). It had been found that large, single overlap joints made with ultrasonic spotwelds could be loaded to sheet stresses above the yield strength. Tests conducted in the current investigation cover series of interlayer situations which can exist in the assembly of aircraft. Fatigue data are also reported for the joints. Other types of joints than ultrasonically welded ones were also prepared and tested in order to develop directly comparable static and fatigue properties. Weight and cost comparisons are included. G.R.

A82-30096 # Finite element analysis of through the canopy emergency crew escape from the T-38 aircraft. R. E. McCarty and R. A. Smith (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, OH). In: Structures, Structural Dynamics and Materials Conference, 23rd, New Orleans, LA, May 10-12, 1982, Collection of Technical Papers. Part 1. New York, American Institute of Aeronautics and Astronautics, 1982, p. 197-205. 15 refs. (AIAA 82-0705)

The nonlinear static response to a concentrated load on the inner surface of the student pilot canopy for the T-38 aircraft has been predicted using the MAGNA (Materially and Geometrically Nonlinear Analysis) finite element computer program. The analyses conducted were intended to simulate the impingement on the canopy inner surface of a breaker located on the student pilot ejection seat. Criteria for defining fracture of the canopy were selected and work required to fracture the canopy was then determined from computed nonlinear load-displacement curves. The static load and work required to fracture two proposed bird-resistant designs for the T-38 student canopy were compared to those required to fracture the current design. It is concluded that transparency penetration for emergency crew escape via ejection seat breaker impingement on the T-38 student canopy is probably not feasible for a 0.68 in. thick monolithic stretched acrylic bird-resistant design. The same mode of transparency penetration might prove feasible for a 0.40 in. thick monolithic polycarbonate bird resistant design. (Author)

A82-30099 * # Mechanical properties of a fiberglass prepreg system at cryogenic and other temperatures. P. J. Klich and C. E. Cockrell (NASA, Langley Research Center, Systems Engineering Div., Hampton, VA). In: Structures, Structural Dynamics and Materials Conference, 23rd, New Orleans, LA, May 10-12, 1982, Collection of Technical Papers. Part 1. New York, American Institute of Aeronautics and Astronautics, 1982, p. 223-230. 9 refs. (AIAA 82-0708)

The compressor driving the flow in the National Transonic Facility, which is nearing completion at the Langley Research Center, has 25 fiberglass blades. E-glass cloth with a pre-impregnated epoxy resin has been selected as the material for the fan blades because of its low cost, high damping, and fatigue resistance. A complete characterization is presented of this fan blade fiberglass system at temperatures of 367 K, room temperature, and 89 K. The characterization test results suggest that the material follows the general trends of metals and other glass-reinforced plastics at cryogenic temperatures. A slight diminution in strength was observed at the elevated temperature. The tests included the following: tensile, compression, fatigue, inplane shear, interlaminar shear, thermal expansion, creep, and thermal cycle. C.R.

A82-30102 # Damping and stiffness of aligned discontinuous fiber reinforced polymer composites. R. F. Gibson, C. T. Sun, and S. K. Chaturvedi (Florida, University, Gainesville, FL). In:

Structures, Structural Dynamics and Materials Conference, 23rd, New Orleans, LA, May 10-12, 1982, Collection of Technical Papers. Part 1. New York, American Institute of Aeronautics and Astronautics, 1982, p. 247-255. 24 refs. Research supported by the University of Florida. (AIAA 82-0712)

This paper describes recent analytical and experimental efforts to determine the effects of fiber aspect ratio, fiber spacing, and the visco-elastic properties of constituent materials on the damping and stiffness of aligned discontinuous fiber reinforced polymer matrix composites. This includes the analysis of trade-offs between damping and stiffness as the above parameters are varied. Two different analytical models show that there is an optimum fiber aspect ratio for maximum damping, and that the predicted optimum aspect ratios lie in the range of actual aspect ratios for whiskers and microfibers. Experimental data for E-glass/epoxy specimens is presented for comparison with predictions. (Author)

A82-30107 # Integrity analyses of surface-flawed aircraft attachment lugs - A new, inexpensive, 3-D alternating method. T. Nishioka and S. N. Atluri (Georgia Institute of Technology, Atlanta, GA). In: Structures, Structural Dynamics and Materials Conference, 23rd, New Orleans, LA, May 10-12, 1982, Collection of Technical Papers. Part 1. New York, American Institute of Aeronautics and Astronautics, 1982, p. 287-300. 24 refs. Grant No. AF-AFOSR-81-0057. (AIAA 82-0742)

A new alternating method for the analysis of a quarter-elliptical corner crack is developed. The completely general analytical solution for an embedded crack, in an infinite solid, subject to arbitrary crack-face tractions, is implemented in the present alternating method. The present finite element alternating method results in an inexpensive procedure for routine evaluation of accurate stress intensity factors for flawed structural components. The present alternating method is applied to the analyses of various shapes of quarter-elliptical corner cracks (1) in a brick subject to remote tension, (2) emanating from a hole in finite-thickness plates, subject to remote tension as well as bearing pressure, and (3) emanating from a pin hole in aircraft attachment lugs subject to simulated pin loading. The results for the problem (1) and (2) are compared with those available in literature. For the problem (3) the stress intensity factors, and their parametric variations for the corner cracks of various shapes are presented. (Author)

A82-30109 # 737 graphite-epoxy horizontal stabilizer certification. J. E. McCarty, R. W. Johnson, and D. R. Wilson (Boeing Commercial Airplane Co., Seattle, WA). In: Structures, Structural Dynamics and Materials Conference, 23rd, New Orleans, LA, May 10-12, 1982, Collection of Technical Papers. Part 1. New York, American Institute of Aeronautics and Astronautics, 1982, p. 307-322. 12 refs. (AIAA 82-0745)

The 737 graphite-epoxy horizontal stabilizer was developed as part of the NASA/ACEE Advanced Composite Structures Program, which was initiated in July 1977. Certification requirements were completed in February 1982. The 737 graphite-epoxy horizontal stabilizer, which represents a weight savings of 21.6 percent, will be the first major component of aircraft primary structure to be certified for commercial airline service. The approach taken to obtain certification is considered. This approach complies with FAA regulations while maintaining the philosophy that commercial aircraft structures are certified by structural analysis and supporting test evidence. G.R.

A82-30114 * # *Experimental stress analysis of a thin-walled* pressurized torus loaded by contact with a plane. D. E. Hill (Deere and Co., Moline, IL) and J. R. Baumgarten (Iowa State University of Science and Technology, Ames, IA). In: Structures, Structural Dynamics and Materials Conference, 23rd, New Orleans, LA, May 10-12, 1982, Collection of Technical Papers. Part 1. New York, American Institute of Aeronautics and Astronautics, 1982, p. 369-373. 6 refs. Grant No. NsG-1605. (AIAA 82-0753)

It is pointed out that pneumatic tires have a large effect on the overall landing characteristics of an aircraft. The dynamic response upon landing and steering are crucial to the safety of the vehicle and the occupants. The present investigation has the objective to compare experimentally determined strains on an inner tube in contact with a flat plate with numerical values obtained on the basis of a finite element prediction, taking into account an employment of the Structural Analysis of General Shells (STAGS). The obtained results suggest that the clamped boundary condition utilized in the STAGS calculation is not exactly simulated by the employed test setup. G.R.

A82-30116 # Flight qualification of composite structures at AMD-BA. D. Chaumette (Avions Marcel Dassault-Breguet Aviation, Saint-Cloud, Hauts-de-Seine, France). In: Structures, Structural Dynamics and Materials Conference, 23rd, New Orleans, LA, May 10-12, 1982, Collection of Technical Papers. Part 1. New York, American Institute of Aeronautics and Astronautics, 1982, p. 381-390. (AIAA 82-0755)

A brief description is provided of the different programs conducted in a French aerospace company, taking into account composite materials employed in the Mirage III rudder, the Mirage F1 horizontal stabilizer, the Mir F1 aileron, the Falcon 50 aileron, and the fin, the rudder, and the elevons of the Mirage 2000. Attention is also given to the introduction of a very new technology in connection with the development of the Super-Mirage 4000, an experimental Alpha Jet empennage, and the Falcon 10 wing. The design of the Falcon 10 wing utilizes integrally stiffened carbon-fiber panels. G.R.

A82-30117 # On the characterization of damages in graphite-epoxy composites. S. V. Hanagud and R. G. Clinton, Jr. (Georgia Institute of Technology, Atlanta, GA). In: Structures, Structural Dynamics and Materials Conference, 23rd, New Orleans, LA, May 10-12, 1982, Collection of Technical Papers. Part 1. New York, American Institute of Aeronautics and Astronautics, 1982, p. 391-404. 39 refs. (AIAA 82-0757)

Flaws are created in graphite-epoxy composites when they are exposed to an environment of high moisture and elevated temperature. The possibility of nondestructively identifying these flawed states and quantitatively estimating the flaws have been attempted by the measurement and analysis of acoustic emission events, counts per events and amplitude distribution. In particular cross ply woven composite laminates have been studied in undamaged and damaged states. Techniques and methods of standardizing the test procedures have also been discussed. (Author)

A82-30118 * # Environmental and high strain rate effects on composites for engine applications. C. C. Chamis and G. T. Smith (NASA, Lewis Research Center, Cleveland, OH). In: Structures, Structural Dynamics and Materials Conference, 23rd, New Orleans, LA, May 10-12, 1982, Collection of Technical Papers. Part 1. New York, American Institute of Aeronautics and Astronautics, 1982, p. 405-419. 9 refs. (AIAA 82-0758)

The complex environmental and loading conditions experienced by many turbine engine components impose severe durability and damage tolerance requirements for component materials. Programs are being conducted to establish the structural performance of composite materials under anticipated engine operating environments. A description is presented of the results obtained in connection with several of these programs. A comparison of predicted and measured hygrothermal effects is considered along with hygrothermal effects on defect growth, high strain rate effects on composite mechanical properties, dynamic stress intensity factors for composites, and the indentation laws for composite impact analysis. G.R.

A82-30119 # A computerized system for the application of fracture tracking data to aircraft management for the C-5A military airlift transport. D. V. Finkle and J. S. Wilson (Lockheed-Georgia Co., Marietta, GA). In: Structures, Structural Dynamics and Materials Conference, 23rd, New Orleans, LA, May 10-12, 1982, Collection of Technical Papers. Part 1. New York, American Institute of Aeronautics and Astronautics, 1982, p. 429-434. USAF-supported research. (AIAA 82-0760)

The Aircraft Operational Suitability Program (AOSP) is a computerized system which provides the United States Air Force a means by which to assess the impact of day-to-day aircraft operations on structural inspection schedules and structural life reserve hours for the C-5A. The AOSP uses data generated by the C-5A individual aircraft fracture tracking system and features

operations via remote computer terminal hookups. Specific operations of the AOSP include evaluations of the relative severity of proposed missions and the impact of proposed missions on established structural inspection and modification schedules. (Author)

A82-30125 # **High temperature, short term tensile strength of C6000/PMR-15 graphite polyimide.** P. R. DiGiovanni and D. Paterson (Raytheon Co., Missile Systems Div., Bedford, MA). In: Structures, Structural Dynamics and Materials Conference, 23rd, New Orleans, LA, May 10-12, 1982, Collection of Technical Papers. Part 1. New York, American Institute of Aeronautics and Astronautics, 1982, p. 487-492. 5 refs. (AIAA 82-0711)

Tensile tests were conducted on 0 deg unidirectionally reinforced Celion 6000 graphite fibers in PMR 15 polyimide matrix. Tensile strengths for coupons subjected to short and long term uniform temperatures were obtained. Thick coupons, heated on one side to produce significant transient through thickness temperature gradients, were tested and compared to the strength of specimens with uniform temperature distributions. All coupons were radiantly heated and reached maximum test temperatures within 15 sec. Tensile loads were applied to the coupons after 15 sec of elevated temperature exposure. Loading rates were selected so that specimen failures occurred within a maximum of 45 sec after reaching the test temperature. Results indicate that significant tensile strength remains beyond the material post cure temperature. (Author)

A82-30137 # **An automated technique for improving modal test/analysis correlation.** D. T. Grossman (McDonnell Aircraft Co., St. Louis, MO). In: Structures, Structural Dynamics and Materials Conference, 23rd, New Orleans, LA, May 10-12, 1982, Collection of Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, 1982, p. 68-76. 7 refs. (AIAA 82-0640)

An automated technique for adjusting individual mass and stiffness elements to improve the correlation of analytical frequency and mode shape data with ground vibration test results is described. Perturbation formulae are used to calculate derivatives of a 'correlation coefficient' representing the overall similarity of the analytical and experimental results. A special iterative routine is developed to maximize this quantity and thus improve the overall correlation. The technique allows the user to take advantage of engineering judgment, produces physically realizable answers, and does not require the starting values of the variables to be near the final answers. Sample results are given. (Author)

A82-30138 # **Pressure measurements on twin vertical tails in buffeting flow.** W. E. Triplett (McDonnell Aircraft Co., St. Louis, MO). In: Structures, Structural Dynamics and Materials Conference, 23rd, New Orleans, LA, May 10-12, 1982, Collection of Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, 1982, p. 77-83. USAF-sponsored research. (AIAA 82-0641)

Buffeting pressures were measured on the vertical tail surfaces of a 13 percent F-15 model in a low-speed wind tunnel. Test variables included dynamic pressure, aircraft angle-of-attack, vertical tail incidence and rudder deflection. Pressure transducers were flush mounted on rigid and flexible tails. Steady and unsteady pressures were obtained from the transducers at levels as low as 0.1 percent full scale. The steady pressures were integrated for aerodynamic coefficients and the unsteady pressures were reduced to spectral densities. The pressures are maximum at approximately 22 deg angle-of-attack and are significantly affected by tail flexibility. (Author)

A82-30139 # **A wind-tunnel study of the aerodynamic characteristics of a slotted versus smooth-skin supercritical wing.** W. F. Grosser (Lockheed-Georgia Co., Marietta, GA). In: Structures, Structural Dynamics and Materials Conference, 23rd, New Orleans, LA, May 10-12, 1982, Collection of Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, 1982, p. 84-93. (AIAA 82-0642)

Wind-tunnel research test data indicate that flutter characteristics at transonic speeds may be different for each supercritical airfoil configuration. Therefore, high-speed flutter testing for limited structural parameters may be inadequate. Models with sectionalized airfoils provide an economical construction method for easily varying important flutter parameters, while testing smooth-skin models is an expensive and difficult way to conduct parametric studies. A wind-tunnel test was performed to evaluate the effects of sectionalized model construction on aerodynamic behavior in the transonic speed range. The results indicate that sectionalized airfoils may not significantly affect supercritical flutter aerodynamics. (Author)

A82-30140 * # **Evaluation of four subcritical response methods for on-line prediction of flutter onset in wind-tunnel tests.** C. L. Ruhlin, J. J. Watson, R. H. Ricketts, and R. V. Doggett, Jr. (NASA, Langley Research Center, Loads and Aeroelasticity Div., Hampton, VA). In: Structures, Structural Dynamics and Materials Conference, 23rd, New Orleans, LA, May 10-12, 1982, Collection of Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, 1982, p. 94-101. 7 refs. (AIAA 82-0644)

Four subcritical response methods were evaluated for on-line use in transonic wind-tunnel tests where the flutter model is excited solely by airstream turbulence. The methods were: randomdec, power-spectral-density, peak-hold, and cross-spectrum. Subcritical response data were obtained during tests in the Langley Transonic Dynamics Tunnel of a cantilevered flutter model wing. The test procedure was to maintain a constant Mach number and increase the dynamic pressure (q) in incremental steps. The four methods provided damping trends by which the flutter mode could be tracked and extrapolated to a flutter-onset q. A hard flutter point was obtained at M = 0.82. The peak-mold and cross-spectrum methods gave reliable results and could be most readily used for on-line testing. (Author)

A82-30141 # **Test demonstration of digital control of wing/store flutter.** E. H. Johnson, C. Hwang, W. S. Pi, D. F. Kesler, D. S. Joshi (Northrop Corp., Aircraft Div., Hawthorne, CA), and C. A. Harvey (Honeywell, Inc., Minneapolis, MN). In: Structures, Structural Dynamics and Materials Conference, 23rd, New Orleans, LA, May 10-12, 1982, Collection of Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, 1982, p. 102-110. 8 refs. Contract No. F33615-80-C-3217. (AIAA 82-0645)

Methods of digital control have been applied to the demonstration of the suppression of wing/store flutter. Digital control laws were developed by applying a modified Jordan canonical transformation to a state variable formulation of a control law synthesized originally for an analog system. After performing a real time simulation of the digital control system at Northrop's Hawthorne facilities, the system was tested in the Transonic Dynamics Tunnel at the NASA Langley Research Center. The results of the test showed that the performance of the digital controller was comparable to that of analog controllers. Attention during the test was focused on the insertion of adequate antialiasing filters, the effects of sample time and on the compensation for phase lags introduced by the digital control process. (Author)

A82-30142 # **Flutter of forward swept wings, analyses and tests.** T. A. Weisshaar, T. A. Zeiler (Purdue University, West Lafayette, IN), T. J. Hertz, and M. H. Shirk (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH). In: Structures, Structural Dynamics and Materials Conference, 23rd, New Orleans, LA, May 10-12, 1982, Collection of Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, 1982, p. 111-121. 20 refs. (AIAA 82-0646)

The forward swept wing body-freedom flutter phenomenon and the Flight Dynamics Laboratory test program to investigate this phenomenon are discussed. Subsonic wind tunnel flutter tests of a variable sweep, forward swept wing model incorporating the rigid body fuselage pitch degree of freedom are conducted, and results illustrate the effects of flutter speed of static margin, wing sweep and composite wing stiffness. The phenomenon occurs well below the fixed root wing divergence speed, and the primary cause of instability is found to be a coupling between the short period and the wing fundamental bending mode. At the onset of body freedom flutter, significant amounts of pitch, plunge and bending motion are present in the aeroelastic and flight mechanics modes. Both decreasing aircraft static margin and decreasing the streamwise angle of attack in the fundamental wing bending mode tend to increase the body-freedom flutter speed. D.L.G.

A82-30143 * # **Measured and calculated effects of angle of attack on the transonic flutter of a supercritical wing.** E. C. Yates, Jr., E. C. Wynne, and M. G. Farmer (NASA, Langley Research Center, Loads and Aeroelasticity Div., Hampton, VA). In: Structures, Structural Dynamics and Materials Conference, 23rd, New Orleans, LA, May 10-12, 1982, Collection of Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, 1982, p. 122-144. 19 refs. (AIAA 82-0647)

The effects of angle of attack between 0 and 4 degrees were studied. The results indicate that increasing angle of attack from zero can produce substantial changes in the transonic flutter characteristics that are favorable or unfavorable depending on Mach number and angle of attack. The bottom of the transonic flutter-boundary 'bucket' is shown to occur at lower Mach number as angle of attack increases. These flutter results correlate well with the effects of Mach number and angle of attack on aerodynamic behavior, especially on the development of transonic flow phenomena. The calculated flutter characteristics are in good agreement with the experimental data at zero angle of attack, but at nonzero angles of attack the experiments show sharply declining and backward-turning transonic flutter boundaries that are not indicated by the calculations. These may be caused by variations in static aeroelastic deformation. C.D.

A82-30144 # **Integrated structural analysis and design support for advanced launch vehicles.** D. G. Wong, R. D. Bousquet, and C. R. Fuller (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA). In: Structures, Structural Dynamics and Materials Conference, 23rd, New Orleans, LA, May 10-12, 1982, Collection of Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, 1982, p. 145-150. 5 refs. (AIAA 82-0675)

The paper discusses a system incorporating the latest developments in computer hardware and software, conceived in accordance with a five year plan initiated to support future advanced launch vehicle programs at the Lockheed Missiles and Space Company. Engineering requirements for the integrated system forming the basis for the department upgrades are presented. Software attributes are discussed, including program modularity, data management, and programming standards. Hardware attributes are also presented, and include system definition and design, communication network links, and various graphical capabilities. D.L.G.

A82-30145 # **Bonded aluminum honeycomb - Aircraft flight surface primary structure application.** T. R. Logan (Boeing Commercial Airplane Co., Seattle, WA) and U. Soudak (Israel Aircraft Industries, Ltd., Tel Aviv, Israel). In: Structures, Structural Dynamics and Materials Conference, 23rd, New Orleans, LA, May 10-12, 1982, Collection of Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, 1982, p. 151-156. 9 refs. (AIAA 82-0676)

The first phase is discussed of a detail design and testing program undertaken to establish cost and weight data for a point-design application and to provide a basis for full-scale development and certification of a bonded aluminum honeycomb empennage structural box. The baseline design is a built-up, mechanically fastened skin/stringer configuration. Structural design goals, inherent advantages and principal constraints of the bonded design are given. Design allowables, optimum design, and substructure arrangement are discussed in detail. A preliminary study demonstrates a significant 9.9 to 14.7 percent weight saving and a 20 percent part count reduction. Potential overall manufacturing cost reduction is estimated at 40 percent. C.D.

A82-30146 * # **Design considerations and experiences in the use of composite material for an aeroelastic research wing.** C. V. Eckstrom (NASA, Langley Research Center, Loads and Aeroelasticity Div., Hampton, VA) and C. V. Spain (Kentron Technical Center, Hampton, VA). In: Structures, Structural Dynamics and Materials Conference, 23rd, New Orleans, LA, May 10-12, 1982, Collection of Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, 1982, p. 157-165. 15 refs. (AIAA 82-0678)

Experiences in using composite skin material on an aeroelastic research wing used in flight flutter testing are described. Significant variations in skin shear modulus due to stress and temperature were encountered with the original fiberglass laminate skin designed to minimize wing torsional stiffness. These variations along with the sensitivity of wing torsional stiffness to the skin-to-frame attachment method complicated the structural model vibration mode predictions. A wing skin redesign with different fiber orientation and a reduction in the amount of skin-to-frame bonding resulted in more predictable modal characteristics without sacrificing design objectives. Design and modeling considerations for future applications are discussed. (Author)

A82-30147 # **Durability and damage tolerance control plans for USAF aircraft.** M. A. Landy and O. L. Smithers (USAF, Aeronautical Systems Div., Wright-Patterson AFB, OH). In: Structures, Structural Dynamics and Materials Conference, 23rd, New Orleans, LA, May 10-12, 1982, Collection of Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, 1982, p. 166-174. 20 refs. (AIAA 82-0679)

A set of disciplined, integrated procedures involving a number of a contractor's functional organizations is necessary if the requirements for a durable and damage tolerant structure are to be met. To this end, the Air Force requires that Durability and Damage Tolerance Control Plans (DADTCPs) be developed and implemented during aircraft development and manufacturing. DADTCPs define all tasks necessary to ensure that the final product meets Air Force durability and damage tolerance requirements. Various aspects to DADTCPs will be discussed in this paper. The foundation for a generalized model outlining the tasks in a DADTCP will be presented. Examples from existing DADTCPs will be used to illustrate elements of the generalized model. (Author)

A82-30150 # **Rigid body-structural mode coupling on a forward swept wing aircraft.** G. D. Miller, J. H. Wykes, and M. J. Brosnan (Rockwell International Corp., El Segundo, CA). In: Structures, Structural Dynamics and Materials Conference, 23rd, New Orleans, LA, May 10-12, 1982, Collection of Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, 1982, p. 201-208. 10 refs. (AIAA 82-0683)

Physical causes of rigid/body wing bending flutter of forward swept wing (FSW) aircraft are discussed, and potential solutions to the phenomenon for a Rockwell design of an FSW demonstrator are considered. The use of active controls technology to design a flutter suppression system in controling the flutter on the demonstrator is discussed, including the integration of the active system with the complete aircraft design to obtain lightweight structure while maintaining strength requirements, structural dynamic stability, and rigid body stability. Improvements in flying qualities, ride qualities and reduction in the gust loads as a result of the active control system are demonstrated. Inertial coupling in addition to wind sweep is found to be a dominant variable causing the phenomenon. D.L.G.

A82-30151 # **Active control of aeroelastic divergence.** R. R. Chipman, A. M. Zislin, and C. Waters (Grumman Aerospace Corp., Bethpage, NY). In: Structures, Structural Dynamics and Materials Conference, 23rd, New Orleans, LA, May 10-12, 1982, Collection of Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, 1982, p. 209-219. 15 refs. (AIAA 82-0684)

On forward-swept-wing aircraft, aerodynamic destiffening of the primary wing-bending mode can cause coupling with the short-period mode, potentially resulting in a low-frequency dynamic instability. For a clamped wing, this coupled mechanism degenerates into conventional static wing divergence. Studies of a fundamental analytical model of this mechanism show that active control of the clamped wing is possible only through the use of displacement feedback. Control laws for the clamped wing are evaluated and also assessed when body freedom is restored. Additionally, control laws are synthesized directly for a more refined representation of the unrestrained vehicle. CCV configurations are not considered. (Author)

A82-30153 * # **Static and unsteady pressure measurements on a 50 degree clipped delta wing at M = 0.9.** R. W. Hess, E. C. Wynne, and F. W. Cazier (NASA, Langley Research Center, Loads and Aeroelasticity Div., Hampton, VA). In: Structures, Structural Dynamics and Materials Conference, 23rd, New Orleans, LA, May 10-12, 1982, Collection of Technical Papers. Part 2.

New York, American Institute of Aeronautics and Astronautics, 1982, p. 234-242. 7 refs. (AIAA 82-0686)

Static and unsteady pressures were measured on a 50.45 degree clipped delta wing in the Langley Transonic Dynamics Tunnel with Freon as the test medium. Data taken at M = 0.9 is presented for static and oscillatory deflections of the trailing edge control surface and for the wing in pitch. Comparisons of the static measured data are made with results computed using the Bailey-Ballhaus small disturbance code. (Author)

A82-30155 # **Transonic time-response analysis of three D.O.F. conventional and supercritical airfoils.** T. Y. Yang (Purdue University, West Lafayette, IN) and J. T. Batina. In: Structures, Structural Dynamics and Materials Conference, 23rd, New Orleans, LA, May 10-12, 1982, Collection of Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, 1982, p. 256-266. 30 refs. (AIAA 82-0688)

Aeroelastic time-response analyses are performed for two conventional airfoils, NACA 64A006 and NACA 64A010, and one supercritical airfoil MBB A-3, in small disturbance transonic flow. Response results for forces and displacements were obtained by simultaneously integrating the structural equations of motion with the unsteady aerodynamic forces computed using two transonic codes: LTRAN2-NLR (improved version of LTRAN2 by Houwink and van der Vooren of NLR, the Netherlands) and USTS (Unsteady Transonic Small Perturbation code by Isogai of NAL, Japan). Three d.o.f.'s, plunge, pitch, and aileron pitch, are considered. Flutter analyses are first performed and the results are used as a guideline for time-response parameter selection. Time-response results are presented showing that for each case the flight speed used to obtain neutrally stable responses is either exactly or nearly the same as the flutter speed determined in the separate flutter analysis. Effect of response amplitudes is investigated. Applicability and limitations of the two transonic codes are evaluated, compared, and discussed. Transonic time-response behavior of these airfoils is physically interpreted, discussed, and comparisons are made. (Author)

A82-30156 * # **Application of a transonic potential flow code to the static aeroelastic analysis of three-dimensional wings.** W. Whitlow, Jr. and R. M. Bennett (NASA, Langley Research Center, Loads and Aeroelasticity Div., Hampton, VA). In: Structures, Structural Dynamics and Materials Conference, 23rd, New Orleans, LA, May 10-12, 1982, Collection of Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, 1982, p. 267-276. 12 refs. (AIAA 82-0689)

A method for including elastic effects in steady, transonic wing analysis is presented. Since the aerodynamic theory is nonlinear, the method requires the coupling of two iterative processes - an aerodynamic analysis and a structural analysis. A full potential analysis code, FL022, is combined with a linear structural analysis to yield aerodynamic load distributions on and deflections of elastic wings. This method was used to analyze an aeroelastically-scaled wind tunnel model of a proposed executive-jet transport wing and an aeroelastic research wing. The results are compared with the corresponding rigid-wing analyses, and some effects of elasticity on the aerodynamic loading are noted. (Author)

A82-30157 * # **Comparison between computations and experimental data in unsteady three-dimensional transonic aerodynamics, including aeroelastic applications.** P. Guruswamy (Informatics, Inc., Palo Alto, CA) and P. M. Goorjian (NASA, Ames Research Center, Moffett Field, CA). In: Structures, Structural Dynamics and Materials Conference, 23rd, New Orleans, LA, May 10-12, 1982, Collection of Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, 1982, p. 277-289. 20 refs. (AIAA 82-0690)

Comparisons were made of computed and experimental data in three-dimensional unsteady transonic aerodynamics, including aeroelastic applications. The computer code LTRAN3, which is based on small-disturbance aerodynamic theory, was used to obtain the aerodynamic data. A procedure based on the U-g method was developed to compute flutter boundaries by using the unsteady aerodynamic coefficients obtained from LTRAN3. The experimental data were obtained from available NASA publications. All the studies were conducted for thin, unswept, rectangular wings with circular-arc cross sections. Numerical and experimental steady and unsteady aerodynamic data were compared for a wing with an aspect ratio of 3 and a thickness ratio of 5% at Mach numbers of 0.7 and 0.9. Flutter data were compared for a wing with an aspect ratio of 5. Two thickness ratios, 6% at Mach numbers of 0.715, 0.851, and 0.913, and 4% at Mach number of 0.904, were considered. Based on the unsteady aerodynamic data obtained from LTRAN3, flutter boundaries were computed; they were compared with those obtained from experiments and the code NASTRAN, which uses linear aerodynamics. (Author)

A82-30161 # **Analysis of aircraft dynamic behavior in a crash environment.** G. Wittlin (Lockheed-California Co., Burbank, CA). In: Structures, Structural Dynamics and Materials Conference, 23rd, New Orleans, LA, May 10-12, 1982, Collection of Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, 1982, p. 316-325. 20 refs. Army-sponsored research. (AIAA 82-0694)

Differences in the crash environments and design aspects which influence occupant survivability in military and commercial aircraft are discussed. Available analytical techniques for assessing structural behavior during a crash are described. The application of a hybrid technique in assessing aircraft structural behavior and trends in crash environments is provided. Representative mathematical simulations of aircraft crash tests and correlation with light fixed-wing and rotary-wing aircraft test results are shown. The results of a recent FAA/NASA sponsored research program involving the review of transport accidents from 1964-79 and the formulation of potential crash scenarios to be considered with future analysis and test verification are presented. Current and future analytical model studies to ascertain the crash dynamics of large transports are also discussed. (Author)

A82-30162 * # **Bird impact analysis package for turbine engine fan blades.** M. S. Hirschbein (NASA, Lewis Research Center, Cleveland, OH). In: Structures, Structural Dynamics and Materials Conference, 23rd, New Orleans, LA, May 10-12, 1982, Collection of Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, 1982, p. 326-334. 8 refs. (AIAA 82-0696)

A computer program has been developed to analyze the gross structural response of turbine engine fan blades subjected to bird strikes. The program couples a NASTRAN finite element model and modal analysis of a fan blade with a multi-mode bird impact analysis computer program. The impact analysis uses the NASTRAN blade model and a fluid jet model of the bird to interactively calculate blade loading during a bird strike event. The analysis package is computationaly efficient, easy to use and provides a comprehensive history of the gross structual blade response. Example cases are presented for a representative fan blade. (Author)

A82-30168 * # **Damage tolerant design using collapse techniques.** R. T. Haftka (Virginia Polytechnic Institute and State University, Blacksburg, VA). In: Structures, Structural Dynamics and Materials Conference, 23rd, New Orleans, LA, May 10-12, 1982, Collection of Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, 1982, p. 383-386. 13 refs. Grant No. NAG1-168. (AIAA 82-0718)

A new approach to the design of structures for improved global damage tolerance is presented. In its undamaged condition the structure is designed subject to strength, displacement and buckling constraints. In the damaged condition the only constraint is that the structure will not collapse. The collapse load calculation is formulated as a maximization problem and solved by an interior extended penalty function. The design for minimum weight subject to constraints on the undamaged structure and a specified level of the collapse load is a minimization problem which is also solved by a penalty function formulation. Thus the overall problem is of a nested or multilevel optimization. Examples are presented to demonstrate the difference between the present and more traditional approaches. (Author)

A82-30169 # **Shape optimization of fiber reinforced composites.** S. V. Hanagud, A. Chattapadhyay, and L. Karlovitz (Georgia Institute of Technology, Atlanta, GA). In: Structures, Structural Dynamics and Materials Conference, 23rd, New Orleans, LA, May 10-12, 1982, Collection of Technical Papers. Part 2.

New York, American Institute of Aeronautics and Astronautics, 1982, p. 387-396. 5 refs. (AIAA 82-0719)

In this paper, the problem of the shape optimization in a fiber reinforced composite has been considered. The shape optimization can be interpreted as the problem of the optimum fiber distribution. In particular, the design of a long cylindrical rod that is subjected to torsion has been discussed. The problem has been formulated as a dual or min-max problem with appropriate constraints. The resulting Lagrange multipliers have been identified with physical parameters by performing the needed variations. The design procedure has been discussed by considering the examples of the torsion of a rod of a circular, a square and a rectangular cross section. (Author)

A82-30171 * # **Transonic flutter study of a wind-tunnel model of a supercritical wing with/without winglet.** C. L. Ruhlin (NASA, Langley Research Center, Loads and Aeroelasticity Div., Hampton, VA), F. J. Rauch, Jr., and C. Waters (Grumman Aerospace Corp., Engineering Dept., Bethpage, NY). In: Structures, Structural Dynamics and Materials Conference, 23rd, New Orleans, LA, May 10-12, 1982, Collection of Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, 1982, p. 407-415. 18 refs. (AIAA 82-0721)

The scaled flutter model was a 1/6.5-size, semispan version of a supercritical wing (SCW) proposed for an executive-jet-transport airplane. The model was tested cantilever-mounted with a normal wingtip, a wingtip with winglet, and a normal wingtip ballasted to simulate the winglet mass properties. Flutter and aerodynamic data were acquired at Mach numbers from 0.6 to 0.95. The measured transonic flutter speed boundary for each wingtip configuration had roughly the same shape with a minimum flutter speed near M = 0.82. The winglet addition and wingtip mass ballast decreased the wing flutter speed by about 7 and 5%, respectively; thus, the winglet effect on flutter was more a mass effect than an aerodynamic effect. Flutter characteristics calculated using a doublet-lattice analysis (which included interference effects) were in good agreement with the experimental results up to M = 0.82. Comparisons of measured static aerodynamic data with predicted data indicated that the model was aerodynamically representative of the airplane SCW. (Author)

A82-30172 # **Aeroelastic flutter and divergence of stiffness coupled, graphite/epoxy, cantilevered plates.** S. J. Hollowell (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, OH) and J. Dugundji (MIT, Cambridge, MA). In: Structures, Structural Dynamics and Materials Conference, 23rd, New Orleans, LA, May 10-12, 1982, Collection of Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, 1982, p. 416-426. 17 refs. Contract No. F33615-77-C-5155. (AIAA 82-0722)

An analytical and experimental investigation was conducted to determine the aeroelastic flutter and divergence behavior of unswept, rectangular wings simulated by graphite/epoxy, cantilevered plates with varying amounts of bending-torsion stiffness coupling. The analytical approach incorporated a Rayleigh-Ritz energy formulation and unsteady, incompressible two-dimensional aerodynamic theory. Flutter and divergence velocities were obtained using the V-g method and compared to results of low-speed wind tunnel tests. Stall flutter behavior was also examined experimentally. There was good agreement between analytical and experimental results. Wings with negative stiffness coupling exhibited divergence, while positive coupling delayed the onset of stall flutter. (Author)

A82-30173 # **Application of optimal control techniques to aircraft flutter suppression and load alleviation.** C. Hwang and W. S. Pi (Northrop Corp., Aircraft Div., Hawthorne, CA). In: Structures, Structural Dynamics and Materials Conference, 23rd, New Orleans, LA, May 10-12, 1982, Collection of Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, 1982, p. 427-438. 14 refs. Contract No. F33615-80-C-3217. (AIAA 82-0724)

Optimal control techniques were applied to design the reduced order controllers for the purpose of aircraft flutter suppression and load alleviation. Special attention was given to the multiple input, multiple output (MIMO) system, to which the classical feedback control theory cannot be conveniently applied. Using the optimal control approach, a number of control laws were designed for the YF-17 flutter suppression model. The relative performances of these control laws and previously synthesized control laws were evaluated analytically. In a wind tunnel entry using the flutter suppression model, one of the newly developed control laws was mechanized and successfully demonstrated. (Author)

A82-30176 # **Flutter analysis using nonlinear aerodynamic forces.** T. Udea and E. H. Dowell (Princeton University, Princeton, NJ). In: Structures, Structural Dynamics and Materials Conference, 23rd, New Orleans, LA, May 10-12, 1982, Collection of Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, 1982, p. 462-481. 11 refs. Grant No. AF-AFOSR-81-0123. (AIAA 82-0728)

The nonlinear effects of transonic aerodynamic forces on the flutter boundary of a typical section airfoil are studied. The flutter speed dependence on amplitude is obtained by utilizing a novel variation of the describing function method which takes into account the first fundamental harmonic of the nonlinear oscillatory motion. By using an aerodynamic describing function, traditional flutter analysis methods may still be used while including the effects of aerodynamic nonlinearities. The aerodynamic forces are computed by the LTRAN2 aerodynamic code for NACA 64A006 and NACA 64A010 airfoils. (Author)

A82-30177 # **Feedback control of a cantilever wing in steady airflow.** L. Meirovitch and L. Silverberg (Virginia Polytechnic Institute and State University, Blacksburg, VA). In: Structures, Structural Dynamics and Materials Conference, 23rd, New Orleans, LA, May 10-12, 1982, Collection of Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, 1982, p. 482-488. (AIAA 82-0729)

A method for the active flutter suppression of a cantilever wing in steady airflow is presented. The wing undergoes bending and torsional vibrations. The control forces are generated by leading-edge or trailing-edge flaps. Only the flutter modes are targetted for control, while the remaining modes are left uncontrolled. Because of inherent structural damping in the wing, however, motion in these modes decays exponentially with time. A numerical example is presented. (Author)

A82-30179 # **Component coupling with time-invariant mass matrix for nonisotropic rotating and nonrotating systems.** S. G. Sadler, J. Corrigan, and J. G. Yen (Bell Helicopter Textron, Fort Worth, TX). In: Structures, Structural Dynamics and Materials Conference, 23rd, New Orleans, LA, May 10-12, 1982, Collection of Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, 1982, p. 503-513. 13 refs. (AIAA 82-0731)

A method has been developed which allows a nonisotropic rotating structure to be coupled with a nonisotropic nonrotating structure such that the system's coupled equations of motion have a time-invariant mass matrix. The modeling requirements for this method are defined and the analytical approach is developed using physical degrees of freedom to describe the motions of both the rotating and the nonrotating components. Extensions to component modal synthesis methods are given for a typical component modal method, and also for a more recently developed method which retains only physical degrees of freedom at the component interfaces. The method is developed for both time-domain and frequency-domain solutions. Demonstration of the method for helicopter coupled rotor/airframe dynamic analysis including a two-bladed teetering rotor are presented. (Author)

A82-30182 * # **On the dynamic collapse of a column impacting a rigid surface.** J. M. Housner and N. F. Knight, Jr. (NASA, Langley Research Center, Structures and Dynamics Div., Hampton, VA). In: Structures, Structural Dynamics and Materials Conference, 23rd, New Orleans, LA, May 10-12, 1982, Collection of Technical Papers. Part 2. New York, American Institute of Aeronautics and Astronautics, 1982, p. 530-541. 24 refs. (AIAA 82-0735)

Results are presented of an analytical investigation on the dynamic collapse of an elastic periodically supported column. The column has an attached mass at one end and impacts a rigid surface with prescribed velocity and angle of incidence at the other end. A first-order approximate nonlinear analysis is developed in which it is assumed that only first-order nonlinear terms need be retained.

Differential equations are derived and solved numerically by explicit time integration in order to determine specific ranges of the basic nondimensional parameters for which the response characteristics are markedly different. To assess modeling sophistication relative to prediction accuracy, a comparison is made of the results from this approximate analysis with those of a finite element computer code based on a convected coordinate formulation. C.D.

A82-30193 * # **Subsonic aerodynamic and flutter characteristics of several wings calculated by the SOUSSA P1.1 panel method.** E. C. Yates, Jr., H. J. Cunningham, R. N. Desmarais (NASA, Langley Research Center, Hampton, VA), W. A. Silva, and B. Drobenko. *AIAA, ASME, ASCE, and AHS, Structures, Structural Dynamics and Materials Conference, 23rd, New Orleans, LA, May 10-12, 1982, AIAA Paper 82-0727.* 20 p. 20 refs.

Several applications of the steady, oscillatory, and unsteady subsonic and supersonic aerodynamics (SOUSSA) computer program to wings with steady and oscillatory motion, including flutter, are discussed. The program employs a generalized Green's function to the full, time-dependent potential-flow equation to obtain an integral equation for the velocity potential at any point in a flow, even points on a body or whole bodies in a flow. Aerodynamic calculations are provided for two rectangular wings, a clipped-tip delta wing, and two swept wings with and without a fuselage. The number and distribution of the finite element panels are varied in order to demonstrate the convergence of the results. The results are shown to be close to those of lifting-surface theory, and further applications with bodies having deformities, arbitrary shapes, motions, and deformations are indicated. M.S.K.

A82-30294 **A giant step toward composite helicopters.** M. M. Schwartz and G. Jacaruso (United Technologies Corp., Sikorsky Aircraft Div., Stratford, CT). *American Machinist,* Mar. 1982, p. 133-140.

The design goals and performance achievements of the UH60A Black Hawk helicopter Composite Rear Fuselage (CRF) structure's development are described, with emphasis on the use of computer-assisted interactive design techniques and on the fabrication and assembly methods used to produce this graphite-reinforced epoxy structure, which is 6 ft high, 8 ft wide, and 9 ft long. The metallic form of the rear fuselage is composed of 1203 parts, divided into 88 assemblies, with 17,000 fasteners. By contrast, the CRF comprises 459 detail parts, 23 assemblies and less than 6000 fasteners. Weight savings of 10% and manufacturing cost reductions of 30% have been demonstrated. Attention is given to the cutting and kitting of prepreg details, their preforming and pre-layup, frame and bulkhead fabrication, and the fabrication of the upper-center skin assembly. O.C.

A82-30311 **Improvements to secondary radar for air traffic control.** R. C. Bowes (Royal Signals and Radar Establishment, Malvern, Worcs., England). *Journal of Navigation,* vol. 35, May 1982, p. 193-204. Research supported by the Civil Aviation Authority.

The civil use of secondary surveillance radar (SSR), which is the prime sensor for the control of the aircraft, is described. The use of SSR in air-traffic control is detailed, and comparisons with primary radar are made. The prevention of sidelobe interrogations and the processing of SSR replies are explained. The two main types of problems with SSR, self-interference effects and reflected signals, are discussed. Additional topics of discussion are monopulse direction finding, which enables an accurate azimuth measurement to be obtained from a single reply, and selective address SSR, which helps solve the SSR garble problem. C.D.

A82-30312 **The reliability of height and identity data.** H. Gent (Royal Signals and Radar Establishment, Malvern, Worcs., England). *Journal of Navigation,* vol. 35, May 1982, p. 204-219. Research sponsored by the Civil Aviation Authority.

The nature and extent of secondary surveillance radar (SSR) errors are discussed with a description of the Mode A and Mode C codes, and a concrete example of error is given. Investigation shows that short-period Mode C and Mode A errors are equally likely, each occurring in about 1 plot in 5000, with neither airborne nor ground equipment being wholly responsible. Pulse error counts are made for both modes, and a comparison with garble shows that while the latter occurs more frequently, it can be anticipated while data errors cannot. Examples of persistent as opposed to short-period errors are also discussed, with the two types for Mode C showing very similar behavior. The airborne equipment was found to be at fault in all errors that cannot be explained as simple pulse code errors. The introduction of Mode S will reduce the incidence of data errors. C.D.

A82-30313 **Secondary radar for airborne collision avoidance.** S. Ratcliffe. *Journal of Navigation,* vol. 35, May 1982, p. 220-239. 14 refs.

Cooperative collision avoidance systems, passive beacon collision avoidance systems (BCAS), and active radar systems are discussed for civil aviation. The detection of collision risk is treated mathematically. The trajectory of a possible threat as plotted in the range/range rate phase plane is discussed, and the range/range-rate logic is quantitatively studied. Parameters are given for the sensitivity levels at which BCAS is operative. The use of height and height-rate data is described, and the operation of the collision avoidance system is analyzed. Finally, the resolution advisory register, which ensures compatibility between BCAS advisories, is discussed. C.D.

A82-30314 **Magnetic anomalies as a reference for ground-speed and map-matching navigation.** C. Tyren. *Journal of Navigation,* vol. 35, May 1982, p. 242-254.

The use of the earth's magnetic field for ground referenced motion and position measurements is discussed. A magnetic terrain-navigation concept is set forth, and its sensor configuration, data processing and data storage unit, and navigation data interface unit are discussed. The navigational accuracy of the system is assessed; one particular advantage of terrain navigation systems is that ground-speed accuracy is independent of vehicle speed until speeds are reached at which the sensors and/or computer operations are too slow to track the vehicle path. The system is therefore excellent at low speeds and can advantageously be used for hovering operations. The results of field tests indicate that the feasibility of both ground-speed and map-matching methods is indeed promising. C.D.

A82-30675 **Aviation gear drives and reducers: Handbook (Aviatsionnye zubchatye peredachi i reduktory: Spravochnik).** Edited by E. B. Vulgakov. Moscow, Izdatel'stvo Mashinostroenie, 1981. 376 p. In Russian.

The book contains data on the geometry, kinematics, design, manufacture, and testing of aviation gear drives and reducers. In particular, consideration is given to the geometrical analysis of involute cylindrical gear drives, gear drive strength and dynamics, splined joints, analysis of torsional and flexural vibrations, and computer-aided design of gear drives. Other topics discussed include materials, chemical and heat treatment, tolerances, and quality assurance during the manufacture of gears, experimental testing techniques, and principal defects. Attention is also given to the design of helicopter reduction gears, overrunning clutches, lubricants for reduction gears, and cost-effectiveness of gear manufacture. V.L.

A82-30697 † **Gas turbine engines used in aviation: Design and construction of components /5th revised and enlarged edition/ (Aviatsionnye gazoturbinnye dvigateli: Konstruktsiia i raschet detalei /5th revised and enlarged edition/).** G. S. Skubachevskii. Moscow, Izdatel'stvo Mashinostroenie, 1981. 552 p. 113 refs. In Russian.

The principles underlying the design of gas turbine engines are expounded. The operating conditions of the various engine compartments, and parts thereof, are considered. Attention is also given to manufacturing processes and the proper choice of materials. Examples of calculations for determining the strength and vibration of the principal engine components are included. C.R.

A82-31048 **Chem-Braze abradable seal practical.** M. Levy (U.S. Army, Army Materials and Mechanics Research Center, Watertown, MA). *ManTech Journal,* vol. 6, no. 2, 1981, p. 9-12. Army-supported research.

An improved Chem-Braze bonding system for attaching sintered abradable seals to titanium, steel, and nickel base compressor blade tip shrouds has been developed. The system incorporates glycerin to prevent premature evaporation which prolongs working life and allows adequate time to attach abradable seals to engine hardware. The system has demonstrated its viability with attachment involving simple mechanical fixturing and curing and removal facilitiated by chemical stripping, and all operations are relatively fast and

inexpensive. Optimum inhibitor concentration was found to be 10 percent. Optimum drying time, cure cycle, proper chemical stripping technique, and inexpensive tooling techniques were also determined. A preliminary cost analysis shows a 74 percent saving compared to attachment with gold-nickel braze. C.D.

A82-31057 **Aircraft cabin air ozone contamination and compliance with regulations.** J. F. Leach, G. R. Robinson (British Aerospace Public Ltd., Co., Filton, Avon, England), and F. J. Sandalls (Atomic Energy Research Establishment, Environmental and Medical Sciences Div., Didcot, Oxon, England). *Atmospheric Environment,* vol. 16, no. 5, 1982, p. 1021-1026. 9 refs. Research supported by the Department of Transport/Department of the Environment and Department of Industry.

Fifteen cabin air ozone measurements made in Concorde are ranked in order and plotted as log-normal and extreme value cumulative probability distributions. It is shown that the log-normal distribution gives adequate accuracy for regulatory purposes and one-sided tolerance limits may be used for statistical methods of compliance with any regulatory limit. Similarly it is shown that compliance by ozone destruction ratio may be difficult due to the extreme stratification of ozone in the lower stratosphere. (Author)

A82-31121 # **Optimal control and estimation for strapdown seeker guidance of tactical missiles.** P. L. Vergez and J. R. McClendon (USAF, Armament Laboratory, Eglin AFB, FL). *Journal of Guidance, Control, and Dynamics,* vol. 5, May-June 1982, p. 225, 226.

An extended Kalman filter is developed that explicitly accounts for the major error sources in a strapdown system and estimates the state information required by an advanced guidance system. The selected guidance law is derived from linear quadratic Gaussian theory, the only assumption being that the missile has instantaneous response and complete control over its acceleration. The filter processes the noise from the strapdown seeker and estimates the information needed by the guidance law referenced to the missile's body-fixed coordinate system. A detailed six-degree-of-freedom simulation of a generic bank-to-turn short range air-to-air missile was used to evaluate the guidance and estimation algorithm developed for the study. C.D.

A82-31125 * # **Comment on 'Optimal control via mathematical programming'.** L. J. Wood (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). *Journal of Guidance, Control, and Dynamics,* vol. 5, May-June 1982, p. 318, 319; Authors' Reply, p. 319. 16 refs. Contract No. NAS7-100.

A82-31179 **Combat training imagery.** *Flight International,* vol. 121, Apr. 24, 1982, p. 1048-1050.

The CT-5 is a computer-generated image (CGI) using raster scan that provides a daylight system design for sophisticated military applications. The imagery includes a formation of F-16s, a CH-46 helicopter, a KC-135, and a sea data-base. Backgrounds are realistically depicted. The CT-5 uses a PDP-11 general-purpose minicomputer connected to the simulator computer and image processor, which consists of the viewpoint processor and the channel processor. There is also a series of display processors, and scanline computation is replaced by area computation. Extra channels and more display processors can be added. C.D.

A82-31290 **The helicopter Navstar GPS test program.** R. D. Till (FAA, Technical Center, Washington, DC). *Vertiflite,* vol. 28, May-June 1982, p. 22-25.

The use of the Navstar Global Positioning System (GPS) for helicopter navigation is reviewed. The GPS system has a space segment with a contingent of 18-24 satellites in 12 hr circular orbits with 2 hr coverage by four satellites over selected areas, a user segment with a receiver/processer, and a control segment composed of four monitor stations. Ephemeris data on satellite location is relayed through the control segments to a Master Control station at Vandenberg AFB. The use of four satellites involves the solution of four equations for three-dimensional requirements and for the user clock bias. Civilian use is thus far limited to a coarse/acquisition code at a signal level of -133 dB. A total of 17 flight hours of tests with civilian craft have been flown to test the system, with the helicopter tests covering the total system cross track error, the flight technical error, and the along track error. Operational status is scheduled for 1984. M.S.K.

A82-31426 # **New materials fly better and cheaper.** *Mechanical Engineering,* vol. 104, May 1982, p. 20-26.

The types of advanced, high-performance fibers and their advantages are described, and the process of forming composites is outlined. The use of composites in present and future commercial and military aircraft, including the Learfan 2100 and the Space Shuttle Discovery, is discussed. Special attention is given to metallic and ceramic materials of the future. C.D.

A82-31602 † **The maximum flying range problem for an aircraft (O zadache poleta letatel'nogo apparata na maksimal'nuiu dal'nost').** V. I. Borzov and T. R. Igonina. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Tverdogo Tela,* Mar.-Apr. 1982, p. 20-24. 5 refs. In Russian.

The maximum flying range problem is examined in terms of the motion of the center of mass of an aircraft in a vertical plane. By using methods based on the theory of differential equations with singular perturbations, the maximum flying range problem is reduced to that of solving a boundary-value problem. The applicability of the proposed model is investigated, and the particular case of the maximum flying range in gliding is examined. V.L.

A82-31603 † **Stability and self-oscillations of coaxial rotors (Ob ustoichivosti i avtokolebaniiakh soosnykh rotorov).** E. L. Pozniak. *Akademiia Nauk SSSR, Izvestiia, Mikhanika Tverdogo Tela,* Mar.-Apr. 1982, p. 38-45. 9 refs. In Russian.

An analysis is presented of the stability and stable self-oscillations induced by viscosity-type nonconservative forces in the material of the shaft in a system of two coaxial rotors supported by a rigid damped frame. The range of stability is studied as a function of the rotor velocities and directions and as a function of damping in the bearings of the frame. A quasi-Galerkin method is used to determine frequencies, amplitudes, and modes for single-frequency as well as multifrequency self-oscillations. The stability of the obtained solutions is investigated. B.J.

A82-31643 † **Effect of operating life on the mechanical properties of the materials and load-bearing capacity of the rotor elements of gas-turbine engines (Vliianie ekspluatatsionnoi narabotki na mekhanicheskie svoistva materialov i nesushchuiu sposobnost' elementov rotorov GTD).** V. L. Akhremenko (Akademiia Nauk Ukrainskoi SSR, Institut Problem Prochnosti, Kiev, Ukrainian SSR). *Problemy Prochnosti,* Apr. 1982, p. 53-55. 5 refs. In Russian.

Experiments have been conducted to investigate changes in the mechanical properties of turbine alloys EI698, EI961, EI437BUVD, and AL4 following long-term service under actual operating conditions. It is found that ductility and impact toughness are most sensitive to damage, whereas the load-bearing capacity of gas-turbine rotors changes insignificantly in the course of service life and, therefore, cannot be used as a damage criterion. V.L.

A82-31669 **Distributed airborne array concepts.** B. D. Steinberg (Pennsylvania, University, Philadelphia, PA) and E. Yadin (Interspec, Inc., Philadelphia, PA). *IEEE Transactions on Aerospace and Electronic Systems,* vol. AES-18, Mar. 1982, p. 219-227. 19 refs. Grant No. AF-AFOSR-78-3688.

The improvement in SNR and detection range due to distributing an antenna array throughout the airframe and skin of an aircraft is examined. SNR formulas for three system configurations are presented and compared with that of a conventional, monostatic radar. Examples given in the paper show detection range increases as large as a factor of 4. Three additional potential advantages of the distributed array are an increase in spatial signal processing capability, an improvement in azimuthal resolution, and a potential reduction in transmitter power for fixed radar performance so as to reduce the probability of intercept. (Author)

STAR ENTRIES

N82-22144# Royal Aircraft Establishment, Farnborough (England).
THE ROYAL AIRCRAFT ESTABLISHMENT: 100 YEARS OF RESEARCH
A. J. Smith 2 Oct. 1981 33 p refs Presented at 1981 Aviation Lighting Sem., Williamsburg, Virginia, 9-13 Nov., 1981; sponsored by Illuminating Engineering Society of North America (RAE-TM-FS-432; BR80894) Copyright. Avail: NTIS HC A03/MF A01

The work of the Royal Aircraft Establishment (RAE) from its days as His Majesty's Balloon factory to modern times is summarized. Early setbacks to aircraft production included the 1909 War Office declaration that the airplane had no military value. The First World War changed this opinion and the interwar years saw an expansion which bore fruit in the development of the gyro gun sight, stabilized bomb sight and high speed aerial reconnaissance during World War 2. The tapered ladder effect used in airfield approach lighting systems was developed after the war, along with subsonic and supersonic wind tunnels. Recent projects involving the RAE include Concorde, Earth resources satellites, and head-up displays. Author (ESA)

N82-22145# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
LA RECHERCHE AEROSPATIALE, BI-MONTHLY BULLETIN NUMBER 1981-5, SEPTEMBER - OCTOBER 1981
Claude Sevestre, ed. ESA Feb. 1982 63 p refs Transl. into ENGLISH of La Rech. Aerospatiale, Bull. Bimestriel (Paris), No. 1981-5, Sep. - Oct. 1981 Sponsored by ESA
(ESA-TT-725) Avail: NTIS HC A04/MF A01; original report in FRENCH available at ONERA, Paris FF 45

Advances in aerospace engineering are reviewed. Flow theory and computation are considered. Signal processing algorithms are presented. Structural analysis of composite materials is discussed. Two wind tunnel investigations, helicopter rotor performance measurement and testing a digital filtering system, are also described.

N82-22151# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
HELICOPTER ROTOR PERFORMANCE IMPROVEMENT BY UTILIZATION OF SWEPT-BACK PARABOLIC BLADE TIP

J. J. Philippe and P. Lafon *In its* La Rech. Aerospatiale, Bi-monthly Bull. No. 1981-5, Sep. - Oct. 1981 (ESA-TT-725) Feb. 1982 p 55-56 refs Transl. into ENGLISH of La Rech. Aerospatiale, Bull. Bimestriel (Paris), No. 1981-5, Sep. - Oct. 1981

Avail: NTIS HC A04/MF A01; original report in FRENCH available at ONERA, Paris FF 45

A sweptback parabolic tip was designed so as to improve the working conditions of an advancing blade by reducing the intensity of the shock waves which arise and the drag associated with such shocks. The design is based on the computated pressure distribution on a helicopter blade in the fundamental case of a nonlifting rotor. The results of the computations clearly show the advantages of using this geometry for a rotor blade tip. Results of tests on such tips, performed in a wind tunnel on a three bladed rotor, demonstrate an overall improvement in the performance of the rotor. Author (ESA)

N82-22152# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
REAL TIME DIGITAL FILTERING TEST IN THE S1 CONTINUOUS WIND TUNNEL AT MODANE
J. Appel *In its* La Rech. Aerospatiale, Bi-monthly Bull. No. 1981-5, Sep. - Oct. 1981 (ESA-TT-725) Feb. 1982 p 57-61 ref Transl. into ENGLISH of La Rech. Aerospatiale, Bull. Bimestriel (Paris), No. 1981-5, Sep. - Oct. 1981

Avail: NTIS HC A04/MF A01; original report in FRENCH available at ONERA, Paris FF 45

A set of real time digital filters was used in a wind tunnel during testing of a transport aircraft model. The performance of the digital filters, programmed at various cutoff frequencies, was compared with that of analog filters already in use. Ten measuring channels, permitting computation of three aerodynamic coefficients for the model, were recorded. The operating principle of the real time digital filters is described. Results confirm the interest of low pass filtering at a very low cutoff frequency for restoring static parameters while a model is performing an angle of attack sweep in continuous mode. Author (ESA)

N82-22153# National Aerospace Lab., Amsterdam (Netherlands). Div. of Structures and Materials.
REVIEW OF AERONAUTICAL FATIGUE INVESTIGATIONS IN THE NETHERLANDS, MARCH 1979 - FEBRUARY 1981
J. B. deJonge Feb. 1981 43 p refs Presented at the 17th ICAF Conf., Noordwijkerhout, Netherlands, 18-19 May 1981
(NLR-MP-81006-U) Avail: NTIS HC A03/MF A01

Reports on aeronautical fatigue investigations are reviewed. The reports are cited in a subject index, covering: loads; flight simulation testing, procedures and evaluation; fatigue investigations; prediction of crack initiation and crack propagation; damage tolerance and residual strength; materials evaluation; inspection methods and service failure analysis; fatigue of aircraft materials; fatigue of laminates; fatigue of joints; and prediction of residual strength of stiffened panels. Author (ESA)

N82-22154# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
DYNAMIC ENVIRONMENTAL QUALIFICATION TECHNIQUES
Dec. 1981 245 p refs Partly in ENGLISH; one in FRENCH Proceedings of the 53rd Meeting of the Structures and Mater. Panel, Noordwijkerhout, Netherlands, 27 Sep. - 2 Oct. 1981
(AGARD-CP-318; ISBN-92-835-0306-6) Avail: NTIS HC A11/MF A01

The state of the art of dynamic qualification techniques and test methods for military aircraft with external stores are reviewed, including consideration of the rationale and interpretation of existing standards. The determination of environmental inputs from various sources and their application to specific aircraft and store configurations, including helicopters, are covered. Presentations were also given on the development of vibration analysis techniques and the evaluation of possible improvements in prediction methods and establishment of criteria.

N82-22155# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio. Combined Environments Test Group.
DEVELOPMENT AND USE OF DYNAMIC QUALIFICATION STANDARDS FOR AIR FORCE STORES
Alan H. Burkhard and Otto F. Maurer *In* AGARD Dyn. Environ. Qualification Tech. Dec. 1981 7 p refs
see N82-22154 13-01)
Avail: NTIS HC A11/MF A01

The cataloging and standardization act for the standardization of items, materials, and engineering practices in the defense industry is discussed. Formal procedures for generating, updating, and utilization of these documents are presented. The advantages of standardization leading to simplification of procurement, development, and production processes by fostering uniformity, direct comparability, interchangeability of standardized objects are outlined. The state of the art of test techniques and procedures are considered. E.A.K.

N82-22158# British Aerospace Aircraft Group, Preston (England). Specialist Functions, Stress Office.
QUALIFICATION OF EQUIPMENT FOR GUNFIRE INDUCED VIBRATION
A. Peacock *In* AGARD Dyn. Environ. Qualification Tech. Dec. 1981 22 p refs
Avail: NTIS HC A11/MF A01

A method to ensure that the Tornado MK1 aircraft equipment withstand gunfire induced vibrations is described. The derivation of test spectra from rig and aircraft measurements is explained. Test failures and in-service malfunctions are reviewed. A comparison with Mil specification is made. E.A.K.

N82-22159# General Dynamics/Fort Worth, Tex.
DYNAMIC QUALIFICATION TESTING OF F-16 EQUIPMENT
H. E. Nevius and W. J. Brignac *In* AGARD Dyn. Environ. Qualification Tech. Dec. 1981 15 p

Avail: NTIS HC A11/MF A01

Vibration prediction methods and qualification test procedures are presented for F-16 equipment. Measured vibration levels are also compared to the predictions. The most severe vibratory environment is produced by the muzzle blast pressure during gunfiring. Gunfiring vibration was measured during the YF-16 prototype program which indicated a correlation between vibration levels and distance from the gun port. Vibration data are presented verifying this relationship. Nongunfiring random vibration test levels are shown for F-16 airframe zones. The prediction procedures were based on a relationship between vibration and dynamic pressure using measured data from other aircraft. Vibration levels were measured on fuselage mounted stores. Other measured dynamic environments are presented which include wing tip missile response to store ejection from wing pylons and to jet wake encounter, and buffet response at high-angles-of-attack. Author

N82-22160# McDonnell-Douglas Corp., St. Louis, Mo. Structural Dynamics Sect.
DEVELOPMENT OF VIBRATION QUALIFICATION TEST SPECTRA FOR THE F-15 AIRCRAFT
G. R. Waymon *In* AGARD Dyn. Environ. Qualification Tech. Dec. 1981 19 p refs

Avail: NTIS HC A11/MF A01

The vibration test spectra used for an F-15 Eagle were based on analytical predictions combined with measured data from similar aircraft. The low frequency vibration below approximately 50 Hertz results primarily from aircraft response to gusts, buffet, landing, and taxi excitation. Vibration at higher frequencies is primarily associated with acoustical excitation and gunfire. The airplane was divided into regions of comparable vibration levels. The test levels were derived using the predicted spectra and applying factors to define a performance and an endurance test. The F-15 flight measured data were used to update these predictions for the present test spectra. Author

N82-22161# British Aerospace Aircraft Group, Kingston-upon-Thames (England).
EQUIPMENT VIBRATION QUALIFICATION FOR HARRIER AND HAWK AIRCRAFT
D. C. Thorby *In* AGARD Dyn. Environ. Qualification Tech. Dec. 1981 7 p refs

Avail: NTIS HC A11/MF A01

Equipment for later versions of the Harrier and all versions of the Hawk aircraft were cleared for flight vibration using test procedures based on the current British Standard. The rationale used in applying this Specification, and the flight vibration test procedures are briefly outlined from a practical viewpoint.Author

N82-22162# Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (West Germany).
ACOUSTIC NOISE TEST AS PART OF THE DYNAMIC QUALIFICATION PROGRAM IN AEROSPACE
G. Bayerdoerfer *In* AGARD Dyn. Environ. Qualification Tech. Dec. 1981 7 p
Avail: NTIS HC A11/MF A01

The mechanisms of noise generation for the purpose of acoustic qualification tests are described. Special emphasis is given to the modal density of acoustic noise fields in enclosures, such as reverberation chambers. A test program shows that for small components a sufficient modal density can be achieved in relatively small test chambers. Where applicable small chambers are favorable because of the lower test costs. Author

N82-22164# Vereinigte Flugtechnische Werke-Fokker G.m.b.H., Bremen (West Germany). Abt. Dynamik/Aeroelastik.
AIRCRAFT FUEL TANK SLOSH AND VIBRATION TEST

Helmut Zimmermann *In* AGARD Dyn. Environ. Qualification Tech. Dec. 1981 11 p

Avail: NTIS HC A11/MF A01

A dynamic qualification test for a subsonic and a supersonic external drop tank for a European fighter is presented. The test rig and the specimens are described and the measuring results are discussed. It is shown that for the supersonic tank as well as for the subsonic tank a certain slosh angle an eigenfrequency of the rig increases the amplitudes at the excitation position and the accelerations on the tank. For the subsonic tank it seems that an eigenfrequency is excited for the nose down position of the tank. The qualification requirements are examined. It is proposed that instead of using an arbitrary vibration amplitude and frequency for excitation, frequency ranges and amplitudes which are averaged out of flight measurements at the tank attachment points on the aircraft be used and that the demand for a certain input amplitude at the top of the attachment bulkheads and an output amplitude at the bottom of the attachment bulkheads be deleted. E.A.K.

N82-22165# Army Aviation Research and Development Command, St. Louis, Mo. Structures and Aeromechanics Div.
THE STRUCTURAL DYNAMIC INTERFACE REQUIRED FOR DEVELOPING HELICOPTER TARGET ACQUISITION SYSTEMS
Sam T. Crews *In* AGARD Dyn. Environ. Qualification Tech. Dec. 1981 9 p refs

Avail: NTIS HC A11/MF A01

A brief description of the helicopter vibration environment is given. Two development programs were used as examples to show how vibration sensitive target acquisition systems can be interfaced to a helicopter. The systems are the Target Acquisition Data System/Pilot Night Vision System mounted to the nose of the Army's new Advanced Attack Helicopter and the Stand-Off Target Acquisition System mounted underneath the Army's BLACK HAWK helicopter. The qualification strategy and specific testing performed and to be performed are included. Author

N82-22166# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).
APPROACH IN DYNAMIC QUALIFICATION OF LIGHT HELICOPTER STORES AND EQUIPMENTS
D. Braun and J. Stoppel *In* AGARD Dyn. Environ. Qualification Tech. Dec. 1981 8 p refs

Avail: NTIS HC A11/MF A01

Problems occurring in connection with the dynamic qualification of equipment and external stores for light military helicopters are evaluated. Special features of the helicopter vibratory environment are discussed. Some general recommendations for the procedure of dynamic qualification for use with helicopters are given. The approach for dynamic qualification of relatively heavy equipment is presented using the example of combining the MBB BO 105 helicopter with HOT anti-tank missile launchers. To obtain a basic understanding of the dynamic behavior of the helicopter with external stores preliminary dynamic calculations were made. Shake tests were done with the separated external stores and flight test vibration measurements were obtained. Test results are presented with regard to the harmonic main rotor excitation. M.D.K.

N82-22167# Westland Helicopters Ltd., Yeovil (England). Dynamics Dept.
THE DYNAMIC QUALIFICATION OF EQUIPMENT AND EXTERNAL STORES FOR USE WITH ROTARY WINGED AIRCRAFT
G. M. Venn *In* AGARD Dyn. Environ. Qualification Tech. Dec. 1981 11 p
Avail: NTIS HC A11/MF A01

The dynamic regime imposed on helicopter-borne stores and equipment, highlighting the differences between the rotary and fixed-wing environments are outlined. The need for helicopter requirements to be addressed in particular is discussed. The influence of a number of contributory factors to the dynamic environment arising from varying military applications covering both land and sea operation is also discussed. The dynamic criteria for design and testing are given, explaining the particular influence of discrete sinusoidal forcing on the helicopter environment. The evolution of these standards and their consolidation through flight and service experience is explained. Some views on the future development of dynamic qualification criteria for rotary-winged aircraft are also outlined. M.D.K.

N82-22168# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Inst. of Aeroelasticity.

APPLICATION OF MODAL SYNTHESIS TECHNIQUES FOR THE DYNAMIC QUALIFICATION OF WINGS WITH STORES

E. Breitbach *In* AGARD Dyn. Environ. Qualification Tech. Dec. 1981 22 p refs

Avail: NTIS HC A11/MF A01

Dynamic qualification as well as flutter clearance of modern combat aircraft were studied using modal coupling methods. Emphasis was placed on how to deal with special phenomena due to nonlinearities, in particular combinations of backlash and dry friction, in the connecting parts between wing, pylon and store which may significantly infringe on the validity of the linear mathematical models as used in ground and flight vibration testing. M.D.K.

N82-22169# Boeing Military Airplane Development, Seattle, Wash. Structural Dynamics Dept.

STOL AIRCRAFT STRUCTURAL VIBRATION PREDICTION FROM ACOUSTIC EXCITATION

B. F. Dotson and J. Pearson (AFWAL) *In* AGARD Dyn. Environ. Qualification Tech. Dec. 1981 20 p refs

Avail: NTIS HC A11/MF A01

A method was developed to improve environment vibration prediction methods, particularly in the lower frequency range where high acoustic excitation is expected on STOL aircraft. A rigorous mathematical spectral analysis approach was used which simulated the structure with finite element models (FEM) and used measured and calculated acoustic input data for the forcing function. Calculated and measured vibrations levels were compared on a medium sized Upper Surface Blowing (USB) STOL aircraft. The development of a method for prediction of the external acoustic environment of USB flap-type STOL aircraft was also accomplished. The method compares favorably with actual measurements and represents a significant improvement in acoustic prediction methods for aircraft with USB type flaps. The method includes scaling factors for engine size, thrust, aircraft size, and other parameters. Finally, noise and vibration levels were predicted on a small STOL aircraft and later compared to measured data. Author

N82-22170# Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.

GUNFIRE BLAST PRESSURE PREDICTIONS

R. M. Munt, A. J. Perry, and S. A. Moorse *In* AGARD Dyn. Environ. Qualification Tech. Dec. 1981 20 p refs

Avail: NTIS HC A11/MF A01

A scheme for predicting the blast pressures from aircraft guns is presented which extends existing theory. The predictions correlate well with some experimental measurements of gun blast pressures in free space. Blast pressures were also measured experimentally on a surface in the vicinity of the muzzle of a 7.62 mm rifle but these could only be satisfactorily predicted in regions where the classical theory of regular reflection of shock waves could be applied. These results are discussed in relation to the surface blast pressures from aircraft mounted guns. Author

N82-22171# Grumman Aerospace Corp., Bethpage, N.Y.

DEVELOPMENT OF A TAPED RANDOM VIBRATION TECHNIQUE FOR ACCEPTANCE TESTING

John Devitt, Richard Pokallus, Joseph Popolo, and Eugene Baird *In* AGARD Dyn. Environ. Qualification Tech. Dec. 1981 6 p

Avail: NTIS HC A11/MF A01

The use of random vibration as a screen for latent workmanship problems normally found in avionic equipment, proved to be significantly more effective than the sinusoidal form of excitation normally employed. This was demonstrated and is now required for acceptance testing by various DoD agencies. The results of a program to develop an economical technique for generating random vibration utilizing an audio tape deck indicate that compensating factors can be developed to account for the variations that exist in generically identical equipment. Using these factors, synthetic random tapes were generated. Author

N82-22172# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).

MAINTENANCE IN SERVICE OF HIGH TEMPERATURE PARTS

Jan. 1982 162 p refs Meeting held at Noordwijkerhout, Netherlands, 27 Sep. - 2 Oct. 1981

(AGARD-CP-317) Avail: NTIS HC A08/MF A01

The problem areas in the inspection, repair, and life extension and prediction of gas turbine engine parts are addressed.

N82-22173# Ministry of Defence, London (England).

MILITARY MAINTENANCE POLICIES AND PROCEDURES FOR HIGH-TEMPERATURE PARTS. WILL THEY BE ADEQUATE?

R. B. G. Hedgecock *In* AGARD Maintenance in Serv. of High Temp. Parts Jan. 1982 7 p refs

Avail: NTIS HC A08/MF A01

The problems involved in developing engine parts maintenance policies which incorporate life estimation, inspection, repair and containment of costs are examined. Computer-based engine usage monitoring systems and a low cycle atigue counter are described along with assembled and unassembled engine inspection procedures and repair techniques. M.G.

N82-22174# Dayton Univ., Ohio. Graduate Materials Engineering Program.

ENGINE DEPOT MAINTENANCE REPAIR TECHNOLOGY

James A. Snide and William J. Schulz (AFWAL) *In* AGARD Maintenance in Serv. of High Temp. Parts Jan. 1982 19 p refs

Avail: NTIS HC A08/MF A01

The scope and mission of the two USAF engine Air Logistics Centers are described. The various processes and organizational structure to identify repair technology requirements are discussed. Approaches to transition and implementation of new technology into a repair depot environment are described. Specific examples of technology developments described are: braze repair, laser metrology, electrophoretic, coatings, sputtered MCrAlY overlay coating and inlet guide vane vibration damping. Author

N82-22175# Naval Aircraft Materials Lab., Fleetlands (England).

MAINTENANCE PROBLEMS IN GAS TURBINE COMPONENTS AT THE ROYAL NAVAL AIRCRAFT YARD, FLEETLANDS

F. J. Plumb *In* AGARD Maintenance in Serv. of High Temp. Parts Jan. 1982 13 p refs

Avail: NTIS HC A08/MF A01

The work of the engine repair facility at Fleetlands and the major problems found in the overhaul and repair of helicopter and marine gas turbines are discussed. Remedies for component reserviceability, developments to obtain longer service lives, and the techniques employed are discussed. Author

N82-22176# KLM Royal Dutch Airlines, Amsterdam (Netherlands). Propulsion Systems Dept.

MAINTENANCE EXPERIENCE WITH CIVIL AERO ENGINES

J. Ph. Stroobach *In* AGARD Maintenance in Serv. of High Temp. Parts Jan. 1982 3 p

Avail: NTIS HC A08/MF A01

The trends in high temperature parts maintenance concept developments are reviewed, indicating the constant activities to optimize the maintenance cost of the propulsion system. As a result of the escalating trends in material and fuel prices, the presently applied maintenance concepts require a more sophisticated condition control in order to comply with the need to find the optimum operating time of each individual engine. With the introduction of the new generation of civil aircraft (Airbus A310) a mutual goal between the engine manufacturer and the airline was defined to develop mathematical programs, based on actual recorded conditions, in order to control the behavior of the engine, aiming at an optimum use of the propulsion system. M.G.

N82-22177# Pratt and Whitney Aircraft Group, West Palm Beach, Fla. Government Products Div.

ENGINE COMPONENT RETIREMENT FOR CAUSE

J. A. Harris, Jr., C. G. Annis, Jr., M. C. VanWanderham, and D. L. Sims *In* AGARD Maintenance in Serv. of High Temp. Parts

Jan. 1982 9 p refs

Avail: NTIS HC A08/MF A01

An engine part retirement for cause (RFC) procedure is discussed which would allow safe utilization of the full life capacity of each individual component. Since gas turbine rotor components are prime candidates and are among the most costly of engine components, adoption of a RFC maintenance philosophy could result in substantial engine systems life cycle cost savings. Two major technical disciplines must be developed and integrated to realize these cost savings: fracture mechanics and nondestructive evaluation. The methodology and development activity required to integrate these disciplines that provide a viable RFC system for use on military gas turbine engines is discussed. The potential economic benefits of its application to a current engine system are also illustrated. M.G.

N82-22178# Rolls-Royce Ltd., Derby (England). Dept. of Materials Engineering.

DEFECTS AND THEIR EFFECT ON THE BEHAVIOR OF GAS TURBINE DISCS

Robert H. Jeal *In* AGARD Maintenance in Serv. of High Temp. Parts Jan. 1982 15 p

Avail: NTIS HC A08/MF A01

Unless the method used to life fatigue critical components like gas turbine discs allows assessment of defect presence and behavior, the risk of serious failure is dramatically increased. A method is discussed where defect behavior can be assessed as part of a total life approach to disc behavior prediction and is explained together with the effects of differing defect types. Such an approach gives realistic manufacturing standards and controls and leads directly to an 'on condition life' approach. Author

N82-22180# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

THE INFLUENCE OF PROTECTIVE TREATMENT ON THE MECHANICAL PROPERTIES OF SUPERALLOY PARTS [INFLUENCE DES TRAITEMENTS DE PROTECTION SUR LES PROPRIETES MECANIQUES DES PIECES EN SUPERALLIAGE]

J. M. Hauser, C. Duret, and R. Pichoir *In* AGARD Maintenance in Serv. of High Temp. Parts Jan. 1982 11 p refs In FRENCH

Avail: NTIS HC A08/MF A01

The high temperature environment of aircraft turbine engines requires the use of protective coatings for engine parts. These coatings are particularly necessary when the composition of the superalloys used and associated heat treatment are chosen in order to obtain the best mechanical properties. The durability of these components is determined not only by the mechanical properties of the protected heat resistance alloys, but equally by the resistance of the coating to oxidation and corrosion. To restore this protection can pose diverse problems and, in certain cases, constitute an additional factor in reducing fatigue life. These aspects are considered and illustrated by results obtained from aluminium coatings applied to IN 100 and IN 738LC superalloys. Factors inherent i to t elaboration of the protection are also considered. Transl. by A.R.H.

N82-22185# Motoren- und Turbinen-Union Muenchen G.m.b.H. (West Germany).

REPAIR AND REGENERATION OF TURBINE BLADES, VANES AND DISCS

H. Huff and J. Wortmann *In* AGARD Maintenance in Serv. of High Temp. Parts Jan. 1982 7 p refs

Avail: NTIS HC A08/MF A01

The repair of incipiently cracked turbine components is essentially limited to non-rotating parts. Repairs to rotating parts are carried out on low-stressed areas, such as seals, only. In this case, weld build-up has proved to be a suitable process. Stator vanes can be high-temperature brazed following reduction annealing. However, problems are encountered when it comes to making sure of the complete removal of oxides. A highly promising method for increasing the reliability of turbine blades that have been in service lies in their regeneration by heat treatment or HIP-processing. Results to date are so positive that the use of regenerated blades may be a reality in the near future. However, a prerequisite for the use of these repair procedures is a guarantee of reliability and a knowledge of the stresses that occur during operation. A.R.H.

N82-22187# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).

COMBAT AIRCRAFT MANOEUVRABILITY

Dec. 1981 242 p refs In ENGLISH and FRENCH Proceedings of the Flight Mechanics Panel Symp., Florence, 5-8 Oct. 1981 (AGARD-CP-319; ISBN-92-835-0304-X) Avail: NTIS HC A11/MF A01

The symposium reviewed the operational requirements for combat aircraft maneuverability, technical prospects for maneuverability improvements, and prediction and assessment methods and their value.

N82-22188# Service Techniques des Programmes Aeronautiques, Paris (France). Section Etudes Generalles.

A REVIEW OF RECENT AGARD SYMPOSIA ON THE ANGLE OF MANEUVERABILITY OF COMBAT AIRCRAFT [RETROSPECTIVE DE RECENTS SYMPOSIUMS AGARD SOUS L'ANGLE DE LA MANOEUVRABILITE DES AVIONS DE COMBAT]

Jean-Michel Duc (Service des Recherches/Groupe 6) and Michel Vergne *In* AGARD Combat Aircraft Maneuverability Dec. 1981 50 p refs In FRENCH

Avail: NTIS HC A11/MF A01

The notion of maneuverability, in terms of flight mechanics, as it was treated at meetings of the Fluid Dynamics and Fluid Mechanics Panels during the past ten years is reviewed. Each point discussed is illustrated by graphics taken from previously cited AGARD proceedings. Operational needs, hopes for improvement, methods for prediction, and methods for evaluation of flight qualities at high incidence are examined. A.R.H.

N82-22189# Royal Netherlands Air Force, Soesterberg.

REVIEW OF PRACTICAL EXPERIENCE ON COMBAT AIRCRAFT MANEUVERABILITY

A. W. Henni *In* AGARD Combat Aircraft Maneuverability Dec. 1981 8 p

Avail: NTIS HC A11/MF A01

Based upon practical experience in both air to air and air to ground operations with F-84F, F-104G, and NF-5 fighter aircraft, an assessment is given of the importance of combat aircraft maneuverability. In air to ground operations the effect of limited maneuverability on tactics is treated in terms of speed/altitude and maneuverability requirements during ingress/egress and weapon delivery, in relation to attack effectiveness and survivability against enemy defenses. For air to air operations the parameters that influence the outcome of a maneuvering flight are identified. The relation between maneuverability and tactics is discussed. It is concluded that the impact of maneuverabilty on mission effectiveness becomes less prominent at increasing total number of air to air capable aircraft, fighting in a limited airspace. Dependent on the type of operation, desirable improvements in maneuverability are discussed with emphasis on turn performance (at low speeds), rapid speed changes and direct force generation. In this context human tolerance limits are taken into account. It is stressed that the main problems confronting a fighter pilot in the Central European environment are not related to maneuverability but to the availability of military subsystems. M.G.

N82-22190# Naval Air Systems Command, Washington, D. C.

THE MILITARY FLYING QUALITIES SPECIFICATION, A HELP OR A HINDRANCE TO GOOD FIGHTER DESIGN

Ralph C. AHarrah and Robert J. Woodcock (AFWAL, Wright-Patterson AFB, Ohio) *In* AGARD Combat Aircraft Maneuverability Dec. 1981 13 p refs

Avail: NTIS HC A11/MF A01

Based on experience with Air Force and Naval aircraft, the current qualities specification is evaluated for application to a future fighter design. Analog and digital fly by wire flight control system having multiple redundancy levels and significant control law variation are discussed. Some specific observations are shared on the following topics with regard to the flying qualities in general and the specification in particular time delays, force commands, forward loop integration, high gains, signal blending,

equivalent systems, pilot location, high angle of attack, roll performance, and systems integration. In addition, some general observations are made on the use of MIL-P-8785B, and a Navy conducted survey on the effectiveness of the flying qualities specification is discussed. M.G.

N82-22191# Systems Technology, Inc., Hawthorne, Calif.
DEVELOPMENT OF A TENTATIVE FLYING QUALITIES CRITERION FOR AIRCRAFT WITH INDEPENDENT CONTROL OF SIX DEGREES OF FREEDOM: ANALYSIS AND FLIGHT TEST
Roger H. Hoh, Thomas T. Myers, and Irving L. Ashkenes *In* AGARD Combat Aircraft Maneuverability Dec. 1981 12 p refs
(Contract F33615-78-C-3616)
Avail: NTIS HC A11/MF A01

A tentative flying qualities specification for aircraft having direct force effectors that allow independent control over the horizontal and vertical degrees of freedom is presented. Since the primary problem with developing flying qualities for such aircraft is their unconventional responses as reflected in a very incomplete data base. A limited flight test of a direct force control (OFC) aircraft was performed. The requirements are based on fundamental aspects of OFC pilot/vehicle dynamics to insure universal applicability. A bandwidth hypothesis is described which makes the fundamental assumption that the primary factor in the pilot's evaluation of a DFC mode is his ability to exert tight control to minimize errors and thereby achieve improved closed loop tracking performance. The bandwidth is a measure of the maximum frequency at which such closed loop tracking can take place without threatening stability. It follows that airplanes capable of operating at a large value of bandwidth will have superior performance. M.G.

N82-22192# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
EXPERIMENTAL FLIGHT TEST PROGRAMS FOR IMPROVING COMBAT AIRCRAFT MANEUVERABILITY BY MANEUVER FLAPS AND PYLON SPLIT FLAPS
D. Jacob, D. Welte, and H. Wonnenberg *In* AGARD Combat Aircraft Maneuverability Dec. 1981 11 p refs

Avail: NTIS HC A11/MF A01

Two flight test programs with the Alpha-Jet as test vehicles are described. In the first program the standard wing of the aircraft was replaced by a transonic wing with maneuver flaps. Wind tunnel and flight test results are presented which show the increase in performance and maneuverability based on the improved drag polars and buffet limits. In the second program pylon split flaps were to provide flat turn and side step maneuvers by an alternating deflection of the four left or right split flaps. A drag modulation mode is ralized by symmetrical deflection of all eight flaps. M.G.

N82-22193*# Purdue Univ., Lafayette, Ind. School of Aeronautics and Astronautics.
MULTIVARIABLE CLOSED LOOP CONTROL ANALYSIS AND SYNTHESIS FOR COMPLEX FLIGHT SYSTEMS
David K. Schmidt *In* AGARD Combat Aircraft Maneuverability Dec. 1981 13 p refs

(Grants NAG4-1; AF-AFOSR-0042-72)
Avail: NTIS HC A11/MF A01

A flight control system analysis and synthesis method is presented that is intended to be especially suitable for application to vehicles exhibiting complex dynamic characteristics. For such vehicles quantitative handling qualities specifications are not usually available. Howver, handling qualities objectives are specifically introduced in this method via the hypothesis of correlation between pilot ratings and the objective function of an optimal control model of the human pilot. Further, since augmentation and pilot operate in parallel, simultaneous determination of the augmentation and pilot model gains is required. Desirable augmented dynamics are obtained for a variety of complex systems and the method is experimentally verified in the case of simple pilot damper gain selection for optimum pitch tracking performance. M.G.

N82-22194# General Dynamics/Fort Worth, Tex. Engineering Div.
INTEGRATION OF AVIONICS AND ADVANCED CONTROL TECHNOLOGY
M. E. Waddoups and C. A. Anderson *In* AGARD Combat Aircraft Maneuverability Dec. 1981 4 p

Avail: NTIS HC A11/MF A01

Two seemingly exclusive requirements, low cost tactical fighters and night under the weather operations, are being merged by means of advanced technology. The key operational problem is forced by the extremely difficult timeline for low altitude, high speed, air to surface weapon delivery. The inherent economy of single seat operation can be developed by automation. The key technological problems are caused by the lack of volume in a small fighter. In order to achieve automation of the required tasks, flight path control and sensor interfaces must be developed. Based upon emerging hardware and software technology, flight control and avionic subsystems can be optimized and integrated to achieve capability previously unavailable to small fighters. R.J.F.

N82-22195# Royal Aircraft Establishment, Farnborough (England). Flight Systems Dept.
ENHANCED PILOTING CONTROL THROUGH COCKPIT FACILITIES AND A.C.T.
D. J. Walker (British Aerospace P.L.C., Brough, U.K.) and P. W. J. Fullam *In* AGARD Combat Aircraft Maneuverability Dec. 1981 6 p refs
Avail: NTIS HC A11/MF A01

Total loop control, advanced cockpits, and other aspects of advanced flight control technology are discussed. General maneuvering, force sidestick, depressed roll axis, a nonlinear pitch controller and carefree maneuvering are discussed. R.J.F.

N82-22196*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
THE DEVELOPMENT OF CRYOGENIC WIND TUNNELS AND THEIR APPLICATION TO MANEUVERING AIRCRAFT TECHNOLOGY
E. C. Polhamus and R. F. Boyden *In* AGARD Combat Aircraft Maneuverability Dec. 1981 12 p refs

Avail: NTIS HC A11/MF A01

The cryogenic wind tunnel and its potential for advancing maneuvering aircraft technology is discussed. A brief overview of the cryogenic wind tunnel concept and the capabilities and status of the Langley cryogenic facilities is given, as is a review of the considerations leading to the selection of the cryogenic concept such as capital and operating costs of the tunnel, model and balance construction implications, and test condition. Typical viscous, compressibility and aeroelastic effects encountered by maneuvering aircraft are illustrated and the unique ability of the cryogenic wind tunnels to isolate and investigate these parameters while simulating full scale conditions is discussed. The status of the Langley cryogenic wind tunnel facilities is reviewed and their operating envelopes described in relation to maneuvering aircraft research and development requirements. The status of cryogenic testing technology specifically related to aircraft maneuverability studies including force balances and buffet measurement techniques is discussed. Included are examples of research carried out in the Langley 0.3 meter transonic cryogenic wind tunnel to verify the various techniques. R.J.F.

N82-22197# Institut de Mecanique des Fluides de Lille (France).
STATE OF THE ART AND RECENT PERSPECTIVES ON THE STUDY OF THE LOSS OF CONTROL AND SPIN [ETAT DE L'ART ET PERSPECTIVES NOUVELLES RELATIVES A L'ETUDE DE LA PERTE DE CONTROLE ET DES VRILLES]

M. G. Vanmansart and D. R. Tristrant *In* AGARD Combat Aircraft Maneuverability Dec. 1981 18 p refs In FRENCH; ENGLISH summary

Avail: NTIS HC A11/MF A01

Some experimental and analysis methods which contribute to aircraft behavior prediction at high angles and during stall-spin are discussed. A brief review of the methods, their limitations and the expected results, is given, illustrated with a few examples. R.J.F.

N82-22198# Office National d'Etudes et de Recherches

Aerospatiales, Paris (France).
APPLICATION OF THE THEORY OF BIFURCATIONS TO THE STUDY OF THE LOSS OF CONTROL IN COMBAT AIRCRAFT [APPLICATION DE LA THEORIE DS BIFURCATIONS A L'ETUDE DES PERTES DE CONTROLE SUR AVION DE COMBAT]
Phillipe Guicheteau *In* AGARD Combat Aircraft Maneuverability Dec. 1981 13 p refs In FRENCH

Avail: NTIS HC A11/MF A01

Aircraft motion can be described in a rigorous manner by a nonlinear differential system, depending on parameters, joining variables of state (incidence, side-slip, speed ...) and variable control (positioning of rudders) by means of equations of flight mechanics and an aerodynamic model. The proposed method consists of determining the stability limits of the system, and of predicting the evolution of that which becomes unstable. It is based on the theory of bifurcation of nonlinear differential systems. A.R.H.

N82-22199# Vought Corp., Dallas, Tex. Aerodynamics Div.
PREDICTIONS OF AERODYNAMIC CHARACTERISTICS OF HIGHLY MANEUVERABLE CONFIGURATIONS
W. B. Brooks and T. D. Beatty *In* AGARD Combat Aircraft Maneuverability Dec. 1981 6 p refs

Avail: NTIS HC A11/MF A01

The ability of a variety of currently available methods to predict the lateral/directional characteristics of arbitrary configurations is discussed. The programs surveyed generally had either nonlinear or arbitrary body capability, but not both. Published comparisons between the hypersonic arbitrary body program and experimental data suggested a direct extension of the commonly used Allen-Jorgenson cross flow analogy to arbitrary bodies. Though useful, this extension of the Allen-Jorgenson method did not include dynamic pressure losses on aft lifting surfaces. An examination of a nonlinear approach which computes the forces on a combined body/separated region contour and corrects these forces by an empirical momentum deficit in the separated region was begun. For axisymmetric bodies the method reduces to the standard Allen-Jorgenson cross flow approach. Two potentially major advantages over the Allen-Jorgenson method are that the method does provide a model for predicting body fin interaction and that the method is extendable to arbitrary bodies. R.J.F.

N82-22200# British Aerospace Aircraft Group, Preston (England). Aerodynamics Dept.
AEROELASTIC TAILORING FOR CONTROL AND PERFORMANCE: ARE REQUIREMENTS COMPATIBLE?
D. Booker *In* AGARD Combat Aircraft Maneuverability Dec. 1981 4 p refs
Avail: NTIS HC A11/MF A01

The variations of camber and twist along a wing required for optimum performance in low 'g' (cruise) and high 'g' (combat) flight are discussed. It is shown that a wing with active leading edge and trailing edge maneuverer devices scheduled with angle of attack, and structurally tailored to control aeroelastic bending and torsion, can approach optimum performance. However the torsional stiffness of such a wing may be too low for satisfactory roll control at high airspeeds in supersonic flight. Some compromise to performance is implied if torsional stiffness has to be increased to provide adequate control capability. Author

N82-22201# Northrop Corp., Hawthorne, Calif. Aircraft Div.
TAIL CONFIGURATIONS FOR HIGHLY MANEUVERABLE COMBAT AIRCRAFT
W. E. Fellers, W. S. Bowman, and P. T. Wooler *In* AGARD Combat Aircraft Maneuverability Dec. 1981 18 p

Avail: NTIS HC A11/MF A01

The drag due to lift, maximum lift, and stability and control characteristics of tailless, canard, and aft tail configurations of highly maneuverable combat aircraft, using both aerodynamic surfaces and vectored thrust for pitch control are evaluated. The same low aspect ratio wing planform was used on all the configurations. Control configured vehicle concepts were employed. Variable wing camber employing leading edge and trailing edge flaps was used to reduce profile drag. The center of gravity was located as far aft as allowed by the stability and control criteria, in order to reduce subsonic and supersonic trim drag. The critical pitch control criterion was found to be the providing of adequate nose down pitch acceleration in the angle of attack region near maximum lift. The aft center of gravity limits for both tailless and canard configurations without pitch thrust vectoring were required to be forward of the optimum location for minimum subsonic maneuver trim drag. The aft tail configuration was not limited in this manner. In addition it could attain a higher subsonic maximum lift. It also had a greater design flexibility since the aft center of gravity limit could be influenced by the tail area. For these reasons it was the preferred configuration. B.W.

N82-22202# Avions Marcel Dassault-Breguet Aviation, Saint-Cloud (France).
EVALUATION OF AIRCRAFT IN SIMULATED COMBAT: COMPUTER AGAINST COMPUTER OR COMPUTER AGAINST HUMAN PILOT [EVALUATION D'AVIONS EN COMBAT SIMULE CALCULATEUR CONTRE CALCULATEUR OU CALCULATEUR CONTRE PILOTE HUMAIN]
J. Pedotti and Y. Hignard (Centre Electronique de l'Armement) *In* AGARD Combat Aircraft Maneuverability Dec. 1981 14 p refs In FRENCH
Avail: NTIS HC A11/MF A01

A program was developed for simulating one aircraft in combat with another. The adaptive logic of aerial maneuvers (LAMA) program was validated by theoretical studies and by pilot/model tests on the CELAR simulator. The program permits either an entirely numerical model or a simulation of interactive hostility against a pilot on a simulator. Not only does the program provide a means for studying new weapons systems, it also provides a hostile performer for training pilots. A.R.H.

N82-22203# Grumman Aerospace Corp., Bethpage, N.Y. Research Dept.
THE ASSESSMENT OF AIRCRAFT COMBAT EFFECTIVENESS USING A NEW COMPUTATIONAL METHOD
Michael Falco and Gilbert Carpenter *In* AGARD Combat Aircraft Maneuverability Dec. 1981 11 p refs Sponsored in part by Army Aviation Research and Development Command

Avail: NTIS HC A11/MF A01

A computational method for the assessment of aircraft combat effectiveness in the design concept phase is discussed. The approach employs a stochastic learning method, in conjunction with dynamic simulation, to derive aircraft maneuver strategies in the form of a feedback control based upon a discretized set of threat visual or warning system cues. The derived strategies maximize either survival probability of kill probability in the one on one setting. Computational results are presented for selected aircraft designs in missile and gun combat. B.W.

N82-22204# McDonnell-Douglas Corp., St. Louis, Mo. Operations Analysis Dept.
EVALUATION OF DIRECT FORCE MODE FIGHTERS BY COMBAT SIMULATION
C. H. Guthrie *In* AGARD Combat Aircraft Maneuverability Dec. 1981 13 p
Avail: NTIS HC A11/MF A01

Advanced fighter concepts which have been significantly influenced by air combat simulation are discussed. Both man in the loop and digital combat simulation are excellent tools for developing and screening advanced fighter concepts. One important application is the evaluation of fighters with high authority aerodynamic and propulsive controls. Manned and digital air combat simulations showed that high authority controls substantially increase combat effectiveness when used both for enhance large scale maneuverability and for automatic pointing of the fuselage. Digital simulation showed that fighters with high authority direct force modes require lower sustained load factors than conventional designs for a constant level of effectiveness in close in combat. Therefore, fighters with direct force modes can be lighter and less expensive than conventional aircraft. In a manned simulation of close in combat, single fighters with several levels of aerodynamic and propulsion control authority were flown against two threat fighters of equal instantaneous sustained turn rate capability and with identical avionics and armament. For the fighter configured with the highest authority controls, many measures of engagement control and effectiveness were double those of the conventional (baseline) fighter. B.W.

N82-22205# British Aerospace Aircraft Group, Preston (England).

THE STUDY OF COMBAT AIRCRAFT MANEUVERABILITY BY AIR TO AIR COMBAT SIMULATION
A. G. Barnes *In* AGARD Combat Aircraft Maneuverability Dec. 1981 9 p
Avail: NTIS HC A11/MF A01

Air to air combat by ground based simulation and its contribution to the design, development and operational use of combat aircraft is evaluated. The merits of different aircraft/missile combinations can be assessed under controlled conditions with pilot involvement. Parameters which influence maneuverability, such as sustained turn rate, attained turn rate, and SEP can be easily varied, and translated into combat success. The relative importance of these parameters are discussed in the light of experimental results. B.W.

N82-22206*# Old Dominion Univ., Norfolk, Va. Dept. of Mechanical Engineering and Mechanics.
AERODYNAMIC PERFORMANCE OF SLENDER WINGS WITH SEPARATED FLOWS Technical Report, period ending 31 Dec. 1981
C. Subba Reddy Mar. 1982 64 p refs
(Grant NsG-1561)
(NASA-CR-168768; NAS 1.26:168768) Avail: NTIS HC A04/MF A01 CSCL 01A

The aerodynamic performance of low aspect ratio sweptback wings with vortex flows was numerically investigated using the free vortex sheet method. The models studied included flat, cambered, strake, and leading edge flapped wings of different planforms. The theoretical results predicted by the method were compared with the existing experimental data wherever available; and the code capabilities and limitations were explored. Also the effects of the wing thickness, fuselage, leading edge flap and multiple vortex modeling on the aerodynamic characteristics were studied. Author

N82-22207*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
WIND-TUNNEL INVESTIGATION OF THE POWERED LOW-SPEED LONGITUDINAL AERODYNAMICS OF THE VECTORED-ENGINE-OVER (VEO) WING FIGHTER CONFIGURATION
John W. Paulson, Perry D. Whitten (General Dynamics Corp., Fort Worth, Tex.), and Stephen C. Stumpfl (AFWAL) Mar. 1982 274 p refs
(NASA-TM-83263; NAS 1.15:83263) Avail: NTIS HC A12/MF A01 CSCL 01A

A wind-tunnel investigation incorporating both static and wind-on testing was conducted in the Langley 4- by 7-Meter Tunnel to determine the effects of vectored thrust along with spanwise blowing on the low-speed aerodynamics of an advanced fighter configuration. Data were obtained over a large range of thrust coefficients corresponding to takeoff and landing thrust settings for many nozzle configurations. The complete set of static thrust data and the complete set of longitudinal aerodynamic data obtained in the investigation are presented. These data are intended for reference purposes and, therefore, are presented without analysis or comment. The analysis of the thrust-induced effects found in the investigation are not discussed. Author

N82-22209*# Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Mechanical Engineering, Aeronautical Engineering and Mechanics.
INVESTIGATION OF PASSIVE SHOCK WAVE-BOUNDARY LAYER CONTROL FOR TRANSONIC AIRFOIL DRAG REDUCTION Final Report, 1 Oct. 1979 - 30 Sep. 1981
H. T. Nagamatsu, W. B. Brower, Jr., L. Bahi, and J. Ross Apr. 1982 204 p refs
(Grant NsG-1624)
(NASA-CR-168844; NAS 1.26:168844) Avail: NTIS HC A10/MF A01 CSCL 01A

The passive drag control concept, consisting of a porous surface with a cavity beneath it, was investigated with a 12-percent-thick circular arc and a 14-percent-thick supercritical airfoil mounted on the test section bottom wall. The porous surface was positioned in the shock wave/boundary layer interaction region. The flow circulating through the porous surface, from the downstream to the upstream of the terminating shock wave location, produced a lambda shock wave system and a pressure decrease in the downstream region minimizing the flow separation. The wake impact pressure data show an appreciably drag reduction with the porous surface at transonic speeds. To determine the optimum size of porosity and cavity, tunnel tests were conducted with different airfoil porosities, cavities and flow Mach numbers. A higher drag reduction was obtained by the 2.5 percent porosity and the 1/4-inch deep cavity. T.M.

N82-22211*# Boeing Commercial Airplane Co., Seattle, Wash.
AERODYNAMIC ANALYSIS OF VTOL INLETS AND DEFINITION OF A SHORT, BLOWING-LIP INLET Final Report
J. Syberg and A. L. Jones Apr. 1982 61 p refs
(Contract NAS3-22369)
(NASA-CR-165617; NAS 1.26:165617; D6-51418) Avail: NTIS HC A04/MF A01 CSCL 01A

The results indicated that, without boundary layer control, either a very long inlet or an inlet with a very high contraction ratio lip will be required to meet the stringent design requirements. It is shown that active boundary layer control is an effective means of preventing separation and that a significant reduction in inlet size can be achieved by removing only a small amount of bleed in the throat region of the inlet. A short, blowing-lip model was designed and fabricated. This model features an adjustable, blowing slot located near the hilite on the windward side of the inlet. T.M.

N82-22212# National Aerospace Lab., Tokyo (Japan). Noise and Emission Research Group.
AERODYNAMIC CHARACTERISTICS OF THE EXTERNAL USB POWERED LIFT SYSTEM USING SIDE FENCES FOR ENHANCEMENT OF COANDA FLOW ATTACHMENT
Masataka Maita, Hirotoshi Fujieda, and Shigemi Shindo Oct. 1981 20 p refs
(NAL-TR-686T; ISSN-0389-4010) Avail: NTIS HC A02/MF A01

The fundamental aspects concerning the effect of side fences on powered lift augmentation for the external upper surface blowing (USB) propulsive-lift configuration, as ascertained by wind tunnel experiment, are presented. From the comparisons of aerodynamic performances made of configurations using side fences and of those using either vortex generators or using no special devices, it is concluded that the USB propulsive-lift concept using side fences for enhancement of engine exhaust flow attachment has promising potential for attaining very high and efficient powered lift performances. M.G.

N82-22213*# Bihrle Applied Research, Inc., Jericho, N. Y.
ANALYSIS OF ROTARY BALANCE DATA FOR THE F-15 AIRPLANE INCLUDING THE EFFECT OF CONFORMAL FUEL TANKS
Billy Barnhart Washington NASA Apr. 1982 71 p refs
(Contract NAS1-16205)
(NASA-CR-3479; NAS 1.26:3479) Avail: NTIS HC A04/MF A01 CSCL 01A

F-15 rotary balance data was analyzed, and the influence of control deflections, Reynolds number and airplane components, i.e., body, wing, horizontal and vertical tails, as well as conformal tanks, on the aerodynamics up to 90 degrees angle of attack are discussed. Steady state spin mode predictions using these data are presented, which show excellent correlation with spin tunnel and flight test results. Generally, the data shows damped yawing moment slopes with rotation at all angles of attack, and good control effectiveness. Differences in the rotary aerodynamics due to the addition of conformal tanks are minimal. The small differences in the region of the flat spin do, however, indicate that the resulting spin mode would be slightly flatter and faster for a conformal tank equipped airplane. The addition of conformal tanks make the airplane more departure susceptible. S.L.

N82-22217*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
EFFECT OF NACELLES ON AERODYNAMIC CHARACTERISTICS OF AN EXECUTIVE-JET MODEL WITH SIMULATED, PARTIAL-CHORD, LAMINAR-FLOW-CONTROL WING GLOVE
Richard L. Campbell Apr. 1982 104 p refs
(NASA-TM-83271; L-14982; NAS 1.15:83271) Avail: NTIS HC A06/MF A01 CSCL 01A

Tests were conducted in the Langley High-Speed 7- by 10-Foot Tunnel using a 1/10-scale model of an executive jet to examine the effects of the nacelles on the wing pressures and model longitudinal aerodynamic characteristics. For the present investigation, each wing panel was modified with a

simulated, partial-chord, laminar-flow-control glove. Horizontal-tail effects were also briefly examined. The tests covered a range of Mach numbers from 0.40 to 0.82 and lift coefficients from 0.20 to 0.55. Oil-flow photographs of the wing at selected conditions are included. Author

N82-22223# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Entwurfsaerodynamik.

DRAG REDUCTION USING PNEUMATIC TURBULATORS

Karl-Heinz Horstmann and Armin Quast Sep. 1981 54 p refs In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-743)

(DFVLR-FB-81-33) Avail: NTIS HC A04/MF A01; DFVLR, Cologne DM 11,40

Reduction of the additional drag, caused by laminar separation bubbles in airfoils and fuselages at Reynolds numbers below 5 million, was investigated theoretically and experimentally. By blowing from a row of holes located at the separation line, the laminar bubble is destroyed and drag is reduced considerably. Drag reduction due to blowing is naturally smaller at lower Reynolds numbers, the bubbles being smaller. The Reynolds number range with low section drag increases if pneumatic turbulators are used in the profile design. Author (ESA)

N82-22224# National Aerospace Lab., Amsterdam (Netherlands). Flight Dynamics Div.

AEROELASTIC PROPERTIES OF WINGS IN TRANSONIC FLOW

R. J. Zwaan 24 Feb. 1981 51 p refs Presented at Lecture Ser. on Unsteady Airloads and Aeroelastic Probl. in Separated and Transonic Flow, Rhode-St.-Genese, Belgium, 9-13 Mar. 1981

(NLR-MP-81005-U) Avail: NTIS HC A04/MF A01

Literature on transonic flutter characteristics of wings, especially the transonic dip phenomenon in the flutter boundaries, was reviewed. The transonic dip occurs most distinctly with sweptback wings. The dip is caused by the phase lag of the lift due to the fundamental wing bending mode and corresponds to a single-mode flutter mechanism. The dip can be predicted qualitatively using methods for inviscid transonic unsteady air loads. Quasi-steady transonic methods are not wholly reliable. The dip becomes relatively deeper with increasing wing-to-air mass ratio. The dip can become more pronounced for a supercritical wing than for a conventional wing. The dip occurs at design conditions as well as off-design conditions. In case of flow separation, a narrow dip which depends strongly on boundary layer conditions and the spatial distribution of the separated flow can occur. Author (ESA)

N82-22225# Societe Nationale Industrielle Aerospatiale, Marignane (France.) Helicopter Div.

AEROSPATIALE SURVEY OF WIND TUNNEL TESTING OF SMALL AND LARGE SCALE ROTORS

J. P. Silvani and A. Vuillet Paris 1981 17 p refs Presented at the 7th European Rotocraft And Powered Lift Aircraft Forum, Garmisch-Partenkirchen, West Germany 8-11 Sep. 1981; sponsored by DFVLR, Cologne

(SNIAS-821-210-107) Avail: NTIS HC A02/MF A01

Wind tunnel tests on Mach scaled rotors (1/10 and 1/3) capable of a wide range of shaft angle settings are summarized. The 1/3 model hub is fitted with a swashplate, general and cyclic inputs. Continuous conversion of a tilt rotor was achieved. Speeds > 500 km/hr were attained with conventional rotors. During autorotation high lift coefficients are obtained without major drag penalties. The OA family 2-D airfoils characteristic improvements were checked. Results show good behaviour throughout the entire rotor flight envelope; a 3% improvement on the rotor figure of merit at nominal thrust in hover; a 9% power improvement at nominal thrust and 300 km/hr in level fight; and 12% maximum thrust improvement at stall. Author (ESA)

N82-22227*# Douglas Aircraft Co., Inc., Long Beach, Calif.

TRANSPORT AIRCRAFT ACCIDENT DYNAMICS Final Technical Report, 11 Feb. 1980 - Mar. 1982

A. Cominsky Atlantic City FAA Mar. 1982 178 p

(Contract NAS1-16111)

(NASA-CR-165850; FAA-RD-74-12; NAS 1.26:165850) Avail: NTIS HC A09/MF A01 CSCL 01C

A study was carried out of 112 impact survivable jet transport aircraft accidents (world wide) of 27,700 kg (60,000 lb.) aircraft and up extending over the last 20 years. This study centered on the effect of impact and the follow-on events on aircraft structures and was confined to the approach, landing and takeoff segments of the flight. The significant characteristics, frequency of occurrence and the effect on the occupants of the above data base were studied and categorized with a view to establishing typical impact scenarios for use as a basis of verifying the effectiveness of potential safety concepts. Studies were also carried out of related subjects such as: (1) assessment of advanced materials; (2) human tolerance to impact; (3) merit functions for safety concepts; and (4) impact analysis and test methods. Author

N82-22228*# Boeing Aerospace Co., Houston, Tex.

A SYSTEM SAFETY MODEL FOR DEVELOPMENTAL AIRCRAFT PROGRAMS

Emil J. Amberboy and Robert L. Stokeld Washington NASA Apr. 1982 84 p refs

(Contract NAS2-10361)

(NASA-CR-3534; NAS 1.26:3534) Avail: NTIS HC A05/MF A01 CSCL 01C

Basic tenets of safety as applied to developmental aircraft programs are presented. The integration of safety into the project management aspects of planning, organizing, directing and controlling is illustrated by examples. The basis for project management use of safety and the relationship of these management functions to 'real-world' situations is presented. The rationale which led to the safety-related project decision and the lessons learned as they may apply to future projects are presented. N.W.

N82-22229# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany). Abteilung Flugverkehrswissenschaft.

DEVELOPMENTAL POSSIBILITIES AND RESTRICTIONS IN AIR TRANSPORT

Aug. 1981 91 p In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-744)

(DFVLR-Mitt-81-9) Avail: NTIS HC A05/MF A01; DFVLR, Cologne DM 16,20

The possibilities of creating or maintaining an efficient air transport system in the present political, economical and technical situation were assessed. Future developments in demand and supply in commercial air transport and questions related to transport policy, airport planning and supply organization of air carriers are discussed.

N82-22230# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany). Abteilung Flugverkehrswissenschaft.

DEVELOPMENTAL POSSIBILITIES IN CIVIL AVIATION IN THE FEDERAL REPUBLIC OF GERMANY [ENTWICKLUNGSMOEGLICHKEITEN IM GEWERBLICHEN LUFTVERKEHR DER BUNDESREPUBLIK DEUTSCHLAND]

H.-G. Nuesser *In its* Develop. Possibilities and Restrictions in Air Transport Aug. 1981 p 11-46 In GERMAN

Avail: NTIS HC A05/MF A01; DFVLR, Cologne DM 16,20

The results of a prognosis was made on the evolution of air traffic until the year 2000 in Germany. Travel motives, flight type, region, season and traffic paths are forecasted. Data are used to derive the required evolution in the supply of passenger and cargo flights. The forecast includes a 5% annual increase in passenger traffic, reaching in the year 2000 a total number of some 765,000 starts and take offs at a seating capacity of about 60%. Forecasts for individual airports are also included. Author (ESA)

N82-22232# Flughafen G.m.b.H., Hamburg (West Germany).

TRAFFIC INTRASTRUCTURE: CAN PLANNING STILL BE CARRIED THROUGH [VERKEHRSINFRASTRUKTUR: IST PLANUNG NOCH DURCHSTEZBAR?]

U. Christiansen *In* DFVLR Develop. Possibilities and Restrictions in Air Transport Aug. 1981 p 61-66 In GERMAN

Avail: NTIS HC A05/MF A01; DFVLR, Cologne DM 16,20

The problems facing German airport authorities in planning either to extend existing, or to create new airports are analyzed. In addition to the growing environmental awareness by the public, the procedures for approval at various administrative and juridical

levels are identified as the major reason for the considerable delays encountered in recent projects. Several proposals are formulated for simplification and shortening these procedures.
Author (ESA)

N82-22236# National Transportation Safety Board, Washington, D. C.
SPECIAL INVESTIGATION REPORT: EVACUATION OF UNITED AIRLINES DC-8-61, SKY HARBOR INTERNATIONAL AIRPORT, PHOENIX, ARIZONA, DECEMBER 29, 1980
9 Sep. 1981 29 p refs
(PB82-115619; NTSB-SIR-81-4) Avail: NTIS HC A03/MF A01 CSCL 01B

On December 29, 1980, United Airlines Charter Flight 5820, a DC-8-61, with 238 passengers and a crew of 9, was evacuated at Sky Harbor International Airport, Phoenix, Arizona, when the failure of the rear landing gear bogie beam resulted in a fire in the aircraft's right main landing gear. The cockpit crew was erroneously advised of an engine fire by the airport tower and began emergency shutdown procedures. The captain initiated the evacuation after all electrical power had been shut down and the public address and cabin interphone systems were without power. Therefore, the second officer had to give the evacuation orders to passengers and flight attendants by 'word of mouth'. As a result of its special investigation and its previous work on the subject of evacuations, the Safety Board has made recommendations to the Federal Aviation Administration to improve the availability of emergency communication equipment and to promote its use. GRA

N82-22237# National Transportation Safety Board, Washington, D. C.
REVIEW OF ROTORCRAFT ACCIDENTS 1977-1979
11 Aug. 1981 59 p
(PB82-115601; NTSB-AAS-81-1) Avail: NTIS HC A04/MF A01 CSCL 01B

Accident data on the rotorcraft, pilots and operating environment which may be most useful to designers, manufacturers, operators and regulators are presented. Tables and graphs presenting accident statistics, cause/factors, rotorcraft make and model data, pilot experience and weather conditions are included. GRA

N82-22238*# Ohio State Univ., Columbus.
A TACTUAL DISPLAY AID FOR PRIMARY FLIGHT TRAINING Final Report, 1 Jul. 1975 - 15 Dec. 1978
Richard D. Gilson Jul. 1979 76 p refs
(Contract NAS2-8954)
(NASA-CR-166242; NAS 1.26:166242) Avail: NTIS HC A05/MF A01 CSCL 01D

A means of flight instruction is discussed. In addition to verbal assistance, control feedback was continously presented via a nonvisual means utilizing touch. A kinesthetic-tactile (KT) display was used as a readout and tracking device for a computer generated signal of desired angle of attack during the approach and landing. Airspeed and glide path information was presented via KT or visual heads up display techniques. Performance with the heads up display of pitch information was shown to be significantly better than performance with the KT pitch display. Testing without the displays showed that novice pilots who had received tactile pitch error information performed both pitch and throttle control tasks significantly better than those who had received the same information from the visual heads up display of pitch during the test series of approaches to landing. Author

N82-22239*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
EFFECTS OF CABLE GEOMETRY AND AIRCRAFT ATTITUDE ON THE ACCURACY OF A MAGNETIC LEADER CABLE SYSTEM FOR AIRCRAFT GUIDANCE DURING ROLLOUT AND TURNOFF
W. Thomas Bundick Apr. 1982 32 p refs
(NASA-TP-1978; L-14975; NAS 1.60:1978) Avail: NTIS HC A03/MF A01 CSCL 17G

A theoretical analysis of a single wire magnetic leader cable system for aircraft rollout and turnoff guidance was performed to determine the errors produced by the leader cable installation geometry and aircraft attitude. It was found that errors in the measurement of lateral displacement from the cable are smaller than errors in the measurement of aircraft heading and that both errors are smallest at or near the cable. Author

N82-22240*# California Univ., Berkeley. Inst. of Transportation Studies.
MEASURES TO INCREASE AIRFIELD CAPACITY BY CHANGING AIRCRAFT RUNWAY OCCUPANCY CHARACTERISTICS
Geoffrey D. Gosling, Abid Kanafani, and Stephen L. M. Rockaday Dec. 1981 218 p refs
(Grant NAG2-19)
(NASA-CR-168841; NAS 1.26:168841; UCB-ITS-RR-81-7) Avail: NTIS HC A10/MF A01 CSCL 17G

Airfield capacity and aircraft runway occupancy characteristics were studied. Factors that caused runway congestion and airfield crowding were identified. Several innovations designed to alleviate the congestion are discussed. Integrated landing management, the concept that the operation of the final approach and runway should be considered in concert, was identified as underlying all of the innovations. R.J.F.

N82-22241# Aeronautical Research Labs., Melbourne (Australia).
STRAPDOWM INERTIAL NAVIGATION SYSTEMS: AN ALGORITHM FOR ATTITUDE AND NAVIGATION COMPUTATIONS
R. B. Miller 1981 33 p refs
(ARL/Sys-Rept-23; AR-002-265) Avail: NTIS HC A03/MF A01

Vehicle attitude is maintained through quaternions, which are updated by a modified third order method. The navigation part of the algorithm uses a split frame technique whereby body related quantities are evaluated in body axis coordinates, and navigation frame related quantities are evaluated in navigation axis coordinates. The algorithm is partitioned into three sections which are performed at different rates according to the application. T.M.

N82-22242# Royal Aircraft Establishment, Farnborough (England).
AIRFIELD VISUAL AIDS RESEARCH AT THE ROYAL AIRCRAFT ESTABLISHMENT
A. J. Smith 2 Oct. 1981 29 p refs Presented at the 1981 Aviation Lighting Sen., Williamsburg, Virginia, 9-13 Nov. 1981; Sponsored by Illuminating Engineering Society of North America
(RAE-TM-FS-431; BR80893) Avail: NTIS HC A03/MF A01

The precision approach path indicator (PAPI) is described and helicopter lighting aids are discussed. The PAPI system indicates correct glide slope at ranges > 10 km under good visibility conditions and provides information up to 300 m from touchdown. Two color light projector units, consisting of three simple optical projectors side by side in a box, tell the pilot if he is too high, too low, or on slope by the combination of red and white lights. Trials show that it can be used by a wide range of civil and military aircraft, e.g., the VC-10, small private airplanes, or helicopters. A mathematical model which predicts what pilots can see when landing in fog was used in order to optimize proposed approach lighting patterns for helicopters. If the lighting pattern is 730 m long, initial contact is possible at altitudes > 100 m. Lighting trials show that red stop bar lighting and green taxiway centerline need further improvement.
Author (ESA)

N82-22243*# Aeronautical Research Associates of Princeton, Inc., N. J.
ANALYSIS AND FLIGHT EVALUATION OF A SMALL, FIXED-WING AIRCRAFT EQUIPPED WITH HINGED PLATE SPOILERS
John W. Olcott, Edward Sackel, and David R. Ellis Sep. 1981 161 p refs
(Contract NAS2-5589)
(NASA-CR-166247; NAS 1.26:166247) Avail: NTIS HC A08/MF A01 CSCL 01C

The results of a four phase effort to evaluate the application of hinged plate spoilers/dive brakes to a small general aviation aircraft are presented. The test vehicle was a single engine light aircraft modified with an experimental set of upper surface spoilers and lower surface dive brakes similar to the type used on sailplanes. The lift, drag, stick free stability, trim, and dynamic response characteristics of four different spoiler/dive brake configurations were determined. Tests also were conducted, under a wide range of flight conditions and with pilots of various experience levels, to determine the most favorable methods of spoiler control and to evaluate how spoilers might best be used

during the approach and landing task. The effects of approach path angle, approach airspeed, and pilot technique using throttle/spoiler integrated control were investigated for day, night, VFR, and IFR approaches and landings. The test results indicated that spoilers offered significant improvements in the vehicle's performance and flying qualities for all elements of the approach and landing task, provided a suitable method of control was available. Author

N82-22244*# Sinacori (John B.) Associates, Hollister, Calif.
CONCEPTUAL DESIGN STUDY OF A VISUAL SYSTEM FOR A ROTORCRAFT SIMULATOR AND SOME ADVANCES IN PLATFORM MOTION UTILIZATION Final Report
John B. Sinacori Aug. 1980 33 p refs
(Contract NAS2-10278)
(NASA-CR-166322; NAS 1.26:166322) Avail: NTIS HC A03/MF A01 CSCL 14B

A conceptual design of a visual system for a rotorcraft flight simulator is presented. Also, drive logic elements for a coupled motion base for such a simulator are given. The design is the result of an assessment of many potential arrangements of electro-optical elements and is a concept considered feasible for the application. The motion drive elements represent an example logic for a coupled motion base and is essentially an appeal to the designers of such logic to combine their washout and braking functions. Author

N82-22245*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A LINEAR DECOMPOSITION METHOD FOR LARGE OPTIMIZATION PROBLEMS. BLUEPRINT FOR DEVELOPMENT
Jaroslaw Sobieszczanski-Sobieski Feb. 1982 61 p refs
(NASA-TM-83248; NAS 1.15:82348) Avail: NTIS HC A04/MF A01 CSCL 01C

A method is proposed for decomposing large optimization problems encountered in the design of engineering systems such as an aircraft into a number of smaller subproblems. The decomposition is achieved by organizing the problem and the subordinated subproblems in a tree hierarchy and optimizing each subsystem separately. Coupling of the subproblems is accounted for by subsequent optimization of the entire system based on sensitivities of the suboptimization problem solutions at each level of the tree to variables of the next higher level. A formalization of the procedure suitable for computer implementation is developed and the state of readiness of the implementation building blocks is reviewed showing that the ingredients for the development are on the shelf. The decomposition method is also shown to be compatible with the natural human organization of the design process of engineering systems. The method is also examined with respect to the trends in computer hardware and software progress to point out that its efficiency can be amplified by network computing using parallel processors. B.W.

N82-22246*# National Aeronautics and Space Administration, Washington, D. C.
REVOLUTION IN AIRPLANE CONSTRUCTION? GROB G110: THE FIRST MODERN FIBER GLASS COMPOSITION AIRPLANE SHORTLY BEFORE ITS MAIDEN FLIGHT
R. Dorpinghaus Mar. 1982 19 p Transl. into ENGLISH from Aerokurier (West Germany), no. 12, Dec. 1981 p 1550-1555 Transl. by Scientific Translation Service, Santa Barbara, Calif.
(Contract NASw-3542)
(NASA-TM-76705; NAS 1.15:76705) Avail: NTIS HC A02/MF A01 CSCL 01C

A single engine two passenger airplane, constructed completely from fiber reinforced plastic materials is introduced. The cockpit, controls, wing profile, and landing gear are discussed. Development of the airframe is also presented. S.L.

N82-22247*# National Aeronautics and Space Administration, Washington, D. C.
SOCATA: TB 20 TRINIDAD GIVEN GERMAN DEBUT
B. Malzbender Mar. 1982 13 p Transl. into ENGLISH from Aerokurier (West Germany), no. 12, Dec. 1981 p 1543, 1546-1547 Transl. by Scientific Translation Service, Santa Barbara, Calif.
(Contract NASw-3542)
(NASA-TM-76706; NAS 1.15:76706) Avail: NTIS HC A02/MF A01 CSCL 01C

Pilot impressions gained in a first flight in the 250 HP single engine TB 20 prototype aircraft are presented along with aircraft specifications. A.R.H.

N82-22248*# Systems Technology, Inc., Hawthorne, Calif.
FUNCTIONAL REQUIREMENTS FOR THE MAN-VEHICLE SYSTEMS RESEARCH FACILITY
Warren F. Clement, R. Wade Allen, Robert K. Heffley, Wayne F. Jewell, Henry R. Jex, Duane T. McRuer, Ted M. Schulman, and Robert L. Stapleford Oct. 1980 221 p refs
(Contract NAS2-10400)
(NASA-CR-166315; NAS 1.26:166315; TR-1156-3) Avail: NTIS HC A10/MF A01 CSCL 01C

The NASA Ames Research Center proposed a man-vehicle systems research facility to support flight simulation studies which are needed for identifying and correcting the sources of human error associated with current and future air carrier operations. The organization of research facility is reviewed and functional requirements and related priorities for the facility are recommended based on a review of potentially critical operational scenarios. Requirements are included for the experimenter's simulation control and data acquisition functions, as well as for the visual field, motion, sound, computation, crew station, and intercommunications subsystems. The related issues of functional fidelity and level of simulation are addressed, and specific criteria for quantitative assessment of various aspects of fidelity are offered. Recommendations for facility integration, checkout, and staffing are included. A.R.H.

N82-22249*# Systems Technology, Inc., Hawthorne, Calif.
TECHNICAL APPROACHES FOR MEASUREMENT OF HUMAN ERRORS Final Report
Warren F. Clement, Robert K. Heffley, Wayne F. Jewell, and Duane T. McRuer May 1980 140 p refs
(Contract NAS2-10400)
(NASA-CR-166314; NAS 1.26:166314; STI-TR-1156-2) Avail: NTIS HC A07/MF A01 CSCL 01C

Human error is a significant contributing factor in a very high proportion of civil transport, general aviation, and rotorcraft accidents. The technical details of a variety of proven approaches for the measurement of human errors in the context of the national airspace system are presented. Unobtrusive measurements suitable for cockpit operations and procedures in part of full mission simulation are emphasized. Procedure, system performance, and human operator centered measurements are discussed as they apply to the manual control, communication, supervisory, and monitoring tasks which are relevant to aviation operations. S.L.

N82-22250*# Systems Technology, Inc., Hawthorne, Calif.
A THEORY OF HUMAN ERROR Final Report
Duane T. McRuer, Warren F. Clement, and R. Wade Allen May 1980 91 p refs
(Contract NAS2-10400)
(NASA-CR-166313; NAS 1.26:166313; STI-TR-1156-1) Avail: NTIS HC A05/MF A01 CSCL 01C

Human error, a significant contributing factor in a very high proportion of civil transport, general aviation, and rotorcraft accidents is investigated. Correction of the sources of human error requires that one attempt to reconstruct underlying and contributing causes of error from the circumstantial causes cited in official investigative reports. A validated analytical theory of the input-output behavior of human operators involving manual control, communication, supervisory, and monitoring tasks which are relevant to aviation operations is presented. This theory of behavior, both appropriate and inappropriate, provides an insightful basis for investigating, classifying, and quantifying the needed cause-effect relationships governing propagation of human error. B.W.

N82-22251*# National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.
PERFORMANCE TESTING OF A MAIN ROTOR SYSTEM FOR A UTILITY HELICOPTER AT 1/4 SCALE
John D. Berry (Army Aviation Research and Development Command, Langley, Va.) Apr. 1982 49 p refs
(DA Proj. 1L1-61102-AH-45)
(NASA-TM-83274; L-15015; NAS 1.15:83274; AVRADCOM-TR-82-B-3) Avail: NTIS HC A03/MF A01 CSCL 01C

Two rotor systems for the UH-1 helicopter were tested in hover and forward flight. The baseline system was a dynamically

scaled model of the current rotor system, while the other system was designed for advanced performance. In hover out of ground effect, the advanced rotor system shows improvements up to 10 percent in the figure of merit and improvements in thrust up to 7 percent. In forward flight, the advanced rotor system demonstrated reductions in required torque throughout the range of conditions tested, with reductions up to 17 percent occurring at the higher advance ratios and higher lift values tested. T.M.

N82-22252*# Hydraulic Research Textron, Valencia, Calif.
AN ELECTRONIC CONTROL FOR AN ELECTROHYDRAULIC ACTIVE CONTROL LANDING GEAR FOR THE F-4 AIRCRAFT
Final Report
Irving Ross Washington Apr. 1982 92 p refs
(Contract NAS1-16420)
(NASA-CR-3552; NAS 1.26:3552; HR-74600000) Avail: NTIS HC A05/MF A01 CSCL 01C

A controller for an electrohydraulic active control landing gear was developed for the F-4 aircraft. A controller was modified for this application. Simulation results indicate that during landing and rollout over repaired bomb craters the active gear effects a force reduction, relative to the passive gear, or approximately 70%. S.L.

N82-22253# British Aerospace Aircraft Group, Weybridge (England).
TAILOR-MADE STRUCTURES; TODAY, AND TOMORROW: NEW MATERIALS, AN EXPLORATORY INVESTIGATION INTO THEIR POTENTIAL USE
W. J. Bird 16 Apr. 1980 48 p
(BAe-SDW-85/A/104/005) Avail: NTIS HC A03/MF A01

The use of fiber/matrix combinations, e.g. in a nonmetallic airplane, is discussed. The development of fiber/matrix structures is hindered by an absence of design experience, designers whose experience is in metallics rather than textiles, the conservative structures employed, and production times for fiber components. A modular tooling system is proposed. The structural feasibility of the aircraft is established by examining the possibility of constructing VC-10 components in fiber/matrix materials. Author (ESA)

N82-22254# Societe Nationale Industrielle Aerospatiale, Marignane (France.) Helicopter Div.
A COMPLETE METHOD FOR COMPUTATION OF BLADE MODE CHARACTERISTICS AND RESPONSES IN FORWARD FLIGHT
J. P. Lefrancq and B. Masure Paris 1981 10 p refs Presented at 7th European Rotorcraft and Powered Lift Aircraft Forum, Garmisch-Partenkirchen, West Germany 8-11 Sep. 1981; sponsored by DFVLR, Cologne
(SNIAS-821-210-101) Avail: NTIS HC A02/MF A01

The modal approach to rotor dynamic behavior is outlined, and an azimuth method is presented. The azimuth method applies to stabilized flights, in particular those in which rotor configuration is considered repeatable after one revolution. Excitation occurs at rotor frequency (R+F) or at multiples of it. Rotor behavior is developed in a Fourier series of which basic frequency is R+F. The series terms are considered negligible beyond the nth harmonic. Development coefficient counts show that (2n+1) successive positions (azimuths), regularly spread over the revolution, can describe rotor behavior. Accuracy depends on the number n of harmonics retained. The n number selection depends on computer capacity. Author (ESA)

N82-22255# Societe Nationale Industrielle Aerospatiale, Marignane (France.) Helicopter Div.
NAVAL VERSIONS OF THE DAUPHIN AND THE AS 15 TT WEAPON SYSTEM
J. P. Dubreuil Paris 1981 11 p Presented at the 7th European Rotorcraft and Powered Lift Aircraft Forum, Garmisch-Partenkirchen, West Germany, 8-11 Sep. 1981; sponsored by DFVLR, Cologne
(SNIAS-821-210-104) Avail: NTIS HC A02/MF A01

Modifications needed to adapt the Dauphin N helicopter for naval rescue and attack missions are outlined. The antisurface vessel weapon system is described. Maximum continuous engine power is increased from 437 to 468 kW, takeoff power from 492 to 552. Pressure refueling is possible in-flight or on-ground. Blades and fin fold. A hydraulic mooring harpoon is located between the two wheels of the main landing gear. A radar system, adopted from army versions, provides overall accuracy > 3% of distance covered. The tail assembly is watertight. The AS 15 TT has a range > 15 km, is roll stabilized, has a 30 kg warhead, and flies a few m above the surface, descending near the target just before impact. Author (ESA)

N82-22256# Societe Nationale Industrielle Aerospatiale, La Courneuve (France). Helicopter Div.
A LIGHT HELICOPTER FOR NIGHT FIRING
J. F. Candau Paris 1981 19 p Presented at the 7th European Rotorcraft and Powered Lift Aircraft Forum, Garmisch-Partenkirchen, West Germany, 8-11 Sep. 1981; sponsored by DFVLR, Cologne
(SNIAS-821-210-105) Avail: NTIS HC A02/MF A01

An antitank helicopter suitable for night operation over difficult terrain is described. A Dauphin helicopter, equipped with HOT missiles, is treated with low IR reflectance paint and antireflective coating of glazed areas. Jet exhaust is deviated, engine cowlings reduce IR emission. Targets are sought by a passive system of thermal imagery. Outside surroundings are viewed via a nocturnal vision device operating on the light intensification principle. The navigation system is self-contained. The missile is guided by a localizer coupled to, and harmonized with a thermal camera, mounted on a gyrostabilized platform. Tanks are detected up to 4 km and identified up to 2 km. Author (ESA)

N82-22257# Societe Nationale Industrielle Aerospatiale, Marignane (France.) Helicopter Div.
CONCEPT STUDIES OF AN ADVANCED COMPOSITE HELICOPTER FIN
A. Desmonceaux and M. Torres Paris 1981 13 p Presented at the 7th European Rotorcraft and Powered Lift Aircraft Forum, Garmisch-Partenkirchen, West Germany, 8-11 Sep. 1981; sponsored by DFVLR, Cologne
(SNIAS-821-210-106) Avail: NTIS HC A02/MF A01

A composite fin and fan in fin assembly was developed for the Dauphin 2. The structure is made of epoxy resin preimpregnated Kevlar or graphite, single or two direction fiber cloths. A single block construction is used in heavily loaded areas or areas stabilized through a sharp curvature. A sandwich construction with Nomex honeycomb filler is used where loads are less. Static tests and theoretical studies show that maximum thrust is increased by 40% compared with a similar weight metal structure. Production costs are reduced by eliminating a great number of parts and assemblies. Operating costs are lowered by abolishing corrosion risks and improving maintenance through the simpler design. The fail safe composites increase safety. Author (ESA)

N82-22258# Societe Nationale Industrielle Aerospatiale, Marignane (France.) Helicopter Div.
TAIL ROTOR STUDIES FOR SATISFACTORY PERFORMANCE: STRENGTH AND DYNAMIC BEHAVIOR
G. Blachere and F. dAmbra Paris 1981 13 p refs Presented at 7th European Rotocraft and Powered Lift Aircraft Forum, Garmisch-Partenkirchen, West Germany 8-11 Sep. 1981; sponsored by DFVLR, Cologne
(SNIAS-821-210-108) Avail: NTIS HC A02/MF A01

Flexbeam, teetered, cantilevered and semirigid two bladed rotors were studied in flight, on whirl test stands and theoretically. The blades are compared with conventional helicopter blades. For 2 ton helicopters, the tested blades have fewer parts, and weigh less than conventional ones. Blade life is increased, manufacturing and maintenance costs are lowered. For 8 ton helicopters, similar improvements were achieved, but at the expense of larger control forces and limited lifetime for the flexbeam. Author (ESA)

N82-22259# Institut de Mecanique des Fluides de Lille (France).
APPLICATION OF KALMAN FILTERING TO THE KINEMATIC RECONSTRUCTION OF FREE FLIGHT OF CATAPULTED AIRCRAFT MODELS IN THE LABORATORY [APPLICATION DU FILTRAGE DE KALMAN A LA RESTITUTION DE LA CINEMATIQUE DES MAQUETTES D'AVION CATAPULTEES EN VOL LIBRE EN LABORATOIRE]
P. Coton 30 Jun. 1980 15 p In FRENCH
(IMFL-80-28; IMFL-8214) Avail: NTIS HC A02/MF A01

A Kalman filtering procedure was developed in order to improve results obtained with a catapult and aircraft model. Application of this procedure is criticized. It is concluded that the procedure as it stands is unreliable. Reconfiguration of the

filtering system is recommended. A protocol of tests intended to determine acceptable performance of the system is presented. Author (ESA)

N82-22260# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Helicopter Div.
CONTROLS AND DISPLAYS FOR ALL-WEATHER OPERATION OF HELICOPTERS
R. D. vonReth 3 Apr. 1981 19 p refs
(MBB-UD-319-81-O) Avail: NTIS HC A02/MF A01

Various mission requirements for all weather operations are reviewed. In particular some of the most important features for military applications are outlined. Some of the basic relations between increasing display sophistication and increasing control sophistication are discussed. Also the influence of various functions on the degree of control automation as it seems desirable for future systems under the aspect of man machine interaction are taken into consideration. The controls and displays arrangement of some representative helicopters of presently operational helicopters are described. An outline of the goals and results of some experimental and research programs is given. The characteristics of presently operational helicopters are compared with the technologically feasible solutions taking into account some of the economic constraints as initial cost, operational cost and reliability. In an outlook at the future some basic requirements for the controls and the displays operation are established. J.M.S.

N82-22262*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THE ROLE OF MODERN CONTROL THEORY IN THE DESIGN OF CONTROLS FOR AIRCRAFT TURBINE ENGINES
J. Zeller, B. Lehtinen, and W. Merrill 1982 17 p refs Presented at 12th Aerospace Sci. Conf., Orlando, Fla., 11-14 Jan. 1982; sponsored by AIAA
(NASA-TM-82815; E-1162; NAS 1.15:82815) Avail: NTIS HC A02/MF A01 CSCL 21E

Accomplishments in applying Modern Control Theory to the design of controls for advanced aircraft turbine engines were reviewed. The results of successful research programs are discussed. Ongoing programs as well as planned or recommended future thrusts are also discussed. Author

N82-22263*# Cessna Aircraft Co., Wichita, Kans. Pawnee Div.
ADVANCED GENERAL AVIATION COMPARATIVE ENGINE/AIRFRAME INTEGRATION STUDY Final Report, Jan. 1980 - Sep. 1981
George L. Huggins and David R. Ellis Sep. 1981 133 p refs (Contract NAS3-22221)
(NASA-CR-165564; NAS 1.26:165564; Cessna-AD-217) Avail: NTIS HC A07/MF A01 CSCL 21E

The NASA Advanced Aviation Comparative Engine/Airframe Integration Study was initiated to help determine which of four promising concepts for new general aviation engines for the 1990's should be considered for further research funding. The engine concepts included rotary, diesel, spark ignition, and turboprop powerplants; a conventional state-of-the-art piston engine was used as a baseline for the comparison. Computer simulations of the performance of single and twin engine pressurized aircraft designs were used to determine how the various characteristics of each engine interacted in the design process. Comparisons were made of how each engine performed relative to the others when integrated into an airframe and required to fly a transportation mission. Author

N82-22264*# Pratt and Whitney Aircraft Group, East Hartford, Conn. Commercial Products Div.
ENERGY EFFICIENT ENGINE EXHAUST MIXER MODEL TECHNOLOGY
H. Kozlowski and M. Larkin Jun. 1981 186 p refs
(Contract NAS3-20646)
(NASA-CR-165459; NAS 1.26:165459; PWA-5594-164) Avail: NTIS HC A09/MF A01 CSCL 21E

An exhaust mixer test program was conducted to define the technology required for the Energy Efficient Engine Program. The model configurations of 1/10 scale were tested in two phases. A parametric study of mixer design options, the impact of residual low pressure turbine swirl, and integration of the mixer with the structural pylon of the nacelle were investigated. The improvement of the mixer itself was also studied. Nozzle performance characteristics were obtained along with exit profiles and oil smear photographs. The sensitivity of nozzle performance to tailpipe length, lobe number, mixer penetration, and mixer modifications like scalloping and cutbacks were established. Residual turbine swirl was found detrimental to exhaust system performance and the low pressure turbine system for Energy Efficient Engine was designed so that no swirl would enter the mixer. The impact of mixer/plug gap was also established, along with importance of scalloping, cutbacks, hoods, and plug angles on high penetration mixers. M.D.K.

N82-22265*# Pratt and Whitney Aircraft Group, East Hartford, Conn. Commercial Products Div.
ADVANCED LOW-EMISSIONS CATALYTIC-COMBUSTOR PROGRAM, PHASE 1 Final Report
G. J. Sturgess Jun. 1981 158 p refs
(Contract NAS3-20821)
(NASA-CR-159656; NAS 1.26:159656; PWA-5589-19; ESL-TR-79-23) Avail: NTIS HC A08/MF A01 CSCL 21E

Six catalytic combustor concepts were defined, analyzed, and evaluated. Major design considerations included low emissions, performance, safety, durability, installations, operations and development. On the basis of these considerations the two most promising concepts were selected. Refined analysis and preliminary design work was conducted on these two concepts. The selected concepts were required to fit within the combustor chamber dimensions of the reference engine. This is achieved by using a dump diffuser discharging into a plenum chamber between the compressor discharge and the turbine inlet, with the combustors overlaying the prediffuser and the rear of the compressor. To enhance maintainability, the outer combustor case for each concept is designed to translate forward for accessibility to the catalytic reactor, liners and high pressure turbine area. The catalytic reactor is self-contained with air-cooled canning on a resilient mounting. Both selected concepts employed integrated engine-starting approaches to raise the catalytic reactor up to operating conditions. Advanced liner schemes are used to minimize required cooling air. The two selected concepts respectively employ fuel-rich initial thermal reaction followed by rapid quench and subsequent fuel-lean catalytic reaction of carbon monoxide, and, fuel-lean thermal reaction of some fuel in a continuously operating pilot combustor with fuel-lean catalytic reaction of remaining fuel in a radially-staged main combustor. Author

N82-22267*# United Technologies Research Center, East Hartford, Conn.
INVESTIGATION OF SOOT AND CARBON FORMATION IN SMALL GAS TURBINE COMBUSTORS Final Report
T. J. Rosfjord Apr. 1982 54 p refs
(Contract NAS3-22524)
(NASA-CR-167853; NAS 1.26:167853; UTRC-R82-915387-16) Avail: NTIS HC A04/MF A01 CSCL 21E

An investigation of hardware configurations which attempt to minimize carbon and soot-production without sacrificing performance in small gas turbine combustors was conducted. Four fuel injectors, employing either airblast atomization, pressure atomization, or fuel vaporization techniques were combined with nozzle air swirlers and injector sheaths. Eight configurations were screened at sea-level takeoff and idle test conditions. Selected configurations were focused upon in an attempt to quantify the influence of combustor pressure, inlet temperature, primary zone operation, and combustor loading on soot and carbon formation. Cycle tests were also performed. It was found that smoke emission levels depended on the combustor fluid mechanics, the atomization quality of the injector and the fuel hydrogen content. R.J.F.

N82-22268*# Beech Aircraft Corp., Wichita, Kans.
ADVANCED GENERAL AVIATION ENGINE/AIRFRAME INTEGRATION STUDY
Leon A. Zmroczek Mar. 1982 131 p refs
(Contract NAS3-22220)
(NASA-CR-165565; NAS 1.26:165565) Avail: NTIS HC A07/MF A01 CSCL 21E

A comparison of the in-airframe performance and efficiency of the advanced engine concepts is presented. The results indicate that the proposed advanced engines can significantly improve the performance and economy of general aviation airplanes. The engine found to be most promising is the highly advanced version of a rotary combustion (Wankel) engine. The low weight and

fuel consumption of this engine, as well as its small size, make it suited for aircraft use. T.M.

N82-22269*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PERFORMANCE OF SINGLE-STAGE AXIAL-FLOW TRANSONIC COMPRESSOR WITH ROTOR AND STATOR ASPECT RATIOS OF 1.63 AND 1.77, RESPECTIVELY, AND WITH DESIGN PRESSURE RATIO OF 2.05
Royce D. Moore and Lonnie Reid Apr. 1982 116 p refs
(NASA-TP-2001; E-334; NAS 1.60:2001) Avail: NTIS HC A06/MF A01 CSCL 21E

The overall and blade-element performance of a transonic compressor stage is presented over the stable operating range for speeds from 50 to 100 percent of design. The stage was designed for a pressure ratio of 2.05 at a flow of 20.2 kg/sec and a tip speed of 455 m/sec. At design speed the rotor and stage achieved peak efficiencies of 0.849 and 0.831, respectively, at the minimum flow condition. The stage stall point occurred at a flow higher than the design flow. Author

N82-22270# Rolls-Royce Ltd., Derby (England).
RB211 POWERPLANT DETERIORATION: REVIEW OF CURRENT SITUATION AND LESSONS LEARNED
Alec G. Collins 1981 5 p
(PNR-90073) Avail: NTIS HC A02/MF A01

The need for high temperatures in the engine cycle of gas turbine aircraft engines was demonstrated; the effects of thermal barrier coatings (TBC) on component life, cooling air requirements, and turbine entry temperature (TET) are discussed. Experience with the RB211, Olympus 593, and Pegasus engines illustrates the usefulness of TBCs consisting of zirconia based ceramics with nickel or cobalt bond coats. Life improvements > 50% are directly attributable to TBCs on combustor walls, vaporizing fuel injectors, and discharge nozzles. Airfoil coatings survive 150 hr RB211-524 tests at higher than normal TET. Author (ESA)

N82-22271# Rolls-Royce Ltd., Derby (England).
THE CONTRIBUTION OF THERMAL BARRIER COATINGS TO IMPROVEMENTS IN THE LIFE AND PERFORMANCE OF GAS TURBINE COMPONENTS
S. J. Hartropp, D. A. Marsh, and G. W. Meetham 1981 11 p
(PNR-90076) Avail: NTIS HC A02/MF A01

Ceramic coatings significantly increase the lives of components in high temperature environments by insulating metal substrates from a hot gas stream. The need for high temperatures in gas turbine engines, and the opportunities for and requirements from thermal barrier coatings are covered. Bench and service engine evaluation and analysis of tested parts from which the features of successful coating systems were derived, are presented.
Author (ESA)

N82-22272# Rolls-Royce Ltd., Derby (England).
DEVELOPMENT OF A CORRELATED FINITE ELEMENT DYNAMIC MODEL OF A COMPLETE AERO ENGINE
R. A. Bellamy, J. C. Bennett, and S. T. Elston 1981 10 p refs
(PNR-90081) Copyright. Avail: NTIS HC A02/MF A01

The accuracy of the dynamic model of the RB211 engine and nacelle was tested. Model descriptions of load/deflection behavior, natural frequencies, and mode shapes were compared with shake tests and modal analyses. Modal analysis was carried out by a frequency response analyzer which used an incremental sine technique and a minicomputer based system that input a random signal to the shaker, operating on transducer measurements with a software Fourier transform in order to achieve the frequency response functions. Correlation between the results is excellent. Author (ESA)

N82-22273# Societe Nationale Industrielle Aerospatiale, Marignane (France.) Helicopter Div.
PARAMETRIC STUDY OF THE INFLUENCE OF THE ENGINE UPON THE OPERATING COST OF A CIVIL HELICOPTER
Gilbert Beziac, Jean-Pierre Dedieu, and Philippe Cabrit Paris 1981 6 p Presented at 7th European Rotorcraft and Powered Lift Aircraft Forum, Garmisch-Partenkirchen, West Germany 8-11 Sep. 1981; sponsored by DFVLR, Cologne
(SNIAS-827-210-102) Avail: NTIS HC A02/MF A01

The influence of engine characteristics (weight, fuel consumption, price, power range) upon helicopter operating cost was studied. The parametric relationship between gross weight, weight of airframe with crew but without engines, engine weight, and fuel weight was defined. An 850 hp engine was made more powerful by increasing turbine inlet temperature through the cooling of the high pressure turbine and by increasing pressure ratio. Analysis shows that a sufficient power reserve is necessary, but too high a value penalizes operating cost. This confirms the interest of having a super emergency rating on civil helicopter engines. Low fuel consumption should be the result of a compromise with level of complexity since high complexity increases the engine cost and can reduce reliability. Simultaneous evolution of aircraft and engine increases cost effectiveness.
Author (ESA)

N82-22274# Rolls-Royce Ltd., Derby (England).
ENCOUNTERS WITH SURGE: SOME EXPERIENCES OF DEVELOPMENT OF AXIAL COMPRESSORS FOR AERO GAS TURBINES
A. B. McKenzie Mar. 1981 35 p
(PNR-90071) Avail: NTIS HC A03/MF A01

Rolls Royce jet engine development is traced. The Avon was the first. Its design pressure ratio is 6.15, corresponding to a design temperature rise of 20 C per stage in each of 12 stages. The first stage entry diameter ratio is 0.5, lower than contemporary compressors. In the Avon RA14, surge, precipitated when a number of stages stalled, was eliminated by progressively increasing the stagger of the last six rotor blade rows by 1 deg to 6 deg. In the Conway, a bypass provides a permanent bleed from the low pressure compressor. The bleed becomes an increasing proportion of total flow as speed is reduced. This eliminates surge problems when the engine is throttled back at high forward speed. In the Tyne, the removal of the hub section permits a higher surge pressure ratio. In the RB211, a handling bleed with a variable input is placed between the compressors.
Author (ESA)

N82-22275# Rolls-Royce Ltd., Derby (England).
RELIABLE POWER
J. M. S. Keen Feb. 1981 21 p Presented at Intern. Aircraft Maintenance Eng. Exhibition and Conf., Zurich, Feb. 1981
(PNR-90078) Avail: NTIS HC A02/MF A01

The Rolls Royce RB211 engine design is reviewed. The three shaft concept increases engine thrust and cuts fuel consumption. The highest thrust version of the RB211 cuts fuel consumption of Boeing 747's by 17%. The 535E4 blends turbine and bypass flows in a buried nozzle within a longer cowl. The resultant gases are exhausted through a single final nozzle. This device provides an automatic rematching of the engine cycle at climb ratings, thereby saving fuel and reducing turbine entry temperature. Reverse thrust is increased by up to 38% relative to an unmixed engine. The on-condition maintenance policy reduces costs without reducing safety. The reliability management program ensures the most cost effective maintainance schedule.
Author (ESA)

N82-22276# Rolls-Royce Ltd., Derby (England).
FUEL EFFICIENCY ENGINES FOR LARGE TRANSPORT AIRCRAFT
D. J. Parfitt 27 Mar. 1981 27 p Presented at Aeron. Soc. of India Conf., Bombay, 27 Mar. 1981
(PNR-90082; MISC-555) Avail: NTIS HC A03/MF A01

The next generation of Rolls Royce aircraft engines is discussed, especially their fuel consumption. For the RB211, improvements on the order of 15% in fuel consumption relative to the initial service standard are planned. Large fan engines are expected to remain technology leaders in the long-term. Fuel savings on the order of 10% to 15% are feasible, using low specific thrust designs. Noise and exhaust emission improvements are predicted. Advanced wing designs and the use of lightweight composite materials, linked with full authority digital control systems, enhance engine performance. Liquid hydrogen is suggested as a replacement for kerosene, because of its high heating value. Author (ESA)

N82-22277# Rolls-Royce Ltd., Derby (England).
COLLABORATIVE DEVELOPMENT OF AERO-ENGINES
G. M. Lewis 1981 9 p
(PNR-90083) Avail: NTIS HC A02/MF A01

European cooperation in aircraft engine development is described, using the Olympus and RB199 projects as examples. The management structure was based on the integration of existing teams in the partner companies. Author (ESA)

N82-22278# Rolls-Royce Ltd., Derby (England).
MULTI-MISSION V/STOL WITH VECTORED THRUST ENGINES
W. J. Lewis and P. Simpkin 1981 10 p
(PNR-90086) Avail: NTIS HC A02/MF A01

The use of V / STOL aircraft in European conflicts is discussed. Conventional aircraft were assumed to be inoperative within 370 km of the main battle area because of the destruction of runways. Achievable bomb delivery rate of subsonic V/STOL aircraft, and available combat air patrol time and the number of aircraft required in order to maintain a standing patrol of supersonic aircraft were considered. If the Harrier concept is adapted, a single vectored thrust engine with plenum chamber burning on two front nozzles, and a single rear nozzle, then the V/STOL aircraft is well suited to supersonic and subsonic air superiority and strike roles. Author (ESA)

N82-22279# Rolls-Royce Ltd., Derby (England).
DIRECTIONAL SOLIDIFICATION: PROJECT B2 Final Report
C. Lecomte-Mertens, M. Lamberigts, and D. Coutsouradis May 1981 109 p refs Transl. into ENGLISH of Rept. no. TLT-00818A, Centre de Rech. Metal. (Belgium) Partly in ENGLISH and FRENCH
(PNR-90088; Trans-15572/TLT-00818A) Avail: NTIS HC A06/MF A01

Thermal fatigue of Mar-M-002 nickel alloy blades with an equiaxial or columnar (directional) structure, precision cast in the laboratory, was evaluated. Their thermal fatigue is compared with that of nickel alloy blades obtained elsewhere. Creep resistance of the Mar-M-002 structures was tested. The influence of chemical composition, grain orientation, microstructural fineness, the presence of carbides, and morphology was determined by metallography. Crack length is always greater in blades treated at 1100 C than in those treated at 1000 C. Blade geometry is the predominant factor in thermal fatigue. Crack resistance, in ascending order is: large solid blade (laboratory); small solid blade (outside supplier); small hollow blade (industrial). The metallographic structure is not a suitable criterion for differentiating between the thermal shock behavior of equaxial blades and that of columnar blades. Author (ESA)

N82-22280*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
CONTROL LAW DESIGN TO MEET CONSTRAINTS USING SYNPAC-SYNTHESIS PACKAGE FOR ACTIVE CONTROLS
William M. Adams, Jr. and Sherwood H. Tiffany Jan. 1982 16 p refs Presented at the Joint Automatic Control Conf., Charlottesville, Va., 17-19 Jun. 1981
(NASA-TM-83264; NAS 1.15:83264) Avail: NTIS HC A02/MF A01 CSCL 01C

Major features of SYNPAC (Synthesis Package for Active Controls) are described. SYNPAC employs constrained optimization techniques which allow explicit inclusion of design criteria (constraints) in the control law design process. Interrelationships are indicated between this constrained optimization approach, classical and linear quadratic Gaussian design techniques. Results are presented that were obtained by applying SYNPAC to the design of a combined stability augmentation/gust load alleviation control law for the DAST ARW-2. Author

N82-22281*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AN ANALYSIS OF A NONLINEAR INSTABILITY IN THE IMPLEMENTATION OF A VTOL CONTROL SYSTEM
Jeanine M. Weber Mar. 1982 65 p refs
(NASA-TM-84220; A-8840; NAS 1.15:84220) Avail: NTIS HC A04/MF A01 CSCL 01C

The contributions to nonlinear behavior and unstable response of the model following yaw control system of a VTOL aircraft during hover were determined. The system was designed as a state rate feedback implicit model follower that provided yaw rate command/heading hold capability and used combined full authority parallel and limited authority series servo actuators to generate an input to the yaw reaction control system of the aircraft. Both linear and nonlinear system models, as well as describing function linearization techniques were used to determine the influence on the control system instability of input magnitude and bandwidth, series servo authority, and system bandwidth. Results of the analysis describe stability boundaries as a function of these system design characteristics. A.R.H.

N82-22282# National Aerospace Lab., Tokyo (Japan).
EXPERIMENT ON ACTIVE FLUTTER SUPPRESSION OF A CANTILEVER WING
Takao Kikuchi and Hae Kyong Lee Dec. 1981 10 p refs In JAPANESE; ENGLISH summary
(NAL-TR-690; ISSN-0389-4010) Avail: NTIS HC A02/MF A01

An experiment on active flutter suppression of a cantilever wing with the control surface at the wing tip is described. The experiment was done in a low subsonic wind tunnel. The deflection of the wing was measured by strain gages located near the root of the wing. The aileron was driven by a servomotor. Comparison was made between the present and previous results. It is concluded that the coefficients of the control law may have a different effect on the stability of the two- and three-dimensional models. Author

N82-22284*# National Aeronautics and Space Administration, Washington, D. C.
STUDIES ON WIND TUNNEL STRAIGHTENERS
F. Schultz-Grunow and K. Wieghardt Mar. 1982 16 p refs Transl. into ENGLISH from Luftfahrtforschung (West Germany), v. 17, no. 3, 20 Mar. 1940 p 82-86 Transl. by Kanner (Leo) Associates, Redwood City, Calif. original doc. prep. by Kaiser-Wilhelm Inst. for Flow Research, Goettingen (West Germany) (Contract NASw-3541)
(NASA-TM-76689; NAS 1.15:76689) Avail: NTIS HC A02/MF A01 CSCL 14B

Tests using small-scale straighteners are reported. The studies allowed conclusions on the most favorable depth relationships, flow conditions behind the straightener and on the drag. The ways an obliquely hitting airflow is deflected by a straightener are examined. In addition the flow drag was measured and the manner in which the individual air columns emanating from the holes unite to form a homogeneous speed field was investigated. N.W.

N82-22285# National Inst. for Aeronautics and Systems Technology, Pretoria (South Africa).
DESIGN OF DYNAMICALLY-SCALED, ASYMMETRICAL WIND TUNNEL MODELS
M. E. Beyers 6 Aug. 1981 18 p refs
(NIAST-78/18) Avail: NTIS HC A02/MF A01

Dynamically scaled models are used in aerodynamic studies, notably in aircraft/store or stage separation studies. Techniques were developed for the design of free flight models in three general categories: dynamic stability free flight models, high maneuverability models optimized for nonoscillatory motion studies, and dynamic separation models. Dynamic scaling with fully simulated mass asymmetries play an important part in each of the three categories, particularly when nonplanar motions are simulated. The method is implemented in a 'FORTRAN IV DSAM'. S.L.

N82-22286# Research Inst. of National Defence, Umea (Sweden). Huvudavdelning 4.
RADIAK SIMULATOR FOR AIRCRAFT INSTRUMENTS [RADIAKSIMULATOR FOER FLYGINDIKERING]
Goeran Hulten, Melker Nordstrand, and Thomas Ulvsand Jun. 1981 30 p ref In SWEDISH
(FOA-C-40136-A3) Avail: NTIS HC A03/MF A01

An intensimeter no. 23 was used to detect radiation from aircraft. A simulator which could be programmed to give different time controlled simulated lapses was added to the equipment. The missions programmed into the memory included indications along a road, over an area and spot indications. Testing was performed at the Army Helicopter school in Boden under realistic conditions. Results indicate that this type of simulation is useful in training aircraft indication personnel. M.D.K.

N82-22314*# Boeing Commercial Airplane Co., Seattle, Wash.
THE 737 GRAPHITE COMPOSITE FLIGHT SPOILER FLIGHT SERVICE EVALUATION Annual Report, May 1980 - Apr. 1981
Randy L. Coggeshall Feb. 1982 50 p refs
(Contract NAS1-11668)
(NASA-CR-165826; NAS 1.26:165826; D6-37330; AR-7) Avail: NTIS HC A03/MF A01 CSCL 11D

A flight service report was prepared which covers the flight service experience of 111 graphite epoxy spoilers on 737 transport aircraft and related ground based environmental exposure of

graphite epoxy material specimens. Spoilers were installed on 28 aircraft representing seven major airlines operating throughout the world. Tests of removed spoilers after the seventh year of service continue to indicate modest changes in composite strength properties. Two spoilers were tested, one with 6 and one with 7 years of service, and both had residual strengths that fall within the original static strength scatter band. Both these units had typical service included discrepancies when tested. Based on visual, ultrasonic, and destructive inspection there continues to be no evidence of moisture migration into the honeycomb core and no core corrosion in the deployed units. M.D.K.

N82-22315*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
DEVELOPMENT AND DEMONSTRATION OF MANUFACTURING PROCESSES FOR FABRICATING GRAPHITE/LARC 160 POLYIMIDE STRUCTURAL ELEMENTS Final Report
R. K. Frost, J. S. Jones, P. J. Dynes, and D. H. Wykes Dec. 1981 499 p refs
(Contract NAS1-15371)
(NASA-CR-165809; NAS 1.26:165809) Avail: NTIS HC A21/MF A01 CSCL 11D

The development and demonstration of manufacturing technologies for the structural application of Celion graphite/LARC-160 polyimide composite material is discussed. Process development and fabrication of demonstration components are discussed. Process development included establishing quality assurance of the basic composite material and processing, nondestructive inspection of fabricated components, developing processes for specific structural forms, and qualification of processes through mechanical testing. Demonstration components were fabricated. The demonstration components consisted of flat laminates, skin/stringer panels, honeycomb panels, chopped fiber compression moldings, and a technology demonstrator segment (TDS) representative of the space shuttle aft body flap. R.J.F.

N82-22316*# Lockheed-California Co., Burbank.
FLIGHT SERVICE EVALUATION OF KEVLAR-49 EPOXY COMPOSITE PANELS IN WIDE-BODIED COMMERCIAL TRANSPORT AIRCRAFT Annual Flight Service Report
Robert H. Stone Jan. 1982 56 p refs
(Contract NAS1-11621)
(NASA-CR-165841; NAS 1.26:165841) Avail: NTIS HC A04/MF A01 CSCL 11D

Kevlar-49 fairing panels, installed as flight service components on three I-1011's, were inspected after 8 years service. The fairings had accumulated a total of 62,000 hours, with one ship set having 20,850 hours service. Kevlar-49 components were found to be performing satisfactorily in service with no major problems. The only defects noted were minor impact damage, a few minor disbonds and a minor degree of fastener hole fraying and elongation. The service history to date indicates that Kevlar-49 epoxy composite materials have satisfactory service characteristics for use in aircraft secondary structures. R.J.F.

N82-22324# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Stuttgart (West Germany).
SERVICE LIFE INVESTIGATION OF A SAILPLANE WING OF CFRP CONSTRUCTION
C. Kensche 1981 33 p refs In GERMAN; ENGLISH summary
Presented at 17th OSTIV Congr., Paderborn-Haxterberg, West Germany, 26 May - 6 Jun. 1981
Avail: NTIS HC A03/MF A01

A sailplane wing of CFRP design was investigated to guarantee a higher stress level and longer service life than with glass fiber reinforced plastics and to define admissible design for the glider industry. Fatigue tests were run according to a block program. The residual wing strength was also tested. Periodic measurements are used to observe stiffness behavior during simulated service life. No change in stiffness is observed during the tests. Stress enhancement of 400 N/sq mm is admissible which increases service life from 3000 to 6000 hr. Author (ESA)

N82-22348# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
CRITICAL METALS CONSERVATION, RECYCLING AND SUBSTITUTION
E. F. Bradley (Pratt and Whitney Aircraft) Jan. 1982 23 p
Presented at the 53rd Meeting of the AGARD Struct. and Mater. Panel, Noordwijkerhout, Netherlands, 27 Sep. - 2 Oct. 1981
(AGARD-R-693; ISBN-92-835-1412-2) Avail: NTIS HC A02/MF A01

Critical metals are reviewed relative to their current importance to the aerospace industry. The roles of conservation, recycling, substitution, stockpiling and market place operations are analyzed. Technologies are discussed relative to their effects on the critical metals, and finally, suggestions are presented for meeting material supply problems. S.L.

N82-22358# Rolls-Royce Ltd., Derby (England).
POWDER METALLURGICAL INNOVATIONS FOR IMPROVED HOT SECTION ALLOYS IN AERO-ENGINE APPLICATIONS
P. Wildgoose, N. G. Turner, H. F. Davies, B. J. Helliwell, R. Ubank, and H. Harrison 1980 27 p refs
(PNR-90072) Avail: NTIS HC A03/MF A01

The state of the art in powder material and processes, for aircraft engine combustor, blade, and disk alloys, was reviewed. Processes developed in the 1970's include: gas atomization of superalloy powder for critical rotating parts; rotating electrode atomization for titanium powder in similar components; controled thermomechanical processing of attrited powders in order to produce superalloy sheet and airfoil parts; and plasma sprayed gas atomized powder for hot section overlay and thermal barrier coatings. Development in titanium powder metallurgy is hampered by difficulties in obtaining clean powder. Properties equivalent to a conventionally processed product are obtained in current alloys, with possible cost advantages. Author (ESA)

N82-22360# National Aerospace Lab., Amsterdam (Netherlands). Div. of Structures and Materials.
ENGINEERING PROPERTY COMPARISONS OF 7050-T73651, 7010-T7651 AND 7010-T73651 ALUMINUM ALLOY PLATE
L. Schra and W. G. J. tHart Dec. 1980 33 p refs Submitted for publication
(NLR-MP-80047-U) Avail: NTIS HC A03/MF A01

The strength, stress corrosion resistance, fracture toughness and fatigue crack propagation resistance under flight simulation loading of aluminum alloys was tested. Standard tensile, notch, center cracked and flight simulation tests were performed. In order to study stress corrosion crack initiation, tuning fork type specimens were clamped to a wheel which immersed them in a 3.5% aqueous NaCl solution for 10 min/hr. Testing lasted for two months. Results show that both 7050 and 7010 are high strength deep hardening alloys with only minor differences in crack tolerance properties. The fracture toughness of both alloys is equivalent, while 7050 possesses slightly better resistances to stress corrosion cracking and fatigue crack propagation under flight simulation loading. Author (ESA)

N82-22392# Transportation Research Board, Washington, D.C.
PAVEMENT MANAGEMENT AND REHABILITATION OF PORTLAND CEMENT CONCRETE PAVEMENTS
Charles V. Zegeer, Kenneth R. Agent, Rolands L. Rizenbergs, P. C. Curtayne, T. Scullion, R. Daryl Pedigo, W. Ronald Hudson, Freddy L. Roberts, M. A. Karan, Ralph Haas et al 1981 79 p refs
(PB82-131384; TRB/TRR-814; ISBN-0-309-03255-5; ISSN-0361-1981; LC-81-18882) Avail: NTIS HC A05/MF A01; HC also available from Transportation Research Board, 2102 Constitution Ave., NW, Washington, D.C. 20418 CSCL 13B

Pavement management and rehabilitation projects and techniques are discussed. The following topics are discussed: economic analyses and dynamic programming in resurfacing project selection; implementation of an urban pavement management system; pavement performance modeling for pavement management; illustration of pavement management: from data inventory to priority analysis; rehabilitation of concrete pavements by using portland cement concrete overlays; pavement management study: Illinois tollway pavement overlays; resurfacing of plain jointed-concrete pavements; design procedure for premium composite pavement; model study of anchored pavement; prestressed concrete overlay at O'Hare International Airport: in-service evaluation; and, bonded portland cement concrete resurfacing. GRA

N82-22398*# Ohio State Univ., Columbus. Dept. of Electrical Engineering.

GTD ANALYSIS OF AIRBORNE ANTENNAS RADIATING IN THE PRESENCE OF LOSSY DIELECTRIC LAYERS Semiannual Report

R. G. Rojas-Teran and W. D. Burnside Aug. 1981 113 p refs

(Grant NsG-1498)

(NASA-CR-168770; NAS 1.26:168770; ESL-710964-8) Avail: NTIS HC A06/MF A01 CSCL 20N

The patterns of monopole or aperture antennas mounted on a perfectly conducting convex surface radiating in the presence of a dielectric or metal plate are computed. The geometrical theory of diffraction is used to analyze the radiating system and extended here to include diffraction by flat dielectric slabs. Modified edge diffraction coefficients valid for wedges whose walls are lossy or lossless thin dielectric or perfectly conducting plates are developed. The width of the dielectric plates cannot exceed a quarter of a wavelength in free space, and the interior angle of the wedge is assumed to be close to 0 deg or 180 deg. Systematic methods for computing the individual components of the total high frequency field are discussed. The accuracy of the solutions is demonstrated by comparisons with measured results, where a 2 lambda by 4 lambda prolate spheroid is used as the convex surface. A jump or kink appears in the calculated pattern when higher order terms that are important are not included in the final solution. The most immediate application of the results presented here is in the modelling of structures such as aircraft which are composed of nonmetallic parts that play a significant role in the pattern. S.L.

N82-22478*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

A PORTABLE, LOW-COST FLIGHT-DATA MEASUREMENT AND RECORDING SYSTEM

Robert J. Miller Mar. 1982 18 p refs

(NASA-TM-84229; A-8871; NAS 1.15:84229) Avail: NTIS HC A02/MF A01 CSCL 14E

The design of and the experience with an inexpensive, hand-portable, onboard data system used to record four parameters in the final portion of the landing approach and touchdown of an airplane are described. The system utilized a high-quality audio tape recorder and amateur photographic equipment with accessory circuitry rather than specialized instrumentation to given satisfactory results. Author

N82-22499# Applied Physics Lab., Johns Hopkins Univ., Laurel, Md.

PROTOTYPE FLYWHEEL SPIN TESTING PROGRAM Final Report, 21 Mar. 1980 - 15 Apr. 1981

D. W. Rabenhorst and W. O. Wilkinson Apr. 1981 59 p refs Prepared for California Univ., Livermore. Lawrence Livermore Lab.

(Contract W-7405-eng-48)

(UCRL-15381; SDO-5988) Avail: NTIS HC A04/MF A01

Flywheels were spin tested to determine for each flywheel (1) the rotational speed at flywheel failure and (2) within the capability of the facility, the initiation and mode of failure of the flywheel. The flywheel tested ranged in size from 12.0 to 24.0 inches diameter; in weight from 5.0 to 28.5 pounds, and in energy at failure up to 711 watt hours. M.D.K.

N82-22808# National Aerospace Lab., Amsterdam (Netherlands). Wetenschappelijke Diensten Hoofdafdel.

CALCULATION OF THE CONTRIBUTIONS OF AIR TRAFFIC AND ROAD TRAFFIC TO AIR POLLUTION IN THE REGION OF SCHIPHOL AIRPORT IN 1974

J. J. Tiggelaar Oct. 1981 51 p refs In DUTCH; ENGLISH summary Sponsored by Netherlands Ministerie van Volksgezondheid en Milieuhygiene

(NLR-TR-77100-U) Avail: NTIS HC A04/MF A01

Annual and quarterly averages of CO, NOx and CxHy concentrations in the Schiphol airport region are calculated using a mathematical model. The method models traffic into a set of line and point sources with constant emission. For CO and NOx the road traffic contribution to air pollution is largest, while for CxHy the air traffic contribution is largest. The measurements suggest that other sources contribute at least as much to global air pollution as do road and air traffic. Author (ESA)

N82-22848*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

THE 1981 DIRECT STRIKE LIGHTNING DATA

Felix L. Pitts and Mitchel E. Thomas Mar. 1982 40 p refs (NASA-TM-83273; NAS 1.15:83273) Avail: NTIS HC A03/MF A01 CSCL 04B

Data waveforms obtained during the 1981 direct strike lightning tests, utilizing the NASA F-106B aircraft specially instrumented for lightning electromagnetic measurements are presented. The aircraft was operated in a thunderstorm environment to elicit strikes. Electromagnetic field data were recorded for both attached lightning and free field excitation of the aircraft. N.W.

N82-22947*# Texas A&M Univ., College Station. Dept. of Mechanical Engineering.

THE ROLE OF COHERENT STRUCTURES IN THE GENERATION OF NOISE FOR SUBSONIC JETS Yearly Progress Report, 1 Nov. 1980 - 31 Oct. 1981

Gerald L. Morrison 5 Apr. 1982 109 p refs

(Grant NAG1-112)

(NASA-CR-168764; NAS 1.26:168764) Avail: NTIS HC A06/MF A01 CSCL 20A

The coherent structure in high Reynolds number (184,000 to 262,000), Mach number 0.6 to 0.8 axisymmetric cold air jets exhausting at atmospheric pressure was studied. The mean flow and the statistical time averaged turbulence properties were measured. Spectra showed a very broad frequency content which shifted towards the lower frequencies as the flow progressed downstream. Axial wave number measurements indicate that the axial wave number-frequency relationship was the same for a wide range of Mach (0.3 to 2.5) and Reynolds (3,700 to over 200,000) numbers. Measurements of the azimuthal mode numbers show that several modes from n = -3 to +3 exist simultaneously in various quantities that the different frequencies studied. Acoustic measurements were made in the near field of the Mach number 0.6 jet. Sound pressure level contours showed that noise appeared to be radiated from a location near the end of the potential core. Directivity plots revealed that the spectra of this noise shifted towards higher frequencies as the angle from the jet axis increased. It was also found that mid-band excitation frequencies produced an increase in full spectrum noise. M.G.

N82-22949*# Kentron International, Inc., Hampton, Va.

PROGRAM FOR NARROW-BAND ANALYSIS OF AIRCRAFT FLYOVER NOISE USING ENSEMBLE AVERAGING TECHNIQUES

Doreen Gridley Mar. 1982 70 p refs

(Contract NAS1-16000)

(NASA-CR-165867; NAS 1.26:165867) Avail: NTIS HC A04/MF A01 CSCL 20A

A package of computer programs was developed for analyzing acoustic data from an aircraft flyover. The package assumes the aircraft is flying at constant altitude and constant velocity in a fixed attitude over a linear array of ground microphones. Aircraft position is provided by radar and an option exists for including the effects of the aircraft's rigid-body attitude relative to the flight path. Time synchronization between radar and acoustic recording stations permits ensemble averaging techniques to be applied to the acoustic data thereby increasing the statistical accuracy of the acoustic results. Measured layered meteorological data obtained during the flyovers are used to compute propagation effects through the atmosphere. Final results are narrow-band spectra and directivities corrected for the flight environment to an equivalent static condition at a specified radius. R.J.F.

N82-22952*# Bolt, Beranek, and Newman, Inc., Canoga Park, Calif.

ANALYTICAL PREDICTION OF THE INTERIOR NOISE FOR CYLINDRICAL MODELS OF AIRCRAFT FUSELAGES FOR PRESCRIBED EXTERIOR NOISE FIELDS. PHASE 2: MODELS FOR SIDEWALL TRIM, STIFFENED STRUCTURES AND CABIN ACOUSTICS WITH FLOOR PARTITION

L. D. Pope and E. G. Wilby Apr. 1982 212 p refs

(Contract NAS1-15782)

(NASA-CR-165869; NAS 1.26:165869) Avail: NTIS HC A10/MF A01 CSCL 20A

An airplane interior noise prediction model is developed to determine the important parameters associated with sound transmission into the interiors of airplanes, and to identify apropriate noise control methods. Models for stiffened structures, and cabin acoustics with floor partition are developed. Validation studies are undertaken using three test articles: a ring stringer stiffened cylinder, an unstiffened cylinder with floor partition,

and ring stringer stiffened cylinder with floor partition and sidewall trim. The noise reductions of the three test articles are computed using the heoretical models and compared to measured values. A statistical analysis of the comparison data indicates that there is no bias in the predictions although a substantial random error exists so that a discrepancy of more than five or six dB can be expected for about one out of three predictions.
S.L.

N82-22953# National Aerospace Lab., Tokyo (Japan). Noise and Emission Research Group.
AERODYNAMIC NOISE GENERATED BY JET-WING/FLAP INTERACTIONS OF THE EXTERNAL USB CONFIGURATION OF STOL AIRCRAFT. PART 1: EIGHT PERCENT SCALE COLD-FLOW MODEL ANALYSIS
Masataka Maita and Shigemi Shindo Oct. 1981 29 p refs (NAL-TR-685T; ISSN-0389-4010) Avail: NTIS HC A03/MF A01

The acoustic characteristics of the external upper surface blowing (USB) concept of a powered high lift system (PHLS) were studied experimentally using an 8%-scale static cold flow model. Observations of exhaust jet flow attachment and spreading characteristics on wing/flap surface were also carried out using several flow visualization techniques. Noise reduction data were obtained by optimizing basic jet nozzle wing/flap structural geometries for the lowest noise. Among the associated parameters which define USB-PHLS configurations, (1) the location relative to wing/flap and the shape of the exhaust jet nozzle and (2) flow attachment devices are important parameters. Flow characteristics dependence on these parameters and PHLS noise were also obtained. From far field noise spectra overall sound pressure level dependence on jet velocity and coherence across near field surface pressure, it was concluded tht the flap trailing edge noise was the most predominant noise source. Several acoustically treated flaps and serrated trailing edge design techniques were applied to attenuate edge noise. Author

N82-22955*# *DyTec Engineering, Inc., Long Beach, Calif.*
RECOMMENDATIONS FOR FIELD MEASUREMENTS OF AIRCRAFT NOISE Final Report
Alan H. Marsh Washington NASA Apr. 1982 94 p refs (NASA-CR-3540; NAS 1.26:3540) Avail: NTIS HC A05/MF A01 CSCL 20A

Specific recommendations for environmental test criteria, data acquisition procedures, and instrument performance requirements for measurement of noise levels produced by aircraft in flight are provided. Recommendations are also given for measurement of associated airplane and engine parameters and atmospheric conditions. Recommendations are based on capabilities which were available commercially in 1981; they are applicable to field tests of aircraft flying subsonically past microphones located near the surface of the ground either directly under or to the side of a flight path. Aircraft types covered by the recommendations include fixed-wing airplanes powered by turbojet or turbofan engines or by propellers. The recommended field-measurement procedures are consistent with assumed requirements for data processing and analysis. R.J.F.

N82-22962# New South Wales Univ., Sydney (Australia). School of Mechanical Engineering.
ACOUSTIC EMISSION FROM FREE JETS
S.-L. Hall *In* Ecole Centrale de Lyon Euromech 142: Acoustics of Turbulent Flows 1981 4 p

Avail: NTIS HC A08/MF A01

Nozzle centered radiation, wider spaced waves, and low angle waves are seen in correctly expanded supersonic jets. In working conditions, shock jet interaction, resulting from incorrect expansion, generates additional high frequency noise. Underexpanded jets emit more noise than overexpanded jets, due to operating at higher Mach numbers and oscillations of the shock cells. Shadowgraphs and Schlieren photographs show that helium jets have larger angles and greater extent of noise radiation than air jets. Mathematical models for correctly expanded supersonic air jets exhausting into the quiescent atmosphere, given no extraneous shocks near the nozzle exit, calculate acoustic wave angles to within 3 deg of measured values. Similar accuracy is achieved for helium jets when the ratio of acoustic impedances is used to correct the air jet values for refraction and convection effects. Models give reasonably good prediction of wave angles from + or - 50% of the correct expansion. For jets without extraneous shocks, when correctly expanded, calculated angles are within 4 deg of measured values. Author (ESA)

N82-22963# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Berlin (West Germany). Abt. Turbulenzforschung.
PREDICTION OF FLYOVER JET NOISE SPECTRA FROM STATIC TESTS
Ulf Michel and Alfons Michalke (Technische Univ., Berlin) *In* Ecole Centrale de Lyon Euromech 142: Acoustics of Turbulent Flows 1981 4 p refs

Avail: NTIS HC A08/MF A01

A scaling law for predicting the overall flyover noise of a single stream shock-free circular jet from static experiments is outlined. It is valid for isothermal and hot jets. It assumes that the jet flow and turbulence field are axially stretched in flight. Effects of the boundary layer within the nozzle and along the engine nacelle are neglected. The scaling laws for the power spectral density and spectra with constant relative bandwidth can be derived. In order to compare static and inflight directivities, the far field point relative to the source position must be denoted by the emission angle and the wave normal distance. From the solution of the convective Lighthill equation in a coordinate system fixed to the jet nozzle (wind tunnel case), the power spectral density of sound pressure at a given frequency is found. Predictions for Aerotrain compare well with measured values. Author (ESA)

N82-22976# Societe Nationale Industrielle Aerospatiale, Toulouse (France).
AIRCRAFT AERODYNAMIC NOISE DURING APPROACH [BRUIT AERODYNAMIQUE DES AVIONS EN APPROCHE]
J. L. Parant *In* Ecole Centrale de Lyon Euromech 142: Acoustics of Turbulent Flows 1981 3 p In FRENCH
Avail: NTIS HC A08/MF A01

The effect of approach velocity, nose and flap inclination, and undercarriage position on aircraft noise was studied. The A 300 B and SN 601 aircraft made two approach passes over a chain of noise recorders. The sound fields and noise spectra show that increasing the speed and flap angle or lowering the undercarriage produces a general increase in noise level such that the directivity of the aerodynamic noise source is hardly changed. All noise spectra increase. Pure frequencies (400 to 500 Hz) accompany flap deployment for the SN 601.
Author (ESA)

N82-22978# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany).
EXPERIMENTS ON PROPELLER NOISE
F. R. Grosche and H. Stiewitt *In* Ecole Centrale de Lyon Euromech 142: Acoustics of Turbulent Flows 1981 4 p refs

Avail: NTIS HC A08/MF A01

Propeller sound generation was investigated. Tests were performed at flow velocities up to 58 m/sec on 90 cm dia. four bladed propellers driven by an electric motor enclosed in a streamlined nacelle. Five models with different blade geometries were tested at helical tip Mach numbers up to 0.69. Nearfield blade tip measurements were made at 0.14 dia. by an in-flow microphone. The acoustic far field was measured by four microphones outside the wind tunnel flow 2.7 m from the propeller axis. An acoustic mirror telescope with three microphones was used to investigate sound generation from the upper, central and lower parts of the propeller. The spectrum in the propeller plane is dominated by the tonal components at the blade passing frequency and its harmonics. Tonal component amplitude is greatly reduced downstream. The blades radiate high frequency noise mainly in motion direction. Author (ESA)

N82-22990# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Abteilung Technische Akustik.
GROUND REFLECTION EFFECTS IN MEASURING PROPELLER AIRCRAFT FLYOVER NOISE
Werner Dobrzynski Aug. 1981 85 p refs In GERMAN; ENGLISH summary Report will also be announced as (ESA-TT-742)
(DFVLR-FB-81-28; ESA-TT-742) Avail: NTIS HC A05/MF A01; DFVLR, Cologne DM 21

In measuring flyover noise for purposes of propeller aircraft noise certification, microphones are positioned 1.2 m above the ground. The influence of ground reflection on the maximum A weighted aircraft noise level was investigated. Ground reflection induces level differences of up to 3 db (A), depending on rotational

speed and number of blades. Since reflection corrections can not successfully be applied to propeller noise signatures, alternative measuring arrangements, such as microphones in close proximity to the ground, were investigated. For different microphone orientations next to an acoustically hard, smooth surface, or above ground plates in case of grass covered surfaces, frequency regimes not affected by ground reflection interferences are determined. Author (ESA)

N82-23068# Committee on Science and Technology (U. S. House).
THE 1983 NASA AUTHORIZATION, VOLUME 1
Washington GPO 1982 114 p Hearing before the Subcomm. on Transportation, Aviation and Mater. of the Comm. on Sci. and Technol., 97th Congr., 2nd Sess., No. 71, 17 Feb. 1982 (GPO-91-488-Vol-1) Avail: Subcommittee on Transportation, Aviation and Materials

The status of NASA systems technology programs which provide focused technology applications principally to civil aviation is addressed in light of the cost effectiveness of NASA's partnership with the aircraft industry and the economic impact of the reduction of NASA's roll in promoting advanced aeronautical technology. Progress made in research and technology programs encompassing aerodynamics, propulsion, materials and structures as well as controls and guidance, human factors, and low speed and high speed aircraft technology is reported. The six elements of the Aircraft Energy Efficiency program are highlighted. These are: engine component improvement, energy efficient engine, advanced turboprop, energy efficient transport, composite primary aircraft structures, and laminar flow control. The budget request for these programs is presented. N.W.

N82-23137# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Zentralbereich Entwicklung.
RESEARCH AND DEVELOPMENT AT MBB. TECHNICAL AND SCIENTIFIC PUBLICATIONS, 1981 [FORSCHUNG UND ETWICKLUNG. TECHNISCH-WISSENSCHAFTLICHE VEROEFFENTLICHUNGEN 1981]
1981 193 p refs Partly in ENGLISH and GERMAN
Avail: NTIS HC A09/MF A01

Research and development work carried out during 1981 at Messetschmitt-Bolkow-Blohm GmbH, Ottobrunn, FRG is presented. Aerodynamics, materials science, infrared imagery, aircraft and spacecraft design, and production engineering are discussed. Calculation methods, mathematical and scale models, and computer aided design are treated. Solar energy and high speed trains were investigated.

N82-23140# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Military Aircraft Div.
EXPERIENCE WITH HIGH PERFORMANCE V/STOL FIGHTER PROJECTS AT MBB
Felix Aulehla and Gerhard K. Kissel *In its* Res. and Develop. at MBB. Tech. and Sci. Publ., 1981 1981 16 p refs Presented at AIAA/NASA Ames V/STOL Conf., Palo Alto, Calif. 7-9 Dec. 1981
(MBB-FE-124/S/PUB/50) Avail: NTIS HC A09/MF A01

Experience gained with V/STOL aircraft having the capability to reach Mach 2 and to take off at after-burning temperatures is described. The German project VJ 101 C and the U.S./FRG project AVS as well as the joint U.S./FRG V/STOL Technology Program serve as examples. Guidance and control systems are depicted, including hover and transition control. Jet interference aspects, e.g., hot gas ingestion during take off with reheated jets are described. Author (ESA)

N82-23141# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Aeroelastic Branch.
APPLICATION OF A STRUCTURAL OPTIMIZATION PROCEDURE FOR ADVANCED WINGS
Heinrich Goedel and Guenter Schneider *In its* Res. and Develop. at MBB. Tech. and Sci. Publ., 1981 1981 15 p refs Presented at 51st AGARD Meeting on Struct. and Mater. Panel, Aix-en-Provence, France, 14-19 Sep. 1981

(MBB-FE-171/S/PUB/49; AGARD-691) Avail: NTIS HC A09/MF A01

A finite element method optimization program was applied to: the sizing of a simplified metal wing for strength and flutter constraints; aeroelastic efficiency calculations for fin and rudder; and the structural layout of a carbon fiber composite delta wing. A flutter speed is calculated for the initial fully stressed design being 700 kt. After 5 iterations the desired flutter speed of 900 kt is reached with an increase < 3% total weight. Good correlation with more sophisticated analyses, e.g., NASTRAN is achieved. The aeroelastic deformation of a fin and rudder are calculated statisfactorily without iteration using the aerodynamic influence matrix produced by a separate program module. A 5% weight saving is achieved for the delta wing. Aileron aeroelastic efficiency is above specification for a supersonic roll.
Author (ESA)

N82-23150# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
FLUID DYNAMICS OF JETS WITH APPLICATIONS TO V/STOL
Jan. 1982 433 p refs Proceedings of Symp. held at Lisbon, 2-5 Nov. 1981
(AGARD-CP-308; ISBN-92-835-0308-2) Avail: NTIS HC A19/MF A01

The fluid dynamics of vertical and short take-off and landing aircraft which employ thrust vectoring or lift augmentation were discussed. Jet interactions with neighboring surfaces, jet structure and development, wind tunnel simulation, injection and thrust augmentation, and theoretical models were considered.

N82-23151# Surrey Univ., Guildford (England). Dept. of Mechanical Engineering.
SOME ASPECTS OF JET DYNAMICS AND THEIR IMPLICATIONS FOR VTOL RESEARCH
L. J. S. Bradbury *In* AGARD Fluid Dyn. of Jets with Appl. to V/STOL Jan. 1982 26 p refs

Avail: NTIS HC A19/MF A01

Some of the problems associated with jet interference on VTOL aircraft are discussed. The jet interference that arises in hovering both in and out of ground effect is considered first and the factors that influence the entrainment that is responsible for the interference are discussed. In particular, it is shown that the flow in the initial region of a jet is strongly affected by circumferential variations in the jet nozzle flow angle and that this might account for some of the anomolous results for the decay of jets issuing from VTOL models. The possible use of Reichardt's method for studying the behavior of nonuniform jets is also discussed. The problem of jet interference in transition is next examined and the basis on which model tests are currently carried out is briefly reviewed. The dynamics of jet interference in transition are then considered in more detail and it is suggested that unlike interference in hovering, transition interference might well be accounted for on the basis of a potential flow model of the jet in a cross flow. Some experimental evidence in support of this notion is examined and a few examples of comparisons between predicted and experimental pressure distributions around a single jet issuing from a flat plate are given. Author

N82-23158# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany). Aircraft Div.
AN EXPERIMENTAL AND THEORETICAL INVESTIGATION OF THE INTERACTION BETWEEN THE ENGINE JET AND THE SURROUNDING FLOW FIELD WITH REGARD TO THE PRESSURE DRAG ON AFTERBODIES
A. Zacharias *In* AGARD Fluid Dyn. of Jets with Appl. to V/STOL Jan. 1982 22 p refs

Avail: NTIS HC A19/MF A01

In order to clarify the interaction between rotationally symmetric engine jets and afterbody configurations, the dependence of the jet characteristics (i.e., the plume effect and the entrainment) and the afterbody pressure drag on the jet parameters, the free stream Mach number, and the afterbody geometry was analyzed. Extensive tests were carried out in the high subsonic Mach number range on three different afterbodies at Reynolds numbers from 500,000 to 1,300,000. The nozzle pressure ratio and the temperature ratio of the model jets were varied in the range (1.0) 1.2 to 2.4 and 1.0 to 2.86 respectively. Measurements were then carried out to determine the static pressure and temperature distribution as well as the boundary layer profiles over the surface of the models. At the same time, the pressure and temperature profiles in the jet were determined in several planes behind the jet exhaust plane. Empirical equations are presented which show the dependence

of the plume effect, the entrainment, and the afterbody pressure drag on the jet parameters, the free stream Mach number, and the afterbody geometry. With the aid of a finite element method and theoretical potential flow model for jet simulation, a numerical procedure was developed which allows the pressure drag on rotationally symmetric afterbodies to be calculated with due allowance for the effects of the engine jets. Comparison of the theoretical and experimental results shows satisfactory agreement. J.D.

N82-23163# Technische Hochschule, Aachen (West Germany). Inst. fuer Luft- und Raumfahrt.

FLOWFIELD AND NOISE SOURCES OF JET IMPINGEMENT OF FLAPS AND GROUND SURFACE

Guenther Neuwerth *In* AGARD Fluid Dyn. of Jets with Appl. to V/STOL Jan. 1982 7 p refs

Avail: NTIS HC A19/MF A01

On the basis of experimental results it is shown that, in an undisturbed free jet of high subsonic speed as well as in a jet deflected by externally blown flaps (EBF), there are ordered turbulence structures. First, a feedback mechanism which develops at small distances between nozzle and stagnation point on the flaps and which amplifies the turbulence structures is explained. It is subsequently shown that the interaction of the jets and EBF generates a strong noise. Even without feedback both the undisturbed free jet and the jet deflected by EBF have the maximum levels in the noise spectrum at the Strouhal numbers of the natural ordered turbulence structures. Author

N82-23165*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

JET V/STOL WIND-TUNNEL SIMULATION AND GROUND-PLANE EFFECTS

Richard J. Margason *In* AGARD Fluid Dyn. of Jets with Appl. to V/STOL Jan. 1982 21 p refs

Avail: NTIS HC A19/MF A01 CSCL 01A

The pretest preparation necessary to define the objectives of an appropriate investigation into the jet V/STOL wind tunnel simulation and ground plane effects were examined. Low speed wind tunnel testing of V/STOL aircraft concepts to determine the aerodynamic propulsion interaction effects during the transition between hover and wingborne flight is a necessary step in the development cycle of this type of aircraft. Powered models are normally used to determine the aerodynamic performance characteristics. Several factors which influence the selection of the model concept and the engine simulator are discussed. Some of the test techniques important for this class of aircraft model are examined. Wind tunnel wall effects important to this aircraft testing with special emphasis on groundplane effects are reviewed. E.A.K.

N82-23166*# McDonnell-Douglas Corp., St. Louis, Mo. Aerodynamics Dept.

THE MODELING AND PREDICTION OF MULTIPLE JET VTOL AIRCRAFT FLOW FIELDS IN GROUND EFFECT

Donald R. Kotansky *In* AGARD Fluid Dyn. of Jets with Appl. to V/STOL Jan. 1982 20 p refs

(Contracts NAS2-9646; NAS2-10184; N62269-76-C-0086; N00014-79-C-0130)

Avail: NTIS HC A19/MF A01 CSCL 01A

An engineering methodology based on an empirical data base and analytical fluid dynamic models was developed for the prediction of propulsive lift system induced aerodynamic effects for multiple lift jet VTOL aircraft operating in the hover mode in and out of ground effect. The effects of aircraft geometry, aircraft orientation (pitch, roll) as well as height above ground are considered. Lift jet vector and splay directions fit the airframe, lift jet exit flow conditions, and both axisymmetric and rectangular nozzle exit geometry are also accommodated. The induced suckdown flows are computed from the potential flowfield induced by the turbulent entrainment of both the free jets and wall jets in ground effect and from the free jets alone out of ground effect. The methodology emphasized geometric considerations, computation of stagnation lines and fountain upwash inclination, fountain upwash formation and development, and fountain impingement on the airframe. E.A.K.

N82-23167# Grumman Aerospace Corp., Bethpage, N.Y.

EVALUATION OF THE EFFECTS OF MODEL SCALE AND TEST TECHNIQUE ON JET-INDUCED EFFECTS

Stanley G. Kalemaris *In* AGARD Fluid Dyn. of Jets with Appl. to V/STOL Jan. 1982 11 p

Avail: NTIS HC A19/MF A01

The effects of model scale and test technique on the jet induced of a twin turbofan V/STOL aircraft were evaluated. The smallest mode was 2.1% as large as the full scale model. It is found that the two most important items to be modeled are fuselage shape and the coannular nature of a typical turbofan exhaust. Lift enhancing strakes are effective in enhancing the ground cushion and eliminating a possible source of scale effect. E.A.K.

N82-23168# Vereinigte Flugtechnische Werke G.m.b.H., Bremen (West Germany).

JET EFFECTS ON FORCES AND MOMENTS OF A VSTOL FIGHTER TYPE AIRCRAFT

B. Haftmann *In* AGARD Fluid Dyn. of Jets with Appl. to V/STOL Jan. 1982 13 p refs

Avail: NTIS HC A19/MF A01

Results of jet effects on forces and moments of the VAK-191 B were compiled. The jet induced effects were investigated during the Vertical/Short Take-Off and Landing (VSTOL) mode in and out of ground effect, in yawed flight, during hover and transition right up to aerodynamic flight. The flight test results were compared with wind tunnel measurements performed during the VAK-191 B development phase and used for preparation of simulation and automatic flight control system development. Trends and deviations between aircraft and model test results are verified. The adequacy of wind tunnel data preparation are questioned. The practicability of wind tunnel data for the assessment of VSTOL aircraft design and determination of flight characteristics and performances are discussed. Recommendations for the measurements of jet induced forces and moments on VSTOL aircraft are outlined. E.A.K.

N82-23169# Aeronautical Research Associates of Princeton, Inc., N. J.

THRUST AUGMENTING EJECTORS: A REVIEW OF THE APPLICATION OF JET MECHANICS TO V/STOL AIRCRAFT PROPULSION

Brian Quinn *In* AGARD Fluid Dyn. of Jets with Appl. to V/STOL Jan. 1982 14 p refs

Avail: NTIS HC A19/MF A01

The fundamental role played by the fluid dynamics of jets within thrust augmenting ejectors that are designed as propulsive units for V/STOL aircraft were reviewed. Energy transfer efficiency and its impact on the production of thrust is discussed. It is explained why propellor like devices more effectively convert available energy to thrust and that overall ejector performance is very sensitive to losses sustained by individual components. The most important loss mechanism is incomplete mixing between the ejector's primary and entrained streams. An experimental data base that provides insight into interactions between turbulent mixing and other factors and improving mixing and ejector performance are reviewed. Free mixing and mixing in a confined environment are contrasted and it is concluded that the development of theoretical methods that successfully predict the performance of V/STOL ejectors must await the results of new experiments that measure turbulence intensities and Reynolds stresses in confined regions. E.A.K.

N82-23170# Centre d'Etudes et de Recherches, Toulouse (France). Dept. of Aerothermodynamique.

THEORETICAL OPTIMISATION AND EXPERIMENTAL VERIFICATION OF AN INJECTOR

A. Mignosi *In* AGARD Fluid Dyn. of Jets with Appl. to V/STOL Jan. 1982 12 p refs In FRENCH; ENGLISH summary

Avail: NTIS HC A19/MF A01

A modelization of induction systems, which could be used for thrust augmentation or more generally constitute a fluid drive system, is proposed for the steady regime case. A simple scheme in which a rapid mixing of the flows is assumed, allows to solve the basic equations and express the main parameters influence. Its verification is effected, using a set of experimental data obtained during the study of an induction driven wind-tunnel.

Various parameters (are ratio between injected and driven flows, Mach number, pressure and temperature ratios) are studied. The injector configuration also appears to be very important, in particular as to pressure fluctuations produced at injection and the corresponding aerodynamic noise in the wind tunnel. Author

N82-23171# West Virginia Univ., Morgantown. Coll. of Engineering.
UNSTEADY EJECTORS
Herman Viets *In* AGARD Fluid Dyn. of Jets with Appl. to V/STOL Jan. 1982 12 p refs

(Grant AF-AFOSR-0025-81)
Avail: NTIS HC A19/MF A01

Ejectors are examined by introducing a time dependency into the flow to increase the mixing rate and hence improve the performance of very short devices. Past studies of unsteady flows related to ejectors are reviewed and a device is proposed which has the potential to increase the mixing by means of both an unsteady flow and also acoustic interaction between the frequencies generated by the jet and the ejector shroud. Standing acoustic waves are identified in the ejector and, it is found that the short unsteady ejector performance is superior to that of a slot jet geometry. E.A.K.

N82-23172# Universite Scientifique et Medicale de Grenoble (France). Inst. de Mechanique.
IMPROVEMENT OF EJECTOR THRUST AUGMENTATION BY PULSATING OR FLAPPING JETS
G. Binder and H. Didelle *In* AGARD Fluid Dyn. of Jets with Appl. to V/STOL Jan. 1982 11 p refs Sponsored in part by Minstere de la Defense

Avail: NTIS HC A19/MF A01

The influence of pulsating or flapping motions forced on the primary jet on the performance of thrust augmenting ejectors was investigated. The effect of the frequency and the amplitude of the forced perturbations was determined for various mixing duct lengths and diffusor geometries. In constant area ejectors the improvement in thrust augmentation ratio over the performance obtained with a steady jet in the same geometry increases with decreasing duct length. Thrust augmentation further improved by the gain in diffusor pressure recovery produced by the unsteady jets. Maximum augmentations of 1.9 and 1.65 were obtained with pulsating and flapping jets respectively as compared to 1.35 and 1.5 in the steady case. These improvements in ejector performance are mainly due to the faster mixing produced by these jets. E.A.K.

N82-23173# Societe Bertin et Cie, Plaisir (France).
EXPERIMENTAL STUDY OF A JET DEFLECTOR [ETUDE EXPERIMENTALE D'UN DEVIATEUR DE JET]
M. Lepretre and C. Portier *In* AGARD Fluid Dyn. of Jets with Appl. to V/STOL Jan. 1982 20 p refs In FRENCH; ENGLISH summary Sponsored in part by Delegation. Generale pour l'Armement
Avail: NTIS HC A19/MF A01

A provisional model of an aerodynamic device for orienting the thrust vector of a jet engine was set up by exploiting the reattachment properties of a sonic or slightly supersonic jet on a flat or curved deflector conveniently positioned downwards from the nozzle outlet. A parametric study shows that it would be possible to obtain important reverse rates without a drastic loss of the resultant thrust. Such a device can be of benefit in improving controllability during combat or in designing a STOL. The arrangement defined is characterized by great simplicity, the jet reattachment is spontaneous over all the explored area, and no extra systems are required for blowing or suction.
Transl. by A.R.H.

N82-23174# Alfa Romeo S.p.A., Naples (Italy).
TURBOPROP AND TURBOJET EJECTOR OPTIMISATION

V. P. Riviello, A. Murolo, and G. Torella (Italian Air Force Academy) *In* AGARD Fluid Dyn. of Jets with Appl. to V/STOL Jan. 1982 13 p refs
Avail: NTIS HC A19/MF A01

The off design performance of turboprop and turbojet engine with ejector exhaust ducts was investigated during the AR 318 turboprop engine development and certification program. The optimization of the matching between angle and exhaust duct system is developed. A theoretical approach is used by a synthesis program the appropriate numerical simulation of the ejector, both in the case of subsonic condition at the engine exhaust station and in a sonic station, with supersonic development of the flow through the ejector. To study the supersonic flow through the ejector a set of available experimental results is examinated to evaluate the reliability of theoretical methods for the secondary flow and for conditions. Hot condition experimental tests were performed and was compared with theoretical calculations. The next step concerns the installation of a suitable ejector system on the AR 180.10 turbojet engine, which is a derived version of the AR 318 turboprop. E.A.K.

N82-23179*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
V/STOL AIRCRAFT AND FLUID DYNAMIC
Leonard Roberts (Stanford Univ.) and Seth B. Anderson *In* AGARD Fluid Dyn. of Jets with Appl. to V/STOL Jan. 1982 5 p refs
Avail: NTIS HC A19/MF A01 CSCL 01A

The impact of military applications on rotorcraft and V/STOL aircraft design with respect to fixed wing aircraft is discussed. The influence of the mission needs on the configurational design of V/STOL aircraft, the implications regarding some problems in fluid dynamics relating to propulsive flows, and their interaction with the aircraft and the ground plane, are summarized. E.A.K.

N82-23183# Vereinigte Flugtechnische Werke-Fokker G.m.b.H., Bremen (West Germany).
INTEGRATED NAVIGATION-TF/TA-SYSTEM BASED ON STORED TERRAIN DATA PROCESSING
Horst-Dieter Lerche *In* AGARD Guidance and Control Technol. for Highly Integrated Systems Feb. 1982 13 p

Avail: NTIS HC A09/MF A01

A method to improve the reliability and optimization of terrain following flight is discussed. The terrain parameter comparison (TERPAC) system is described in which the main source of information is a terrain data base aboard the aircraft. The comparison is done in the position-fix-mode by matching the measured terrain signatures against terrain reference signatures stored in the mass memory. A hardware and software design of the combined navigation and terrain following/avoidance flight control system was developed and adapted to a modern avionic system architecture. M.G.

N82-23184# Societe d'Applications Generales d'Electricite et de Mecanique, Paris (France).
OPTIMAL INERTIAL NAVIGATION USING TERRAIN CORRELATION: AN ATTRACTIVE SOLUTION TO THE GROUND ATTACK AIRCRAFT NAVIGATION PROBLEM

L. Camberlein, M. deCremiers, and D. Chermette *In* AGARD Guidance and Control Technol. for Highly Integrated Systems Feb. 1982 15 p In FRENCH; ENGLISH summary

Avail: NTIS HC A09/MF A01

The use of terrain correlation for all-weather penetration and ground attack aircraft is discussed. Positioning by terrain correlation is briefly reviewed. For the ground attack aircraft application special algorithms allow large heading freedom over the updating area. The parameter sensitivity of the updating accuracy is analysed. This includes the terrain characteristics, the cartography accuracy, and the altitude measurement accuracy. The main operational features for ground attack aircraft are summarized: tri-dimensional updating; high accuracy facilitated by low altitude flight; self-contained, secure, jam-resistant, automated operation; a low level of heading constraint to and over the updating area; savings in weight, volume, electrical power and cost using sensors already needed on the aircraft. The principle of inertial system optimal updating is also briefly discussed. Temporal carryover from position and velocity updates can be crucial for accurate horizontal terrain following and weapon delivery initialization and in-flight alignment of tactical missiles. The possibility of integrating correlation and optimal filtering in the inertial unit is shown. A typical all weather ground attack mission scenario is described. This includes the extensive mission preparation, the nominal flight plan and possible alternatives, update area selection using ground based equipment and map data bases, and the data assembly and cassette loading. A possible operational systems architecture is described with the necessary equipment. M.G.

N82-23185# McDonnell Aircraft Co., St. Louis, Mo.
INTEGRATED FLIGHT AND FIRE CONTROL DEMONSTRATION ON AN F-15B AIRCRAFT: SYSTEM DEVELOPMENT AND GROUND TEST RESULTS
R. J. Landy, C. A. Scolatti, and J. E. Hunter (AFWAL) *In* AGARD Guidance and Control Technol. for Highly Integrated Systems Feb. 1982 17 p refs

Avail: NTIS HC A09/MF A01

An integrated flight and fire control (IFFC) system is described which utilizes an automatic coupler and modified flight control system to steer out tracking errors calculated by a director fire control system using information from an ATLIS 2 electro-optical tracker. The F-15B aircraft is the test bed aircraft. Simulation and analysis results indicate that the IFFC system has excellent air-to-air gunnery accuracy with decreased pilot workload. These results also indicate that attacker survivability in air-to-ground gunnery and bombing encounters can be increased by using maneuvering approaches without compromising air-to-ground weapon delivery accuracy. Extensive ground testing of IFFC hardware and software is described. Details of the flight test program plan are presented. M.G.

N82-23186# Singer Co., Wayne, N. J.
THE INTEGRATION OF MULTIPLE AVIONIC SENSORS AND TECHNOLOGIES FOR FUTURE MILITARY HELICOPTERS

Albert J. Shapiro *In* AGARD Guidance and Control Technol. for Highly Integrated Systems Feb. 1982 21 p refs

Avail: NTIS HC A09/MF A01

Multi-sensor navigation systems already available and in use in helicopters are discussed followed by a review of the system trade-offs and considerations leading to new systems that use more advanced digital electronic techniques to achieve the goals of reduced pilot workload, improved performance at minimum size, weight, and cost. The beneficial impact of ongoing technological advances in improving the operating capabilities of future avionics systems is indicated. R.J.F.

N82-23187# Aeronautical Systems Div., Wright-Patterson AFB, Ohio. Plans and Management Information Dept.
PRODUCTION VERIFICATION TESTING (PVT) OF GUIDANCE AND CONTROL SYSTEMS FOR HIGH RELIABILITY

Paul J. Logus *In* AGARD Guidance and Control Technol. for Highly Integrated Systems Feb. 1982 11 p refs

Avail: NTIS HC A09/MF A01

The testing of equipment for highly integrated guidance and control systems is addressed. A departure to the usual acceptance testing is discussed by examining in some detail a technique called production verification testing (PVT). Some of the recent literature and experience is reviewed. Computer simulation are used to examine various facets of PVT. Particular emphasis is directed toward the implementation of 100% testing of all systems prior to delivery through the use of N sequential failure-free cycles. Finally, conclusions drawn from computer simulations are presented. The number of N sequential failure free cycles that may be necessary is suggested, providing insight into interpreting the results. Simulation results suggest a means for determining not only expected operational reliability but also process control problems during manufacturing. R.J.F.

N82-23189# Systems Control, Inc., Palo Alto, Calif.
ANALYSIS OF COMPUTING SYSTEM CONFIGURATIONS FOR HIGHLY INTEGRATED GUIDANCE AND CONTROL SYSTEMS
J. Edwin Jones, Jay S. Karmarkar, and Randall E. Fleming *In* AGARD Guidance and Control Technol. for Highly Integrated Systems Feb. 1982 9 p refs

Avail: NTIS HC A09/MF A01

The importance of early and sustained validation of architectures for highly integrated systems is discussed. Two early validation tools are presented. A description of the two tools, (1) generalized reliability and maintainability program (GRAMP), and (2) functional emulation, is presented, along with a discussion of their utility in the development of highly integrated guidance and control systems. B.W.

N82-23192*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A FLIGHT INVESTIGATION OF BLADE-SECTION AERODYNAMICS FOR A HELICOPTER MAIN ROTOR HAVING RC-SC2 AIRFOIL SECTIONS
Charles E. K. Morris, Jr. Mar. 1982 163 p refs
(NASA-TM-83298; NAS 1.15:83298) Avail: NTIS HC A08/MF A01 CSCL 10A

Pressure data at 90 percent blade radius for a helicopter main rotor with RC-SC2 blade sections was obtained. Concurrent measurements were made of vehicle flight state, performance and some rotor loads. The test envelope included hover, level flight from about 65 to 144 knots, climb and descent, and collective fixed maneuvers. Airfoil pressure distributions obtained in flight agree with those theoretical calculations for two dimensional, steady flow. S.L.

N82-23193*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
APPLICATION OF A TRANSONIC POTENTIAL FLOW CODE TO THE STATIC AEROELASTIC ANALYSIS OF THREE-DIMENSIONAL WINGS
Woodrow Whitlow, Jr. and Robert M. Bennett Apr. 1982 12 p refs Presented at the AIAA/ASME/ASCE/AHS 23rd Struct., Structural Dyn. and Mater. Conf., New Orleans, 10-12 May 1982
(NASA-TM-83296; NAS 1.15:83296; AIAA-PAPER-82-0689) Avail: NTIS HC A02/MF A01 CSCL 01A

Since the aerodynamic theory is nonlinear, the method requires the coupling of two iterative processes - an aerodynamic analysis and a structural analysis. A full potential analysis code, FLO22, is combined with a linear structural analysis to yield aerodynamic load distributions on and deflections of elastic wings. This method was used to analyze an aeroelastically-scaled wind tunnel model of a proposed executive-jet transport wing and an aeroelastic research wing. The results are compared with the corresponding rigid-wing analyses, and some effects of elasticity on the aerodynamic loading are noted. T.M.

N82-23194*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AN ACCURATE METHOD FOR EVALUATING THE KERNEL OF THE INTEGRAL EQUATION RELATING LIFT TO DOWNWASH IN UNSTEADY POTENTIAL FLOW
Robert N. Desmarais Apr. 1982 15 p refs Presented at the AIAA/ASME/ASCE/AHS 23rd Struct., Structural Dyn. and Mater. Conf., New Orleans, 10-12 May 1982 10-12 May 1982
(NASA-TM-83281; NAS 1.15:83281; AIAA-PAPER-82-687) Avail: NTIS HC A02/MF A01 CSCL 01A

The method is capable of generating approximations of arbitrary accuracy. It is based on approximating the algebraic part of the nonelementary integrals in the kernel by exponential functions and then integrating termwise. The exponent spacing in the approximation is a geometric sequence. The coefficients and exponent multiplier of the exponential approximation are computed by least squares so the method is completely automated. Exponential approximates generated in this manner are two orders of magnitude more accurate than the exponential approximation that is currently most often used for this purpose. The method can be used to generate approximations to attain any desired trade-off between accuracy and computing cost. T.M.

N82-23195*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
STATIC AND UNSTEADY PRESSURE MEASUREMENTS ON A 50 DEGREE CLIPPED DELTA WING AT M = 0.9
R. W. Hess, E. C. Wynne, and F. W. Cazier Apr. 1982 10 p refs
(NASA-TM-83297; NAS 1.15:83297) Avail: NTIS HC A02/MF A01 CSCL 01A

Pressures were measured with Freon as the test medium. Data taken at M = 0.9 is presented for static and oscillatory deflections of the trailing edge control surface and for the wing in pitch. Comparisons of the static measured data are made with results computed using the Bailey-Ballhaus small disturbance code. T.M.

N82-23196*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
TIME-MARCHING TRANSONIC FLUTTER SOLUTIONS INCLUDING ANGLE-OF-ATTACK EFFECTS
John W. Edwards, Robert M. Bennett, Woodrow Whitlow, Jr., and David A. Seidel Apr. 1982 16 p refs Presented at the

AIAA/ASME/ASCE/AHS Struct., Structural Dyn. and Mater. Conf., New Orleans, 10-12 May 1982
(NASA-TM-83295; NAS 1.15:83295; AIAA-PAPER-82-0685) Avail: NTIS HC A02/MF A01 CSCL 01A

Transonic aeroelastic solutions based upon the transonic small perturbation potential equation were studied. Time-marching transient solutions of plunging and pitching airfoils were analyzed using a complex exponential modal identification technique, and seven alternative integration techniques for the structural equations were evaluated. The HYTRAN2 code was used to determine transonic flutter boundaries versus Mach number and angle-of-attack for NACA 64A010 and MBB A-3 airfoils. In the code, a monotone differencing method, which eliminates leading edge expansion shocks, is used to solve the potential equation. When the effect of static pitching moment upon the angle-of-attack is included, the MBB A-3 airfoil can have multiple flutter speeds at a given Mach number. T.M.

N82-23197# Aeronautical Research Labs., Melbourne (Australia).
A NUMERICAL INVESTIGATION OF TWO-DIMENSIONAL, SUBSONIC, LINEAR, WIND TUNNEL INTERFERENCE THEORY
N. Pollock Jun. 1981 40 p refs
(ARL/AERO-NOTE-403; AR-002-294) Avail: NTIS HC A03/MF A01

An investigation of two-dimensional, subsonic, linear wind tunnel interference using the computer program TSFOIL as a numerical tunnel was carried out for solid, open, porous and slotted walls. The use of a computer code rather than physical experiment has the advantage that test parameters such as wall characteristics and model chord can be varied widely at low cost. The aim was to determine the relative merits of the various walls and to establish the limits of applicability of linear interference theory. The most favorable wall type was found to be an ideal slotted wall with the slot parameter appropriate for zero solid blockage (F = 1.1844). For this wall type linear interference theory accurately predicted lift and pitching moment corrections for tunnel height to chord ratios greater than 2 and supersonic region height to tunnel height ratios less than 0.2.
Author

N82-23198# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. fuer Aeroelastik.
UNSTEADY PRESSURE MEASUREMENTS AT STALL AND BUFFETING
Peter Bublitz Apr. 1979 52 p refs In GERMAN; ENGLISH summary Translation was announced as N81-21041
(DFVLR-Mitt-79-09) Avail: NTIS HC A04/MF A01

The fluid dynamic phenomena of stall and buffeting, as well as the marked effects on elastic structures are described. By applying the generalized form of the equations of motion and the Fourier transforms, the governing equation of the dynamic response problem is concisely derived. Quantities needed to treat the problem under consideration are determined. Then the test installation and the relevant test method are depicted to some extent, in which the direct pressure measuring method and the statistical evaluation method are the main topics. A trapezoidal stalled wing with and without strake are tested. The efficiency of the test procedure is shown and some insight into the dynamic behavior of the stall is provided. S.L.

N82-23199# Applied Physics Lab., Johns Hopkins Univ., Laurel, Md.
APPROXIMATE METHOD FOR PREDICTING SUPERSONIC NORMAL FORCE COEFFICIENT VERY-LOW-ASPECT-RATIO LIFTING SURFACES
E. F. Lucero 14 May 1981 32 p refs Sponsored in part by NAVSEA 62R
(AD-A111770) Avail: NTIS HC A03/MF A01 CSCL 20/4

A simple, empirical method has been developed for predicting at supersonic speeds the normal force coefficient, C(N), (including carryover) of very-low-aspect ratio lifting surfaces mounted on bodies of revolution. Predicted values of C(N) using this method are shown to be in good agreement with test data obtained on both thick and thin surfaces, at Mach numbers from about 2.5 to 7.7 and angles of attack to 24 degrees. Author (GRA)

N82-23200# Akademische Fliegergruppe Braunschweig (West Germany).
WIND TUNNEL INVESTIGATIONS OF SAILPLANE FUSELAGES WITH DIFFERENT LACINGS AND WING SETTINGS [WINDKANALUNTERSUCHUNGEN AN SEGELFLUGZEUGRUEMPFEN MIT VERSCHIEDENER EINSCHNUERUNG UND FLUEGELANORDNUNG]
Rolf Radespiel 1981 14 p In GERMAN
Avail: NTIS HC A02/MF A01

The parameter fuselage lacing, sailplane wing setting and fuselage nose radius of nine glider configurations were investigated in a wind tunnel. Laminar peeling off blisters were found on strongly laced fuselages. These in the transition between fuselage and wing are essential for the harmful aerodynamic resistance. Resistance reduction was measured for increasing lacing and wing setting in the rear. These results are only valid for undisturbed flow on the fuselage front part, a condition which is not yet fulfilled for original sailplanes. Author (ESA)

N82-23207*# Boeing Commercial Airplane Co., Seattle, Wash.
COMMERCIAL JET TRANSPORT CRASHWORTHINESS
E. Widmayer and Otto B. Brende Apr. 1982 255 p refs
(Contract NAS1-16076)
(NASA-CR-165849; NAS 1.26:165849; DOT-FAA-CT-82-86) Avail: NTIS HC A12/MF A01 CSCL 01C

The results of a study to identify areas of research and approaches that may result in improved occupant survivability and crashworthiness of transport aircraft are given. The study defines areas of structural crashworthiness for transport aircraft which might form the basis for a research program. A 10-year research and development program to improve the structural impact resistance of general aviation and commercial jet transport aircraft is planned. As part of this program parallel studies were conducted to review the accident experience of commercial transport aircraft, assess the accident performance of structural components and the status of impact resistance technology, and recommend areas of research and development for that 10-year plan. The results of that study are also given. R.J.F.

N82-23208*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
HELICOPTER HANDLING QUALITIES
Apr. 1982 243 p refs Proceedings of the special meeting held at Moffett Field, Calif., 14-15 Apr. 1982; sponsored by the American Helicopter Society
(NASA-CP-2219; A-8891; NAS 1.55:2219) Avail: NTIS HC A11/MF A01 CSCL 01C

Helicopters are used by the military and civilian communities for a variety of tasks and must be capable of operating in poor weather conditions and at night. Accompanying extended helicopter operations is a significant increase in pilot workload and a need for better handling qualities. An overview of the status and problems in the development and specification of helicopter handling-qualities criteria is presented. Topics for future research efforts by government and industry are highlighted.

N82-23209*# Naval Air Development Center, Warminster, Pa.
VTOL AND VSTOL HANDLING QUALITIES SPECIFICATIONS, AN OVERVIEW OF THE CURRENT STATUS
Kevin W. Goldstein *In* NASA, Ames Research Center Helicopter Handling Qualities Apr. 1982 p 1-7 refs

Avail: NTIS HC A11/MF A01 CSCL 01C

The highlights of a comparative analysis between the current helicopter and VSTOL specifications and four representative rotary wing aircraft are presented. Longitudinal, lateral, and directional control power and dynamic stability characteristics were analyzed for hovering conditions. Forward flight static and dynamic stability were analyzed for the longitudinal and lateral-directional axes. Results of the analyses in terms of the applicability/utility of the MIL-H-8501A criteria are presented for each of the above areas. The review of the MIL-H-8301A criteria against those in MIL-F-83300 and AGARD 577 indicate many areas in which MIL-H-8501A does not give adequate design guidance.
T.M.

N82-23210*# Aerospatiale Helicopter Corp., Grand Prairie, Tex.
CIVIL (FRENCH/US) CERTIFICATION OF THE COAST GUARD'S HH-65A DAUPHIN
J. C. Hart, J. M. Besse (Societe Nationale Industrielle Aerospatiale, Marignane, France), and K. W. McElreath (Rockwell Collins Government Avionics Div., Cedar Rapids, Iowa) *In* NASA. Ames Research Center Helicopter Handling Qualities Apr. 1982 p

9-13
Avail: NTIS HC A11/MF A01 CSCL 01C

Certification programs with particular emphasis on handling qualities requirements are described. A dynamic simulator was designed and constructed to support and verify the dynamic aspects of the avionics system, particularly the Automatic Flight Control System (AFCS). The role of the Dynamic Simulator is discussed. T.M.

N82-23211*# Boeing Vertol Co., Philadelphia, Pa.
BOEING 234 FLIGHT CONTROL DEVELOPMENT
James J. Morris *In* NASA. Ames Research Center Helicopter Handling Qualities Apr. 1982 p 15-22

Avail: NTIS HC A11/MF A01 CSCL 01C

The Boeing 234 is the commercially certified derivative of the CH-47 Chinook. The automatic flight control system and flight director with coupler were designed to reduce pilot work-load for missions of approximately six hour duration during VFR, IFR, day and night conditions. The AFCS system for the 234 is essentially the same system as developed for the CH-47D, which has airspeed hold, attitude hold, and maneuver enhancement in all three axes. The system also has the capability to couple to the Sperry Helcis flight director system which provides for enroute navigation and landing approaches. Certification testing was completed, by both the FAA and CAA, to FAR Part 29 for Transport Category Rotorcraft and BCAR Section G: Rotorcraft. The aircraft was certified for civil operation in June 1981.
Author

N82-23212*# Grumman Aerospace Corp., Bethpage, N.Y.
INFLUENCE OF MANEUVERABILITY ON HELICOPTER COMBAT EFFECTIVENESS
Michael Falco and Roger Smith (Army Aviation Research and Development Command, St. Louis, Mo.) *In* NASA. Ames Research Center Helicopter Handling Qualities Apr. 1982 p 23-33 refs
Avail: NTIS HC A11/MF A01 CSCL 01C

A computational procedure employing a stochastic learning method in conjunction with dynamic simulation of helicopter flight and weapon system operation was used to derive helicopter maneuvering strategies. The derived strategies maximize either survival or kill probability and are in the form of a feedback control based upon threat visual or warning system cues. Maneuverability parameters implicit in the strategy development include maximum longitudinal acceleration and deceleration, maximum sustained and transient load factor turn rate at forward speed, and maximum pedal turn rate and lateral acceleration at hover. Results are presented in terms of probability of skill for all combat initial conditions for two threat categories. T.M.

N82-23213*# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugmechanik.
FLIGHT TESTS FOR THE ASSESSMENT OF TASK PERFORMANCE AND CONTROL ACTIVITY
Heinz-Juergen Pausder and Dieter Hummes *In* NASA. Ames Research Center Helicopter Handling Qualities Apr. 1982 p 35-46 refs
Avail: NTIS HC A11/MF A01 CSCL 01C

The tests were performed with the helicopters BO 105 and UH-1D. Closely connected with tactical demands the six test pilots' task was to minimize the time and the altitude over the obstacles. The data reduction yields statistical evaluation parameters describing the control activity of the pilots and the achieved task performance. The results are shown in form of evaluation diagrams. Additionally dolphin tests with varied control strategy were performed to get more insight into the influence of control techniques. From these test results recommendations can be derived to emphasize the direct force control and to reduce the collective to pitch crosscoupling for the dolphin. T.M.

N82-23214*# Army Research and Technology Labs., Moffett Field, Calif.
A HELICOPTER HANDLING-QUALITIES STUDY OF THE EFFECTS OF ENGINE RESPONSE CHARACTERISTICS, HEIGHT-CONTROL DYNAMICS, AND EXCESS POWER ON NAP-OF-THE-EARTH OPERATIONS
Lloyd D. Corliss *In* NASA. Ames Research Center Helicopter Handling Qualities Apr. 1982 p 47-57 refs
Avail: NTIS HC A11/MF A01 CSCL 01C

The helicopter configuration with an rpm-governed gas-turbine engine was examined. A wide range of engine response time, vehicle damping and sensitivity, and excess power levels was studied. The data are compared with the existing handling-qualities specifications, MIL-F-83300 and AGARD 577, and in general show a need for higher minimums when performing such NOE maneuvers as a dolphin and bob-up task. T.M.

N82-23215*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
UNIFIED RESULTS OF SEVERAL ANALYTICAL AND EXPERIMENTAL STUDIES OF HELICOPTER HANDLING QUALITIES IN VISUAL TERRAIN FLIGHT
Robert T. N. Chen *In its* Helicopter Handling Qualities Apr. 1982 p 59-74 refs

Avail: NTIS HC A11/MF A01 CSCL 01C

The studies were undertaken to investigate the effects of rotor design parameters, interaxis coupling, and various levels of stability and control augmentation on the flying qualities of helicopters performing low-level, terrain-flying tasks in visual meteorological conditions. Some unified results are presented, and the validity and limitations of the flying-qualities data obtained are interpreted. Selected results, related to various design parameters, provide guidelines for the preliminary design of rotor systems and aircraft augmentation systems. T.M.

N82-23216*# Boeing Vertol Co., Philadelphia, Pa.
AN ASSESSMENT OF VARIOUS SIDE-STICK CONTROLLER/STABILITY AND CONTROL AUGMENTATION SYSTEMS FOR NIGHT NAP-OF-EARTH FLIGHT USING PILOTED SIMULATION
Kenneth H. Landis and Edwin W. Aiken (Army Research and Technology Labs., Moffett Field, Calif.) *In* NASA. Ames Research Center Helicopter Handling Qualities Apr. 1982 p 75-96 refs
Avail: NTIS HC A11/MF A01 CSCL 01C

Several night nap-of-the-earth mission tasks were evaluated using a helmet-mounted display which provided a limited field-of-view image with superimposed flight control symbology. A wide range of stability and control augmentation designs was investigated. Variations in controller force-deflection characteristics and the number of axes controlled through an integrated side-stick controller were studied. In general, a small displacement controller is preferred over a stiffstick controller particularly for maneuvering flight. Higher levels of stability augmentation were required for IMC tasks to provide handling qualities comparable to those achieved for the same tasks conducted under simulated visual flight conditions. T.M.

N82-23217*# Martin Marietta Corp., Orlando, Fla.
DEFINITION OF DISPLAY/CONTROL REQUIREMENTS FOR ASSAULT TRANSPORT NIGHT/ADVERSE WEATHER CAPABILITY
R. Joseph Milelli, Gary W. Mowery, and Carmen Pontelandolfo (Naval Air Development Center, Warminister, Pa.) *In* NASA. Ames Research Center Helicopter Handling Qualities Apr. 1982 p 97-107 refs
Avail: NTIS HC A11/MF A01 CSCL 01C

A Helicopter Night Vision System was developed to improve low-altitude night and/or adverse weather assult transport capabilities. Man-in-the-loop simulation experiments were performed to define the minimum display and control requirements for the assult transport mission and investigate forward looking infrared sensor requirements, along with alternative displays such as panel mounted displays (PMD) helmet mounted displays (HMD), and integrated control display units. Also explored were navigation requirements, pilot/copilot interaction, and overall cockpit arrangement. Pilot use of an HMD and copilot use of a PMD appear as both the preferred and most effective night navigation combination. M.D.K.

N82-23218*# National Research Council of Canada, Ottawa (Ontario). Airborne Simulator Facility.
SOME PILOTING EXPERIENCES WITH MULTIFUNCTION ISOMETRIC SIDE-ARM CONTROLLERS IN A HELICOPTER
J. Murray Morgan *In* NASA. Ames Research Center Helicopter Handling Qualities Apr. 1982 p 109-119 ref

Avail: NTIS HC A11/MF A01 CSCL 01C

The installation of two side-arm mounted, isometric controllers

in the NAE Airborne Simulator, a modified, variable stability Bell 205 A is described, as is the development of various control systems for use with them. The results of two experiments are presented indicating both the feasibility and acceptability of such systems for a wide variety of tasks in a conventional single rotor helicopter, with a minimum of stability augmentation. Areas of future research are indicated. Author

N82-23219*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
RESULTS OF NASA/FAA GROUND AND FLIGHT SIMULATION EXPERIMENTS CONCERNING HELICOPTER IFR AIRWORTHINESS CRITERIA
J. Victor Lebacqz, Robert T. N. Chen, Ronald M. Gerdes, Jeanine M. Weber, and Raymond D. Forrest (FAA, Moffett Field, Calif.) *In its* Helicopter Handling Qualities 1 Apr. 1982 p 121-138 refs
Avail: NTIS HC A11/MF A01 CSCL 01C

A sequence of ground and flight simulation experiments was conducted to investigate helicopter instrument-flight-rules airworthiness criteria. The first six of these experiments and major results are summarized. Five of the experiments were conducted on large-amplitude motion base simulators. The NASA-Army V/STOLAND UH-1H variable-stability helicopter was used in the flight experiment. Artificial stability and control augmentation, longitudinal and lateral control, and in pitch and roll attitude augmentation were investigated. M.D.K.

N82-23220*# Rockwell International Corp., Cedar Rapids, Iowa. Government Avionics Div.
STATE-OF-THE-ART COCKPIT DESIGN FOR THE HH-65A HELICOPTERS
Daniel E. Castleberry and Marsha Y. McElreath *In* NASA. Ames Research Center Helicopter Handling Qualities Apr. 1982 p 139-143 refs
Avail: NTIS HC A11/MF A01 CSCL 01C

In the design of a HH-65A helicopter cockpit, advanced integrated electronics systems technology was employed to achieve several important goals for this multimission aircraft. They were: (1) integrated systems operation with consistent and simplified cockpit procedures; (2) mission-task-related cockpit displays and controls, and (3) reduced pilot instrument scan effort with excellent outside visibility. The integrated avionics system was implemented to depend heavily upon distributed but complementary processing, multiplex digital bus technology, and multifunction CRT controls and displays. This avionics system was completely flight tested and will soon enter operational service with the Coast Guard. M.D.K.

N82-23221*# Ohio State Univ., Columbus.
PERFORMANCE EVALUATION OF A KINESTHETIC-TACTUAL DISPLAY
Richard J. Jagacinski, John M. Flach, Richard D. Gilson, and Richard S. Dunn (Army Research and Technology Lab., Moffett Field, Calif.) *In* NASA. Ames Research Center Helicopter Handling Qualities Apr. 1982 p 145-150 refs

(Grant NsG-2179)
Avail: NTIS HC A11/MF A01 CSCL 01C

Simulator studies demonstrated the feasibility of using kinesthetic-tactual (KT) displays for providing collective and cyclic command information, and suggested that KT displays may increase pilot workload capability. A dual-axis laboratory tracking task suggested that beyond reduction in visual scanning, there may be additional sensory or cognitive benefits to the use of multiple sensory modalities. Single-axis laboratory tracking tasks revealed performance with a quickened KT display to be equivalent to performance with a quickened visual display for a low frequency sum-of-sinewaves input. In contrast, an unquickened KT display was inferior to an unquickened visual display. Full scale simulator studies and/or inflight testing are recommended to determine the generality of these results. Author

N82-23222*# Army Avionics Research and Development Activity, Fort Monmouth, N. J. Avionics Lab.
SYNTHESIS OF AN INTEGRATED COCKPIT MANAGEMENT SYSTEM
Joseph A. Dasaro and Charles T. Elliott *In* NASA. Ames Research Center Helicopter Handling Qualities Apr. 1982 p 151-162 refs
Avail: NTIS HC A11/MF A01 CSCL 01C

The process used in the synthesis of an integrated cockpit management system was discussed. Areas covered included flight displays, subsystem management, checklists, and procedures (both normal and emergency). The process of evolving from the unintegrated conventional system to the integrated system is examined and a brief description of the results presented.M.D.K.

N82-23223*# United Technologies Corp., East Hartford, Conn. Aircraft Div.
THE ROLE OF VOICE TECHNOLOGY IN ADVANCED HELICOPTER COCKPITS
Howard P. Harper *In* NASA. Ames Research Center Helicopter Handling Qualities Apr. 1982 p 163-170 refs
Avail: NTIS HC A11/MF A01 CSCL 01C

The status of voice output and voice recognition technology in relation to helicopter cockpit applications is described. The maturing of this technology provides many opportunities for new approaches to crew workload reduction. The helicopter operating environment, potential application areas, and the impact on advanced cockpit design are discussed. Author

N82-23224*# Pacer Systems, Inc., Arlington, Va.
COCKPIT INTEGRATION FROM A PILOT'S POINT OF VIEW
David L. Green *In* NASA. Ames Research Center Helicopter Handling Qualities Apr. 1982 p 171-181
Avail: NTIS HC A11/MF A01 CSCL 01C

Extensive experience in both operational and engineering test flight was used to suggest straightforward changes to helicopter cockpit and control system design that would improve pilot performance in marginal and instrument flight conditions. Needed control system improvements considered include: (1) separation of yaw from cyclic force trim; (2) pedal force proportional to displacement rate; and (3) integration of engine controls in collective stick. Display improvements needed include: (1) natural cuing of yaw rate in attitude indicator; (2) collective position indication and radar altimeter placed within primary scan; and (3) omnidirectional display of full range airspeed data. M.D.K.

N82-23225*# Costruzioni Aeronautiche Giovanni Agusta S.p.A., Samarate (Italy). Helicopter Systems Engineering Div.
INTEGRATED COCKPIT FOR A-129
Filippo Reina, James J. Gracia (Harris Government Information Systems Div.), and Bryce W. Koth (Harris Government Information Systems Div.) *In* NASA. Ames Research Center Helicopter Handling Qualities Apr. 1982 p 183-192
Avail: NTIS HC A11/MF A01

Weight, size, and mission requirements for the A-129 mandated an integrated system approach for the crew/cockpit interface design. Instead of the usual multitude of cockpit controls, indicators, gauges, and lights, the primary crew interface is a single multifunction keyboard and one or more multifunction CRT display units. This cockpit design approach imposed unusual constraints upon the system architecture to overcome the inherent information access limitations of a data input/output window that was restricted by the available space. The conceptual approach and resulting design of the A-129 cockpit with the intent to enhance the development of cockpit standardization are described. Author

N82-23226*# Systems Technology, Inc., Hawthorne, Calif.
NEW DEVELOPMENT IN FLYING QUALITIES WITH APPLICATION TO ROTARY WING AIRCRAFT
Roger H. Hoh *In* NASA. Ames Research Center Helicopter Handling Qualities 9 Apr. 1982 p 193-198 refs
Avail: NTIS HC A11/MF A01 CSCL 01C

Some recent considerations and developments in handling quality criteria are reviewed with emphasis on using fixed wing experience gained in developing MIL-F-8785C and the more recent MIL Standard and Handbook. Particular emphasis is placed on the tasks and environmental conditions used to develop the criterion boundaries, SAS failures, and potential fixed wing criteria that are applicable to rotary wing aircraft. Author

N82-23227*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

HELICOPTER SIMULATION TECHNOLOGY: AN AMES RESEARCH CENTER PERSPECTIVE
Richard S. Bray *In its* Helicopter Handling Qualities Apr. 1982 p 199-208 refs
Avail: NTIS HC A11/MF A01 CSCL 01C

The total experience for evidence regarding the levels of motion and visual cueing fidelity required for handling-qualities research in ground-based simulators is reviewed. Positive contributions of cockpit motion were identified, but much remains to be learned regarding the sensitivities of individual control modes to cueing attenuation. A firmer understanding of the pilot's utilization of visual and motion cues is the key to more efficient use of simulation in helicopter control-systems research. Author

N82-23228*# Stanford Univ., Calif. Joint Inst. of Aeronautics and Acoustics.
PAST APPLICATIONS AND FUTURE POTENTIAL OF VARIABLE STABILITY RESEARCH HELICOPTERS
William S. Hindson *In* NASA. Ames Research Center Helicopter Handling Qualities Apr. 1982 p 209-219 refs

Avail: NTIS HC A11/MF A01 CSCL 01C

The historical development of variable-stability research helicopters and some of their previous applications are presented as a guide for assessing their future potential. The features of three general-purpose rotary-wing flight research aircraft that provide complementary capabilities are described briefly, and a number of future applications are proposed. Author

N82-23229*# Systems Technology, Inc., Mountain View, Calif.
A PILOT IN THE LOOP ANALYSIS OF HELICOPTER ACCELERATION/DECELERATION MANEUVERS
Robert K. Heffley *In* NASA. Ames Research Center Helicopter Handling Qualities Apr. 1982 p 221-232 refs

Avail: NTIS HC A11/MF A01 CSCL 01C

Helicopter flight acceleration/deceleration maneuvers are quantified and put to use in the fields of handling qualities, flight training and evaluation of simulator fidelity. The three specific cases include the normal speed change maneuver, the nap-of-the-Earth dash/quickstop, and the decelerating approach to hover. All of these maneuvers share common generic features in terms of pilot adaptation and mathematical description; yet each differs in terms of the essential feedback loop structure, implications for handling qualities requirements, and simulator fidelity criteria. Author

N82-23230*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
APPLICATIONS OF SYSTEM IDENTIFICATION METHODS TO THE PREDICTION OF HELICOPTER STABILITY, CONTROL AND HANDLING CHARACTERISTICS
G. D. Padfield (RAE, Bedford, England) and R. K. DuVal *In its* Helicopter Handling Qualities Apr. 1982 p 233-247 refs

Avail: NTIS HC A11/MF A01 CSCL 01C

A set of results on rotorcraft system identification is described. Flight measurements collected on an experimental Puma helicopter are reviewed and some notable characteristics highlighted. Following a brief review of previous work in rotorcraft system identification, the results of state estimation and model structure estimation processes applied to the Puma data are presented. The results, which were obtained using NASA developed software, are compared with theoretical predictions of roll, yaw and pitching moment derivatives for a 6 degree of freedom model structure. Anomalies are reported. The theoretical methods used are described. A framework for reduced order modelling is outlined. Author

N82-23231* National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.
SUN SENSING GUIDANCE SYSTEM FOR HIGH ALTITUDE AIRCRAFT Patent
Robert D. Reed, Principal Investigator Issued 27 Apr. 1982 7 p Filed 12 Mar. 1980 Supersedes N80-20249 (18 - 11, p 1375)
(NASA-Case-FRC-11052-1; US-Patent-4,326,685; US-Patent-Appl-SN-129783; US-Patent-Class-244-175; US-Patent-Class-244-168; US-Patent-Class-244-190; US-Patent-Class-318-580) Avail: US Patent and Trademark Office CSCL 17G

A sun sensing guidance system for high altitude aircraft is described. The system is characterized by a disk shaped body mounted for rotation aboard the aircraft in exposed relation to solar radiation. The system also has a plurality of mutually isolated chambers; each chamber being characterized by an opening having a photosensor disposed therein and arranged in facing relation with the opening for receiving incident solar radiation and responsively providing a voltage output. Photosensors are connected in paired relation through a bridge circuit for providing heading error signals in response to detected imbalances in intensities of solar radiation.

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

N82-23233*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ANALYSIS AND MONTE CARLO SIMULATION OF NEAR-TERMINAL AIRCRAFT FLIGHT PATHS
James R. Schiess and Christine G. Matthews (Computer Sciences Corp.) Apr. 1982 39 p refs
(NASA-TP-1997; L-15062; NAS 1.60:1997) Avail: NTIS HC A03/MF A01 CSCL 17G

The flight paths of arriving and departing aircraft at an airport are stochastically represented. Radar data of the aircraft movements are used to decompose the flight paths into linear and curvilinear segments. Variables which describe the segments are derived, and the best fitting probability distributions of the variables, based on a sample of flight paths, are found. Conversely, given information on the probability distribution of the variables, generation of a random sample of flight paths in a Monte Carlo simulation is discussed. Actual flight paths at Dulles International Airport are analyzed and simulated. S.L.

N82-23234*# *Lockheed-Georgia Co., Marietta.*
DETERMINATION OF WIND TUNNEL CONSTRAINT EFFECTS BY A UNIFIED PRESSURE SIGNATURE METHOD. PART 1: APPLICATIONS TO WINGED CONFIGURATIONS Final Report, Oct. 1980 - Nov. 1981
J. E. Hackett, S. Sampath, and C. G. Phillips Jun. 1981 185 p refs 2 Vol.
(Contract NAS2-9883)
(NASA-CR-166186; NAS 1.26:166186; LG81ER0166-Pt-1) Avail: NTIS HC A09/MF A01 CSCL 01C

A new, fast, non-iterative version of the 'Wall Pressure Signature Method' is described and used to determine blockage and angle-of-attack wind tunnel corrections for highly-powered jet-flap models. The correction method is complemented by the application of tangential blowing at the tunnel floor to suppress flow breakdown there, using feedback from measured floor pressures. This tangential blowing technique was substantiated by subsequent flow investigations using an LV. The basic tests on an unswept, knee-blown, jet flapped wing were supplemented to include the effects of slat-removal, sweep and the addition of unflapped tips. C sub mu values were varied from 0 to 10 free-air C sub l's in excess of 18 were measured in some cases. Application of the new methods yielded corrected data which agreed with corresponding large tunnel 'free air' resuls to within the limits of experimental accuracy in almost all cases. A program listing is provided, with sample cases. Author

N82-23235*# Lockheed-Georgia Co., Marietta.
DETERMINATION OF WIND TUNNEL CONSTRAINT EFFECTS BY A UNIFIED PRESSURE SIGNATURE METHOD. PART 2: APPLICATION TO JET-IN-CROSSFLOW Final Report, Oct. 1980 - Nov. 1981
J. E. Hackett, S. Sampath, and C. G. Phillips Jun. 1981 186 p refs 2 Vol.
(Contract NAS2-9883)
(NASA-CR-166187; NAS 1.26:166187; LG81ER0167-Pt-2) Avail: NTIS HC A09/MF A01 CSCL 01C

The development of an improved jet-in-crossflow model for estimating wind tunnel blockage and angle-of-attack interference is described. Experiments showed that the simpler existing models fall seriously short of representing far-field flows properly. A new, vortex-source-doublet (VSD) model was therefore developed which employs curved trajectories and experimentally-based singularity strengths. The new model is consistent with existing and new experimental data and it predicts tunnel wall (i.e. far-field) pressures properly. It is implemented as a preprocessor to the wall-pressure-signature-based tunnel interference predictor. The supporting experiments and theoretical studies revealed some new results. Comparative flow field measurements with 1-inch 'free-air' and 3-inch impinging jets showed that vortex penetra-

tion into the flow, in diameters, was almost unaltered until 'hard' impingement occurred. In modeling impinging cases, a 'plume redirection' term was introduced which is apparently absent in previous models. The effects of this term were found to be very significant. Author

N82-23236*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
COMPARISON OF ANALYTICAL PREDICTIONS OF LONGITUDINAL SHORT PERIOD PILOT-INDUCED OSCILLATIONS WITH RESULTS FROM A SIMULATION STUDY OF THE SPACE SHUTTLE ORBITER
Donald R. Riley and G. Kimball Miller, Jr. Apr. 1982 43 p refs
(NASA-TM-83267; L-14847; NAS 1.15:83267) Avail: NTIS HC A03/MF A01 CSCL 01C

An analytical analysis of conditions producing pilot induced oscillations (PIO's) was made for the space shuttle orbiter in a landing approach configuration for the task of milling the elevation angle of the line of sight to a target vehicle. The analysis yielded a value of PIO frequency and a value for the amount of total system time delay (pilot + control system) that can be tolerated before instability results. Calculations were performed showing the effect of varying the range to the target and of varying the handling qualities of the orbiter vehicle. Analytical predictions were compared with simulation results obtained using a visual motion simulator. Author

N82-23237*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
VALIDATION OF ZERO-ORDER FEEDBACK STRATEGIES FOR MEDIUM RANGE AIR-TO-AIR INTERCEPTION IN A HORIZONTAL PLANE
Josef Shinar Apr. 1982 48 p refs
(NASA-TM-84237; NAS 1.15:84237; A-8895) Avail: NTIS HC A03/MF A01 CSCL 01C

A zero order feedback solution of a variable speed interception game between two aircraft in the horizontal plane, obtained by using the method of forced singular perturbation (FSP), is compared with the exact open loop solution. The comparison indicates that for initial distances of separation larger than eight turning radii of the evader, the accuracy of the feedback approximation is better than one percent. The result validates the zero order FSP approximation for medium range air combat analysis. S.L.

N82-23238*# North Carolina State Univ., Raleigh. Dept. of Mechanical and Aerospace Engineering.
AUTOMATED DESIGN OF MINIMUM DRAG LIGHT AIRCRAFT FUSELAGES AND NACELLES Final Report
Frederick O. Smetana, Star R. Fox, and Baruch E. Karlin 14 May 1982 25 p refs
(Grant NsG-1584)
(NASA-CR-168913; NAS 1.26:168913) Avail: NTIS HC A02/MF A01 CSCL 01C

The constrained minimization algorithm of Vanderplaats is applied to the problem of designing minimum drag faired bodies such as fuselages and nacelles. Body drag is computed by a variation of the Hess-Smith code. This variation includes a boundary layer computation. The encased payload provides arbitrary geometric constraints, specified a priori by the designer, below which the fairing cannot shrink. The optimization may include engine cooling air flows entering and exhausting through specific port locations on the body. M.D.K.

N82-23239*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
TRANSONIC FLUTTER STUDY OF A WIND-TUNNEL MODEL OF A SUPERCRITICAL WING WITH/WITHOUT WINGLET
Charles L. Ruhlin, Frank J. Rauch, Jr., and Catherine Waters Mar. 1982 11 p refs Presented at the 23rd AIAA/ASME/ASCE/AHS Struct., Structural Dyn. and Mater. Conf., New Orlean, 10-12 May 1982 Prepared in cooperation with Grumman Aerospace Corp., Bethpage, N.Y.
(NASA-TM-83279; NAS 1.15:83279) Avail: NTIS HC A02/MF A01 CSCL 01C

The model was a 1/6.5-size, semipan version of a wing proposed for an executive-jet-transport airplane. The model was tested with a normal wingtip, a wingtip with winglet, and a normal wingtip ballasted to simulate the winglet mass properties. Flutter and aerodynamic data were acquired at Mach numbers (M) from 0.6 to 0.95. The measured transonic flutter speed boundary for each wingtip configuration had roughly the same shape with a minimum flutter speed near M = 0.82. The winglet addition and wingtip mass ballast decreased the wing flutter speed by about 7 and 5 percent, respectively; thus, the winglet effect on flutter was more a mass effect than an aerodynamic effect. T.M.

N82-23240*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
EVALUATION OF FOUR SUBCRITICAL RESPONSE METHODS FOR ON-LINE PREDICTION FLUTTER ONSET IN WIND-TUNNEL TESTS
Charles L. Ruhlin, Judith J. Watson, Rodney H. Ricketts, and Robert V. Doggett, Jr. Mar. 1982 10 p refs Presented at the AIAA/ASME/ASCE/AHS 23rd Struct., Structural Dyn. and Mater. Conf., New Orleans, 10-12 May 1982
(NASA-TM-83278; NAS 1.15:83278; AIAA-PAPER-82-0644CP) Avail: NTIS HC A02/MF A01 CSCL 01C

The methods were evaluated for use in tests where the flutter model is excited solely by airstream turbulence. The methods were: randomdec, power-spectral-density, peak-hold, and cross-spectrum. The test procedure was to maintain a constant Mach number (M) and increase the dynamic pressure (q) in incremental steps. The test Mach numbers were 0.65, 0.75, 0.82, 0.90, and 1.15. The four methods provided damping trends by which the flutter mode could be tracked and extrapolated to a flutter-onset q. A hard flutter point was obtained at M = 0.82. The peak-hold and cross-spectrum methods gave reliable results and could be most readily used for on-line testing. At M = 0.82, a p-k analysis predicted the same flutter mode as the experiment but a 6-percent lower flutter q. At the subcritical dynamic pressures, calculated damping values were appreciably lower than measured data. T.M.

N82-23241*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NASA/HAA ADVANCED ROTORCRAFT TECHNOLOGY AND TILT ROTOR WORKSHOP. VOLUME 5: PROPULSION SESSION
1980 211 p Workshop held at Palo Alto, Calif., 3-5 Dec. 1980
(NASA-TM-84207; NAS 1.15:84207) Avail: NTIS HC A10/MF A01 CSCL 01C

The expressed needs and priorities of the civil helicopter users, the existing research efforts, and technology requirements as perceived by leading airframe and engine manufacturers were addressed, compared, and evaluated. Specifically, the observations and conclusions of these areas as they relate to the helicopter propulsion system are reported. Author

N82-23242*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
NASA/HAA ADVANCED ROTORCRAFT TECHNOLOGY AND TILT ROTOR WORKSHOP. VOLUME 6: VEHICLE CONFIGURATION SESSION
1980 256 p Workshop held at Palo Alto, Calif., 2-5 Dec. 1980
(NASA-TM-84180; NAS 1.15:84180) Avail: NTIS HC A12/MF A01 CSCL 01C

Five high speed rotorcraft configurations are considered: the high speed helicopter, compound helicopter, ABC, tilt rotor and the X wing. The technology requirements and the recommended actions are discussed. S.L.

N82-23243*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
NASA/HAA ADVANCED ROTORCRAFT TECHNOLOGY AND TILT ROTOR WORKSHOP. VOLUME 7: TILT ROTOR SESSION
1980 37 p Workshop held at Palo Alto, Calif., 2-5 Dec. 1980
(NASA-TM-84705; NAS 1.15:84705) Avail: NTIS HC A03/MF A01 CSCL 01C

The technical characteristics of the XV-15 aircraft were discussed. Program objectives, concept evaluation, tilt rotor experiments and civil market applications are presented. The XV-15 status and test schedule are also included. S.L.

N82-23244*# National Aeronautics and Space Administration.

Langley Research Center, Hampton, Va.
PLANAR EQUATIONS OF ROLLOUT MOTION FOR AN AIRCRAFT WITH FREE OR STEERABLE LANDING GEARS
Robert K. Sleeper and Eunice G. Smith May 1982 54 p refs
(NASA-TP-1984; L-11689; NAS 1.60:1984) Avail: NTIS HC A04/MF A01 CSCL 01C

Equations were derived for an aircraft in a three-point attitude. Transient tire forces were simulated by delaying the application of forces derived from steady-state considerations. Predicted rollout trajectories were similar to those measured in tests of a small-scale landing-gear model equipped with pneumatic tires (where a laterally sloping runway was used to simulate a crosswind), both with and without nose-wheel steering. T.M.

N82-23245*# Kansas Univ. Center for Research, Inc., Lawrence.
DEVELOPMENT OF A SIMPLE, SELF-CONTAINED FLIGHT TEST DATA ACQUISITION SYSTEM Progress Report
Robert Clarke, Douglas Shane, Jan Roskam, and Dale I. Rummer Apr. 1982 250 p refs
(Grant NsG-4019)
(NASA-CR-168912; NAS 1.26:168912; KU-FRL-407-7) Avail: NTIS HC A11/MF A01 CSCL 14B

The flight test system described combines state-of-the-art microprocessor technology and high accuracy instrumentation with parameter identification technology which minimize data and flight time requirements. The system was designed to avoid permanent modifications of the test airplane and allow quick installation. It is capable of longitudinal and lateral-directional stability and control derivative estimation. Details of this system, calibration and flight test procedures, and the results of the Cessna 172 flight test program are presented. The system proved easy to install, simple to operate, and capable of accurate estimation of stability and control parameters in the Cessna 172 flight tests. Author

N82-23246*# Pratt and Whitney Aircraft Group, West Palm Beach, Fla. Government Products Div.
COMPUTER MODELING OF FAN-EXIT-SPLITTER SPACING EFFECTS ON F100 RESPONSE TO DISTORTION Final Report
M. Shaw and R. W. Murdoch Mar. 1982 115 p refs
(Contract NAS3-22739)
(NASA-CR-167879; NAS 1.26:167879; FR-15596) Avail: NTIS HC A06/MF A01 CSCL 21E

The distortion response of the F100(3) engine was effected by the fan exit splitter configuration. The sensitivity for a proximate splitter fan is calculated to be slightly greater than a remote splitter configuration with identical airfoils. Predicted response was based upon a multiple segment parallel compressor Model modified to include a bypass ratio representation that effects the performance characteristics of the last rotor and intermediate case struts. The predicted distortion response required an accurate definition of row pre- and post-stall undistorted operation. Author

N82-23247*# Notre Dame Univ., Ind. Dept. of Electrical Engineering.
ALTERNATIVES FOR JET ENGINE CONTROL Technical Progress Report, 1 Oct. 1980 - 30 Sep. 1981
Michael K. Sain 1981 140 p refs
(Grant NsG-3048)
(NASA-CR-168894; NAS 1.26:168894; TPR-12) Avail: NTIS HC A07/MF A01 CSCL 21E

Research centered on basic topics in the modeling and feedback control of nonlinear dynamical systems is reported. Of special interest were the following topics: (1) the role of series descriptions, especially insofar as they relate to questions of scheduling, in the control of gas turbine engines; (2) the use of algebraic tensor theory as a technique for parameterizing such descriptions; (3) the relationship between tensor methodology and other parts of the nonlinear literature; (4) the improvement of interactive methods for parameter selection within a tensor viewpoint; and (5) study of feedback gain representation as a counterpart to these modeling and parameterization ideas. Author

N82-23248*# Pratt and Whitney Aircraft Group, East Hartford, Conn.
ANALYSIS OF HIGH LOAD DAMPERS Final Report
S. T. Bhat, D. F. Buono, and D. H. Hibner 21 Aug. 1981 79 p refs
(Contract NAS3-22518)
(NASA-CR-165503; NAS 1.26:165503; PWA-5779-10) Avail: NTIS HC A05/MF A01 CSCL 21E

High load damping requirements for modern jet engines are discussed. The design of damping systems which could satisfy these requirements is also discusseed. In order to evaluate high load damping requirements, engines in three major classes were studied: large transport engines, small general aviation engines, and military engines. Four damper concepts applicable to these engines were evaluated: multi-ring, cartridge, curved beam, and viscous/friction. The most promising damper concept was selected for each engine and performance was assessed relative to conventional dampers and in light of projected damping requirements for advanced jet engines. B.W.

N82-23249*# Pratt and Whitney Aircraft Group, West Palm Beach, Fla. Government Products Div.
ADVANCED TURBINE STUDY Final Report, Aug. 1980 - Dec. 1981
12 Apr. 1982 94 p
(Contract NAS8-33821)
(NASA-CR-162003; NAS 1.26:162003; FR-15978) Avail: NTIS HC A05/MF A01 CSCL 21E

Experiments to determine the available increase in turbine horsepower achieved by increasing turbine inlet temperature over a range of 1800 to 2600 R, while applying current gas turbine airfoil cling technology are discussed. Four cases of rocket turbine operating conditions were investigated. Two of the cases used O2/H2 propellant, one with a fuel flowrate of 160 pps, the other 80 pps. Two cases used O2/CH4 propellant, each having different fuel flowrates, pressure ratios, and inlet pressures. Film cooling was found to be the required scheme for these rocket turbine applications because of the high heat flux environments. Conventional convective or impingement cooling, used in jet engines, is inadequate in a rocket turbine environment because of the resulting high temperature gradients in the airfoil wall, causing high strains and low cyclic life. The hydrogen-rich turbine environment experienced a loss, or no gain, in delivered horsepower as turbine inlet temperature was increased at constant airfoil life. The effects of film cooling with regard to reduced flow available for turbine work, dilution of mainstream gas temperature and cooling reentry losses, offset the relatively low specific work capability of hydrogen when increasing turbine inlet temperature over the 1800 to 2600 R range. However, the methane-rich environment experienced an increase in delivered horsepower as turbine inlet temperature was increased at constant airfoil life. The results of a materials survey and heat transfer and durability analysis are discussed. M.G.

N82-23250# Shaker Research Corp., Ballston Lake, N. Y.
BASIC TECHNOLOGY OF SQUEEZE-FILM DAMPERS FOR ROTOR DYNAMICS CONTROL Final Report, Jul. 1978 - Jul. 1981
C. H. T. Pan Nov. 1981 47 p refs
(Contract DAAG29-78-C-0027)
(AD-A110842; SRC-81-TR-74; ARO-15657.4-E) Avail: NTIS HC A03/MF A01 CSCL 21/5

Research was performed to develop a rigorous treatment for the film rupture process in the squeeze-film damper. The short bearing analysis was generalized to accommodate a consistent treatment of the rupture domain for a squeeze-film damper, which is undergoing a circular orbit motion either in a submerged condition or with one end subjected to a pressurized feed condition. GRA

N82-23252# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Kurzuebersicht fuer Information und Dokumentation.
ACTTA: INVESTIGATION OF NEW PILOTING AND FLIGHT CONTROL TECHNOLOGIES. VOLUME 1: REVIEW; ACTIVE WING Milestone Report on Phase 1, 1979 - 1980 [ACTTA: UNTERSUCHUNG NEUARTIGER STEUERUNGS- UND FLUGFUEHRUNGSTECHNOLOGIEN. MEILENSTEINBERICHT ZUR PHASE 1: 1979/1980. BAND 1: UEBERSICHT; AKTIVER FLUEGEL]
Weise Kolander and U. A. Fischer 23 Mar. 1981 192 p refs In GERMAN 2 Vol.
(Contract BMFT-LFK-7960-9)
(MBB-UH-05-81-Vol-1) Avail: NTIS HC A09/MF A01

Flight control technologies were investigated as to their realizability and economy. The conceptual phase of project Active Wing is presented. Investigation methodology, calculation

methods, tests, and results, concerning system interpretation, system dynamics and achievable cost reduction, are described. The problems with an integrated digital flight control system are treated. Gust load alleviation can be realized with available components. Operating cost reductions from 1% to 1.5% can be obtained. The choice of control surfaces represents a risk, since their unsteady highly subsonic aerodynamics during fast control is not sufficiently known. Author (ESA)

N82-23253# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Kurzueberischt fuer Information und Dokumentation.

ACTTA: INVESTIGATION OF NEW PILOTING AND FLIGHT CONTROL TECHNOLOGIES. VOLUME 2: AIRCRAFT WITH REDUCED LATERAL STABILITY Milestone Report on Phase 1, 1979 - 1980 [ACTTA: UNTERSUCHUNG NEUARTIGER STEUERUNGS- UND FLUGFUEHRUNGSTECHNOLOGIEN. MEILENSTEINBERICHT ZUR PHASE 1: 1979/1980. BAND 2: FLUGZEUG REDUZIERTER LAENGSSTABILITAET]

Weise Kolander and U. A. Fischer 23 Mar. 1981 194 p refs In GERMAN 2 Vol.

(Contract BMFT-LFK-7960-9)

(MBB-UH-05-81-Vol-2) Avail: NTIS HC A09/MF A01

The stretched version of the A-300 aircraft was used to assess the feasibility and economy of various digital flight technologies for aircraft with reduced lateral stability. Investigation methodology, calculation methods, tests, and results, concerning system interpretation, system dynamics and achievable cost reduction, are described. Operating cost reduction of 1% to 3% is expected with reduced stability, using a trim tank as the first step in a stepped design where sufficient emergency flight safety is maintained in case the stabilizing system fails. Author (ESA)

N82-23254* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

METRIC HALF-SPAN MODEL SUPPORT SYSTEM Patent

Charlie M. Jackson, Jr., Samuel M. Dollyhigh, and David S. Shaw, inventors (to NASA) Issued 4 May 1982 5 p Filed Supersedes N80-24334 (18 - 15, p 1943)

(NASA-Case-LAR-12441-1; US-Patent-4,327,581; US-Patent-Appl-SN-145210; US-Patent-Class-73-147) Avail: US Patent and Trademark Office CSCL 14B

A model support system used to support a model in a wind tunnel test section is described. The model comprises a metric, or measured, half-span supported by a nonmetric, or nonmeasured half-span which is connected to a sting support. Moments and forces acting on the metric half-span are measured without interference from the support system during a wind tunnel test. Official Gazette of the U.S. Patent and Trademark Office

N82-23255# British Aerospace Aircraft Group, Preston (England). Engine Simulation Section.

DEVELOPMENT OF A CONVOLUTED INTAKE SEAL FOR MODEL R66

A. P. Winstanley Mar. 1981 33 p refs

(BAE-ARG-163) Copyright. Avail: NTIS HC A03/MF A01

A low constraint convoluted seal is described which connects the live intake to the earthed ejector duct in a 1/7.5 scale low speed model with full engine simulation. A 6 component model with two earthed ejectors is required. Several seals were tested, achieving a progressively lower constraint by modifying either the geometry, material or manufacturing process. Subjecting the final seal to a representative pressure difference and end offset causes a lateral load of 6N, but incorporating the modifications recommended for future seals reduces this. Because the seals are on a moment arm from the balance when they are installed in the model, calibrations may have to account for pressure and end misalignment. A facility for measuring pressure differences at the seal is incorporated in the design. Author (ESA)

N82-23263# National Aerospace Lab., Amsterdam (Netherlands). Spaceflight Div.

MULTILAYER INSULATION BLANKETS FOR SPACECRAFT APPLICATIONS. THERMAL MODEL ACCOUNTING FOR OUTGASSING AND DIFFERENT WAYS OF GAS MIGRATION

A. A. M. Delil and J. F. Heemskerk 2 Sep. 1981 10 p refs Presented at 7th Intern. Heat Transfer Conf., Munich, 6-10 Sep. 1982

(NLR-MP-81051-U) Avail: NTIS HC A02/MF A01

A model of hybrid pumping (broadside and edge) in spacecraft insulation blankets was developed for an evacuated circular multilayer insulation blanket placed between a hot and a cold boundary. The blanket consists of parallel identical perforated shields with left and right side emissivity. Shield thickness is so small that shield temperature is assumed to be even. The gas is assumed to flow from the hot towards the cold boundary, as in the case of insulation of a hot black box from cold space environment. The model also applies for cryogenic vessel insulation (the cryogen at the cold side, the low pressure environment at the hot boundary) by interchanging suffixes in the governing equations. Results from guarded hot plate calorimeter tests confirm model predictions. Author (ESA)

N82-23281# Utah Univ., Salt Lake City.

THE EFFECT OF AN ACIDIC CATALYST ON SIMULTANEOUS HYDRODENITROGENATION AND HYDRODESULFURIZATION OF MODEL COMPOUNDS Ph.D. Thesis

Holly Jean Moore 1981 171 p

Avail: Univ. Microfilms Order No. 8125903

The hydrodesulfurization of thiophene and the hydrodenitrogenation of pyridine over acidic catalysts was studied. Four catalysts were considered: CoMo-SiO2/Al2O3, CoMo-Al2O3, NiW-SiO2/Al2O3, and NiW-Al2O3. These catalysts were chosen so that the effect of the metallic complex and the effect of the acidic support could be isolated. Reaction conditions of 200 to 400 C and 40 to 200 psia were used. A two site reaction mechanism (sites 1 and 2) based on the Langmuir adsorption isotherm was used to model the reaction of thiophene. A single site (site 1) analysis described the reaction of pyridine. Values of the reaction rate constants (k), and the adsorption equilibrium constants (K) were calculated from the data collected for pure thiophene, pure pyridine, and for a 50/50 solution of each. The results showed that both thiophene and pyridine adsorb significantly on the type 1 sites, but not on the type 2 sites. No consistent metal effect (NiW or CoMo) was observed. However, alumina was the more effective catalyst substrate for the reaction of both thiophene and pyridine for 50/50 feeds. Alumina was *also more effective for pure thiophene reaction, but silica alumina* was more effective for pyridine reaction from a pure feed. Dissert. Abstr.

N82-23409# Research Inst. of National Defence, Linkoeping (Sweden)..

TRANSIENT MEASUREMENTS UNDER ELECTRIC PULSE EXCITATION IN 37 VIGGEN AIRCRAFT [TRANSIENTMAETNINGAR VID STROEMPULSEXCITERING AV FPL-37 VIGGEN]

Sven Garmland Oct. 1981 54 p In SWEDISH

(FOA-C-30243-A3) Avail: NTIS HC A04/MF A01

Determinations of the magnetic field at different locations in aircraft and of the induced electromotive force in two typical communication cables of a transmission system, during full scale electric pulse tests, are reported. These measurements were carried out in relation with lightning tests, for trying out a computerized measurement system, including transient digitizers, microwave link and magnetic field cells. The pulse generator was equipped with capacitors charged up to 75 kV, developing a sine wave 30 kHz pulse current with a 100 kA max amplitude. Results enabled a computer program to be modified so as to account for actual conditions. Author (ESA)

N82-23471*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

BLOCKAGE AND FLOW STUDIES OF A GENERALIZED TEST APPARATUS INCLUDING VARIOUS WING CONFIGURATIONS IN THE LANGLEY 7-INCH MACH 7 PILOT TUNNEL

Cindy W. Albertson Mar. 1982 50 p

(NASA-TM-83301; NAS 1.15:83301) Avail: NTIS HC A03/MF A01 CSCL 20D

A 1/12th scale model of the Curved Surface Test Apparatus (CSTA), which will be used to study aerothermal loads and evaluate Thermal Protection Systems (TPS) on a fuselage-type configuration in the Langley 8-Foot High Temperature Structures Tunnel (8 ft HTST), was tested in the Langley 7-Inch Mach 7 Pilot Tunnel. The purpose of the tests was to study the overall flow characteristics and define an envelope for testing the CSTA in the 8 ft HTST. Wings were tested on the scaled CSTA model to select a wing configuration with the most favorable characteristics for conducting TPS evaluations for curved and intersecting surfaces. The results indicate that the CSTA and selected wing configuration can be tested at angles of attack up to 15.5 and 10.5 degrees, respectively. The base pressure for both models

was at the expected low level for most test conditions. Results generally indicate that the CSTA and wing configuration will provide a useful test bed for aerothermal pads and thermal structural concept evaluation over a broad range of flow conditions in the 8 ft HTST. Author

N82-23494*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
HISTORICAL PERSPECTIVES ON THERMOSTRUCTURAL RESEARCH AT THE NACA LANGLEY AERONAUTICAL LABORATORY FROM 1948 TO 1958
Richard R. Heldenfels *In its* Computational Aspects of Heat Transfer in Struct. 1982 p 363-392 refs

Avail: NTIS HC A24/MF A01 CSCL 20D

Some of the early research on structural problems produced by aerodynamic heating, conducted at the Langley Aeronautical Laboratory of the National Advisory Committee for Aeronautics from 1948 to 1958 is described. That was the last decade of the NACA; in 1958 NACA became the nucleus of NASA. The NACA initially contracted for research but was aware that a well-equipped and suitably staffed laboratory was required to fulfill its obligations. Langley was established in 1920; the other listed were added during the NACA expansion in the World War II years. Some specific research activities are described, starting with calculation of the temperature of the structure.
B.W.

N82-23542# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.
COMPARISON OF RELIABILITY, SENSITIVITY AND ACCURACY OF SOME NDI-TECHNIQUES
E. A. B. deGraaf and P. deRijk Oct. 1980 32 p refs In DUTCH; ENGLISH summary Presented at Dutch Soc. for Non-Destructive Testing Lecture Series, 4 Nov. 1980
(NLR-MP-80039-U) Avail: NTIS HC A03/MF A01

Reliability, sensitivity and accuracy of some nondestructive inspection (NDI) methods were investigated and compared. Reliability, sensitivity and accuracy of nondestructive inspection are defined. The restrictions on reusing NDI reliability specimens are described. Inspection results obtained with fluorescent and red penetrants are compared. Reliability, sensitivity and accuracy of a number of the most popular NDI methods, as applied to aluminum specimens and rejected steel aircraft landing gear components are treated. Three investigations are briefly depicted. Spreading in NDI results is substantial. Corrosion deteriorates reliability, sensitivity and accuracy. Red penetrant is much worse than fluorescent penetrant. Fluorescent penetrant inspection results strongly depend on the specimen configuration and vary from very good to moderate. Eddy current method gives good results. Magnetic inspection is advisable wherever it can be applied. Author (ESA)

N82-23549*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A TWO-DEGREE-OF-FREEDOM FLUTTER MOUNT SYSTEM WITH LOW DAMPING FOR TESTING RIGID WINGS AT DIFFERENT ANGLES OF ATTACK
Moses G. Farmer Apr. 1982 20 p refs Presented at Va. Academy of Sci. Meeting, Blacksburg, Va., 20-23 Apr. 1982
(NASA-TM-83302; NAS 1.15:83302) Avail: NTIS HC A02/MF A01 CSCL 14B

A wind tunnel model mount system for conducting flutter research using a rigid wing was developed. The wing is attached to a splitter plate so that the two move as one rigid body. The splitter plate is supported away from the tunnel wall by a system of rods with fixed fixed and conditions. The rods flex in such a way that only pitch and plunge oscillations are permitted. At the tunnel wall the rods are attached to a remotely controlled turntable so that angle of attack can be varied. Wind tunnel data obtained by using the mount system are presented for a supercritical and a conventional airfoil. Both classical flutter and stall flutter data are presented. S.L.

N82-23560# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugmechanik.
A THEORETICAL STUDY OF THE IMPACT OF AIRCRAFT WAKE VORTICES ON ROOFS IN THE FINAL APPROACH AREA OF DUSSELDORF AIRPORT
Otto Weber and Rolf Ulken Dec. 1981 63 p refs In GERMAN; ENGLISH summary
(DFVLR-Mitt-82-01) Avail: NTIS HC A04/MF A01; DFVLR, Cologne DM 21.50

Damage to buildings caused by the impact of trailing wake vortices shed from widebodied aircraft in the final approach area of Dusseldorf Airport was studied. Forty-two occurrences of roof damage were analyzed, using a simplified model for the strength, transport, and decay of wake vortices. The model is interpreted with reference to the results of a vortex allevation program carried out in the U.S. Wake vortex characteristics, maximum tangential velocity and vortex decay are discussed. Measurement of vortex far field reduction is considered. Other investigations of roof damage in the approach areas of Hamburg, Berlin (Tempelhof), and London (Heathrow) airports are summarized. The value of potential aircraft modifications and precautions on the ground are assessed, suggesting supplementary measurements on board aircraft and in buildings. Author (ESA)

N82-23561# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.
SOME CASE STUDIES AND THE SIGNIFICANCE OF FATIGUE THRESHOLDS
R. J. H. Wanhill Apr. 1981 15 p refs Presented at Intern. Symp. on Fatigue Thresholds, Stockholm, Jun. 1981
(NLR-MP-81015-U) Avail: NTIS HC A02/MF A01

Examples of service failures, involving low-cycle and/or high-cycle fatigue, are described and discussed with respect to the significance of thresholds for high-cycle fatigue crack propagation. The examples are: aircraft undercarriage cylinders made of high strength 4340 steel; aircraft gas turbine compressor drive shafts made of A286 steel; and aircraft gas turbine blades made of Rene 80 nickel-base superalloy. The examples show that the importance of Delta K sub th is unlikely to be important for a particular service fatigue problem. Delta K sub th as a design criterion is restricted to safe crack growth components and structures whose anticipated service loads consist mainly or entirely of large numbers of low amplitude cycles and which are difficult or impossible to inspect in service. Author (ESA)

N82-24050*# Boeing Vertol Co., Philadelphia, Pa.
AN INVESTIGATION OF ROTOR HARMONIC NOISE BY THE USE OF SMALL SCALE WIND TUNNEL MODELS Final Report
Harry Sternfeld, Jr. and Edward G. Schaffer Apr. 1982 100 p refs
(Contract NAS2-10767)
(NASA-CR-166337; NAS 1.26:166337) Avail: NTIS HC A05/MF A01 CSCL 20A

Noise measurements of small scale helicopter rotor models were compared with noise measurements of full scale helicopters to determine what information about the full scale helicopters could be derived from noise measurements of small scale helicopter models. Comparisons were made of the discrete frequency (rotational) noise for 4 pairs of tests. Areas covered were tip speed effects, isolated rotor, tandem rotor, and main rotor/tail rotor interaction. Results show good comparison of noise trends with configuration and test condition changes, and good comparison of absolute noise measurements with the corrections used except for the isolated rotor case. Noise measurements of the isolated rotor show a great deal of scatter reflecting the fact that the rotor in hover is basically unstable.
Author

N82-24137*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
RESEARCH AND TECHNOLOGY ANNUAL REPORT FY-1981
Nov. 1981 100 p
(NASA-TM-84199; NAS 1.15:84199) Avail: NTIS HC A05/MF A01 CSCL 05A

Space transportation systems are summarized: space shuttle enhancement, a space operations center, the space platform, and geostationary activites are discussed. Aeronautics and space technology are summarized: experiments, energy systems, propulsion technology, synthetic aperture radar, large space systems, and shuttle-launched vehicles are discussed. Space sciences are summarized: lunar, planetary, and life sciences are discussed. Space and terrestrial applications are summarized. The AgRISTARS program, forest and wildland resource, and Texas LANDSAT applications are discussed. N.W.

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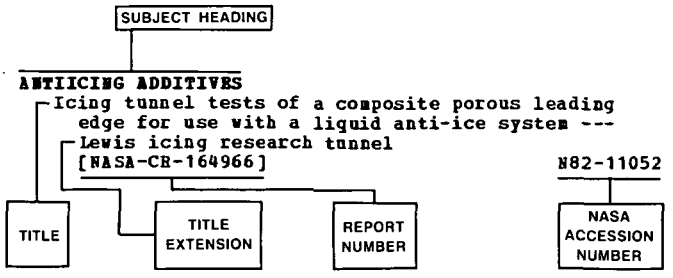

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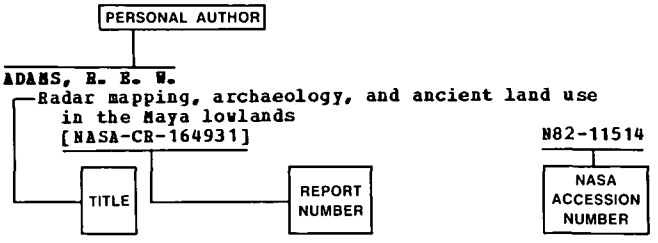

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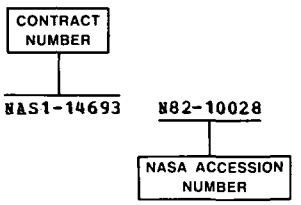

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